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1. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC) Authors/Task Force Members: Borja Ibanez* (Chairperson) (Spain), Stefan James* (Chairperson) (Sweden), Stefan Agewall (Norway), Manuel J. Antunes (Portugal), Chiara Bucciarelli-Ducci (UK), He´ctor Bueno (Spain), Alida L. P. Caforio (Italy), John A. Goudevenos (Greece), Sigrun Halvorsen (Norway), Gerhard Hindricks (Germany), Adnan Kastrati (Germany), Mattie J. Lenzen (The
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Keywords Guidelines • Acute coronary syndromes • Acute myocardial infarction • Antithrombotic therapy • Antithrombotics • Emergency medical system • Evidence • Fibrinolysis • Ischaemic heart disease • Primary percutaneous coronary intervention • Quality infarction • Antithrombotics • Emergency medical system • Str-segment elevation myocardial infarction • Antithrombotics • Emergency medical system • 52. Introduction — 52. Epidemiology of ST-segment elevation myocardial infarction — 63. What is new in the 2017 version? — 74. Emergency care — 84.1 Initial diagnosis — 84.1 Initial diagnosis — 84.2 Relief of pain, breathlessness, and anxiety. — 94.3 Cardiac arrest. — 104.4 Pre-hospital logistics of care — 104.4.1 Delays — 125. Reperfusion therapy — 125. Springly percutaneous coronary intervention and adjunctive therapy — 125. Procedural aspects of primary percutaneous coronary intervention and adjunctive therapy — 125. Reperfusion therapy — 125. Reperfusio
Survival at Six months follow-up AMI acute myocardial infarction ARB angiotensin II receptor blocker ASSENT 3 ASsessment of the Safety and Efficacy of a New Thrombolytic 3 ATLANTIC Administration of Ticagrelor in the Cath Lab or in the Ambulance for New ST Elevation Myocardial Infarction to Open the Coronary Artery ATLAS ACS 2-TIMI 51
 Anti-Xa Therapy to Lower cardiovascular events in Addition to Standard therapy in subjects with Acute Coronary Syndrome-Thrombolysis In Myocardial Infarction 51 ATOLL Acute myocardial Infarction 51 ATOLL Acute myocardial infarction Treated with primary angioplasty and inTravenous enOxaparin or unfractionated heparin to Lower ischaemic and bleeding events at short- and Long-
  term follow-up AV atrioventricular b.i.d. bis in die (twice a day) BMI body mass index BMS bare-metal stent BNP B-type natriuretic peptide CABG coronary artery bypass graft surgery CAD coronary artery disease CAPITAL AMI Combined Angioplasty and Pharmacological Intervention versus Thrombolytics ALone in Acute Myocardial Infarction
 CCNAP Council on Cardiovascular Nursing and Allied Professions CCP Council for Cardiology Practice; CCU coronary care unit CHA2DS2-VASc Cardiac failure, Hypertension, Age 75 (Doubled), Diabetes, Stroke (Doubled) - VAScular disease, Age 65–74 and Sex category (Female) CI confidence interval CKD chronic kidney disease CMR cardiac
  magnetic resonance CPG Committee for Practice Guidelines CRISP AMI Counterpulsation to Reduce Infarct Size Pre-PCI-Acute Myocardial Infarction CT computed tomography COMFORTABLE- AMI Effect of biolimus-eluting stents with biodegradable polymer vs. bare-metal stents on cardiovascular events among patients with acute myocardial
  infarction trial; Compare-Acute Comparison Between FFR Guided Revascularization Versus Conventional Strategies in ischaemic syndromes CvLPRIT
 Complete Versus Lesion-Only Primary PCI Trial DANAMI 3 - Deferred versus conventional stent implantation in patients with ST-segment elevation myocardial infarction ESC Guidelines 3 Downloaded from by guest on
                                                                                                                                                       .....DANAMI-3- PRIMULTI DANAMI 3 - Complete revascularisation versus treatment of the culprit lesion only in patients with ST-segment elevation myocardial infarction and multivessel disease DAPT dual antiplatelet
  therapy DES drug-eluting stent EACVI European Association of Percutaneous Cardiovascular Imaging EAPC European Association of Preventive Cardiology EAPCI European Association of Preventive Cardiovascular Infarction Before Primary
  Percutaneous Coronary Intervention ECG electrocardiogram ECLS extracorporeal life support ECMO extracorporeal membrane oxygenation eGFR estimated glomerular filtration rate EHRA European Heart Rhythm Association EMS emergency medical system EPHESUS Eplerenone Post-AMI Heart failure Efficacy and SUrvival Study ESC European
  Society of Cardiology EXAMINATION Everolimus-Eluting Stents Versus Bare-Metal Stents in ST-Segment Elevation Myocardial Infarction Treatment-Thrombolysis In Myocardial Infarction FFR fractional flow reserve FMC first medical contact FOCUS Fixed-
  Dose Combination Drug for Secondary Cardiovascular Prevention FOURIER Further Cardiovascular Outcomes Research with PCSK9 Inhibition in Subjects with Elevated Risk trial. GP glycoprotein GRACE Global Registry of Acute Coronary Events GRACIA Grupo de Analisis de la Cardiovascular Prevention FOURIER Further Further Cardiovascular Prevention FOURIER Further Furth
 cholesterol HFA Heart Failure Association HR hazard ratio IABP intra-aortic balloon pump ICCU intensive cardiac care unit ICD implantable cardioverter defibrillator IMPROVE-IT Improved Reduction of Outcomes: Vytorin Efficacy International Trial IRA infarct-related artery IU international units i.v. intravenous LBBB left bundle branch block LDL-C
  low-density lipoprotein cholesterol LGE late gadolinium enhancement LV left ventricular ejection fraction MACE major adverse cardiac event MATRIX Minimizing Adverse Haemorrhagic Events by TRansradial Access Site and Systemic Implementation of angioX METOCARD- CNIC
  NT-proBNP N-terminal pro B-type natriuretic peptide OASIS-6 Organization for the Assessment of Strategies for Ischemic Syndromes o.d. omni die (once a day) PAMI-II Second Primary Angioplasty in Myocardial Infarction PaO2 partial pressure of oxygen PCI percutaneous coronary intervention PCSK9 proprotein convertase subtilisin/kexin type 9
  PEGASUS- TIMI 54 Prevention of Cardiovascular Events in Patients with Prior Heart Attack Using Ticagrelor Compared to Placebo on a Background of Aspirin-Thrombolysis in Myocardial Infarction 54 PET positron emission tomography PIONEER AF-PCI Open-Label, Randomized, Controlled, Multicenter Study Exploring Two Treatment Strategies of
  Rivaroxaban and a Dose-Adjusted Oral Vitamin K Antagonist Treatment Strategy in Subjects with Atrial Fibrillation who Undergo Percutaneous Coronary Intervention p.o. per os (orally) PPI proton pump inhibitor PRAMI Preventive Angioplasty in Acute Myocardial Infarction PRODIGY PROlonging Dual Antiplatelet Treatment After Grading stent-
  induced Intimal hyperplasia studY RBBB right bundle branch block REMINDER A Double-Blind, Randomized, Placebo- Controlled Trial Evaluating The Safety And Efficacy Of Early Treatment With Eplerenone In Patients With Acute Coronary
  Syndrome RIVAL Radial Versus Femoral Access for Coronary intervention RV right ventricular SaO2 arterial oxygen saturation 4 ESC Guidelines Downloaded from by guest on 16 September 2017 5. ....
                                                                                                                                                                                                                                                                                                                                . SBP systolic blood pressure s.c. subcutaneous SGLT2 sodium-glucose co-
  transporter-2 SPECT single-photon emission computed tomography STEMI ST-segment elevation myocardial infarction TNK-tPA Tenecteplase tissue plasminogen activator TOTAL Trial of Routine Aspiration Thrombectomy with PCI versus
  PCI Alone in Patients with STEMI tPA tissue plasminogen activator UFH unfractionated heparin VALIANT VALsartan In Acute myocardial iNfarcTion VF ventricular fibrillation VT ventricular fibrillation 
  in selecting the best management strat- egies for an individual patient with a given condition. Guidelines and their recommendations should facilitate decision making of health professionals in their daily practice. However, the final decisions con- cerning an individual patient must be made by the responsible health professional(s) in consultation with
  the patient and caregiver as appropriate. A great number of guidelines have been issued in recent years by the European Society of Cardiology (ESC), as well as by other soci- eties and organisations. Because of the impact on clinical practice, quality criteria for the development of guidelines have been established in order to make all decisions
  transparent to the user. The recommendations for formulating and issuing ESC Guidelines can be found on the ESC website (Guidelines-Guidelines-Guidelines-Guidelines-Guidelines-Guidelines-Guidelines). ESC Guidelines represent the official posi- tion of the ESC on a given topic and are regularly updated. Members of this Task Force
  were selected by the ESC, including representation from its relevant ESC sub-specialty groups, in order to represent professionals involved with the medical care of patients with this pathology. Selected experts in the field undertook a com- prehensive review of the published evidence for management of a given condition according to ESC Committee
  for Practice Guidelines (CPG) policy. A critical evaluation of diagnostic and therapeutic pro- cedures was performed, including assessment of the recommendation of particular management options were weighed and graded accord- ing to predefined scales, as outlined in Tables 1 and 2.
  The experts of the writing and reviewing panels provided declara- tion of interest forms for all relationships that might be perceived as real or potential sources of conflicts of interest. These forms were compiled into one file and can be found on the ESC website (http:// www.escardio.org/guidelines). Any changes in declarations of interest that arise
  during the writing period were notified to the ESC and updated. The Task Force received its entire financial support from the ESC without any involvement from the healthcare industry. The ESC CPG supervises and coordinates the preparation of new ESC Guidelines. The Committee is also responsible for the endorse- ment process of these
  Guidelines. The ESC Guidelines undergo extensive review by the CPG and external experts involved in the European Heart Journal. The Guidelines were developed after careful consideration of
  the scientific and medical knowledge and the evidence available at the time of their dating. Table 1 Classes of recommendations ESC Guidelines 5 Downloaded from by guest on 16 September 2017 6. ....
  includes the creation of educational tools and implementation programmes for the recom- mendations including condensed pocket guideline versions, summary cards for non-specialists and an electronic version for digital applications (smart- phones, etc.). These versions are abridged and thus, if
  needed, one should always refer to the full text version, which is freely available via the ESC are encouraged to endorse, translate and imple- ment all ESC Guidelines. Implementation programmes are needed because it has been shown that the outcome of disease may be
  favourably influenced by the thorough application of clinical recommended in the guidelines, disseminating them and implementing them into clinical practice
  Health professionals are encouraged to take the ESC Guidelines fully into account when exercising their clinical judgment, as well as in the determination and the implementation of preventive, diagnostic or therapeutic medical strategies. However, the ESC Guidelines do not override in any way whatsoever the individual responsibility of health
  professionals to make appropriate and accurate decisions in consideration of each patient's health condition and in consultation with that patient or the patient or the patient's caregiver where appropriate and devices at the time of prescription
  2. Introduction Updates on the management of patients presenting with ST-segment elevation myocardial infarction (STEMI) should be based on sound evidence, derived from well-conducted clinical trials have been
  undertaken, the results are open to interpretation and treatments may need to be adapted to take account of clinical circumstances and resources. The present Task Force has made an important effort to be as aligned as possible with the other ESC Guidelines1-6 and consensus documents, including the simultaneously published update on dual
  antiplatelet therapy (DAPT),7 for consistency in the ESC Guidelines strategy. The levels of evidence and the strengths of recommendations with a level of evidence being based on expert opinion, this Task
  Force decided to add references to guide the reader regarding data that were taken into consideration for these decisions in some cases. 2.1 Definition of acute myocardial infarction the term acute myocardial infarction for these decisions in some cases.
  one value above the 99th percentile upper reference limit) with necrosis in a clinical setting consistent with myocardial ischaemia. For the sake of immediate treatment strategies such as reperfusion therapy, it is usual practice to designate patients with persistent chest discomfort or other symptoms sugges- tive of ischaemia and ST-segment
  elevation in at least two contiguous leads as STEMI. In contrast, patients without ST-segment elevation are usually designated as having a non-ST-segment elevation are usually designated as having a non-ST-segment elevation myocardial infarction (MI) (NSTEMI) and separate guidelines have recently been developed for these. 2 Some patients with MI develop Q-waves (Q-wave MI), but many
  do not (non-Q-wave MI). In addition to these categories, MI is classified into various types, based on pathological, clinical, and prognostic differences, along with different treatment strategies (see the Third Universal Definition of MI document,8 which will be updated in 2018). Despite the fact that the majority of STEMI patients are classified as a
  type 1 MI (with evi- dence of a coronary thrombus), some STEMI, also occurs in the absence of obstructive coronary arteries' (MINOCA) and is discussed in Chapter 9 of
  this document. 2.2 Epidemiology of ST-segment elevation myocardial infarction Worldwide, ischaemic heart disease is the single most common cause of death and its frequency is increasing. However, in Europe, there has been an overall trend for a reduction in ischaemic heart disease mortality over the past three decades.13 Ischaemic heart disease
  now accounts for almost 1.8 million annual deaths, or 20% of all deaths in Europe, although with large variations between countries.14 The relative incidences of STEMI and NSTEMI are decreasing and increasing, respectively.15,16 Probably the most comprehensive European STEMI registry is found in Sweden, where the incidence rate of STEMI
  was 58 per 100000 per year in 2015.17 In other European countries, the incidence rate ranged from 43 to 144 per 100000 in 1999 to 50 per 100000 in 2008, whereas the incidence of NSTEMI remained con-stant or increased slightly.19 There
  is a consistent pattern for STEMI to be relatively more common in younger than in older people, and more common in men than in women.17,20 The mortality in STEMI patients is influenced by many factors, among them advanced age, Killip class, time delay to treatment, Table 2 Levels of evidence 6 ESC Guidelines Downloaded from by guest on 16 minutes.
                                                                    . presence of emergency medical system (EMS)-based STEMI net- works, treatment strategy, history of MI, diabetes mellitus, renal fail- ure, number of diseased coronary arteries, and left ventricular ejection fraction (LVEF). Several recent studies have highlighted a fall in acute and long-term
  mortality following STEMI in parallel with greater use of reperfusion therapy, primary percutaneous coronary intervention (PCI), modern antithrombotic therapy, and secondary prevention. 14,21,22 Nevertheless, mortality remains substantial; the in- hospital mortality of unselected patients with STEMI in the national registries of the ESC countries
  varies between 4 and 12%,23 while reported 1-year mortality among STEMI patients in angiography registries is approximately 10%.24,25 Although ischaemic heart disease develops on average 7-10years later in women compared with men, MI remains a leading cause of death in women. Acute coronary syndrome (ACS) occurs three to four times
  more often in men than in women below the age of 60 years, but after the age of 75, women represent the majority of patients.26 Women tend to present later than men.28,29 It is therefore important to maintain a high degree of awareness for MI in women with
  potential symptoms of ischaemia. Women also have a higher risk of bleeding complications with PCI. There is an ongoing debate regarding whether outcomes are poorer in women, with several studies have indicated that
  women tend to undergo fewer interventions than men and receive reperfusion therapy less fre- quently.26,32,33 These guidelines aim to highlight the fact that women and men receive equal benefit from a reperfusion strategy and STEMI- related therapy, and that both genders must be managed in a similar fashion. 3. What is new in the 2017
  version? patients stenting Figure 1 What is new in 2017 STEMI Guidelines. BMS = bare metal stent; DES = drug eluting stent; IRA = infarct related artery; i.v. = intravenous; LDL = low-density lipoprotein; PCI = percutaneous coronary intervention; SaO2 = arterial oxygen saturation; STEMI = ST-elevation myocardial infarction; TNK-tPA =
  Tenecteplase tissue plasminogen activator. For explanation of trial names, see list of. a Only for experienced radial operators. b Before hospital discharge (either immediate or staged). c Routine thrombus aspiration (bailout in certain cases may be considered). d In 2012 early discharge was considered after 72h, in 2017 early discharge is 48-72h. e If
 symptoms or haemodynamic instability IRA should be opened regardless time from symptoms onset. In left and mid panels, below each recommendation, the most representative trial (acronym and reference) driving the indication is mentioned. ESC Guidelines 7 Downloaded from by guest on 16 September 2017 8. ..... 4. Emergency care 4.1 Initial
  diagnosis Management—including diagnosis and treatment—of STEMI starts from the point of first medical contact (FMC, defined in Table 4). It is recommended that a regional reperfusion strategy should be estab- lished to maximize efficiency. A working diagnosis of STEMI (called the 'STEMI diagnosis' throughout this document) must first be
  made. This is usually based on symptoms consistent with myocardial ischaemia (i.e. persistent chest pain) and signs [i.e. 12-lead electrocardiogram (ECG)]. Important clues are a history of CAD and radiation of pain to the neck, lower jaw, or left arm. Some patients present with less-typical symptoms such as shortness of breath, nausea/vomiting,
  fatigue, pal- pitations, or syncope.34 A reduction in chest pain after nitroglycerin (glyceryl trinitrate) administration can be misleading and is not rec- ommended as a diagnostic manoeuvre.35 In cases of symptom relief after nitroglycerin administration, another 12-lead ECG must be obtained. A complete normalization of the ST-segment elevation
  after nitroglycerin administration, along with complete relief of symp- toms, is suggestive of coronary spasm, with or without associated MI. In these cases, an early coronary angiography (within 24h) is recommended to
 initiate ECG monitoring as soon as possible in all patients with suspected STEMI in order to detect life- threatening arrhythmias and allow prompt defibrillation if indicated. When a STEMI is suspected, a 12-lead ECG must be acquired and interpreted as soon as possible at the time of FMC to facilitate early STEMI diagnosis and triage.36-40 In
 patients with a clinical suspicion of myocardial ischaemia and ST- segment elevation, reperfusion therapy needs to be initiated as soon as possible.41 If the ECG is equivocal or does not show evidence to support the clinical suspicion of MI, ECGs should be repeated and, when possible compared with previous recordings. If interpretation of pre-
  hospital ECG is not possible on-site, field transmission of the ECG is recommended.42 ECG criteria are based on changes of electrical currents of the heart (measured in millivolts). Standard calibration of the ECG is 10mm/mV. Therefore 0.1mV equals to 1 mm square on the vertical axis. For simplicity, in this document ECG deviations are expressed
  in mm following the standard calibration. In the proper clinical context, ST-segment elevation (measured at the J-point) is considered suggestive of ongoing coronary artery acute occlusion in the following cases: at least two contiguous leads V2-V3
  and/or 1 mm in the other leads [in the absence of left ventricular (LV) hypertrophy or left bundle branch block LBBB)].8 In patients with inferior MI, it is recommended to record right precordial leads (V3R and V4R) seek- ing ST-segment depression in leads
 V1-V3 suggests myocardial ischaemia, especially when the terminal T-wave is positive (ST-segment elevation of a Q-wave on the ECG should not necessarily change the
  reperfusion strategy decision. The ECG diagnosis may be more difficult in some cases, which nevertheless deserve prompt management and triage. Among these: Bundle branch block. In the presence of LBBB, the ECG diagnosis may be more difficult but often possible if marked ST-segment abnor- malities are present. Somewhat complex algorithms
  have been offered to assist the diagnostic cer- tainty.52 The presence of concordant ST-segment elevation (i.e. in leads with a clinical suspicion of ongoing myocardial ischaemia and
  LBBB should be managed in a way similar to STEMI patients, regardless of whether the LBBB is previously known. It is important to remark that the presence of a (presumed) new LBBB does not predict an MI per se.54 Patients with MI and right bundle branch block (RBBB) have a poor prognosis.55 It may be difficult to detect transmural ischaemic
  in patients with chest pain and RBBB.55 Therefore, a primary PCI strat- egy (emergent coronary angiography and PCI if indicated) should be considered when persistent ischaemic symptoms occur in the pres- ence of RBBB. Recommendations for initial diagnosis Recommendations Classa Levelb ECG monitoring 12-lead ECG recording and
  interpretation is indicated as soon as possible at the point of FMC, with a maximum target delay of 10 min.36,38 I B ECG monitoring with defibrillator capacity is indicated as soon as possible in all patients with high suspicion of posterior MI
  (circumflex occlusion) should be considered.8,46-49 IIa B The use of additional right precordial leads (V3R and V4R) in patients with inferior MI should be considered to identify concomi- tant RV infarction.8,43 IIa B Blood sampling for serum markers is indicated as soon as possible in the acute phase but should not delay
  reperfusion treatment.8 I C ECG = electrocardiogram; FMC = first medical contact; MI = myocardial infarction. a Class of recommendation. b Level of evidence. 8 ESC Guidelines Downloaded from by guest on 16 September 2017 9.
                                                                                 .. Ventricular pacing. Pacemaker rhythm may also prevent interpretation of ST-segment changes and may require urgent angiog- raphy to confirm diagnosis and initiate therapy. Reprogramming the pacemaker—allowing an evaluation of ECG changes during intrinsic heart rhythm—
  may be considered in patients who are not depend- ent on ventricular pacing, without delaying invasive investigation. 56,57 Non-diagnostic ECG. Some patients with an acute coronary occlusion may have an initial ECG without ST-segment elevation, sometimes because they are seen very early after symptom onset (in which case, one should look for
 hyper-acute T-waves, which may pre- cede ST-segment elevation). It is important to repeat the ECG or monitor for dynamic ST-segment changes. In addition, there is a con- cern that some patients with acute occlusion of a vein graft
  or left main disease, may present without ST-segment elevation and be denied reperfusion ther- apy, resulting in a larger infarction and worse outcomes. Extending the standard 12-lead ECG with V7-V9 leads may identify some of these patients. In any case, suspicion of ongoing myocardial ischaemia is an indication for a primary PCI strategy even in
  patients without diagnos- tic ST-segment elevation. 8,38,46-49 Table 3 lists the atypical ECG pre- sentations that should prompt a primary PCI strategy in patients with ongoing symptoms consistent with myocardial ischaemia. Isolated posterior MI. In AMI of the inferior and basal portion of the heart, often corresponding to the left circumflex territory
  iso-lated ST-segment depression 0.5mm in leads V1-V3 represents the dominant finding. These should be managed as a STEMI. The use of additional posterior chest with inferior and basal MI. Left main coronary obstruction.
  The presence of ST depres- sion 1 mm in six or more surface leads (inferolateral ST depres- sion), coupled with ST-segment elevation in aVR and/or V1, suggests multivessel ischemia or left main coronary artery obstruction, partic-
  out in the acute phase. This is indicated, but should not delay the reperfusion strategy/treatment. If in doubt regarding the possibility of acute evolving MI, emergency imaging aids the provision of timely reperfusion therapy to these patients. Recommendations for the use of echocardiography for ini- tial diagnosis are described in section 6.6.2. If
  echocardiography is not available or if doubts persist after echo, a primary PCI strategy is indi- cated (including immediate transfer to a PCI centre). In the STEMI emergency setting, there is no role for routine com- puted tomography (CT). Use of CT should be confined to selected cases where acute
  aortic dissection or pulmonary embolism is sus- pected, but CT is not recommended if STEMI diagnosis is likely. Some non-AMI conditions can present with symptoms and ECG findings similar to STEMI. An emergency coronary angiography is therefore indicated in these cases (Chapter 9 expands on this topic). 4.2 Relief of pain, breathlessness, and
  anxiety Relief of pain is of paramount importance, not only for comfort rea- sons but because the pain is associated with sympathetic activation, which causes vasoconstriction and increases the workload of the heart. Titrated intravenous (i.v.) opioids (e.g. morphine) are the anal- gesics most commonly used in this context. However, morphine use is
  associated with a slower uptake, delayed onset of action, and diminished effects of oral antiplatelet agents (i.e. clopidogrel, ticagre-lor, and prasugrel), which may lead to early treatment failure in sus-ceptible individuals.61-63 Table 3 Atypical electrocardiographic presentations that should prompt a primary percutaneous coronary intervention
  strategy in patients with ongoing symp- toms consistent with myocardial ischaemia ECG = electrocardiogram; LBBB = left bundle branch block; RV = right ventricular; STEMI = ST-segment elevation myocardial infarction. Relief of hypoxaemia and symptoms Recommendations Classa Levelb Hypoxia Oxygen is
  indicated in patients with hypo- xaemia (SaO2 90% or PaO2 60 mmHg). I C Routine oxygen is not recommended in patients with SaO2 90%.64-66 III B Symptoms Titrated i.v. opioids should be considered to relieve pain. IIa C A mild tranquillizer (usually a benzodiaze- pine) should be considered in very anxious patients. IIa C i.v. = intravenous; PaO2
  = partial pressure of oxygen; SaO2 = arterial oxygen saturation. a Class of recommendation. b Level of evidence suggesting that hyper- oxia may be harmful
  in patients with uncomplicated MI, presumably due to increased myocardial injury.64-67 Thus, routine oxygen is not recommended when SaO2 is 90%. Anxiety is a natural response to the pain and the circumstances surrounding an MI. Reassurance of patients and those closely associ- ated with them is of great importance. A mild tranquillizer
  (usually a benzodiazepine) should be consid-ered in anxious patients. 4.3 Cardiac arrest Many deaths occur very early after STEMI onset due to ventricular fibrillation (VF).68 As this arrhythmia frequently occurs at an early stage, these deaths usually happen out of hospital. It is indicated that all medical and paramedical personnel caring for patients
  with sus-pected MI have access to defibrillation equipment and are trained in cardiac life support, and that, at the point of FMC, ECG monitoring must be implemented immediately for all patients with suspected MI. Patients wit
  transferred to the hospital by the EMS. In patients following cardiac arrest and ST-segment elevation on the ECG, primary PCI is the strategy of choice. 69-74 Given the high prevalence of coronary occlusions and the potential difficulties in interpreting the ECG in patients after cardiac arrest, urgent angiography (within 2 h)2 should be considered in
  survivors of cardiac arrest, including unresponsive survivors, when there is a high index of suspicion of ongoing infarction (such as the presence of chest pain before arrest, in patients without ST- segment elevation, a quick evaluation at the emergency department
  or intensive cardiac care unit (ICCU) to exclude non-coronary causes (cerebrovascular event, respiratory failure, non-cardiogenic shock, pulmonary embolism, and intoxication), and to perform urgent echocardiography, is reasonable. The decision to perform urgent coronary angiography and PCI if indicated should also take into account factors
  associated with poor neurological outcome. Unfavourable pre-hospital settings indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital settings indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital settings indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital settings indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital settings indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological recovery [i.e. unwitnessed cardiac arrest, late arrival of a pre-hospital setting indicating a remote likelihood for neurological setting a remote likelihood for neurological setting a remote likelihood for neurological settin
  spontaneous circulation]75 should be taken strongly into consideration to argue against an invasive coro- nary strategy.73 Unconscious patients admitted to critical care units after out-of- hospital cardiac arrest are at high risk for death, and neurologic defi- cits are common among those who survive.76 Targeted temperature management (also called
  therapeutic hypothermia), aiming for a con-stant temperature between 32 and 36 C for at least 24 h, is indicated in patients who remain unconscious after resuscitation from cardiac cause).73,77-82 However, hypothermia conditions are associated with slow uptake, delayed onset of action, and diminished effects of oral
 antiplatelet agents (i.e. clopidogrel, tica- grelor, and prasugrel). Moreover, metabolic conversion of clopidog- rel in the liver may be reduced in hypothermia conditions.83 Cooling should not delay primary PCI and can be started in parallel in the catheterization laboratory. Close attention to anticoagulation needs to be paid in patients reaching low
 temperatures.84 Prevention and improved treatment of out-of-hospital cardiac arrest is crucial to reduce the mortality related to CAD. For a more detailed discussion of these issues, refer to the recent European Resuscitation.74 4.4 Pre-hospital logistics of care 4.4.1 Delays Treatment delays are the most easily
 audited index of quality of care in STEMI; they should be recorded in every system providing care to STEMI patients and be reviewed regularly, to ensure that simple qual- ity of care indicators are met and maintained over time (see Chapter Cardiac arrest Recommendations Classa Levelb A primary PCI strategy is recommended in patients with
 resuscitated cardiac arrest and an ECG consistent with STEMI.69-71,85 I B Targeted temperature managements is indicated that healthcare systems imple-ment strategies to facilitate transfer of all patients in whom a MI is suspected directly
 to the hospital offering 24/7 PCI-mediated reperfusion therapy via one specialized EMS. I C It is indicated that all medical and paramedical end paramedical e
 patients with resus- citated cardiac arrest without diagnostic ST- segment elevation but with a high suspicion of ongoing myocardial ischaemia.69-71,73 IIa C Pre-hospital cooling using a rapid infusion of large volumes of cold i.v. fluid immediately after return of spontaneous circulation is not recommended.86 III B 24/7 = 24 h a day, 7 days a week;
  ECG = electrocardiogram; EMS = emergency medical system; i.v. = intravenous; MI = myocardial infarction. a Class of recommendation. b Level of evidence. c Targeted temperature management refers to active methods (i.e. cooling cathe- ters,
 cooling blankets, and application of ice applied around the body) to achieve and maintain a constant specific duration of time (most commonly used 24 h). 10 ESC Guidelines Downloaded from by guest on 16 September 2017 11...
 not met, then interventions are needed to improve performance of the system. Components of the ischaemic time, delays of initial management, and selection of reperfu- sion strategy are shown in Figure 2. To minimize patient delay, it is recommended to increase public awareness of how to recognize common symptoms of AMI and to call the
 emergency services. All components of the system delay rep- resent the quality of care and it is recommended to measure them as quality indicators (see Chapter 10). In hospitals and EMS participating in the care of STEMI diagnosis refers to the time
  when the ECG is interpreted as ST-segment elevation or equivalent and it is the time zero to guide appropriate therapy. System delay is more readily modifiable by organizational meas- ures than is patient delay, and it is a predictor of outcomes.87 When STEMI diagnosis is made in the pre-hospital setting (EMS), immediate activation of the
 catheterization laboratory not only reduces treatment delays but may also reduce patient mortality.88-91 When a STEMI diagnosis is made by the EMS in the pre-hospital set- ting and the patient straiged for a primary PCI strategy, it is indicated to bypass the emergency department and bring the patient straight Figure 2 Modes of patient
 presentation, components of ischaemia time and flowchart for reperfusion strategy selection. EMS = Emergency Medical System; FMC = First Medical Contact; PCI = Percutaneous Coronary Intervention; STEMI = ST-segment elevation myocardial infarction. The recommended mode of patient presentation is by alerting the EMS (call national
  emergency number: 112 or similar number according to region). When STEMI diagnosis is made in the out-of-hospital setting (via EMS) or in a non-PCI centre, the decision for choosing reperfusion strategy is based on the estimated time from STEMI diagnosis to PCI-mediated reperfusion (wire crossing). System delay for patients alerting the EMS
 starts at the time of phone alert, although FMC occurs when EMS arrives to the scene (see Table 4).denotes minutes. a Patients with fibrinolysis should be transferred to a PCI centre immediately after administration of the lytic bolus. ESC Guidelines 11 Downloaded from by guest on 16 September 2017 12.
                                                                                                                       ..to the catheterization laboratory. Bypassing the emergency depart- ment is associated with a 20min saving in the time from FMC to wire crossing.92 For patients presenting in a non-PCI centre, door-in to door-out time, defined as the duration
 between arrival of the patient at the hospital to discharge of the patient in an ambulance en route to the PCI centre, is a new clinical performance measure, and _30min is recommended to expedite reperfusion care.93 4.4.2 Emergency medical system An EMS with an easily recalled and well publicized unique medical dis- patching number (112 for
 most medical emergencies across Europe) is important to speed up activation. Parallel circuits for referral and transport of patients with a STEMI that bypass the EMS should be avoided. The ambulance system to enhance early
 initial diagnosis, triage, and treatment, 87,94 It is indicated that all ambulances in the EMS are equipped with ECG recorders, defibrillators, and at least one person trained in advanced life support. The quality of the care provided depends on the training of the staff involved. It is indicated that all ambulances in the EMS are equipped with ECG recorders, defibrillators, and at least one person trained in advanced life support.
 symptoms of an AMI, administer oxygen when appropriate, relieve pain, and provide basic life sup-port.95 Ambulance staff should be able to record an ECG for diagnostic purposes and either interpret or transmit it, so that it can be reviewed by experienced staff in a coronary care unit (CCU)/ICCU or elsewhere and establish a STEMI diagnosis.
 Paramedics trained to administer fibrinolytics do so safely and effectively.96 As pre-hospital fibrinolysis is indicated in patients presenting early when anticipated STEMI diagnosis to PCI-mediated reperfusion time is 120 min,97-99 ongoing training of paramedics training of paramedics to undertake these functions is recommended, even in the current setting of pri-mary
 PCI. 4.4.3 Organization of ST-segment elevation myocardial infarction treatment in networks between hospitals ('hub' and 'spoke') with various levels of technology, linked by a prioritized and efficient ambulance service. The goal of these networks is to provide optimal
 care while minimiz- ing delays, thereby improving clinical outcomes. Cardiologists should actively collaborate with all stakeholders, particularly emergency physicians, in establishing such networks. The main features of such a network are: 

Clear definition of geographic areas of responsibility. 

Shared written protocols, based on risk stratification of geographic areas of responsibility.
 and transportation by a trained physician, nurse, or paramedic staff in appropriate institution, bypassing non-PCI hospitals or hospitals or hospitals without a 24h a day, 7 days a week (24/7) primary PCI programme. | On arrival at the appropriate hospital, the
 patient should immediately be taken to the catheterization laboratory, bypassing the emergency department. | Patients presenting to a non-PCI-capable hospital and awaiting trans- portation for primary or rescue PCI must be attended in an appropri- ately monitored and staffed area. | If the diagnosis of STEMI has not been made by the ambulance
 crew and the ambulance arrives at a non-PCI-capable hospital, the ambu- lance should await the diagnosis and, if a STEMI diagnosis is made, should continue to a PCI-capable hospital. To maximize staff experience, primary PCI centres should perform the procedure systematically on a 24/7 basis for all STEMI patients. Other models, although not
  ideal, may include weekly or daily rotation of primary PCI centres or multiple primary PCI centres in the same region. Hospitals that cannot offer a 24/7 service for primary PCI should be allowed to perform primary PCI in patients already admit- ted for another reason who develop STEMI during their hospital stay. However, these hospitals should be
  discouraged from initiating a serv- ice limited to daytime- or within-hours primary PCI, as this may gener- ate confusion with the EMS operators and may affect the STEMI diagnosis-to-reperfusion time and the quality of intervention of focused 24/7 true primary PCI, as this may gener- ate confusion with the EMS operators and may affect the STEMI diagnosis-to-reperfusion time and the quality of intervention of focused 24/7 true primary PCI.
  with an established interventional cardiology programme available 24/7, if necessary bypassing a non-PCI-capable hospital (if the transfer time is within the recommended time-windows for primary PCI; see Figure 3). Geographic areas where the expected transfer time to the primary PCI centre makes it impossible to achieve the maximal allowable
 delays indicated in the recommendations (Figure 2) should develop systems for rapid fibrinolysis, at the place of STEMI diagnosis, with subsequent immediate transfer to primary PCI centres. Such net-works increase the proportion of patients receiving reperfusion with the shortest possible treatment delay, 100-102. The quality of care, time delays,
 and patient outcomes should be measured and com- pared at regular intervals for improvement. 4.4.3.1. General practitioners play a role in the early care of patients with AMI and are often the first to be contacted by the patients. If general practitioners respond quickly they can be very effective, as they
 usually know the patient and can perform and interpret the ECG. Their first task after the STEMI diagnosis should be to alert the EMS. In addition, they can administer opioids and antithrombotic drugs (including fibrinolytics, if that management strategy is indi- cated), and can undertake defibrillation if needed. However, in most settings,
 consultation with a general practitioner—instead of a direct call to the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay. Therefore, in gen- eral, the public should be educated to call the EMS—will increase pre-hospital delay.
 therapy 5.1 Selection of reperfusion strategies Table 4 lists the definitions of terms relating to reperfusion strategy in patients with STEMI within 12 h of symptom onset, provided it can be performed expeditiously (i.e. 120 min from STEMI diagnosis, Figures 2 and 3) by an experienced team. An
 experienced team includes not only inter- ventional cardiologists but also skilled support staff. Lower mortality rates among patients undergoing primary PCI are observed in centres with a high volume of PCI procedures.111 Real-life data confirm that primary PCI is performed faster and results in lower mortality if per- formed in high-volume
  centres.112 Randomized clinical trials in high-volume, experienced centres have repeatedly shown that, if delay to treatment is similar, primary PCI is not an immediate option and fibrinolysis could be initiated expeditiously.
  The extent to which the PCI-related time delay diminishes the advantages of PCI over fibrinolysis has been widely debated. Because no specifically designed study has addressed Logistics of pre-hospital management of STEMI patients is based on regional networks
 designed to deliver reperfusion therapy expeditiously and effec- tively, with efforts made to make primary PCI available to as many patients as possible. 100 I B It is recommended that primary PCI available to as many patients as possible.
 PCI-capable centre for primary PCI bypass the emergency department and CCU/ICCU and are transferred directly to the catheterization laboratory, 92,107-110 I B It is recommended that ambulance teams are trained and equipped to identify STEMI (with use of ECG recorders and telemetry as necessary) and administer initial therapy, including
 fibrinolysis when applicable.95 I C It is recommended that all hospitals and EMS participating in the care of patients with STEMI recommended that EMS transfer STEMI patients to a PCI-capable centre, bypassing non-PCI centres. I C It is recommended
 that EMS, emergency departments, and CCU/ICCU have a writ- ten updated STEMI management protocol, preferably shared within geographic networks. I C It is recommended that patients presenting to a non-PCI-capable hospital and awaiting transportation for primary or rescue PCI are attended in an appropriately monitored area (e.g. the
 emergency department, CCU/ ICCU, or intermediate care unit). I C 24/7 = 24 h a day, 7 days a week; CCU = coronary care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; ICCU = intensive cardiac care unit; ECG = electrocar- diogram; EMS = emergency medical system; EMS = emergency medica
 recommendation. b Level of evidence. Table 4 Definitions of terms related to reperfusion therapy ECG = electrocardiogram; EMS = emergency medical system; FMC = first medi- cal contact; IRA = infarct-related artery; PCI = percutaneous coronary interven- tion; STEMI = ST-segment elevation myocardial infarction. ESC Guidelines 13 Downloaded
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                                                                    ... this issue, caution is needed when interpreting available data from post hoc analyses. A PCI-related time delay potentially mitigating the benefits of PCI has been calculated as 60 min117, 110 min,118 and 120 min119 in different studies. Registry data estimated this time limit as 114 min for
 in-hospital patients 107 and 120min in patients present- ing in a non-PCI centre, 120 All these data are old and patients under- going fibrinolysis, The recent STrategic Reperfusion Early After Myocardial infarction (STREAM) trial randomized early
 STEMI presenters without the possibility of immediate PCI to immediate PCI to immediate PCI to immediate PCI to immediate PCI.121 The median PCI-related delay in this trial was 78 min, and there were no differences in clinical outcomes. This Task Force recognizes the lack of contemporaneous data to set the limit to choose
 PCI over fibrinolysis. For simplicity, an absolute time from STEMI diagnosis to PCI-related artery (IRA)] rather than a relative PCI-related delay over fibrinolysis has been chosen. This limit is set to Figure 3 Maximum target times according to reperfusion strategy selection in patients presenting
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via EMS or in a non-PCI centre. ECG = electro- cardiogram; PCI = Percutaneous Coronary Intervention; STEMI = ST-segment elevation myocardial infarction. STEMI diagnosis is the time 0 for the strategy clock. The decision for choosing reperfusion strategy in patients presenting via EMS (out-of-hospital setting) or in a non-PCI centre is based on the estimated time from STEMI diagnosis to PCI-mediated reperfusion. Target times from STEMI diagnosis represent the maximum time to do specific interventions. a if fibrinolysis is contra-indicated, direct for primary PCI strategy regardless of time to PCI. b 10 min is the maximum target delay time from STEMI diagnosis to fibrinolytic bolus administration, however, it should be given as soon as possible after STEMI diagnosis (after ruling out contra-indications). 14 ESC Guidelines Downloaded from by guest on 16 September 2017 15. 120 min absolute time would correspond to a

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PCI-related delay in the range of 110-120 min, being in the reperfusion strategy is fibrinolysis, the goal is to inject the bolus of fibrinolytics within 10min from STEMI diagnosis. This time is selected based on the median time from
 randomization to bolus recorded in the STREAM trial, which was 9 min.121 In previous ESC STEMI diagnosis should occur within 10min from FMC. Figure 3 summarizes target times for patients presenting in the pre- hospita
setting or in a non-PCI centre. To shorten time to treatment, fibrinolysis should be administered in the pre-hospital setting if possible98,121,123 (Figures 2 and 3). Patients should be transferred to a PCI-capable facility as soon as pos-sible after bolus of lytics administration. Rescue PCI is indicated in the case of failed fibrinolysis (i.e. ST-segment
resolution 50% within 60-90 min of fibrinolysis (preferably 2-24h after fibrinolysis) (see section 5.3).125-130 Patients with a clinical
 presentation compatible with AMI and a non-interpretable ST-segment on the ECG, such as those with bun- dle branch block or ventricular pacing, 55,131,132 should undergo a pri- mary PCI strategy. There is general agreement that a primary PCI strategy should also be followed for patients with symptoms lasting 12h in the presence of: (1) ECG
evidence of ongoing ischaemia; (2) ongoing or recurrent pain and dynamic ECG changes; and (3) ongoing or recurrent pain, symptoms, and signs of heart failure, shock, or malignant arrhythmias. However, there is no consensus as to whether PCI is also beneficial in patients presenting 12h from symptom onset in the absence of clinical and/or
electrocardiographic evidence of ongoing ischaemia. In asymptomatic patients without persistent symptom onset, a small (n = 347) randomized study showed improved myocardial salvage and 4 year survival in patients treated with primary PCI compared with conservative treatment alone.133,134 However, in stable patients
 with persistent occlusion of the IRA 3-28 days after MI, the large (n = 2166) Occluded Artery Trial (OAT) revealed no clinical benefit from medical management, beyond that from medical management is the following that 
showed no benefit of reperfusion.137 Therefore, routine PCI of an occluded IRA in asymptoms or objective evidence of symptoms is not indicated. These patients should be considered in the presence of symptoms or objective evidence of
viability/ischaemia in the territory of the occluded artery. 1 Recommendations for reperfusion therapy Recommendation Classa Levelb Reperfusion therapy is indicated in all patients with symptoms of ischaemia of 12 h duration and persistent ST-seg- ment elevation. 119,138 I A A primary PCI strategy is recommended over fibrinolysis within
indicated timeframes.114,116,139,140 I A If timely primary PCI cannot be performed after STEMI diagnosis, fibrinolytic therapy is recommended within 12 h of symptom onset in patients with suspected ongoing ischaemications.107,120,122 I A In the absence of ST-segment elevation, a primary PCI strategy is indicated in patients with suspected ongoing ischaemications.
symp- toms suggestive of MI and at least one of the following criteria present: - haemodynamic instability or cardiogenic shock - recurrent or ongoing chest pain refrac- tory to medical treatment or T- wave changes
particularly with intermit- tent ST-segment elevation. I C Early angiography (within 24 h) is recom- mended if symptoms are completely relieved and ST-segment elevation is com- pletely normalized spontaneously or after nitroglycerin administration (provided there is no recurrence of symptoms or ST-seg- ment elevation). I C In patients with time
 from symptom onset 12 h, a primary PCI strategy is indicated in the presence of ongoing symptoms sugges- tive of ischaemia, haemodynamic instability, or life-threatening arrhythmias.141 I C A routine primary PCI strategy should be considered in patients presenting late (12-48 h) after symptom onset.133,134,142 IIa B In asymptomatic patients,
routine PCI of an occluded IRA 48 h after onset of STEMI is not indicated.135,137 III A IRA = infarct-related artery; MI, myocardial infarction. a Class of recommendation. b Level of evidence. ESC Guidelines 15 Downloaded from by guest on 16
                                                                                                                                                                       .. Table 5 summarizes the important time targets in acute STEMI. 5.2 Primary percutaneous coronary intervention and adjunctive therapy 5.2.1 Procedural aspects of primary percutaneous coronary intervention 5.2.1.1
 Access route Over recent years, several studies have provided robust evidence in favour of the radial approach as the default access site in ACS patients undergoing primary PCI by experienced radial operators. The Minimizing Adverse Haemorrhagic Events by TRansradial Access Site and Systemic Implementation of angioX (MATRIX)143 trial
recruited 8404 ACS patients (48% STEMI) who were randomly allocated to transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding, vascular complications, and need for transferoral access site bleeding.
reinforced previous observations from the Radial Versus Femoral Access for Coronary Intervention (RIVAL) access for coronary Intervention (RIVAL) access for coronary Intervention trial,144 and the Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Intervention (RIVAL) access for coronary Intervention (RIVAL) access for coronary Intervention trial,144 and the Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Intervention (RIVAL) access for Coronary Intervention (RIVAL) a
type of ACS and treatment benefit, suggesting that the results of this investigation can be extended with confidence to the treatment of patients with STEMI. 5.2.1.2 Stenting in primary PCI. Compared with balloon angioplasty alone, stenting with a bare-metal
stent (BMS) is associated with a lower risk of reinfarction but is not associated with a reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction in the mortality rate. 146,147 In primary PCI, drug-eluting stents (DES) reduce the risk of repeated target vessel revascularization but is not associated with a Reduction bu
or even improved efficacy compared with first-generation DES, in particular with respect to lower risks of stent thrombosis and recur- rent MI. In two recent trials—the Effect of biolimus-eluting stents with AMI (COMFORTABLE AMI) trial149 and the
Everolimus-Eluting Stents Versus Bare-Metal Stents in ST- Segment Elevation Myocardial Infarction (EXAMINATION) trial150 —new-generation DES have been shown to be superior to BMS in patients with AMI, mostly in terms of need for reintervention. In the latter trial, the recently released 5 year follow-up results showed a reduction in all-cause
mortality by DES as compared to BMS.151 In the Norwegian Coronary Stent (NORSTENT) trial,152 9013 patients undergoing PCI (26% with STEMI) were randomized to DES or BMS. There were no differences in the incidence of the pri- mary endpoint (composite of death from any cause or non-fatal spontaneous MI) after a median follow-up of 5
years. However, DES were associated with lower rates of definite stent thrombosis (0.8% vs. 1.2%; P = 0.0498) and of target lesion and any repeat revascularization (MVO) and preserve microcirculatory function
 Two small studies recently found opposite results in the effect of deferred stenting on cardiac magnetic reso- nance (CMR) imaging-measured MVO.153,154 In the larger DANish Study of Optimal Acute Treatment of Patients with ST-
 segment elevation myocardial infarc- tion (DANAMI 3-DEFER) trial,155 in 1215 STEMI patients, deferred stenting (48 h after the index procedure) had no effect on the pri- mary clinical outcome (composite of all-cause mortality, non-fatal MI, or ischaemia-driven revascularization of non-IRA lesions). Routine deferred stenting was associated with a
 higher need for target vessel revascularization. Based on these findings, routine use of deferred stenting is not recommended. 5.2.1.3 Thrombus aspiration A number of small-scale or single-centre studies and one meta-analysis of 11 small trials156 suggested that there could be benefits from routine manual thrombus aspiration during primary PCI
 Recently, two large (10000 and 7000 patients) randomized controlled trials, which were adequately powered to detect superiority of routine aspiration strategy overall.157-160 A safety concern emerged in the Trial of Routine Aspiration
Thrombectomy with PCI versus PCI Alone in Patients with STEMI (TOTAL) trial (n = 10732), with an increase in the risk of stroke.161 In the subgroup with high thrombus burden [TIMI (Thrombolysis in Myocardial Infarction) thrombus burden [TIMI (Thrombolysis in Myocardial Infarction) thrombus associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%) vs. 205 (3.1%); hazardy associated with fewer cardiovascular deaths [170 (2.5%) vs. 205 (3.1%) vs. 205 (3.1%)
ratio (HR) 0.80, 95% confidence interval (CI) 0.65-0.98; P = 0.03] and with more strokes or transient ischaemic attacks [55 (0.9%) vs. 34 (0.5%); odds Table 5 Summary of important time targets ECG = electrocardiogram; FMC = first medical contact; PCI = percutaneous cor- onary intervention; STEMI = ST-segment elevation myocardial infarction at the segment elevation myocardial infarction myocard
ECG should be interpreted immediately. 16 ESC Guidelines Downloaded from by guest on 16 September 2017 17. ....
                                                                                                                                                                                                 . ratio 1.56, 95% CI 1.02-2.42, P =0.04]. However, the interaction P val- ues were 0.32 and 0.34, respectively.162 In the Taste157 and TOTAL trials159, 1-5% of randomized patients crossed over from PCI
alone to thrombus aspiration. Based on these data and the results of a recent meta-analysis, 162 routine thrombus aspiration is not recommended, but in cases of large residual throm- bus burden after opening the vessel with a guide wire or a balloon, thrombus aspiration may be considered. 5.2.1.4 Multivessel coronary revascularization Multivessel
disease is common (in approximately 50%) in patients with STEMI.163,164 While it is recommended to always treat the IRA, evidence supporting immediate (preventive) revascularization of additional significant coronary stenoses is conflicting. It has been reported that patients with extensive CAD in vessels remote from the IRA have lower rates of
ST-segment recovery and an adverse prognosis following primary PCI.163 Data from the US National Cardiovascular Data Registry and New York State's Percutaneous Coronary Interventions Reporting System suggested an increase in adverse events, including mortality, in patients treated with immediate multivessel revascularization versus IRA
 PCI only, while patients in cardiogenic shock were excluded from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing this issue have been small (each of them included from the analysis.165,166 Randomized clinical trials addressing the analysis.165,16
 staged revascula- rization of the non-IRA. At a mean follow-up of 2.5 years, patients allo- cated to IRA angioplasty-only had more major adverse cardiac events (MACE) (i.e. death, reinfarction, rehospitalization for ACS, and repeat coronary revascularization) than the patients treated with other strat- egies. 167 After this study, four randomized clinical
trials have compared PCI of the IRA only vs. complete revascularisation: the Preventive Angioplasty in Acute Myocardial Infarction (PRAMI) trial (n = 465, 23months follow-up),168 the Complete revascularisation versus treatment of the culprit lesion
only in patients with ST-segment elevation myocardial infarction and multivessel dis- ease (DANAMI-3-PRIMULTI) trial (n = 627, 27months follow-up),170 and the Comparison Between FFR Guided Revascularization Versus Conventional Strategy in Acute STEMI Patients With Multivessel dis- ease (Compare-Acute, n = 885, 12months follow-up)
trial.171 PCI of non-IRA was done either during the index procedure (PRAMI and Compare-Acute), staged during hospital admission (DANAMI- 3-PRIMULTI), or any time before discharge (immediate or staged) (CVLPRIT). Indication for PCI in non-IRA was angiography-guided in lesions with 50% stenosis (PRAMI), 70% stenosis (CVLPRIT), or
fractional flow reserve (FFR)-quided (DANAMI-3-PRIMULTI and Compare-Acute). Primary outcome (composite of different in any of the four trials. Repeat revascularization was significantly reduced in the
complete revascularization arm in the PRAMI, DANAMI- 3-PRIMULTI, and Compare-Acute trials. Non-fatal MI was reduced in the non-IRA PCI group only in PRAMI. The lack of significant treatment effect of non-IRA lesion intervention on death or MI was confirmed by three meta-analyses 172-174 (none of these meta-analyses included the Compare
 Acute trial, and one 173 did not include the DANAMI-3-PRIMULTI). Based on these data, revascularization of non-IRA lesions should be considered in STEMI patients with multives- sel disease before hospital discharge. As the optimal timing of revascu- larization (immediate vs. staged) has not been adequately investigated, no recommendation in
favour of immediate vs. staged multivessel PCI can be formulated. 5.2.1.5 Intra-aortic balloon pump (IABP) in anterior MI without shock,175 but there was increased bleeding, which is
consistent with previous data regarding the role of IABP in high-risk STEMI without cardiogenic shock.177 Haemody- namic support in patients with cardiogenic shock is discussed in Chapter 8. Procedural aspects of the primary
percutaneous cor- onary intervention strategy Primary PCI of the IRA is indicated is recommended in patients with symptoms or signs of recurrent or remaining ischaemia after primary PCI. I C IRA technique Stenting is recommended
(over balloon angio- plasty) for primary PCI.146,147 I A Stenting with new-generation DES is recommended over femoral access if performed by an experienced radial operator.143-145,180 I A Routine use of thrombus aspiration is not recommended.157,159 III A Routine
use of deferred stenting is not recommended.153-155 III B Non-IRA strategy Routine revascularization of non-IRA lesions should be considered in STEMI patients with mul- tivessel disease before hospital discharge.167-173 IIa A Non-IRA PCI during the index procedure should be considered in patients with cardiogenic shock. IIa C CABG should be
considered in patients with ongoing ischaemia and large areas of jeopardized myocardium if PCI of the IRA cannot be performed. IIa C CABG = coronary intervention; STEMI = ST- segment elevation myocardial infarction. a Class of
                                                                                                                                                                                                                                                                                    .5.2.2 Periprocedural pharmacotherapy 5.2.2.1 Platelet inhibition Patients undergoing primary PCI should receive DAPT, a combina-tion of
recommendation. b Level of evidence. ESC Guidelines 17 Downloaded from by guest on 16 September 2017 18. ....
 aspirin and a P2Y12 inhibitor, and a parenteral anticoagulant. Aspirin can be given orally including chewing, or i.v. to ensure com- plete inhibition of thromboxane A2-dependent platelet aggregation. The oral dose of plain aspirin (non-enteric-coated formulation) should preferably be 150-300 mg. There are few clinical data on the optimal i.v. dosage.
Given a 50% oral bioavailability of oral aspirin, a corresponding dose is 75-150mg. Pharmacological data suggest that this lower dose range avoids inhibition of cyclooxygenase-2- dependent prostacyclin. A recent randomized study showed that a single dose of 250 or 500 mg acetylsalicylic acid i.v. compared to 300 mg orally was associated with a
 faster and more complete inhibi- tion of thromboxane generation and platelet aggregation at 5 min, with comparable rates of bleeding complications. The Administration of Ticagrelor in the Cath Lab or in the Ambulance for New ST Elevation
Myocardial Infarction to Open the Coronary Artery (ATLANTIC) trial 182 is the only randomized study testing the safety and efficacy of different timings of P2Y12 inhibitor initiation in STEMI. In this trial, patients were randomized to receive ticagrelor either during transfer to a primary PCI centre or immediately before angiography 182. The median
difference between the two tested loading treatment strat- egies was only 31min. This study failed to meet the pre-specified pri- mary endpoint in terms of improved ST-segment elevation resolution or TIMI flow before intervention. Rates of major and minor bleeding events were identical in both treatment arms. While the evidence of a clinical benefit
of P2Y12 inhibitor pre-treatment in this setting is lacking, early initiation of a P2Y12 inhibitor while the patient is being transported to a primary PCI centre is common practice in Europe and is consistent with high-dose clopidogrel was super rior to in-catheterization laboratory treatment of the patient is being transported to a primary PCI centre is common practice in Europe and is consistent with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was super rior to in-catheterization laboratory treatment with high-dose clopidogrel was
in observational stud- ies and one small randomized trial. 183-185 In all, the data suggest that the earliest administration may be preferable to achieve early efficacy, particularly for long delays. However, in cases in which the STEMI diagnosis is not clear, delaying P2Y12 inhibitor loading until the anat- omy is known should be considered. The
preferred P2Y12 inhibitors are prasugrel [60 mg loading dose and 10 mg maintenance dose once daily per os (p.o.)] or ticagrelor (180 mg p.o. loading dose and 90 mg maintenance dose twice daily). These drugs have a more rapid onset of action, greater potency, and are superior to clopidogrel in clinical outcomes. 186, 187 Prasugrel is contraindicated
 in patients with previous stroke/transient ischaemic attack, and its use is generally not recommended in patients aged 75 years or in patients with lower body weight (60kg) as it was not associated with net clinical benefit in these subsets. In case prasu-grel is used in these patients, a reduced dose (5mg)188 is recom-mended. Ticagrelor may cause
transient dyspnoea at the onset of therapy, which is not associated with morphological or functional lung abnormalities, and which rarely leads to permanent discontinua- tion. 189 Neither prasugrel nor ticagrelor should be used in patients with a previous haemorrhagic stroke, in patients on oral anticoagu- lants, or in patients with moderate-to-severe
liver disease. When neither of these agents is available (or if they are contraindi- cated), clopidogrel 600mg p.o. should be given instead.190 Clopidogrel has not been evaluated against placebo in any large out- comes studies in the first week was
 superior to the 300/75 mg regimen in the subset of patients under- going PCI in the Clopidogrel and aspirin Optimal Dose usage to reduce recurrent events-Seventh organization to assess strategies in ischaemic syndromes (CURRENT-OASIS 7) trial,190 and use of high clopidogrel loading doses has been demonstrated to achieve more rapid inhibition
of the adenosine diphosphate receptor. All P2Y12 inhibitors should be used with caution in patients at high risk of bleed- ing or with significant anaemia. Cangrelor is a potent i.v. reversible P2Y12 inhibitor with a rapid onset and offset of action. It has been assessed in three random- ized controlled trials enrolling patients with PCI for stable angina or
ACS against clopidogrel loading or placebo.191-193 A pooled analysis of these three trials showed that cangrelor reduced peri- procedural ischaemic complications at the expense of an increased risk of bleeding.194 The fact that no potent P2Y12 inhibitors (prasu- grel or ticagrelor) were used in patients with an ACS, and only about 18% of the
enrolled patients presented with STEMI,193 limits the applicability of the results to current practice of management of STEMI patients. Nevertheless, cangrelor may be considered in patients not pre-treated with oral P2Y12 receptor inhibitors at the time of PCI or in those who are considered unable to absorb oral agents. The pre-hospital routine
upstream use of glycoprotein (GP) IIb/IIIa inhibitors before primary PCI has not been demonstrated to offer a benefit and increases bleeding risk compared with routine use in the catheterization laboratory.195,196 Procedural use of abciximab plus unfractionated heparin (UFH) showed no benefit compared to biva- lirudin.197 Using GP IIb/IIIa
 inhibitors as bailout therapy in the event of angiographic evidence of a large thrombus, slow- or no-reflow, and other thrombotic complications is reasonable, although this strategy has not been tested in a randomized trial. Overall, there is no evi- dence to recommend the routine use of GP IIb/IIIa inhibitors for pri- mary PCI. The intracoronary
administration of GP IIb/IIIa inhibitors is not superior to its i.v. use.198 5.2.2.2 Anticoagulation Anticoagulation Anticoagulation Anticoagulation for the Assessment of Strategies for Ischemic Syndromes 6 (OASIS
6) trial and is not recommended.199 There has been no placebo-controlled trial evaluating UFH in pri- mary PCI, but there is a large body of experience with this agent. 18 ESC Guidelines Downloaded from by guest on 16 September 2017 19. Dosage should follow standard recommendations for PCI (i.e. initial bolus 70-100U/kg). There are no robust
data recommending the use of activated clotting time to tailor dose or monitor UFH, and if activated clotting time is used, it should not delay recanalization of the IRA. An i.v. bolus of enoxaparin 0.5mg/kg was compared with UFH in the randomized open-label Acute myocardial infarction Treated with primary angioplasty and inTravenous enOxaparin
or unfractionated heparin to Lower ischaemic and bleeding events at short- and Long-term follow-up (ATOLL) trial, including 910 STEMI patients. 200 The primary composite endpoint of 30 day death, MI, procedural failure, or major bleeding was not significantly reduced by enoxaparin (17% relative risk reduction, P = 0.063), but there was a
reduction in the composite main secondary endpoint of death, recur- rent MI or ACS, or urgent revascularization. Importantly, there was no evidence of increased bleeding following the use of enoxaparin over UFH.200 In the per-protocol analysis of the ATOLL trial (87% of the study population), i.v. enoxaparin was superior to UFH in reduc- ing the
primary endpoint, ischaemic endpoints, mortality, and major bleeding. 201 In a meta-analysis of 23 PCI trials (30 966 patients, 33% primary PCI), enoxaparin was associated with a significant reduction in death compared to UHF. This effect was particularly significant in the primary PCI context and was associated with a reduction in major
bleeding.202 Based on these considerations, enoxaparin should be considered in STEMI. Five dedicated randomized controlled trials have compared bivalir- udin with UFH with or without planned use of GP IIb/IIIa inhibitors in patients with STEMI.197,203-207 A meta-analysis of these trials showed no mortality advantage with bivalirudin and a
reduction in the risk of major bleeding, but at the cost of an increased risk of acute stent thrombosis.208 In the recent MATRIX trial including 7213 ACS patients (56% with STEMI), bivalirudin was associated with lower total and
cardio- vascular mortality, lower bleeding, and more definite stent thrombosis.209 The recently published STEMI subanalysis confirmed a lack of statistical interaction between the type of ACS and out- comes within the study.210 The MATRIX trial showed that prolonging bivalirudin infusion after PCI did not improve the outcomes com- pared with
bivalirudin infusion confined to the duration of PCI.209 However, a post hoc analysis suggested that prolonging bivalirudin with a full-PCI dose after PCI was associated with the cur- rent label of the drug.209 Based on these data, bivalirudin should be considered in STEMI
especially in patients at high bleeding risk. 197,211,212 Bivalirudin is recommended for patients with heparin- induced thrombocytopenia. Routine post-procedural anticoagulation [due, for instance, to atrial fibrillation (AF),
mechanical valves, or LV thrombus)2 or prophylactic doses for the prevention of venous thromboembolism in patients undergoing primary percutaneous coronary intervention Recommendations Classb Levelc Antiplatelet therapy A potent P2Y12 and post-procedural and post-procedural antithrombotic therapy A potent P2Y12 and post-procedural antithrombotic therapy A potent
inhibitor (prasugrel or tica- grelor), or clopidogrel if these are not avail- able or are contraindicated, is recommended before (or at latest at the time of) PCI and maintained over 12 months, unless there are contraindicated as soon as possible for
 all patients without contraindications. 213,214 I B GP IIb/IIIa inhibitors should be considered for bailout if there is evidence of no-reflow or a thrombotic complication. IIa C Cangrelor may be considered for all patients in
considered.209,215 IIa A Fondaparinux is not recommended for pri- mary PCI.199 III B GP = glycoprotein; i.v. = intravenous; PCI = percutaneous coronary intervention; UFH = unfractionated heparin. a Dose regimens are specified in Table 6. b Class of recommendation. c Level of evidence. ESC Guidelines 19 Downloaded from by guest on 16
                                                                                                                                                 . 5.2.2.3 Therapies to reduce infarct size and microvascular obstruction Final infarct size and MVO are major independent predictors of long-term mortality and heart failure in survivors of STEMI.216,217 MVO is defined as inadequate
 myocardial perfusion after success- ful mechanical opening of the IRA, and is caused by several fac- tors.218 MVO is diagnosed immediately after PCI when post- procedural angiographic TIMI flow is 3, or in the case of a TIMI flow of 3 when myocardial blush grade is 0 or 1, or when ST reso- lution within 60-90 min of the procedure is 70%. Other
non- invasive techniques to diagnose MVO are late gadolinium enhancement (LGE) CMR (the current state of the art for MVO identification), contrast echocardiography, single-photon emission tomography (SPECT), and posi- tron emission tomography (SPECT), and posi- tron emission tomography (SPECT), and posi- tron emission tomography, single-photon emission tomography, single-photon emission tomography (SPECT).
remote ischaemic conditioning, early i.v. metoprolol, GP IIb/IIIa inhibitors, drugs targeting mitochondrial integrity or nitric oxide pathways, adenosine, glucose modulators, hypothermia, and others, have been shown to be beneficial in pre-clinical and small-scale clinical trials, 217, 219 but still there is no ther- apy aimed at reducing
ischaemia/reperfusion injury (MI size) that is clearly associated with improved clinical outcomes. The reduction of ischaemia/reperfusion injury in general, and MVO in particular, remains an unmet need to further improve long-term ventricular function in STEMI. 5.3 Fibrinolysis and pharmacoinvasive strategy 5.3.1 Benefit and indication of
fibrinolysis Fibrinolytic therapy is an important reperfusion strategy in settings where primary PCI cannot be offered in a timely manner, and pre- vents 30 early deaths per 1000 patients treated within 6 h after symptom onset. 220 The largest absolute benefit is seen among patients at highest risk, including the elderly, and when treatment is offered
2 h after symptom onset.138,221 Fibrinolytic therapy is recommended within 12 h of symptom onset if primary PCI can- not be performed within 120 min from STEMI diagnosis (see Figure 3) and there are no contraindications. The later the patient presents (particularly after 3 h),98,120,121 the more consideration should be given to transfer for
primary PCI (as opposed to admin- istering fibrinolytic therapy) because the efficacy and clinical bene- fit of fibrinolytic treatment, it is important to weigh the potentially life-saving effect of fibrinolysis against potentially life-threatening side
effects, taking into account alternative treatment options such as delayed primary PCI. Table 6 Doses of antiplatelet and anticoagulant cotherapies in patients undergoing primary percutane- ous coronary intervention or not reperfused b.i.d. = twice a day; GP = glycoprotein; i.v. = intravenous; IU = international units; PCI = percutane-ous coronary
17% compared with in-hospital fibrinolysis, 123 particularly when administered in the first 2 h of symp- tom onset. 138 These and more recent data support pre-hospital initiation of fibrinolytic treatment when a reperfusion strategy is indi- cated. 97,99,100,237 The STREAM trial showed that pre-hospital fibrinoly yais followed by an early PCI strategy
 was associated with a similar outcome as transfer for primary PCI in STEMI patients presenting within 1 h after FMC.121,238 If trained medical or paramedical staff are able to analyse the ECG on- site or to transmit the ECG to the hospital for interpretation, it is Fibrinolytic therapy
 Recommendations Classa Levelb When fibrinolysis is the reperfusion strategy, it is recommended to initiate this treatment as soon as possible after STEMI diagnosis, preferably in the pre-hospital setting.96,98,123,222 I A A fibrin-specific agent (i.e. tenecteplase, alteplase, or reteplase) is recommended.223,224 I B A half-dose of tenecteplase should
be considered in patients 75 years of age.121 IIa B Antiplatelet co-therapy with fibrinolysis Oral or i.v. aspirin is indicated for up to 1 year in patients undergoing fibrinolysis and subsequent PCI. I C Anticoagulation co-
therapy with fibrinolysis Anticoagulation is recommended in patients treated with lytics until revascularization (if performed) or for the duration of hospital stay up to 8 days.199,224,227-233 The anticoagulant can be: • Enoxaparin i.v. followed by infusion.224
• In patients treated with streptokinase: fondaparinux i.v. bolus followed by an s.c. dose 24 h later.199,233 I A I A I B IIa B Transfer after fibrinolysis.121,124,126–130,234 I A Interventions following fibrinolysis Emergency angiography and
PCI if indicated is recommended in patients with heart failure/shock.124, 235 I A Rescue PCI is indicated immediately when fibrinolysis has failed (50% ST-segment resolution at 60-90 min) or at any time in the presence of haemodynamic or electrical instability, or worsening ischaemia.121,124,236 I A Angiography and PCI of the IRA, if indicated, is
recommended between 2 and 24 h after successful fibrinolysis.125-128,234 I A Emergency angiography and PCI if needed is indicated in the case of recurrent ischaemia or evidence or evide
intervention; SBP = systolic blood pressure; s.c. = subcutaneous; STEMI = ST-segment elevation myocardial infarction; UFH = unfractionated heparin. a Class of recommendation. b Level of evidence. c Clopidogrel is the P2Y12 inhibitor of choice as co-adjuvant and after fibrinolysis, but 48 h after fibrinolysis, switch to prasugrel/ticagrelor may be
considered in patients who underwent PCI. ESC Guidelines 21 Downloaded from by guest on 16 September 2017 22. .......
                                                                                                                                                                                                         ..recommended to initiate fibrinolytic therapy in the pre-hospital setting. The aim is to start fibrinolytic therapy within 10min from STEMI diagnosis. 5.3.3 Angiography and percutaneous coronary
intervention after fibrinolysis (pharmacoinvasive strategy) Following initiation of lytic therapy, it is recommended to transfer the patients to a PCI centre (Figure 3). In cases of failed fibrinolysis, or if there is evidence of reocclusion or reinfarction with recurrence of ST-segment elevation, immediate angiography and rescue PCI is indicated. 124 In
this setting, re-administration of fibrinolysis has not been shown to be beneficial and should be discouraged.124 Even if it is likely that fibrinolysis will be successful (ST-segment resolution 50% at 60-90min; typical reperfusion arrhythmia; and disappear- ance of chest pain), a strategy of routine early angiography is recom- mended if there are no
contraindications. Several randomized trials126-128,234,239,240 and meta-analyses129,130 have shown that early routine angiography with subsequent PCI (if needed) after fibrinolysis reduced the rates of reinfarction and recurrent ischaemia compared with a 'watchful waiting' strategy, in which angiography and revascularization were indicated
only in patients with spontane- ous or induced severe ischaemia or LV dysfunction, or in those with a positive outpatient ischaemia test. The benefits of early routine PCI after fibrinolysis were seen in the absence of an increased risk of adverse events (stroke or major bleeding), and across patient sub- groups.241 Thus, early angiography with
subsequent PCI if indicated is also the recommended standard of care after successful lysis and PCI; there was a wide variation in delay in trials, from a median of 1.3h in the Combined Angioplasty and Pharmacological Intervention versus Thrombolytics ALone in
Acute Myocardial Infarction (CAPITAL AMI) trial240 to 17h in the Grupo de Analisis de la Cardiopatia Isque´mica Aguda (GRACIA)-1234 and STREAM trials.121 In a pooled patient-level analysis of six randomized trials, very early angiography (2h) after fibrinolysis was not associated with an increased risk of 30day death/ reinfarction or in-hospital
 major bleeding, and a shorter time from symptom onset to angiography (4h) was associated with reduced 30day and 1 year death/reinfarction and 30day recurrent ischaemia.125 Table 7 Doses of fibrinolytic agents and antithrombotic co-therapies a PTT = activated partial thromboplastin time; eGFR = estimated glomerular filtration rate; i.v. =
intravenous; IU = international units; rPA = recombinant plasminogen activator; s.c. = subcutaneous; tPA = tissue plasminogen activator; UFH = unfractionated heparin. 22 ESC Guidelines Downloaded from by guest on 16 September 2017 23. .....
between start of lysis and angiography of 2-17h,121,126-128 a time- window of 2-24h after successful lysis is recommended. 5.3.4 Comparison of fibrin-specific agents A fibrin-specific agent should be preferred.224 Single-bolus weight- adjusted tenecteplase tissue plasminogen activator (TNK-tPA) is equivalent to accelerated tPA in reducing 30 day
mortality, but is safer in preventing non-cerebral bleeds and blood transfusion, and is easier to use in the pre-hospital setting.223 5.3.5 Adjunctive antiplatelet and anticoagulant therapies An early study showed that the benefits of aspirin should be chewed or given i.v. and
a low dose (75-100mg) given orally daily thereafter. Clopidogrel added to aspirin reduces the risk of cardio- vascular events and overall mortality in patients treated with fibrinol- ysis225,226 and should be added to aspirin as an adjunct to lytic therapy. Prasugrel and ticagrelor have not been studied as adjuncts to fibrinolysis. There is no evidence
that administration of GP IIb/IIIa inhibitors improves myocardial perfusion or outcomes in patients treated with fibrinolysis, and bleeding may increase. 242 Parenteral anticoagulation should preferably be given until revascula- rization (if performed). Otherwise, it should be given for at least 48h or for the duration of hospital stay, up to 8 days. In spite
of an increased risk of major bleeding, the net clinical benefit favoured enoxaparin over UFH in the ASsessment of the Safety and Efficacy of a New Thrombolysis Reperfusion for Acute myocardial infarction Treatment-Thrombolysis In Myocardial Infarction 25 (ExTRACT-
TIMI 25) trial (n = 20506), a lower dose of enoxaparin was given to patients 75 years of age and to those with a reduction in the risk of death and reinfarction at 30 days when compared with a weight-adjusted UFH dose, but at the cost of a significant
increase in non-cerebral bleeding complications. The net clinical benefit (i.e. absence of death, non-fatal infarction, 199,233 especially in patients
 who received streptokinase. In a large trial with streptokinase, 243 significantly fewer reinfarc- tions were seen with bivalirudin fewer reinfarc- tions were seen with bivalirudin has not been studied with fibrin-specific agents. Thus, there is no evidence
in support of direct thrombin inhibitors as an adjunct to fibrinolysis. Weight-adjusted i.v. tenecteplase, aspirin, and clopidogrel given orally, and enoxaparin i.v. followed by s.c. administration until the time of PCI (revascularisation), comprise the antithrombotic cocktail most extensively studied as part of a pharmacoinvasive
strategy.121,126,128,242,244 5.3.6 Hazards of fibrinolysis Fibrinolytic therapy is associated with a small but significant excess of strokes, largely attributable to cerebral haemorrhage, with the excess hazard appearing on the first day after treatment.220 Advanced age, lower weight, female sex, previous cerebrovascular disease, and systolic and
diastolic hypertension on admission are significant predictors of intracranial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial, the initial excess in intracranial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial, the initial excess in intracranial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial, the initial excess in intracranial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial, the initial excess in intracranial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial, the initial excess in intracranial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the dosean trial haemorrhage in patients 75years was reduced after the protocol amendment to reduce the patients 75years was reduced after the protocol amendment to reduce the patients 75years was reduced
of tenecteplase by 50%. Data from a number of studies suggest that major non-cerebral bleeds occurred in 4-13% of the patients treated.121,223,224,246 Administration of streptokinase should be avoided because of antibodies that can
 impair its activity, and because of the risk of allergic reactions. 5.3.7 Contraindications to fibrinolytic therapy Short successful resuscitation does not contraindicate fibrinolytic therapy. In patients in refractory cardiac arrest, lytic therapy is not effective, increases the risk of bleeding, and is therefore not recom- mended. Prolonged, or traumatic but
successful, resuscitation increases bleeding risk and is a relative contraindication to fibrinoly- sis.247 Table 8 Contra-indications to fibrinolytic therapy. Table 8 Contra-indications to fibrinolytic therapy DBP = diastolic blood pressure; SBP = systolic blood pressure; SBP = systolic blood pressure.
                                                                                                                                                                    .. 5.4 Coronary artery bypass graft surgery Emergent coronary artery bypass graft surgery (CABG) should be considered for patients with a patent IRA but with unsuitable anat- omy for PCI, and either a large myocardial area at
jeopardy or with cardiogenic shock. 248 In patients with MI-related mechanical compli- cations who require coronary occlusion not amenable to PCI, emergent CABG is infre- quently performed because the benefits of surgical
 revascularization in this setting are uncertain. As the delay to reperfusion is long, the probabilities of myocardial salvage affecting prognosis are low and the surgical risks are elevated. In the absence of randomized data, optimal timing for non- emergent CABG in stabilized post-MI patients should be determined individually. A review of California
discharge data compared patients who underwent early (3 days, n = 4676) versus delayed (3 days, n = 4676) ve
 whom surgery was performed on the day of the MI (8.2%). However, no differentiation was made between NSTEMI and STEMI, and higher-risk patients were more likely to be treated rapidly. Patients with a large area of myocardium at jeopardy due
to critical coronary stenoses or recurrent ischaemia) should be operated on as soon as possible without waiting for the full recovery of platelet function following discontinuation of DAPT. For all other patients, a wait- ing period of 3-7 days may be the best compromise (at least 3 days following interruption of ticagrelor, 187, 250 5 days for clopidogrel
and 7 days for prasugrel), 7 while it is recommended that aspirin is contin- ued. 251 The first aspirin administration post-CABG is recommended that aspirin administration post-CABG is recommended that aspirin administration post-CABG is recommended 6-24h after surgery in the absence of ongoing bleeding events. 252, 253 6. Management during hospitalization and at discharge 6.1 Coronary care unit/intensive cardiac care unit Following reperfusion, it is
recommended to admit STEMI patients to a CCU/ICCU or equivalent unit where continuous monitoring (arterial and pulmonary, heart failure, mechani- cal circulatory support, invasive and non-invasive haemodynamic monitoring (arterial and pulmonary).
artery pressures), respiratory monitoring, mechanical ventilation, and targeted temperature man- agement. The unit should also be able to manage patients with serious renal and pulmonary disease. The desirable organization, structure, and criteria of the CCU/ICCU have been described in an ESC-Acute Cardiovascular Care Association (ACCA)
position paper.254 6.2 Monitoring ECG monitoring ECG monitoring for arrhythmias and ST-segment deviations is recommended for at least 24 h after symptom onset in all STEMI patients. Longer monitoring should be considered in patients at intermediate- to high-risk for cardiac arrhythmias (those with more than one of the following criteria: haemodynamically
unstable, presenting major arrhythmias, LVEF 40%, failed reper- fusion, additional critical coronary stenoses of major vessels, or complications related to PCI). Further monitoring may be continued by telemetry. It is recommended that
personnel adequately equipped and trained to manage life-threatening arrhythmias and cardiac arrest accom- pany patients who are transferred between facilities during the time-window in which they require continuous rhythm monitoring. 6.3 Ambulation (day 1) is recommended in the majority of patients and is facilitated by using
the radial access for PCI. Patients with extensive myocardial func- tion and achievement of myocardial func- tion and a
severe complications depending on symptoms and ability. 6.4 Length of stay in the CCU/ICCU and hospital should be determined on an individual basis, according to the patient's cardiac risk, comorbidities, functional status, and social support. Generalization of successful reperfusion and knowledge of coro- nary anatomy
has led to progressive reductions in length of stay after STEMI, with significant reductions in 30 day mortality, sug- gesting that earlier discharge is not associated with late mortal- ity.255,256 Several studies have shown that low-risk patients with successful primary PCI and complete revascularization can safely be discharged from hospital on day 2
or day 3 after PCI.256-262 Candidates for early discharge after STEMI can be identified using simple criteria [e.g. the Second Primary PCI Index, or other criteria].257,258 The PAMI-II criteria designate as low risk patients aged 70 years, with an LVEF 45%, one- or two-vessel
disease, successful PCI, and no persistent arrhythmias. A short hospital stay implies limited time for proper patients should have early post-discharge consultations with a cardiologist, primary care physician, or specialized nurse sched- uled and be rapidly and be rapidly for proper patients.
enrolled in a formal rehabilitation programme, either in-hospital or on an outpatient basis. Early (i.e. same day) transfer to a local hospital following successful primary PCI is routine practice. This can be done safely under adequate monitoring and supervision in selected patients, i.e. those without signs or symptoms consistent with ongoing
myocardial ischaemia, without arrhythmia, who are haemodynamically stable, not requiring vasoactive or mechanical support, and are not sched- uled for further revascularization. 263 24 ESC Guidelines Downloaded from by guest on 16 September 2017 25.
                                                                                                                                             . 6.5 Special patient subsets Several specific patient subsets deserve particular consideration. 6.5.1 Patients taking oral anticoagulation Many patients presenting with STEMI are previously on oral anticoa- gulation or require long-term
anticoagulation afterwards. The addition afterwards. The addition is a rel- ative contraindication for fibrinolysis, when these patients present with a STEMI, they should be
triaged for primary PCI strategy regard- less of the anticipated time to PCI-mediated reperfusion. Patients should be avoided. Loading of aspirin should be done as in all STEMI patients, and clopidogrel is the P2Y12
inhibitor of choice (600 mg loading dose) before or at the latest at the time of PCI. Prasugrel and ticagrelor are not recommended. Ideally, a chronic anticoagulation regimen should not be stopped during admission. Gastric protection with a proton pump inhibitor (PPI) is recommended. Maintenance after STEMI: In general, continuation of oral
anticoa- gulation in patients with an indication for DAPT (e.g. after STEMI) should be evaluated carefully and continued only if compelling evi- dence exists. Ischaemic and bleeding risks should be taken into con- sideration. While there is a considerable overlap of risk factors associated with ischaemic with bleeding outcomes, multiple bleeding risks
scores outperform CHA2DS2-VASc [Cardiac failure, Hypertension, Age 75 (Doubled), Diabetes, Stroke (Doubled) - VAScular disease, Age 65-74 and Sex category (Female)] in predict- ing bleeding risk.270,271 For most patients, triple therapy (in the form of oral anticoagula- tion, aspirin, and clopidogrel) should be considered for 6 months. Then, oral
anticoagulation plus aspirin or clopidogrel should be con- sidered for an additional 6 months. After 1 year, it is indicated to maintain only oral anticoagulation. In cases of very high bleeding risk, triple therapy can be reduced to 1 month after STEMI, continuing on dual therapy (oral anticoagulation plus aspirin or clopidogrel) up to 1 year, and
thereafter only anticoagulation.5,7 The dose intensity of oral anticoagulation should be carefully monitored with a target international normalized ratio in the lower part of the recommended target range. When non-vitamin K antago- nist oral anticoagulation should be carefully monitored with a target international normalized ratio in the lower part of the recommended target range. When non-vitamin K antago- nist oral anticoagulation should be carefully monitored with a target international normalized ratio in the lower part of the recommended target range.
 dose reduction below the approved dose is not recommended. Recently, the Open- Label, Randomized, Controlled, Multicenter Study Exploring Two Treatment Strategy in Subjects with Atrial Fibrillation who Undergo Percutaneous Coronary Intervention (PIONEER
AF-PCI) study randomized 2124 patients with non- valvular AF, who had undergone PCI with stenting (12% STEMI patients), to receive low-dose rivaroxaban (2.5 mg b.i.d.) plus DAPT (95% clopidog- rel) for 1, 6, or 12 months, or
standard therapy with a dose-adjusted vitamin K antagonist plus DAPT (96% clopidogrel) for 1, 6, or 12 months.272 The primary safety endpoint (TIMI clinically significant bleeding) was lower in the two groups receiving rivaroxaban. No dif- ference in major bleeding or transfusion was observed across groups. However, this study was underpowered
for assessing differences in ischaemic events such as stent thrombosis or stroke rates. Therefore, uncertainty remains regarding the comparative perform- ance of three tested antithrombotic regimens in patients at high stroke and/or stent thrombosis risk. 6.5.2 Elderly patients Owing to the ageing of the population, a higher proportion of elderly
patients is expected to present with STEMI. As these patients may present with atypical symptoms, the diagnosis of MI may be delayed or missed.27 In addition, the elderly have more comorbidities and are less likely to receive reperfusion therapy compared with younger Logistical issues for hospital stay Recommendations Classa Levelb It is
 indicated that all hospitals participating in the care of STEMI patients have a CCU/ICCU equipped to provide all aspects of care for STEMI patients, including treatment of ischaemia, severe heart failure, arrhythmias, and common comorbidities. I C Transfer back to a referring non-PCI hospital Same day transfer should be considered appropri- ate in
 selected patients after successful primary PCI, i.e. those without ongoing myocardial ischae-mia, arrhythmia, or haemodynamic instability, not requiring vasoactive or mechanical support, and not needing further early revascularization. 263 IIa C Monitoring It is indicated that all STEMI patients have ECG monitoring for a minimum of 24 h. I C Length
of stay in the CCU It is indicated that patients with successful reperfu- sion therapy and an uncomplicated clinical course are kept in the CCU/ICCU for a minimum of 24 h whenever possible, after which they may be moved to a step-down monitored bed for an addi- tional 24-48 h. I C Hospital discharge (within 48-72 h) should be
consid- ered appropriate in selected low-risk patientsc if early rehabilitation and adequate follow-up are arranged.257,259-262,264,265 IIa A CCU = coronary care unit; ICCU = intensive cardiac care unit; LVEF = left ven- tricular ejection fraction; PAMI-II, Second Primary Angioplasty in Myocardial Infarction; PCI = percutaneous coronary
intervention; STEMI = ST-segment ele- vation myocardial infarction. a Class of recommendation. b Level of evidence. c For example, PAMI-II criteria: age 70 years, LVEF 45%, one- or two-vessel dis- ease, successful PCI and no persistent arrhythmias. ESC Guidelines 25 Downloaded from by guest on 16 September 2017 26.
                                                 ...patients.273,274 Elderly patients are also at particular risk of bleeding and other complications from acute therapies because bleeding risk increases with age, renal function tends to decrease, and the preva-lence of comorbidities is high. Observational studies have shown fre- quent excess dosing of
        rombotic therapies in elderly patients. 275 Furthermore, they have a higher risk of mechanical complications. It is key to maintain a high index of suspicion for MI in elderly patients who present with atypical complications. It is key to maintain a high index of suspicion for MI in elderly patients.
proper dosing of antithrombotic therapies, particularly in relation to renal function, frailty, or comor- bidities, and using radial access whenever possible. There is no upper age limit with respect to reperfusion, especially with primary PCI.276 6.5.3 Renal dysfunction Renal dysfunction [estimated glomerular filtration rate (eGFR) 30mL/min/1.73 m2] is
present in approximately 30-40% of patients with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to differences in presentation (less frequent presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to differences in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to differences in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to differences in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to difference in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to difference in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to difference in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to difference in presentation with ACS and is associated with a worse prognosis and increased risk of in-hospital complications.277 Owing to difference in presentation with a worse prognosis and increased risk of in-hospital complications.
be made before any assessment of renal function is available, it is important to estimate the GFR as soon as possible. The type and dose of antithrombotic agent (see Table 9) and the amount of con- trast agent should be considered based on renal function.
antithrombotics, contributing to the increased bleeding risk.275 Consequently, in patients with known or anticipated reduction, several antithrombotic agents should either be withheld or their doses reduced appropriately. Ensuring proper hydration during and after primary PCI and limiting the dose of con-trast agents,
preferentially low-osmolality contrast agents, are important steps in minimizing the risk of contrast-induced nephropathy. 1 6.5.4 Non-reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients Patients who, for specific reasons (e.g. long delay), fail to receive reperfused patients P
presence of clinical, Table 9 Recommended doses of antithrombotic agents in the acute care of patients with chronic kidney disease (eGFR 15 to 30 mL/min/1.73 m2) 70-100 IU/kg i.v. (50-70 IU/kg if concomitant with GP IIb/IIIa inhibitors) aPTT = activated partial thromboplastin time; CKD = chronic kidney disease;
eGFR = estimated glomerular filtration rate; GP = glycoprotein; IU = international units; i.v. = intravenous; PCI = percutaneous coronary intervention; s.c. = subcutaneous; UFH = unfractionated heparin. a Double bolus if administered during primary PCI. 26 ESC Guidelines Downloaded from by guest on 16 September 2017 27.
haemodynamic, or electrical instability. A primary PCI strategy is indi-cated in the presence of signs or symptom onset.133,142 After
that time, either a non-invasive test for the presence of residual myocardial ischaemia/viability to decide a late invasive strategy or elective coronary angiography should be considered. However, routine PCI is not indi- cated in totally occluded IRA beyond the first 48h from symptom onset due to the increased risk of late complications (see Figure
4).135,137 Early echocardiography with LVEF assessment is indicated in all patients. Medical therapy should include DAPT, anticoagulation, and Figure 4 Reperfusion strategies in the infarct-related artery according to time from symptoms onset. PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction. In
early presenters (i.e. those with STEMI diagnosis within 3 hours from symptoms onset), a primary PCI strategy of choice. If the anticipated time from STEMI diagnosis to PCI-mediated reperfusion is 120 min, then immediate fibrinolysis is indicated. After 3 hours (and up to 12 hours) of symptoms onset, the later the patient
presents, the more consideration should be given to a primary PCI strategy as opposed to administering fibrinolytic therapy. In evolved STEMI (12-48 hours after symptoms onset), a routine primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy as opposed to administering fibrinolytic therapy. In evolved STEMI (12-48 hours after symptoms onset), a routine primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent angiography and subsequent PCI if indicated) should be given to a primary PCI strategy (urgent angiography and subsequent ang
should be performed but routine PCI of a total occluded IRA is not recommended. Regardless of the time from symptoms onset, the presence of ongoing symptoms on the presence of ongoing symptoms of the presence of one of the presence of the presence of the presence of one of the presence of one of the presence of one of the presence of th
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                                                                                                                    secondary prevention therapies. In patients in whom PCI is finally performed, ticagrelor or prasugrel are preferred,186,187 while in patients who do not undergo PCI, clopidogrel is indicated.225 Anticoagulation, preferably with fondaparinux, is indicated until
coro- nary revascularisation is done or hospital discharge.199 These patients are often undertreated. Therefore, it is important to emphasize that they should receive all the same secondary prevention medical thera- pies as those who receive timely reperfusion. 6.5.5 Patients with diabetes Patients with diabetes are known to present with atypical
chest pain more frequently than patients without diabetes and conse- quently may receive delayed initiation of treatment. 278 In addition, diabetes are at higher risk of death and complications (including repeat revascularization after PCI),
selection of antithrombotic therapies and reperfusion ther- apy is the same as in patients with diabetes. Regarding the use of antiplatelet drugs, the more potent oral P2Y12 receptor inhibi- tors (prasugrel or ticagrelor) have consistently shown increased relative benefits with higher absolute risk reductions in patients with diabetes compared with
clopidogrel. 280 On admission, it is recommended to evaluate glycaemia, and to monitor it frequently in diabetes or hyperglycaemia, and to monitor it frequently in diabetes or hyperglycaemia, and to monitor it frequently in diabetes or hyperglycaemia, and to monitor it frequently in diabetes or hyperglycaemia.
insulin ther- apy.281 In the absence of robust data to guide the optimal glucose management (e.g. treatment thresholds and glucose control seems the best approach. In the acute phase, it is reasonable to manage hyperglycaemia (i.e. maintain a blood glucose concentration _11.0 mmol/L or
200 mg/dL) but absolutely avoid hypoglycae-mia.282 To assess the risk of renal insufficiency, it is recommended to measure eGFR in patients on metformin and/or sodium-glucose co-transporter-2 (SGLT2) inhibitors. 6.6. Risk assessment 6.6.1 Clinical risk assessment All patients with STEMI should have an early assessment of short-term risk,
including an evaluation of the extent of myocardial damage, the occurrence of successful reperfusion, and the presence of clinical markers of high risk of further events including older age, fast heart failure, or peripheral arterial disease.
Several risk scores have been developed, based on readily identifiable parameters in the acute phase before reperfusion. 264,283 The Global Registry of Acute Coronary Events (GRACE) risk score is recommended for risk assessment and adjustment. 283,284 All patients should also have an evaluation of long-term risk before discharge, including
LVEF, severity of CAD and completeness of cor- onary revascularization, residual ischaemia, occurrence of complica- tions during hospitalization, and levels of metabolic risk markers, including total cholesterol (HDL-C), fasting triglycer- ides, and plasma glucose, as well
as renal function. As LDL-C levels tend to decrease during the first days after MI, they should be meas- ured as soon as possible after admission. Patients should have an assess- ment of the presence of residual ischaemia and, if appropriate, myo-
cardial viability. Because the risk of events decreases with time, early risk assessment is indicated. 6.6.2 Non-invasive imaging in management and risk stratification LV dysfunction is a key prognostic factor. Therefore, it is recom- mended that the LVEF is determined before hospital discharge in all STEMI patients. Emergency echocardiography at
presentation is indi- cated in patients with cardiac arrest, cardiogenic shock, haemody- namic instability or suspected mechanical complications, and if the diagnosis of STEMI is uncertain. Routine echocardiography after pri- mary PCI is recommended to assess resting LV function, as well as Management of hyperglycaemia Recommendations Classa
Levelb It is recommended to measure glycaemic status at initial evaluation in all patients, and perform frequent monitoring in patients on metformin and/or SGLT2 inhibitors, renal function should be carefully monitored for at least 3 days after
coronary angiography/PCI.c I C Glucose-lowering therapy should be considered in ACS patients with glucose levels 10 mmol/L or 70 mg/dL), while episodes of hypoglycaemia (defined as glucose levels as glucose levels 10 mmol/L or 70 mg/dL), while episodes of hypoglycaemia (defined as glucose levels 10 mmol/L or 70 mg/dL).
advanced cardiovascular disease, older age, longer diabetes duration, and more comorbidities. IIa C ACS = acute coronary syndrome; PCI = percutaneous coronary intervention; SGLT2 = sodium-glucose co-transporter-2. a Class of recommendation. b Level of evidence. c A short withdrawal of metformin may be considered after an invasive coronary
procedure. 28 ESC Guidelines Downloaded from by guest on 16 September 2017 29. RV and valve function, to exclude early post-infarction mechanical complications and LV thrombus. This assessment is usually per- formed with echocardiography, but in the limited cases in which echocardiography may be suboptimal or inconclusive, CMR may be a
good alternative. Patients with multivessel disease in which only the IRA lesion has been treated, or patients with late-presenting STEMI, may benefit from additional assessment for residual ischaemia or via- bility. Treatment of non-IRA lesions in patients with multivessel disease in which only the IRA lesion has been treated, or patients with late-presenting STEMI, may benefit from additional assessment for residual ischaemia or via- bility. Treatment of non-IRA lesions in patients with multivessel disease in which only the IRA lesion has been treated, or patients with late-presenting stempers.
acute event with a completed MI, the presence of recurrent angina or documented ischaemia and proven viability in a large myo- cardial territory may help define a strategy of planned revascularization of an occluded IRA,135,285,286 although the evidence is controversial. The timing of and best imaging technique (echocardiography, SPECT, CMR,
or PET) to detect residual ischaemia and myocardial viability remains to be determined, but will also depend on local avail- ability and expertise. The best validated and widely available tests are stress echocardiography and SPECT (both used in combination with exercise or pharmacological stress), but PET and CMR are equally indicated. However,
in post-MI patients, the detection of residual ischaemia by echocardiography is challenging due to existing wall motion abnormalities. 287 LGE-CMR imaging has a high diagnostic accuracy for assessing the transmural extent of myocardial scar tis- sue. 288 However, the ability to detect viability and predict recovery of wall motion is not significantly
superior to other imaging techni- ques. 289 The presence of dysfunctional viable myocardium by LGE- CMR is an independent predictor of mortality in patients with improved contractility and res- olution of wall
thinning after revascularization, emphasizing the importance of viability beyond wall thickness and myocardial revascu- larization to improve prognosis.291 PET is also a high-resolution tech- nique but its use is limited by cost and availability. A randomized clinical trial with PET imaging demonstrated that patients with a sub- stantial amount of
dysfunctional but viable myocardium are likely to benefit from myocardial revascularisation and may show improve- ments in regional and global contractile function, symptoms, exercise capacity, and long-term prognosis.292 The association between viable- ity and improved survival after revascularisation was also demon- strated by a meta-
analysis.293 In patients with a pre-discharge LVEF 40%, re-evaluation of LVEF 6-12 weeks after complete revascularization and optimal medical therapy is recommended to assess the potential need for primary prevention implantable cardioverter defibrillator (ICD) implantation. 3 Additional parameters that are measured by imag- ing in these
patients and that could be used as endpoints in clinical trials are: (1) infarct size (CMR, SPECT, and PET); (2) myocar-dium at risk (SPECT, CMR); (3) MVO (CMR); and (4) intra- myocardial haemorrhage (CMR). Infarct size and MVO are pre- dictors of long-term mortality and heart failure in STEMI survivors.216,217,294 Summary of indications for
imaging and stress testing in ST-elevation myocardial infarction patients Recommendations Classa Levelb At presentation Emergency echocardiography is indicated in patients with cardiogenic shock and/or haemody- namic instability or suspected mechanical compli- cations without delaying angiography.295 I C Emergency echocardiography before
coronary angiography should be considered if the diagnosis is uncertain. 295 III C Coronary CT angiography is not recommended III C During hospital stay (after primary PCI) Routine echocardiography to assess resting LV and RV function, detect early post
MI mechanical complications, and exclude LV thrombus is rec- ommended in all patients. 296,297 I B Emergency echocardiography is indicated in hae- modynamically unstable patients. 295 I C When echocardiography is indicated in hae- modynamically unstable patients.
SPECT, or PET may be used to assess myocardial ischaemia and viability, including in multivessel CAD.1,298-300 IIb C After discharge LVEF 40%, repeat echocardiography 6-12 weeks after MI, and after complete revascularization and optimal medical therapy, is recommended to assess the potential need for primary
prevention ICD implantation.3,296 I C When echo is suboptimal or inconclusive, alterna- tive imaging methods (CMR preferably) should be considered to assess LV function. IIa C CAD = coronary artery disease; CMR = cardiac magnetic resonance; CT = com- puted tomography; ICD = implantable cardioverter defibrillator; LV = left ven- tricular;
LVEF = left ventricular ejection fraction; PEI = positron emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; SPECT = single-photon emission tomography; RV = right ventricular; 
                                                                                                                                                .... 7. Long-term therapies for ST-segment elevation myocardial infarction 7.1 Lifestyle interventions and risk factor control Key lifestyle interventions include cessation of smoking, optimal blood pressure control, diet advice and weight control,
and encour- aging physical activity. Detailed recommendations are available from the ESC Guidelines on prevention. 4 During hospitalization, the time for implementing secondary prevention is limited and a close collaboration between the cardiologist and the general practitioner, special- ist rehabilitation nurses, pharmacists, dieticians, and
physiotherapists is critically important. Habits of a lifetime are not easily changed, and the implementation and follow-up of these changes are a long-term undertaking. 7.1.1 Smoking cessation is potentially the most (cost) effective of all secondary prevention measures. 301 Smoking cessation is potentially the most (cost) effective of all secondary prevention measures.
cessation interventions should start during hospitalization, when smoking is not allowed, and continue during the post-discharge follow-up period.302,303 The beneficial effect of smok- ing cessation in patients with CAD, including a majority suffering an MI, has been shown in a meta-analysis (20 observational studies, including 12603 patients)
reporting a 36% reduction of mortality in quitters.304 A significant number of CAD patients continue or restart smoking, illustrating the addictive nature of the smoking habit.305 There is a strong evidence base for brief interventions, with a combination of behavioural support and pharmacotherapies including nicotine replacement therapy
bupropion, and varenicline.305,306 Electronic cigarettes may also be helpful in achieving smoking cessation, as there is some evidence from two pooled randomized clinical trials (662 patients) showing that electronic cigarettes with nicotine had higher quit or reduced smoking rates when compared with placebo.307 7.1.2 Diet, alcohol, and weight
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vegetables per day; (v) fish 1-2 times per week (especially oily vari- eties); (vi) 30g unsalted nuts daily; (vii) limited alcohol intake [maxi- mum of 2 glasses (20 g of alcohol) daily for men and 1 for women]; and (viii) discouraging sugar-sweetened drinks. 4 Moderate alcohol consumption in abstainers is not recommended. Overweight and obesity [body
mass index (BMI) 25kg/m2] is associated with higher all-cause mortality compared with a healthy weight (BMI between 20 kg/m2 and 25kg/m2). Abdominal fat is par- ticularly harmful and weight loss has beneficial effects on cardiovascu- lar disease risk factors. Consequently, maintaining a healthy weight or losing weight is recommended for all
subjects, 308 including patients with STEMI. However, it has not been established that weight reduc- tion per se reduces mortality. 7.1.3 Exercise-based cardiac rehabilitation All AMI patients should participate in an exercise-based cardiac rehabilitation All AMI patients with STEMI. However, it has not been established that weight reduc- tion per se reduces mortality. 7.1.3 Exercise-based cardiac rehabilitation programme, 309 taking into account their age, pre-infarction level of activity, and physical
limitations. A cardiac rehabilitation pro- gramme preferably includes exercise training, risk factor modification, education, education pro- gramme was associated with a 22% reduction in cardiac mortality rate in patients with CAD.309
The benefit of cardiac rehabilitation appears to be through direct physiological effects of exercise training and through cardiac rehabilitation appears to be through direct physiological effects on risk factor control, lifestyle behaviours, and mood.310 An additional benefit in the context of a short hospital stay is to ensure proper titration and monitoring of key, evidence-based therapies after
STEMI. Nowadays, most rehabilitation is offered as an outpatient programme of 8-24weeks' duration.311,312 7.1.4 Resumption of activities Return to work after AMI represents an important indicator of recovery after MI than similarly
aged men.313 Decisions should be individualized, based on LV function, completeness of revascularization and rhythm con- trol, and the job characteristics. Extended sick leave is usually not beneficial and light-to-moderate physical ability.
Guidance on air travel including repatriation for patients suffering an MI abroad is constrained by limited data. Factors related to the clinical circumstances as well as length of travel, whether accompanied, and the degree of anxiety also play a role. For uncomplicated completely revascularized MI with LVEF 40% the risk is low and travelling is
regarded as safe after hospital discharge (from day 3 onwards). In complicated STEMI, including patients with heart failure, LVEF 40%, residual ischaemia, and arrhythmia, travelling should be deferred until the condition is stable.314 7.1.5 Blood pressure control Hypertension is a prevalent risk factor in patients admitted with STEMI and,
consequently, blood pressure should be well controlled. In addition to lifestyle changes, including reduced salt intake, increased physical activity, and weight loss, pharmacotherapy with a systolic blood pressure (SBP) target of 140 mmHg should be initi- ated. In elderly, frail patients, the target can be more lenient, whereas in patients at very high
risk who tolerate multiple blood pressure- lowering drugs, a target of 120mmHg may be considered.4,315,316 Despite the proven efficacy of this treatment to treatment to treatment adherence to life- style interventions and medications may affect treatment adherence to life- style interventions and medications may affect treatment.
treatment targets and is associated with worse outcomes. 317 Delayed outpatient follow-up after AMI results in worse short- and long-term medication adherence. 318 In a meta-analysis of 376 162 30 ESC Guidelines Downloaded from by guest on 16 September 2017 31.
                                                                                                                                               . patients, adherence to cardiovascular medications was estimated to be about 57% after a median of 2 years.319 It is generally recognized that adherence is determined by the interplay of socioeconomic, medication-related, condition-related
health system-related, and patient-related factors.320 A strategy to reduce poor adherence is the use of a fixed-dose combination or pol-ypill, including key medicated to post-MI patients is the recent phase 2 Fixed-Dose Combination Drug for Secondary
Cardiovascular Prevention (FOCUS) trial,323 in which 695 patients post-MI were randomized to usual care or to a polypill-based strategy [polypill containing aspirin, an angiotensin-converting enzyme (ACE) inhibitor, and a statin]. In this trial, after 9 months of follow-up, the polypill group showed improved adherence compared with the group
receiving separate medications. Larger trials are needed to confirm a clinical benefit in secondary prevention. Although low adherence has been qualified as an ubiquitous problem, 324 healthcare professionals and patients should be aware of this challenge and optimize communication by providing clear information, simplify treatment regimens
aim at shared decision-making, and implement repetitive monitoring and feedback. 7.2 Antithrombotic therapy Full text about long-term antithrombotic therapy can be found in the online Web Addenda. In addition, this topic is covered in great detail in the ESC Focused Update on DAPT in CAD published simultane- ously with these guidelines. 7.2.1
Aspirin Aspirin is recommended indefinitely in all patients with STEMI.329,330 For long-term prevention, low aspirin doses (75-100 mg) are indi-cated due to similar anti-ischaemic and less adverse events than higher doses, as demonstrated in the CURRENT-OASIS 7 trial.330 7.2.2 Duration of dual antiplatelet therapy and antithrombotic
combination therapies DAPT, combining aspirin and a P2Y12 inhibitor (i.e. prasugrel, ticagre- lor, or clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel), is recommended in patients with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are undergoing primary PCI (for up to 12 months).186,187 Clopidogrel with STEMI who are 
duration of DAPT up to 12 months should be considered in these patients undergoing fibrinolysis. Potent P2Y12 inhibitor of choice as co-adjuvant and after fibrinolysis. Potent P2Y12 inhibitors have not been properly tested in patients undergoing fibrinolysis, and safety
(i.e. bleeding complications) is not well established. However, in patients who underwent PCI after fibrinolysis, after a safety period (arbitrarily considered 48 h), there are no biological grounds to con- sider that potent P2Y12 inhibitors will add risk and not exert a benefit over clopidogrel as in the primary PCI setting. Whereas no dedicated study
exists on optimal DAPT duration in patients at high bleeding risk, multiple studies have shown that short- ening DAPT to 6 months, compared with 12 months or longer, reduces the risk of major bleeding complications, with no apparent trade-off in ischaemic events.331,332 Two major studies have shown the benefit towards reduction of non-fatal
ischaemic events in patients receiving longer than 12 months of DAPT.333,334 The DAPT Study included only roughly 10% of STEMI patients and no information has so far been provided with respect to the benefit of prolonging clopidogrel or prasugrel from 12 to 30 months in this patient subset. Hence, no formal recom- mendations are possible for
the use of clopidogrel or prasugrel beyond 1 year.334 More recently, the Prevention of Cardiovascular Events in Myocardial Infarction 54 (PEGASUS-TIMI 54) trial examined two doses of ticagrelor (60 mg and 90mg b.i.d.) vs. placebo
in patients with a history of MI 1-3 years previously and with high-risk features; the study showed a reduction in MACE with 90mg ticagrelor.333 There was no reduction in total mortality, but there was a borderline signal towards reduced cardio-vascular mortality (when both doses were pooled) consistent with the reduction in non-fatal
outcomes.333 The 60mg (but not the 90 mg) ticagrelor (plus aspirin) regimen also significantly reduced the stroke risk compared with a significantly reduced the stroke risk reduced risk reduced reduced reduced risk reduced r
subgroup analysis has shown consistent results in patients with previous STEMI vs. NSTEMI.333 According to the available data, extension of DAPT beyond 1 year (up to 3 years) in the form of aspirin plus ticagrelor 60mg b.i.d. may be considered in patients who have tolerated DAPT without a bleed-ing complication and having one additional risk
factor for ischaemic events. Gastric protection with a PPI is recommended for patients with a history of gastrointestinal bleeding, such as advanced age, concur- rent use of anticoagulants, steroids or non-steroidal anti-inflamma- tory drugs including high-dose aspirin, and
Helicobacter pylori infection.335-337 Behavioural aspects after ST-elevation myocardial infarction Recommendations Classa Levelb It is recommended to identify smokers and provide repeated advice on stopping, with offers to help with the use of follow-up support, nicotine replacement therapies, varenicline, and bupropion individually or in
combination.4,302,303,325-327 I A Participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation protocol is indicated for each hospital participation in a cardiac rehabilitation programme is recommended.4,309,328 I A A smoking cessation protocol is indicated for each hospital participation protocol is indicated for each hospital particip
STEMI = ST-segment elevation myocardial infarction. a Class of recommendation. b Level of evidence. ESC Guidelines 31 Downloaded from by guest on 16 September 2017 32. .....
                                                                                                                                                                                                                                                                      .. In the Acute Coronary Syndrome-Thrombolysis In Myocardial Infarction 51 (ATLAS ACS 2-TIMI 51) trial (n = 15526, 50% STEMI), a low dose of
rivaroxaban (2.5 mg twice daily), on top of aspirin plus clopidogrel, reduced the composite primary endpoint of cardiovas- cular death, MI, or stroke, but also all-cause mortality, over a mean follow-up of 13months.338 Stent thrombosis was reduced by one- third. However, this was associated with a three-fold increase in non- CABG-related major
bleeding and intracranial haemorrhage.338 Based on the ATLAS ACS 2-TIMI 51 trial, in selected patients at low bleeding risk, the 2.5 mg dose of rivaroxaban may be considered in patients undergoing fibrinolysis, early
i.v. beta-blocker treatment reduces the incidence of acute malignant ventricular arrhythmias, although there is no clear evidence of long-term clinical benefit.344-346 In patients undergoing primary PCI, the Effect of Metoprolol in Cardioprotection During an Acute Myocardial Infarction (METOCARD-CNIC) trial (n = 270) showed that the very early
administration of i.v. metoprolol (15 mg) at the time of diagnosis in patients with anterior STEMI, no signs of heart failure, and SBP 120 mmHg was associated with a reduction in infarct size measured by CMR at 5-7 days (25.6 g vs. 32.0 g; P = 0.012), and higher LVEF at 6 months CMR (48.7% vs. 45.0%; P = 0.018) compared with control
treatment.347,348 All patients without con- traindications received oral metoprolol within 24 h. The incidence of MACE (composite of death, admission as a result of heart failure, reinfarction, or malignant ventricular arrhythmias) at 2 years was 10.8% vs. 18.3% in the i.v. metoprolol and control arms (P = 0.065).348 Metoprolol treatment was
associated with a significant reduction in the incidence and extent of MVO.349 The Early Intravenous Beta-Blockers in Patients With ST-Segment Elevation Myocardial Infarction Before Primary Percutaneous Coronary Intervention (EARLY-BAMI) trial randomized 683 patients with STEMI within 12 h of onset to i.v. metoprolol (5 mg at recruitment
and an additional 5 mg immediately before PCI) or placebo.350 All patients without contraindications Maintenance antithrombotic strategy after ST-elevation myocardial infarction Recommendations Classa Levelb Antiplatelet therapy with low-dose aspirin (75–100 mg) is indicated.329 I A DAPT in the form of aspirin plus ticagrelor or prasugrel (or
clopidogrel if ticagrelor or prasugrel are not available or are contraindicated), is recommended in patients at high risk of gastrointestinal bleeding. 135-337 I B In patients with an indication for
oral anticoagulation, oral anticoagulation, oral anticoagulation of P2Y12 inhibitor therapy after 6 months should be considered.332,339,340 IIa B In STEMI patients with stent implantation and an indication for oral anticoagulation, triple
therapyd should be considered for 1-6 months (according to a balance between the estimated risk of recurrent coronary events and bleeding). 5 IIa C DAPT for 12 months in patients with LV thrombus, anticoagulation
should be administered for up to 6 months guided by repeated imaging.341-343 IIa C In high ischaemic-risk patientse who have tolerated DAPT without a bleeding complication, treatment with DAPT in the form of ticagrelor 60 mg twice a day on top of aspirin for longer than 12 months may be considered for up to 3 years.333 IIb B In low bleeding-
risk patients who receive aspirin and clopidogrel, low-dose rivaroxaban (2.5 mg twice daily) may be considered.338 IIb B The use of ticagrelor or prasugrel is not recommended as part of triple antithrombotic therapy with aspirin and oral anticoagulation. III C AMI = acute myocardial infarction; CAD = coronary artery disease; DAPT = dual
antiplatelet therapy; eGFR = estimated glomerular filtration rate; LV = left ventricular; PCI = percutaneous coronary intervention, a Class of recommendation b Level of evidence. c History of gastrointestinal bleeding, anticoagulant therapy, chronic non-steroidal infarction.
anti-inflammatory drug/corticosteroid user, and 2 or more of the following: age 65 years, dyspepsia, gastro-oesophageal reflux disease, H. pylori infection, and chronic alcohol use. d Oral anticoagulant, aspirin, and clopidogrel. e Defined as age 50 years, and at least one of the following additional high-risk features: age 65 years, diabetes mellitus on
medication, a prior spontaneous AMI, multivessel CAD, or chronic renal dysfunction (eGFR 60 ml/min/1.73 m2). 32 ESC Guidelines Downloaded from by guest on 16 September 2017 33. ....
metoprolol admin- istration did not show any benefit in reducing CMR-based infarct size, the trial primary endpoint, available only in 342 patients (55%), or the level of cardiac biomarker release. Early i.v. metoprolol was associated with a borderline reduction of malig- nant ventricular arrhythmias (3.6% vs. 6.9%; P = 0.050). Patients treated with i.v.
metoprolol showed no increased risk of haemo-dynamic instability, atrioventricular (AV) block, or MACE at 30 days. Post hoc analyses from primary PCI trials testing other hypotheses have suggested that early i.v. beta-blocker administration might be associated with a clinical benefit, but a selection bias cannot be excluded even after correction for
imbal- ances in baseline characteristics. 351,352 Based on the current avail- able evidence, early administration of i.v. beta-blockers at the time of presentation followed by oral beta-blocker treatment. The benefit of long-term
treatment with oral beta-blockers after STEMI is well established, although most of the supporting data come from trials performed in the pre-reperfusion era.353 A recent multicentre registry enrolling 7057 consecutive patients with AMI showed a benefit in terms of mortality reduction at a median follow-up of 2.1 years associated with beta-blocker
pre- scription at discharge, although no relationship between dose and outcomes could be identified.354 Using registry data, the impact of newly introduced beta-blocker treatment on cardiovascular events in 19 843 patients with either ACS or undergoing PCI was studied.355 At an average of 3.7 years of follow-up, the use of beta-blockers was
associated with a significant mortality reduction (adjusted HR 0.90, 95% CI 0.84-0.96). The association between patients with and without a recent MI (HR for death 0.85 vs. 1.02; Pint = 0.007). Opposing these results, in a longitudinal observatio- nal propensity-matched study including 6758
patients with pre- vious MI, beta-blocker use was not associated with a lower risk of cardiovascular events or mortality.356 Based on the current evi- dence, routine administration of beta-blockers are recommended in patients with
reduced systolic LV function (LVEF 40%), in the absence of contraindications such as acute heart failure, haemodynamic insta- bility, or higher degree AV block. Agents and doses of proven effi- cacy should be administered.357-361 As no study has properly addressed beta-blocker duration to date, no recommendation in this respect can be made
Regarding the timing of initiation of oral beta-blocker treatment in patients not receiving early i.v. beta- blocker administration con- veyed a survival benefit compared with a delayed one.362 Therefore, in haemodynamically stable patients, oral beta-
blocker initiation should be considered within the first 24 h. 7.4 Lipid-lowering therapy The benefits of statins in secondary prevention have been unequivocally demonstrated, 363 and trials comparing more- vs. less-intensive LDL-C lowering with
statins indicated that more-intensive statin therapy produced greater reductions in the risks of cardiovascular death, non-fatal MI, ischaemic stroke, and coronary revascularization.366 For every 1.0 mmol/L reductions in the trials of statins vs. control. Therefore,
statins are recommended in all patients with AMI, irrespective of cholesterol concentration at presenta- tion. Lipid-lowering treatment should be started as early as possi- ble, as this is associated with early and sus- tained clinical benefits. 4 The intensity of
statin therapy should be increased in those receiving a low- or moderate-intensity statin treatment at presentation, unless they have a history of intoler- ance to high-intensity statin therapy or other characteristics that may influence safety.366-368 The treatment goal is an LDL-C con- centration of 1.8 mmol/L (70 mg/dL) or at least 50% reduction in
LDL-C if the baseline LDL-C level is 1.8-3.5 mmol/L.4,367,369 The use of lower-intensity statin therapy should be considered in patients at increased risk of side effects from statins (e.g. elderly, hepatic or renal impairment, previous side effects from statins (e.g. elderly, hepatic or renal impairment, previous side effects from statins (e.g. elderly, hepatic or renal impairment, previous side effects.)
through phasic changes, with small reduc- tions in total cholesterol, LDL-C, and HDL-C, and HDL-C, and increases in tri- glycerides within the first 24 h.370,371 A lipid profile should be obtained as early as possible after admission for STEMI and can be non-fasting, as total and HDL-C show little diurnal variation and LDL-C variation is within 10%.372 Lipids
should be re-evaluated 4-6 weeks after the ACS to determine whether the target levels have been reached and regarding safety issues; the lipid lowering therapy can then be adjusted accordingly. Trial results with high doses of atorvastatin and simvastatin366,373-375 favour a high- intensity statin. In patients known to be intolerant of any dose of
statin, treat- ment with ezetimibe should be considered. In the Improved Reduction of Outcomes: Vytorin Efficacy International Trial (IMPROVE-IT), 18 144 patients with a recent ACS (29% with STEMI) were randomized to either ezetimibe 10 mg/simvastatin 40 mg or simvastatin 40 mg or simvastatin was up-titrated to 80 mg if LDL-C was 79
mg/dL or 2.04 mmol/L).376 Over a period of 7 years, the composite primary endpoint of cardiovascular death, MI, hospital admission for unstable angina, coronary revas- cularization, or stroke was significantly lower in the combined treatment arm compared with the statin-only arm (32.7% vs. 34.7%; HR 0.94, 95% CI 0.89-0.99). Recent data from
phase I-III trials show that proprotein con- vertase subtilisin/kexin type 9 (PCSK9) inhibitors decrease LDL- C up to 60%, either as monotherapy or in addition to a statin dose, and also have beneficial effects on triglycerides and HDL- C.377-380 Meta-analyses of existing trials with more than 10 000 patients indicate a significant mortality benefit (HR
0.45, 95% CI 0.23-0.86) but are based on relatively few endpoints.378,381 In the Further Cardiovascular Outcomes Research with PCSK9 Inhibition in Subjects with Elevated Risk (FOURIER) trial consist- ing of 27 564 patients with atherosclerotic cardiovascular disease, additional risk factors, and LDL 70 mg/dL (1.8 mmol/L), who ESC Guidelines 33
                                                                                                                                                                                                         ..were already receiving moderate or high intensity statin therapy as compared to placebo, evolocumab injections reduced the pri- mary composite endpoint of cardiovascular death, MI, stroke,
hospitalization for unstable angina, or coronary revascularization by 1.5% in absolute rate and by 1.5% in adverse events. 382 Given the moderate effect over 2 years and the absence of mortality reduction, its use should still be
restricted to selected high-risk patients. Based on this relatively limited body of evidence, clinicians should consider adding a non-statin treatment to patients at high risk who do not reach treatment to patients at high risk who do not reach treatment to patients. Based on this relatively limited body of evidence, clinicians should consider adding a non-statin treatment to patients.
controlled trial against placebo and is therefore not recommended.383 Intravenous nitrates may be useful during the acute phase in patients with hypertension, or use of phospho- diesterase type 5 inhibitors in the previous 48 h. Following the acute phase, nitrates remain valuable
agents to control residual angina symptoms. 7.6 Calcium antagonists A meta-analysis of 17 trials involving calcium antagonists in the acute phase is not
indicated.384,385 In the chronic phase, a random- ized controlled trial allocating 1775 patients with MI not on beta- blockers to verapamil or placebo found that the risk of mortality and reinfarction was reduced with verapamil or placebo found that the risk of mortality and reinfarction was reduced with verapamil or placebo found that the risk of mortality and reinfarction was reduced with verapamil.
calcium antagonists are a rea- sonable option for patients without heart failure or impaired LV function. Routine use of dihydropyridines, on the other hand, has failed to show benefit after STEMI,387 and they should therefore only be prescribed for clear additional indications such as hyper- tension or residual angina.388 7.7 Angiotensin-converting
enzyme inhibitors and angiotensin II receptor blockers ACE inhibitors are recommended in patients with an impaired LVEF ( 40%) or who have experienced heart failure in the early phase. 383,389-392 A systematic overview of trials of ACE inhibition early in STEMI indicated that this therapy is safe, well tolerated, and associated with a small but
significant reduction in 30-day mortality, with most of the benefit observed in the first week.383,393 Treatment with ACE inhibitors is recommended in patients who do not tolerate an ACE inhibitor should be given
an angiotensin II receptor blocker (ARB). In the context of STEMI, valsartan was found to be non-inferior to cap- topril in the VALsartan In Acute myocardial iNfarcTion (VALIANT) trial.396 7.8 Mineralocorticoid/aldosterone receptor antagonists Mineralocorticoid receptor antagonists (MRA) therapy is recom- mended in patients with LV dysfunction
(LVEF 40%) and heart failure after STEMI.397-400 Eplerenone, a selective aldosterone receptor antagonist, has been shown to reduce morbidity and SUrvival Study (EPHESUS) randomized 6642 post-MI patients with LV dysfunction (LVEF 40%) and symptoms of
heart failure/diabetes to eplerenone or placebo within 3-14 days after their infarction. 397 After a mean follow-up of 16 months, there was a 15% relative reduction in total mortality and a 13% reduction in total 
MRA in the setting of STEMI without heart failure. The Double-Blind, Randomized, Placebo-Controlled Trial Evaluating The Safety And Efficacy Of Early Treatment With Eplerenone In Patients With Acute Myocardial Infarction (REMINDER) trial randomized 1012 patients with acute STEMI without heart failure to eplerenone or placebo within 24 h of
symptom onset.401 After 10.5 months, the primary combined end- point [CV mortality, re-hospitalization, or extended initial hospital stay due to diagnosis of heart failure, sustained ventricular tachy- cardia or fibrillation, ejection fraction 40%, or elevated B-type natriuretic peptide (BNP)/N-terminal pro B-type natriuretic peptide (NT-proBNP)
with acute STEMI or high-risk NSTEMI to a single i.v. bolus of potassium canrenoate (200 mg) followed by spironolactone (25 mg daily) vs. placebo. Overall, the study found no effect on the composite out- come (death, resuscitated cardiac arrest, significant ventricular arrhythmia, indication for implantable defibrillator, or new or worsening heart
failure) at 6 months. In an exploratory analysis of the STEMI subgroup (n = 1229), the outcome was significantly reduced in the active treatment group (HR 0.20, 95% CI 0.06-0.70).402 Future studies will clarify the role of MRA treat-ment in this setting. 34 ESC Guidelines Downloaded from by guest on 16 September 2017 35.
strategies. 8. Complications following ST- segment elevation myocardial infarction Expanded information about complications following STEMI is pre- sented in the Web Addenda. Routine therapies in the acute, subacute, and long-term phases: beta-blockers, angiotensin-converting enzyme inhibi- tors, angiotensin II receptor blockers,
mineralocorticoid receptor antagonists, and lipid-lowering treatments after ST- elevation myocardial infarction Recommendations Classa Levelb Beta-blockers oral treatment with beta-blockers should be considered at the time of the standard or the standard
 Intravenous beta-blockers must be avoided in patients with hypotension, acute heart failure or AV block, or severe bradycardia.344 III B Lipid lowering therapies It is recommended to start high-intensity statin therapyc as early as possible, unless contraindicated, and maintain it long- term.364,366,368 I A An LDL-C goal of 1.8 mmol/L (70 mg/dL) or a
risk, further therapy to reduce LDL-C should be considered.376,382 IIa A ACE inhibitors/ARBs ACE inhibitors are recommended, starting within the first 24 h of STEMI in patients with evidence of heart failure, LV systolic dysfunction, diabetes, or an anterior infarct.383 I A An ARB, preferably valsartan, is an alternative to ACE inhibitors in patients
percutaneous coronary intervention; SBP = systolic blood pressure; STEMI = ST-seg- ment elevation myocardial infarction. a Class of recommendation. b Level of evidence. c High-intensity statin defined as atorvastatin 40-80 mg and rosuvastatin 20-40 mg. ESC Guidelines 35 Downloaded from by guest on 16 September 2017 36. Figure 5 "Do not
 forget" interventions in STEMI patients undergoing a primary PCI strategy. ACE = angiotensin-converting enzyme; DAPT = dual antiplatelet therapy; DES = drug eluting stent; ECG = electrocardiogram; echo = echocardiogram; echo = echocardiogram; echo = drug eluting stent; ECG = electrocardiogram; echo = echocardiogram; ec
 ejection fraction; MRA = mineralcorticoid receptor antagonist; PCI = percuta- neous coronary intervention; STEMI = ST-segment elevation myocardial infarction; UFH = Unfractionated heparin. Mostly prescribed intervention; STEMI = ST-segment elevation myocardial infarction; UFH = Unfractionated heparin.
(daily) intervention. Double-arrowed dashed lines represent a time-window in which the intervention can be delivered. 1 Aspirin loading dose: 150-300 mg chewed or 75-250 mg intravenous (in patients not already on an aspirin maintenance dose). 2 Prasugrel loading dose: 60 mg. Ticagrelor loading dose: 180 mg. If there are contra-indications for
prasugrel/ticagrelor or these are not available, a loading dose of clopidogrel (600 mg) is indicated. 3 If the interventional cardiologist is not expert in radial access, the femoral route is then preferred. 4 Enoxaparin or bivalirudin are alternatives to unfractionated heparin (Class IIa A). 5 Aspirin maintenance dose: 75-100 mg oral. 6 Prasugrel
maintenance dose: 10 mg once daily. Ticagrelor maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose: 90 mg twice daily. If there are contra-indications for pra- sugrel/ticagrelor or these are not available, clopidogrel maintenance dose.
time is 60 min. b Prolongation of ticagrelor (60 mg twice daily) in addition to aspirin may be considered for up to 36 months in patients at high ischaemic risk who have tolerated DAPT without a bleeding complication. 36 ESC Guidelines Downloaded from by guest on 16 September 2017 37. Figure 6 "Do not forget" interventions in STEMI patients
undergoing a successful fibrinolysis strategy. ACE = angiotensin-converting enzyme; DAPT = dual antiplatelet therapy; DES = drug eluting stent; ECG = electrocardiogram; HF = heart failure; i.v. = intravenous; IRA = infarct related artery; LVEF = left ventricular ejection fraction; MRA = mineralcorticoid receptor
antagonist; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction; UFH = Unfractionated heparin. Mostly prescribed interventions (class I, green, and IIa, light yellow) are presented along with the expected timing of delivery. Solid lines represent recurrent (daily) intervention. Double-arrowed dashed lines
represent a time-window in which the intervention can be delivered. 1 Enoxaparin dose: 30 mg i.v. bolus followed by 1 mg/kg subcutaneous every 12 hours (dose adjustment for 75 years and renal insuffi- ciency is presented in Table 9). Unfractionated heparin is an alternative to enoxaparin. 2 Aspirin loading dose: 150-300 mg chewed or 75-250 mg
intravenous. 3 Clopidogrel loading dose: 300 mg oral (75 mg in 75 years). 4 Aspirin maintenance dose: 75-100 mg oral 5 Clopidogrel maintenance therapy: 75 mg daily. 6 48 hours after fibrinolysis, switch to prasugrel/ticagrelor may be considered in PCI-treated patients. ESC Guidelines 37 Downloaded from by guest on 16 September 2017 38.
                                               8.1 Myocardial dysfunction 8.1.1 Left ventricular dysfunction See Web Addenda. 8.2.2 Management Patients with heart failure should be under continuous monitoring of heart rhythm, blood
pressure, and urinary output. The mecha- nism of heart failure should be assessed early by physical examina- tion, ECG, echocardiography, and (when not rapidly controlled) with invasive haemodynamic monitoring, and corrected as soon as possible. Patients with pulmonary congestion and SaO2 90% or partial pressure of oxygen (PaO2) 60 mmHg
(8.0 kPa) require oxygen therapy and SaO2 monitoring to correct hypoxaemia, with a tar- get of 95%, and may require periodic blood-gas assessment. Initial pharmacological treatment includes i.v. loop diuretics (e.g. furose- mide 20-40 mg i.v. with repeated doses at intervals as needed according to clinical evolution and diuresis) and, if blood
pressure allows it, i.v. nitrates, avoiding hypotension or excessive falls in blood pressure. The early use of beta-blockers, ACE inhibitors/ ARBs, and MRA is recommended in the absence of hypotension, hypovolaemia, or renal dysfunction. Causal treatment is essential. Coronary revascularization should be performed early when sig- nificant CAD is still
present. Rhythm disturbances, valvular dys- function, and hypertension should be corrected as soon as possible. Hypertension should be treated promptly with oral ACE inhibitors/ARBs and i.v. nitrates. In very severe cases, sodium nitroprusside infusion may be necessary. Persistent myocardial ischaemia should be treated with early coronary
revascularization. Atrial and ventricular dysfunction or Recommendations for the management of left ventricular dysfunction myocar- dial infarction Recommendations Classa Levelb ACE inhibitor (or if not tolerated, ARB) therapy is indicated as soon as haemodynamically stable for all
patients with evidence of LVEF 40% and/or heart failure to reduce the risk of hospitalization and death.390,396,412,413 I A Beta-blocker therapy is recommended in patients with LVEF 40% and/or heart failure after stabilization, to reduce the risk of death, recurrent MI, and hospitalization for heart failure 358-361,414-416 I A An MRA is
recommended in patients with heart failure and LVEF 40% with no severe renal failure or hyperkalaemia to reduce the risk of cardiovascular hospitalization and death.397 I B Loop diuretics are recommended in patients with acute heart failure with symptoms. I C Nitrates are recommended in patients with acute heart failure and LVEF 40% with no severe renal failure or hyperkalaemia to reduce the risk of cardiovascular hospitalization and death.397 I B Loop diuretics are recommended in patients with acute heart failure with symptoms.
 with symptomatic heart failure with SBP 90 mmHg to improve symptoms and reduce congestion. I C Oxygen is indicated in patients with respiratory failure or exhaustion, leading to hypoxaemia, hypercapnia, or acidosis, and if non-
invasive ventilation is not tolerated. I C Non-invasive positive airway pressure, biphasic positive airway pressure, biph
should be considered in patients with heart failure and elevated SBP to control blood pressure and improve symptoms. IIa C Opiates may be considered to relieve dyspnoea and anxiety in patients with pulmonary oedema and severe dyspnoea and anxiety in patients with pulmonary oedema and severe dyspnoea.
heart failure with hypotension refractory to standard medical treatment. IIb C ACE = angiotensin-converting enzyme; ARB = angiotensin receptor antagonist; SaO2 = arterial oxygen saturation; SBP = systolic blood pressure; STEMI = ST
segment elevation myocardial infarction. a Class of recommendation. b Level of evidence. 38 ESC Guidelines Downloaded from by guest on 16 September 2017 39.
this document). Severely symptomatic patients with pulmonary congestion may also need i.v. morphine to reduce dyspnoea and anxiety, but rou- tine use is not recommended due to concerns about its safety, as it may induce nausea and hypopnea. 408,409 Non-invasive pressure ventilation (continuous positive airway pressure, bipha-sic
positive airway pressure) or high-flow nasal cannula is effective in treating pulmonary oedema and should be considered in patients with respiratory rate 25 breaths/ min, SaO2 90%) and started soon.410,411 Endotracheal intubation and ventilatory support may be required in patients unable to achieve adequate oxygenation, or
in those with excess respiratory work or evidence of hypercapnia due to respiratory exhaustion. Ultrafiltration to reduce fluid overload may be considered in patients with heart failure and adequate blood pressure (SBP 90mmHg), but a severe reduction in cardiac
output resulting in compromised vital organ perfusion not responding to standard therapy, treatment with dobutamine or levosimendan may be considered. However, the clinical evidence of levosimendan in cardiogenic shock is limited. Further details on the management of acute heart failure can be found in the 2016 ESC Guidelines for the diagnosised vital organ perfusion not responding to standard therapy, treatment with dobutamine or levosimendan may be considered.
and treatment of acute and chronic heart failure. 6 8.2.2.1 Management of hypotension and normal perfusion without evidence of congestion or volume overload (i.e. collapsible inferior vena cava), gentle volume loading should be attempted after ruling out complication or volume overload (i.e. collapsible inferior vena cava), gentle volume loading should be attempted after ruling out complication or volume overload (i.e. collapsible inferior vena cava), gentle volume loading should be attempted after ruling out complication or volume overload (i.e. collapsible inferior vena cava).
with central pressure monitoring. Bradycardia or tachyarrhythmias should be cor- rected or controlled. In patients with RV infarction, volume overload- ing should be avoided because it might worsen haemodynamics. 420 If hypotension persists, inotropic therapy, preferably with dobut- amine, may be considered. 420 8.2.2.2 Management of
cardiogenic shock Cardiogenic shock is defined as persistent hypotension (SBP 90mmHg) despite adequate filling status with signs of hypoperfu-sion. It complicates 6-10% of all STEMI cases and remains a leading cause of death, with in-hospital mortality rates 50%.421 Shock is also considered to be present if i.v. inotropes and/or mechanical
support are needed to maintain an SBP 90mmHg. In STEMI patients present- ing with cardiogenic shock in which PCI-mediated reperfusion is esti- mated to occur 120min, immediate fibrinolysis and transfer to a PCI centre, emergent angiography is indicated, regardless of the ST
resolution and the time from fibrinolysis administration. It is usually associated with extensive LV damage, but may occur in RV infarction. Cardiogenic shock characterization and management do not necessa- rily need invasive haemodynamic monitoring, but ventricular and valve function should be urgently evaluated by transthoracic echocardiogra-
phy and associated mechanical complications ruled out.422-426 The first step in patients with cardiogenic shock is to identify the mechanism and to correct any reversible causes, such as hypo-volaemia, drug-induced hypotension, or arrhythmias; alternatively, initiate the treatment of potential specific causes, such as mechanical complications or
tamponade. Treatments include immediate reperfusion, with primary PCI whenever possible,248,427 and complete revascularisation if multives- sel disease is present. In addition, patients at the highest risk for devel- opment of shock might benefit from an early transfer to tertiary centres before the onset of haemodynamic instability. Antithrombotic
therapy does not differ from that in any STEMI patient. The specificities of the management of low-output cardio- genic shock associated with RV infarction are mentioned in the Web Addenda. Invasive monitoring with an arterial line is recommended. A pulmonary artery catheter may be considered, in order to per- form a careful adjustment of filling
 pressures and assessment of cardiac output or in cases of shock of unexplained cause. Hypovolaemia should be ruled out first and corrected with fluid loading. Pharmacological therapy aims to improve organ perfusion is attained. Intravenous
inotropic agents or vasopressors are usually required to maintain an SBP 90 mmHg, and to increase cardiac output, whereas nore- pinephrine may be safer and more effective than dopamine in patients with cardiogenic shock and
severe hypotension. 428 Levosimendan may be considered as an alternative, especially for patients on chronic beta-blocker therapy, because its inotropic effect is independent of beta-adrenergic stimulation. Phosphodiesterase III inhibitors are not recommended in STEMI patients. IABP counterpulsation does not improve outcomes in patients with
STEMI and cardiogenic shock without mechanical complications, 177 nor does it significantly limit infarct size in those with potentially large anterior MIs. 175 Therefore, routine IABP countricular septa
defect). A small exploratory trial studying the Impella CP percutaneous circulatory support devices (i.e. intra-cardiac axial flow pumps and arterial
venous extracorporeal membrane oxy- genation), have been used in patients not responding to standard therapy, including inotropes, fluids, and IABP, but evidence regarding their benefits is limited.430 Therefore, short-term mechanical circulatory support may be considered as a rescue therapy in order to stabilize the patients and preserve organ
perfusion (oxygenation) as a bridge to recovery of myocardial function, cardiac transplanta- tion, or even LV assist device destination therapy on an individual basis. 431, 432 ESC Guidelines 39 Downloaded from by guest on 16 September 2017 40. ....
8.3 Management of arrhythmias and conduction disturbances in the acute phase Arrhythmias and conduction disturbances are common during the early hours of STEMI and are also important prognostic factors.438 Despite increased awareness and improved basic and advanced life support, the incidence of sudden cardiac death, mainly due to fast
ventricular tachycardia (VT) and VF in the pre-hospital phase, remains high.438,439 Early reperfusion therapy reduces the risk of ven-tricular arrhythmias and cardiovascular death.440,441 The presence of life-threatening arrhythmias are quires an urgent need for a fast and complete revascularization in STEMI.438,442 The evidence for benefits of
antiarrhythmic drugs in STEMI patients is limited and negative effects of antiarrhythmic drugs on early mortality have been demon- strated. 439 Careful use of antiarrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion, a 'wait and see' strategy for arrhythmic drugs is generally recom- mended and alternative treatment options such as electrical cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment of the cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment of the cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment options are such as electrical cardioversion and alternative treatment of the cardioversion
haemodynamic relevance, or in selected cases cardiac pac- ing and catheter ablation, should be considered. Correction of elec- trolyte imbalances and early treatment with beta-blockers, ACE inhibitors/ARBs, and statins is recommended.438,443 8.3.1 Supraventricular arrhythmias The most frequent supraventricular arrhythmia is AF, with up to 21% and statins is recommended.438,443 8.3.1 Supraventricular arrhythmias The most frequent supraventricular arrhythmia is AF, with up to 21% architecture and statins is recommended.438,443 8.3.1 Supraventricular arrhythmias The most frequent supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia is AF, with up to 21% architecture are supraventricular arrhythmia architecture are supraventricular arrhythmia architecture are supraventricular architecture are supraventricular arrhythmia architecture are supraventricular arrhythmia architecture are supraventricular architecture architect
of STEMI patients affected.444 AF may be pre-existing, first- time detected, or of new onset. Patients with AF have more comorbidities and are at higher risk for complications.445 In many cases, the arrhythmia is well tolerated and no specific treatment is required, other than anticoagulation.5 Prompt treatment is required in acute haemodynamic
instability. There is scarce infor- mation indicating preferences for rate control over rhythm control in this situation. 446 Electrical cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered but early recurrence of AF is frequent after successful cardioversion should be considered by the frequent after successful cardioversion should be considered by the frequent after successful cardioversion after successful cardioversion should be considered by the frequent after successful cardioversion after successful cardioversion should be considered by the frequent after successful cardioversion after 
can be accom- plished by administration of beta-blockers. 438,446 In patients with extensive myocardial damage or severe LV dysfunction, rate con- trol is more safely achieved with i.v. digoxin with or without con- comitant administration of i.v. amiodarone. When co- administration of beta-blockers.
necessary as digoxin serum concentrations may be increased. Several, but not all, studies have suggested that new- onset AF may be reduced by beta-blockers, ACE inhibitors/ARBs, and also early-onset statin therapy.444 Patients with AF and risk fac- tors for thromboembolism should be adequately treated with chronic oral anticoagulation.5 STEMI
patients with documented AF have worse short- and long-term prognoses when compared with a higher risk for heart fail- ure, and may also increase the risk for sudden cardiac death.444,445,448 Of note, also transient, self-terminating AF
during STEMI relates to a significantly higher stroke rate during long-term follow-up.445,448 Recommendations for the management of cardio- genic shock in ST-elevation myocardial infarction Recommendations Classa Levelb Immediate PCI is indicated for patients with cardiogenic shock if coronary anatomy is suitable. If coronary anatomy is not
suitable for PCI, or PCI has failed, emergency CABG is recommended. I C Immediate Doppler echocardiography is indicated to assess ventricular and valvular functions, loading conditions, and to detect mechanical complications. I C It is indicated that mechanical
complications are treated as early as possible after discus- sion by the Heart Team. I C Oxygen/mechanical respiratory support is indicated according to blood gases. I C Fibrinolysis should be considered in patients presenting with cardiogenic shock if a pri- mary PCI strategy is not available within 120 min from STEMI diagnosis and mechanical respiratory support is indicated according to blood gases.
complications have been ruled out. IIa C Complete revascularization during the index procedure should be considered in patients with haemodynamic instability/cardiogenic shock due to mechan- ical complications. IIa C Haemodynamic
assessment with pulmonary artery catheter may be considered for con- firming diagnosis or guiding therapy. 433 IIb B Ultrafiltration may be considered for patients with refractory congestion, who failed to respond to diuretic-based strategies. 434-436 IIb B Inotropic/vasopressor agents may be considered for haemodynamic stabilization. IIb C Short
term mechanical supports may be considered in patients in refractory shock. IIb C Routine intra-aortic balloon pumping is not indicated.177,437 III B CABG = coronary artery bypass graft surgery; ECLS = extracorporeal life sup- port; ECMO = extracorporeal membrane oxygenation; PCI = percutaneous cor- onary intervention; STEMI = ST-segment
elevation myocardial infarction, a Class of recommendation, b Level of evidence, c Percutaneous cardiac support devices, ECLS, and ECMO, 40 ESC Guidelines Downloaded from by quest on 16 September 2017 41...
and VF has declined over recent decades, most probably due to the uptake of reperfusion strategies and the early use of beta-blockers. However, 6-8% of patients still develop haemodynamically significant VT or VF during this phase.
degenerating into VF. Urgent reperfusion is most important as ischaemia often triggers these arrhythmias.72 Beta-blockers are recommended if no contraindications exist.346,347,350,454 Repetitive electrical cardiover- sion or defibrillation may be necessary.455 If there is no sufficient control, i.v. administration of amiodarone should be considered in the control of the control 
ered.439,456 In case of contraindications to amiodarone, i.v. lido-caine may be considered, although no studies comparing superiority of either drug in STEMI is still con-troversial. Available data suggest that patients with early VT/VF have increased 30-day
mortality but no increased long-term arrhythmic risks.442,457,458 VT or VF may occur at the time of restoration of coronary blood flow (reperfusion arrhythmics). No specific antiarrhythmic drug therapy is necessary due to the benign long-term course. Ventricular premature beats are very frequent on the first day of the acute phase and complex
arrhythmias (multiform complexes, short runs, or the R-on-T phenomenon) are common. Their value as predictors of VF is questionable and no specific therapy is required. Sustained VT or VF outside the early phase (usually 48 h after STEMI onset) not triggered by recurrent ischaemia has a poor prognostic implication, and evaluation for ICD
implantation for sec- ondary prevention of sudden cardiac death is recommended according to current guidelines. Primary prevention of sudden cardiac death with the ICD within 40 days after MI in the absence of VT/VF is generally not indicated. Patients should be re-evaluated for ICD implantation 6-12 weeks after revascularization, although
situation; however, recurrence of VT/VF upon cessation of stimulation is fre- quent and catheter ablation of such triggers appears to be the only treatment of atrial fibrillation Recommendations Classa Levelb Acute rate control of AF
Intravenous beta-blockers are indicated for rate control if necessary and there are no clinical signs of acute heart failure or hypotension. 449 I C Intravenous amiodarone is indicated for rate control if necessary in the presence of con- comitant acute heart failure and no hypotension. 450 I C Intravenous digitalis should be considered for rate control if
necessary in the presence of concomitant acute heart failure and hypotension. 451 IIa B Cardioversion is indi-cated when adequate rate control cannot be achieved promptly with pharmacological agents in patients with AF and ongoing ischaemia, severe haemodynamic compro-mise, or heart failure. I C Intravenous failure and hypotension.
amiodarone is indicated to pro- mote electrical cardioversion and/or decrease risk for early recurrence of AF after electrical cardioversion in unstable patients with documented de novo AF during the acute phase of STEMI, long-term oral anticoagulation should be considered depending on CHA2DS2-VASc score
and taking concomitant antithrombotic therapy into account, 5.444 IIa C Digoxin is ineffective in converting recent onset AF to sinus rhythm and is not indicated for rhythm control. 452.453 III A Calcium channel blockers and beta-blockers including soldal are ineffective in converting recent onset AF to sinus rhythm.
with antiarrhythmic drugs to prevent AF is not indicated.438,444 III B AF = atrial fibrillation; CHA2DS2-VASc = Cardiac failure, Hypertension, Age 75 (Doubled), Diabetes, Stroke (Doubled), Diabetes, Diabe
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                                                                                                                                                                      .. 8.3.3 Sinus bradycardia and atrioventricular block Sinus bradycardia is common in the first hours of STEMI, especially in inferior MI. In some cases, opioids are responsible.468 It often requires no treatment. If accompanied
by severe hypotension, sinus bradycardia should be treated with i.v. atropine. Second-degree type I (Mobitz I or Wenckebach) AV block is usually associated with infe- rior wall MI and seldom causes adverse haemodynamic effects. If so, atropine should be used first; if it fails, pacing should be instituted. Agents that slow AV conduction (such as beta-
blockers, digitalis, verapamil, or amiodarone) should be used with caution. Second- degree type II (Mobitz II) AV block and complete AV block, RV infarction, and haemodynamic compromise. Revascularization should be considered in patients
with AV block who have not yet received reperfusion therapy (e.g. late arrival). AV block associated with inferior wall MI is usually infra-Hisian and has a high mortality rate due to the extensive myocardial necrosis. The
development of a new bundle branch block or hemiblock usually indi- cates extensive anterior MI. A transvenous pacing electrode should be inserted in the presence of advanced AV block with a low escape rhythm, as described above, and considered if bifascicular or trifascic- ular block develops. Indications for pacing are outlined in detail in the ESC
Guidelines for cardiac pacing and cardiac resynchronization therapy.469 Management of ventricular arrhythmias and conduction disturbances in the acute phase Recommendations Classa Levelb Intravenous beta-blocker treatment is indicated for patients with polymorphic VT and/or VF unless contraindicated.462,463 I B Prompt and complete
revascularization is recom- mended to treat myocardial ischaemia that may be present in patients with recurrent VT and/or VF71,72 I C Intravenous amiodarone is recommended for treatment of recurrent polymorphic VT.3 I C Correction of electrolyte imbalances (especially hypokalaemia and hypomagnesemia) is recom- mended in patients with VT
and/or VF.3 I C In cases of sinus bradycardia with haemodynamic intolerance or high degree AV block without stable escape rhythm: i.v. positive chronotropic medication (epinephrine, vasopressin, and/or atropine) is indicated in cases of failure to respond to positive chronotropic medication I C urgent angiography
with a view to revasculariza- tion is indicated if the patient has not received pre- vious reperfusion therapy. I C Intravenous amiodarone should be considered for recurrent VT with haemodynamic intolerance despite repetitive electrical cardioversion. 438 IIa C Transvenous catheter pace termination and/or overdrive pacing should be considered if VT
can- not be controlled by repetitive electrical cardioversion. IIa C Radiofrequency catheter ablation at a specialized ablation centre followed by ICD implantation and optimal medical therapy. IIa C Recurrent VT, VF, or electrical storm despite complete revascularization and optimal medical therapy. IIa C Recurrent VT with haemodynamic
repercussion despite repetitive electrical cardioversion may be treated with lidocaine if beta-blockers, amiodar- one, and overdrive stimulation are not effective/ applicable.438 IIB C Prophylactic treatment with antiarrhythmic drugs is not indicated and may be harmful.464,465 III B Asymptomatic and haemodynamically irrelevant ventricular
arrhythmias should not be treated with antiarrhythmic drugs. III C AV = atrioventricular; i.v. = intravenous; ICD = implantable cardioverter defibril- lator; VF = ventricular fibrillation; VT = ventricular fibrillatio
Recommendations Classa Levelb ICD therapy is recommended to reduce sudden cardiac death in patients with symptomatic heart failure (NYHA class II-III) and LVEF 35% despite optimal medical therapy for 3 months and 6 weeks after MI, who are expected to survive for at least 1 year with good functional status.3,466,467 I A ICD implantation or
temporary use of a wearable cardioverter defibrillator may be considered 40 days after MI in selected patients (incomplete revascularization, pre-existing LVEF dysfunction, occurrence of arrhythmias 48 h after STEMI onset, polymorphic VT or VF). IIb C ICD = implantable cardioverter defibrillator; LVEF = left ventricular ejection frac- tion; MI =
myocardial infarction; NYHA = New York Heart Association; STEMI = ST-segment elevation myocardial infarction; VT = ventricular fibrillation; VT = ventricul
                                                                                                . 8.4 Mechanical complications Mechanical complications may occur in the first days following STEMI, although incidence has fallen significantly in the era of primary PCI. Mechanical complications are life-threatening and need prompt detection and management. Sudden
hypotension, recurrence of chest pain, new cardiac murmurs suggestive of mitral regurgitation or ventricular septal defect, pulmonary congestion, or jugular vein dis- tension should raise suspected. A full section describing mechanical complications
can be found in the Web Addenda. 8.4.1 Free wall rupture See Web Addenda. 8.4.2 Ventricular septal rupture See Web Addenda. 8.4.3 Papillary muscle rupture See Web Addenda. 8.4.3 Papillary muscle rupture See Web Addenda. 8.4.3 Papillary muscle rupture See Web Addenda. 8.4.0 Pericarditis or post-cardiac injury (Dressler syndrome), and
pericardial effusion. These are expanded upon in the Web Addenda. 8.5.1 Early and late (Dressler syndrome) infarct-associated pericarditis See Web Addenda. 8.5.2 Pericardial effusion See Web Addenda. 8.5.1 Early and late (Dressler syndrome) infarct-associated pericarditis See Web Addenda. 8.5.2 Pericardial effusion See Web Addenda. 8.5.3 Pericardial effusion See Web Addenda. 8.5.4 Pericardial effusion See Web Adden
obstructive (50% stenosis) CAD.10,11 The demonstra- tion of non-obstructive (50%) CAD in a patient presenting with symptoms suggestive of ischaemia and ST-segment elevation or equivalent does not preclude an atherothrombosis aetiology, as thrombosis is a very dynamic phenomenon and the underlying ather rosclerotic plaque can be non-
obstructive. The diagnostic criteria of MINOCA are presented in Table 10. MINOCA is a working diagnosis and should lead the treating physician to investigate underlying causes. Failure to identify the underlying cause may result in inadequate and inappropriate therapy in these patients. The description of the pathophysiology of the different
aetiological entities leading to MINOCA is beyond the scope of the present document, and has been extensively described and defined in posi- tion papers from the ESC12 and in dedicated review papers. 10,11 MINOCA patients can fulfil the criteria for both MI type 1 and type 2 according to the universal definition of MI.8 There are disparate aeti-
ologies causing MINOCA and they can be grouped into: (1) secondary to epicardial coronary artery disorders (e.g. atheroscler- otic plaque rupture, ulceration, fissuring, erosion, or coronary artery spasm and coronary embolism)
(MI type 2); (3) coronary endothelial dysfunction (e.g. microvascular spasm) (MI type 2); and (4) secondary to myocardial disorders without involvement of the coronary arteries (e.g. myocardial injury conditions. The identification of the
underlying cause of MINOCA should lead to specific treatment strategies. Although the outcome of MINOCA, the use of additional diag-nostic tests beyond coronary angiography is recommended. In
gen- eral, after ruling out obstructive CAD in a patient presenting with STEMI, an LV angiogram or echocardiography should be considered. CMR is a very helpful
imaging technique due to its unique non- invasive tissue characterization, allowing the identification of wall motion abnormalities, presence of oedema, and myocardial scar/fib- rosis presence and pattern. Performance of CMR within 2 weeks after onset of symptoms should be considered to increase the diag- nostic accuracy of the test for identifying
the aetiological cause of MINOCA.471-473 10. Assessment of quality of care There is a wide practice gap between optimal and actual care for patients with STEMI in hospitals around the world.474,475 To reduce this gap and improve quality of care, it is recommended that STEMI networks and their individual components establish measura- ble
quality indicators, systems to measure and compare these indicators, systems to measure and compare the system to measure and compare the systems to 
arteries (adapted from Agewall et al12) AMI = acute myocardial infarction; IRA = infarct-related artery; MINOCA = myo-cardial infarction with non-obstructive coronary arteries. ESC Guidelines 43 Downloaded from by quest on 16 September 2017 44. Figure 7 Diagnostic test flow chart in MINOCA. CMR = Cardiac Magnetic Resonance; IVUS =
IntraVascular UltraSound; LV = Left Ventricle; MINOCA = Myocardial Infarction with Non-Obstructed Coronary Arteries; OCT = Optical Coherence Tomography; TTE = Trans-Thoracic Echocardiography. Takotsubo syndrome cannot be diagnosed with
certainty in the acute phase as the definition requires follow up imaging to document recovery of left ventricular function. IVUS and OCT frequently show more atherosclerotic plaque than may be appreciated on angiography. They also increase sensitivity for dissection. If intra- coronary imaging is to be performed, it is appropriate to carry out this
imaging at the time of the acute cardiac catheterization, after diagnostic angiog-raphy. Patients should be made aware of the additional information the test can provide and the small increase in risk associated with intracoronary imaging. 1 • Provocative testing for coronary artery spasm might be considered in selected patients with a recent AMI
with suspected vasospas- tic angina. Provocative manoeuvres have to be always performed by operators with experience and not necessarily in the acute phase of STEMI. 2 • Clinically suspected myocarditis by ESC Task Force criteria
= No angiographic stenosis 50% plus endomyocardial biopsy confirmation (histology, immunohistology, polymerase-chain reaction based techniques to search for genome of infectious agents, mainly viruses). 44 ESC Guidelines Downloaded from by guest on 16 September 2017 45. ...
                                                                                                                                                                                                                                                                                                                                                                                                   ..... (see Web Addenda). Quality indicators are intended to
measure and compare the quality of health service provision and serve as a foundation for quality improvement initiatives. 476 Proposed quality indicators can be found in the Web Addenda. 11. Gaps in the evidence and areas for future
research Despite the great advances in STEMI management over recent deca- des, important areas of uncertainty persist that should be explored in the future. Here, we identify some, but not all, specific areas that should be explored in the future. Here, we identify some, but not all, specific areas that should be explored in the future. Here, we identify some, but not all, specific areas that should be explored in the future.
receptor blocker; DAPT = dual antiplatelet therapy; ECG = electrocardiogram; GRACE = Global Registry of Acute Coronary Events; IRA = Infarct-related artery; LVEF = left ventricular ejection fraction; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myo-cardial infarction. ESC Guidelines 45 Downloaded from by guest on
                                                                                                                                                                   Public awareness and emergency care The very early stages of STEMI are the most vulnerable time, when most sudden cardiac deaths occur. Public campaigns aiming to increase early alerting of patients with ischaemic
symptoms should clearly state that the safest way to alert is to call the EMS. While selected centres and geographic areas have made great progress in ensuring high-quality rapid care for STEMI patients with routine pre- alert of the interventional team, there remains a need for streamlining of (pre-)hospital management in a homogeneous fashion
worldwide, including rural areas. Educational programmes and cross-country exchange of experiences should help in this matter. The selection of a 120 min from STEMI diagnosis to PCI-mediated reperfusion as the cut-off to choose PCI or fibrinolysis is based on relatively old registries and trials with different treatment strategies from those
presented in this document. The identification of the best cut-off timing to choose a strategy is of extreme importance. Reduction of ischaemia/reperfusion injury Final infarct size is one of the best cut-off timing to choose a strategy is of extreme importance. Reduction of ischaemia/reperfusion injury Final infarct size is one of the best cut-off timing to choose a strategy is of extreme importance. Reduction of ischaemia/reperfusion injury Final infarct size is one of the best cut-off timing to choose a strategy is of extreme importance.
clinical and socioeconomic impact. Several strategies, including pharmacological and mechanical therapies, have shown a reduction of infarct size by reducing ischaemia/reperfusion injury (including MVO) in experimen- tal and small-scale clinical trials, but to date no large trial has demon- strated a clinical benefit. One potential reason for this poor
translation is the difficulty of securing funds to conduct proper large-scale clinical trials in this context. Refinement of (acute and long-term) antithrombotic regimes Antithrombotic therapy is the cornerstone of the pharmacological approach in STEMI. Despite major recent advances, important ques-tions remain unaddressed. What is the best acute
and maintenance antithrombotic regimen in patients who have an indication for oral anticoagulants? What is the best timing for the loading dose of oral P2Y12 inhibitors in patients undergoing fibrinolysis? What is the real role of aspirin in
this new era of potent antiplatelet agents and low dose anticoagulation? What is the best duration of maintenance therapy with P2Y12 inhibitors Although research regarding these classes of drugs was intense sev- eral decades ago, more recently, there has been a lack
of properly powered clinical trials. The best timing for initiation (and route of administration) of beta-blocker therapy is well established for patients with heart failure and/or low LVEF, but its clinical value for the rest of STEMI has not been prospectively tested in dedicated clinical
trials of reperfused patients. Similar limitations apply to the use of mainte- nance ACE inhibitors. Post-STEMI risk stratification The optimal therapeutic strategy to minimize the clinical benefit of ICDs in patients with low LVEF and
reduced functional class weeks after STEMI being well established, there is a need for better sudden death risk stratifi- cation algorithms. The best management of non-IRA lesions should be addressed. Unresolved issues are the best criteria to guide PCI (angiography, FFR, or assessment of plaque vulnerability) and the best timing for complete
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revascularization if indicated (during index PCI or staged, including staged during hospitalization vs. after discharge). Shock and left ventricular assist devices Severe heart failure and shock are among the most important nega-tive prognostic predictors in patients with STEMI. In addition to urgent revascularization of IRA and standard medical

control Current guidelines on prevention recommend: (i) a diet similar to the Mediterranean diet, which includes a maximum of 10% of total energy intake from saturated fatty acids; (ii) 30-45g fibre per day; (iv) 200 g fruits and 200g

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LV assist devices and ECMO are increasingly popular but have not been sufficiently evaluated in clinical trials. Systematic evaluation of phar- macological and interventional strategies and LV assist devices for patients with shock are urgently needed. Myocardial repair/rescue The effectiveness and safety of novel therapies able to replace dead
myocardium or prevent poor remodelling (e.g. cell therapy or gene therapy) is an unfulfilled promise. There is a strong need for basic research studies to better understand the biological processes involved in cardiac development and repair, in order for there to be strong grounds to translate studies into clinically relevant animal models and finally
into humans. Need for observational data and real- world evidence In order to understand shortcomings and clinical prac- tice, for quality assessment and for benchmarking, unselected and validated registries and clinical prac- tice, for quality indicators intended to measure and compare thereof and validated registries and clinical prac- tice, for quality assessment and for benchmarking, unselected and validated registries and clinical prac- tice, for quality indicators intended to measure and compare thereof and validated registries and clinical prac- tice, for quality indicators intended to measure and compare thereof and validated registries and clinical prac- tice, for quality indicators intended to measure and compare thereof and validated registries and clinical prac- tice, for quality indicators intended to measure and compare thereof and validated registries and clinical prac- tice, for quality indicators intended to measure and compare thereof and validated registries and clinical prac- tice, for quality indicators in the prac- tice, for quality indicator
quality of health service provision and serve as a founda- tion for quality improvement initiatives. Their effects on procedural and clinical outcomes need to be evaluated. 46 ESC Guidelines Downloaded from by guest on 16 September 2017 47. ....
pragmatic real-life clinical trials One major limitation of highly selective controlled clinical trials in a bias that precludes universal implementation. An opportunity is the implementation of pragmatic clinical trials including registry.
 based randomized clinical trials.477 These trials are less selective and less expensive alternatives to classical ones, especially for therapies used in clinical practice. 12. Key messages (1) Epidemiology of STEMI: Although the rate of mortality associated with ischaemic heart disease have reduced in Europe over the last few decades, this is still the
single most common cause of death worldwide. The relative incidences of STEMI and NSTEMI, in parallel with the widespread use of reperfusion, mortality remains substantial. The in-hospital mortality rates of unselected patients
with STEMI in national European registries vary between 4-12%. (2) Gender aspects: Women tend to receive reperfusion therapy and other evidence-based treatments less frequently and/or in a delayed way than men. It is important to highlight that women and men receive equal benefit from a reperfusion and other STEMI- related therapies, and so
both genders must be managed equally. (3) ECG and STEMI diagnosis: In some cases, patients may have coro- nary artery occlusion/global ischaemia in the absence of character- istic ST elevation (e.g. bundle branch block, ventricular pacing, hyperacute T-waves, isolated ST-depression in anterior leads, and/ or universal ST depression with ST-
elevation in aVR). In patients with the mentioned ECG changes and clinical presentation com- patible with ongoing myocardial ischaemia, a primary PCI strategy (i.e. urgent angiography and PCI if indicated) should be followed. (4) Reperfusion strategy selection: STEMI diagnosis (defined as the time at which the ECG of a patient with ischaemic
symptoms is interpreted as presenting ST-segment elevation or equivalent) is the time zero in the reperfusion strategy clock. STEMI diagnosis to PCI-mediated reperfusion is 120 min, when fibrinolysis should be initiated immediately (i.e. within 10min
of STEMI diagnosis). (5) STEMI management networks: Coordination between EMS and hospitals with common written protocols is at the centre of STEMI management. EMS should transfer patients to 24/7 high-volume PCI centres irrespective of whether the primary treatment strategy is PCI or pre-hospital fibrinolysis. EMS should always alert the
PCI centre immediately after selection of the reperfusion strat- egy. Patient transfer to the PCI centre should bypass the emer- gency department. (6) Cardiac arrest and reperfusion strat- egy. Patient transfer to the PCI centre should bypass the emer- gency department.
but with a high suspicion of ongoing myocardial ischaemia, urgent angiography should be done within 2 h after a quick evaluation to exclude non-coronary causes. In all cases, the decision to perform urgent coronary angiography should take into account factors associated with poor neurological outcome. (7) Technical aspects during primary PCI:
Routine radial access and routine DES implant is the standard of care during primary PCI. Routine thrombus aspiration or deferred stenting are contraindicated. (8) Management of non-IRA lesions: Treatment of severe stenosis (evaluated either by angiography or FFR) should be considered before hospital discharge (either immediately during the
index PCI or staged at a later time). In cardiogenic shock, non-IRA PCI should be considered during the index procedure. (9) Antithrombotic therapy: Anticoagulants and DAPT are the cor- nerstone of the pharmacological approach in the acute phase of STEMI. Primary PCI: unfractionated heparin (enoxaparin and biva- lirudin may be alternative), and
loading dose of aspirin and prasu- grel/ticagrelor. Fibrinolysis: enoxaparin (unfractionated heparin may be alternative), and loading dose of aspirin plus prasugrel/ticagrelor. (10) Early care: After reperfusion therapy, patients should be
moni- tored for at least 24h. Early ambulation and early discharge are the best option in uncomplicated patients. Consequently, time for implementing secondary prevention is limited highlighting the importance of close collaboration between all stakeholders. (11) Special patient subsets: Patients taking oral anticoagulants with renal insufficiency
and/or the elderly represent a challenge in terms of optimal antithrombotic therapy. Special attention should be paid to dose adjustment of some pharmacological strategies in these subsets. Patients with diabetes and those not undergoing reperfusion represent another subset of patients that require addi- tional attention. (12) Imaging in STEMI: Non-
invasive imaging is very important for the acute and long-term management of STEMI patients to identify the aetiology and tailor appropriate therapy
which may be different from typical STEMI. (14) Quality indicators: In some cases, there is a gap between optimal guideline-based treatment and actual care of STEMI patients. In order to reduce this gap, it is important to measure established quality indicators to audit practice and improve outcomes in real-life. The use of well-defined and validated
quality indicators to measure and improve STEMI care is recommended. ESC Guidelines 47 Downloaded from by guest on 16 September 2017 48. 13. Evidenced-based 'to do and not to do' messages from the Guidelines Recommendations Recommendations for initial diagnosis Classa Levelb Twelve-lead ECG recording and interpretation is indicated
as soon as possible at the point of FMC, with a maximum target delay of 10 min. I B ECG monitoring with defibrillator capacity is indicated as soon as possible in all patients with SaO2 90%. III B Recommendations for relief of hypoxaemia and symptoms Routine oxygen is not recommended in patients with SaO2 90%. III B Recommendations for relief of hypoxaemia and symptoms Routine oxygen is not recommended in patients with SaO2 90%. III B Recommendations for relief of hypoxaemia and symptoms Routine oxygen is not recommended in patients with SaO2 90%. III B Recommendations for relief of hypoxaemia and symptoms Routine oxygen is not recommendation for relief of hypoxaemia and symptoms Routine oxygen is not recommendation for relief of hypoxaemia and symptoms Routine oxygen is not recommendation.
cardiac arrest A primary PCI strategy is recommended in patients with resuscitated cardiac arrest and an ECG consistent with STEMI. I B Targeted temperature management is indicated early after resuscitation of cardiac arrest patients who remain unresponsive. I B Pre-hospital cooling using a rapid infusion of large volumes of cold i.v. fluid
immediately after return of spontaneous circulation is not recommended. III B Recommended that the pre-hospital management of STEMI patients is based on regional networks designed to deliver reperfusion therapy expeditiously and effectively, with efforts made to make primary PCI available
to as many patients as possible. I B It is recommended that primary PCI eapable centres deliver a 24/7 service and are able to perform primary PCI without delay. I B It is recommended that primary PCI without delay. I B It is recommended that primary PCI without delay. I B It is recommended that primary PCI without delay. I B It is recommended that primary PCI without delay.
laboratory. I B Recommendations for reperfusion therapy is indicated in all patients with symptoms of ischaemia of _ 12 h duration and persistent ST-segment elevation. I A If primary PCI cannot be performed in a timely way after STEMI diagnosis, fibrinolytic therapy is recommended within 12 h of symptom onset in patients
without contraindications. I A In asymptomatic patients, routine PCI of an occluded IRA 48 h after onset of STEMI is not indicated. II A Stenting is recommended (over balloon angioplasty) for primary PCI. I A Stenting with new-generation
DES is recommended over BMS for primary PCI. I A Radial access is recommended. III A Routine use of thrombus aspiration is not recommended. III A Routine use of deferred stenting is not recommended.
therapy in patients undergoing primary PCI A potent P2Y12 inhibitor (prasugrel or ticagrelor), or clopidogrel if these are not available or are contraindications such as excessive risk of bleeding. I A Continued 48 ESC Guidelines
Downloaded from by guest on 16 September 2017 49. Aspirin oral or i.v. (if unable to swallow) is recommended as soon as possible for all patients without contraindications. I B Fondaparinux is not recommended to initiate
this treatment as soon as possible after STEMI diag- nosis, preferably in the pre-hospital setting. I A A fibrin-specific agent (i.e. tenecteplase, alteplase, or reteplase, is recommended in patients treated with lytics until
revascularization (if performed) or for the duration of hos- pital stay up to 8 days. The anticoagulant can be: I A Enoxaparin i.v. followed by s.c. (preferred over UFH). I A UFH given as a weight-adjusted i.v. bolus followed by s.c. (preferred over UFH). I A UFH given as a weight-adjusted in all patients immediately after fibrinolysis. I A
Emergency angiography and PCI if indicated is recommended in patients with heart failure/shock. I A Rescue PCI is indicated immediately when fibrinolysis has failed (50% ST-segment resolution at 60-90 min) or at any time in the presence of haemodynamic or electrical instability, or worsening ischaemia. I A Angiography and PCI of the IRA, if
indicated, is recommended between 2-24 h after successful fibrinolysis. I A Emergency angiography and PCI if needed is indicated in the case of recurrent ischaemia or evidence of reocclusion after initial successful fibrinolysis. I B Recommendations for imaging and stress testing in STEMI patients Routine echocardiography during hospital stay to
assess resting LV and RV function, detect early post-MI mechanical complica- tions, and exclude LV thrombus is recommended to identify smokers and provide repeated advice on stopping, with offers to help with the use of follow-up support, nicotine
replacement therapies, varenicline, and bupropion individually or in combination. I A Participation in a cardiac rehabilitation programme is recommended. I A Recommendations for maintenance antithrombotic strategy after STEMI Antiplatelet therapy with low-dose aspirin (75-100 mg) is indicated. I A DAPT in the form of aspirin plus ticagrelor or
prasugrel (or clopidogrel if ticagrelor or prasugrel are not available or are contra- indicated) is recommended for 12 months after PCI, unless there are contraindications such as excessive risk of bleeding. I A A PPI in combination with DAPT is recommended in patients at high risk of gastrointestinal bleeding. I B Recommendations for routine
therapies in the acute, subacute, subacute, and long-term phases Oral treatment with beta-blockers is indicated in patients with hypotension, acute heart failure, or AV block or severe bradycardia. III B It is recommended to start high-intensity
statin therapy as early as possible, unless contraindicated, and maintain it long-term. I A An LDL-C goal of 1.8 mmol/L (70-135 mg/dL) is recommended. I B ACE inhibitors are recommended, starting within the first 24 h of STEMI in patients with evidence of
Guidelines/Acute-Myocardial-Infarction-in-patients-presenting-with- ST-segment-elevation-Ma 15. Appendix ESC Committee for Practice Guidelines (CPG): Stephan Windecker (Chairperson) (Switzerland), Victor Aboyans (France), Stefan Agewall (Norway), Emanuele Barbato (Italy), He´ctor Bueno (Spain), Antonio Coca (Spain), Jean-Philippe Collet
(France), Ioan Mircea Coman (Romania), Veronica Dean (France), Victoria Delgado (The Netherlands), Donna Fitzsimons (UK), Oliver Gaemperli (Switzerland), Patrizio Lancellotti (Belgium), Christophe Leclercq (France), Victoria Delgado (The Netherlands), Donna Fitzsimons (UK), Oliver Gaemperli (Switzerland), Patrizio Lancellotti (Belgium), Christophe Leclercq (France), Victoria Delgado (The Netherlands), Donna Fitzsimons (UK), Oliver Gaemperli (Switzerland), Germany), Juhani Knuuti (Finland), Patrizio Lancellotti (Belgium), Christophe Leclercq (France), Victoria Delgado (The Netherlands), Donna Fitzsimons (UK), Oliver Gaemperli (Switzerland), Germany), Juhani Knuuti (Finland), Patrizio Lancellotti (Belgium), Christophe Leclercq (France), Victoria Delgado (The Netherlands), Donna Fitzsimons (UK), Oliver Gaemperli (Switzerlands), Donna Fitzsimons (UK), Oliver Gae
Theresa McDonagh (UK), Massimo Francesco Piepoli (Italy), Piotr Ponikowski (Poland), Dimitrios J. Richter (Greece), Marco Roffi (Switzerland), Evgeny Shlyakhto (Russia), Iain A. Simpson (UK), Jose Luis Zamorano (Spain). ESC National Cardiac Societies actively involved in the review process of the 2017 ESC Guidelines for the manage- ment of such activation (Spain).
acute myocardial infarction in patients presenting with ST-segment elevation: Algeria: Algerian Society of Cardiology, Mohamed Chettibi; Armenian Cardiology, Bernhard Metzler; Azerbaijan: Azerbaijan
valsartan, is an alternative to ACE inhibitors in patients with heart failure and/or LV systolic dysfunction, particularly those who are intolerant of ACE inhibitors. I B MRAs are recommended in patients with an ejection fraction 40% and heart failure or diabetes, who are already receiving an ACE inhibitor and a beta-blocker, provided there is no renal
failure or hyperkalaemia. I B Recommendations for the management of LV dysfunction and acute heart failure in STEMI ACE inhibitor (or if not tolerated, ARB) therapy is indicated as soon as haemodynamically stable for all patients with evidence of LVEF 40% and/or heart failure to reduce the risk of hospitalization and death. I A Beta-blocker
therapy is recommended in patients with LVEF 40% and/or heart failure after stabilization, to reduce the risk of cardiovascular hospitalization and
 death. I B Recommendations for the management of cardiogenic shock in STEMI Immediate PCI is indicated for patients with cardiogenic shock if coronary anatomy is not suit-able for PCI, or PCI has failed, emergency CABG is recommended. I B Routine intra-aortic balloon pumping is not indicated. III B
Recommendations for management of atrial fibrillation Digoxin is ineffective in converting recent onset AF to sinus rhythm and is not indicated for rhythm control. III A Calcium channel blockers and beta-blockers including sotalol are ineffective in converting recent onset AF to sinus rhythm. III B Prophylactic treatment with antiarrhythmic drugs to
prevent AF is not indicated. III B Recommendations for management of ventricular arrhythmias and conduction disturbances in the acute phase Intravenous beta-blocker treatment with antiarrhythmic drugs is not indicated and may be harmful
III B Recommendations for long-term management of ventricular arrhythmias and risk evaluation for sudden death ICD therapy is recommended to reduce sudden cardiac death in patients with symptomatic heart failure (New York Heart Association class II-III) and LVEF 35%, despite optimal medical therapy for 3 months and at least 6 weeks after
MI, who are expected to survive for at least 1 year with good functional status. I A Recommendations with a class I or III and a level of evidence A or B. See 'Abbreviations and acronyms' list for explanation of abbreviations and acronyms' list for explanation of abbreviations. a Class of recommendation. b Level of evidence A or B. See 'Abbreviations and acronyms' list for explanation of abbreviations and acronyms' list for explanation of abbreviations.
                                                                                                                                                    Ibrahimov; Belarus: Belorussian Scientific Society of Cardiologists, Volha Sujayeva; Belgium: Belgian Society of Cardiology, Christophe Beauloye; Bosnia and Herzegovina: Association of Cardiologists of Bosnia and Herzegovina, Larisa
Dizdarevic-Hudic; Bulgaria: Bulgaria: Bulgaria: Bulgaria: Society of Cardiology, Kiril Karamfiloff; Croatia: Croatian Society of Cardiology, Petr Tousek; Denmark: Danish Society of Cardiology, Christian Juhl Terkelsen; Egypt: Egyptian Society of Cardiology, Cardiology, Cardiology, Christian Juhl Terkelsen; Egypt: Egyptian Society of Cardiology, Cardiol
Sameh Mohamad Shaheen; Estonia: Estonia: Estonia: Estonia: Estonia: Society of Cardiology, Toomas Marandi; Finland: Finnish Cardiology, Alexander Aladashvili; France: French Society of Cardiology, Martine Gilard; Georgia: Georgi
Germany: German Cardiac Society, Albrecht Elsaesser; Greece: Hellenic Society of Cardiology, Ioannis Georgios Kanakakis; Hungary: Hungary:
Bolognese; Kazakhstan: Association of Cardiology, Medet Beishenkulov; Latvia: Latvian Society of Cardiology, Gani Bajraktari; Kyrgyzstan: 
Olivija Gustiene; Luxembourg: Luxembourg Society of Cardiology, Bruno Pereira; Malta: Maltese Cardiology, Vibeke Juliebø; Poland: Polish Cardiology, Samir Ztot; Norway: Norwa
Timoteo; Romania: Romanian Society of Cardiology, Gabriel Tatu-Chit, oiu; Russian Federation: Russian Federation: Russian Federation: Russian Federation Society of Cardiology, Martin Studencan; Slovenia: Slovenian Society of Cardiology, Alexey Yakovley; San Marino Society of Cardiology, Martin Studencan; Slovenia: Slovenian Society of Cardiology, Alexey Yakovley; San Marino: San Marino Society of Cardiology, Martin Studencan; Slovenia: Slovenian Society of Cardiology, Alexey Yakovley; San Marino: San Marino: San Marino: San Marino Society of Cardiology, Martin Studencan; Slovenia: Slovenian Society of Cardiology, Alexey Yakovley; San Marino: San 
Cardiology, Matjaz Bunc; Spain: Spain
Yildirir; Ukraine: Ukrainian Association of Cardiology, Alexander Parkhomenko; United Kingdom: British Cardiovascular Society, Chris P. Gale. 16. References 1. Windecker S, Kolh P, Kastrati A, Knuuti J, Landmesser U, Laufer G, Neumann FJ, Richter DJ,
Schauerte P, Sousa Uva M, Stefanini GG, Taggart DP, Torracca L, Valgimigli M, Wijns W, Witkowski A. 2014 ESC/ EACTS Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Association for Cardio-Thoracic Surgery (EACTS). Developed with the
special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI). Eur Heart J 2014;35(37):2541-2619. 2. Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F, Bax JJ, Borger MA, Brotons C, Chew DP, Gencer B, Hasenfuss G, Kjeldsen K, Lancellotti P, Landmesser U, Mehilli J, Mukherjee D, Storey
RF, Windecker S, Baumgartner H, Gaemperli O, Achenbach S, Agewall S, Badimon L, Baigent C, Bueno H, Bugiardini R, Carerj S, Casselman F, Cuisset T, Erol C, Fitzsimons D, Halle M, Hamm C, Hildick-Smith D, Huber K, Iliodromitis E, James S, Lewis BS, Lip GY, Piepoli MF, Richter D, Rosemann T, Sechtem U, Steg PG, Vrints C, Luis Zamorano J
2015 ESC Guidelines for the management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2016;37(3):267-315. 3. Priori
SG, Blomstrom-Lundqvist C, Mazzanti A, Blom N, Borggrefe M, Camm J, Elliott PM, Fitzsimons D, Hatala R, Hindricks G, Kirchhof P, Kjeldsen K, Kuck KH, Hernandez-Madrid A, Nikolaou N, Norekval TM, Spaulding C, Van Veldhuisen DJ. 2015 ESC Guidelines for the management of patients with ven-tricular arrhythmias and the prevention of sudden
cardiac death: The Task Force for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiology (AEPC). Eur Heart J 2015;36(41):2793-2867. 4. Piepoli MF, Hoes AW, Agewall S, Albus C
Brotons C, Catapano AL, Cooney MT, Corra U, Cosyns B, Deaton C, Graham I, Hall MS, Hobbs FD, Lochen ML, Lollgen H, Marques-Vidal P, Perk J, Prescott E, Redon J, Richter DJ, Sattar N, Smulders Y, Tiberi M, van der Worp HB, van Dis I, Verschuren WM. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth
Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts). Developed with the special contribution of the European Association for Cardiovascular Prevention Rehabilitation (EACPR). Eur Heart J
2016;37(29):2315-2381. 5. Kirchhof P, Benussi S, Kotecha D, Ahlsson A, Atar D, Casadei B, Castella M, Diener HC, Heidbuchel H, Hendriks J, Hindricks G, Budts W, Carerj S, Casselman F, Coca A, De Caterina R, Deftereos S, Dobrev D,
Ferro JM, Filippatos G, Fitzsimons D, Gorenek B, Guenoun M, Hohnloser SH, Kolh P, Lip GY, Manolis A, McMurray J, Ponikowski P, Rosenhek R, Ruschitzka F, Savelieva I, Sharma S, Suwalski P, Tamargo JL, Taylor CJ, Van Gelder IC, Voors AA, Windecker S, Zamorano JL, Zeppenfeld K. 2016 ESC Guidelines for the management of atrial fibrillation
developed in collaboration with EACTS. Eur Heart J 2016;37(38):2893-2962. 6. Ponikowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, Falk V, Gonzalez-Juanatey JR, Harjola VP, Jankowski P, Voors AA, Anker SD, Balanda VP, Lankowski P, Voors AA, Anker SD, Bala
ESC Guidelines for the diagno- sis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure Association (HFA) of the ESC. Eur Heart J 2016;37(27): 2129-2200. 7.
Valgimigli M, OTHER AUTHORS TO BE INSERTED HERE. 2017 ESC Focused Update on Dual Antiplatelet Therapy in Coronary Artery Disease in collabora- tion with the European Association for Cardio-Thoracic Surgery (EACTS). The Task Force for the Management of Dual Antiplatelet Therapy in Coronary Artery Disease of the European Society of
Cardiology (ESC). Eur Heart J 2017. 8. Thygesen K, Alpert JS, Jaffe AS, Simoons ML, Chaitman BR, White HD, Writing Group on the Joint ESC/ACCF/AHA/WHF Task Force for the Universal Definition of Myocardial Infarction, Thygesen K, Alpert JS, White HD, Jaffe AS, Katus HA, Apple FS, Lindahl B, Morrow DA, Chaitman BA, Clemmensen PM,
Johanson P, Hod H, Underwood R, Bax JJ, Bonow RO, Pinto F, Gibbons RJ, Fox KA, Atar D, Newby LK, Galvani M, Hamm CW, Uretsky BF, Steg PG, Wijns W, Bassand JP, Menasche P, Ravkilde J, Ohman EM, Wallentin LC, Armstrong PW, Simoons ML, Januzzi JL, Nieminen MS, Gheorghiade M, Filippatos G, Luepker RV, Fortmann SP,
 Rosamond WD, Levy D, Wood D, Smith SC, Hu D, Lopez-Sendon JL, Robertson RM, Weaver D, Tendera M, Bove AA, Parkhomenko AN, Vasilieva EJ, Mendis S, ESC Committee for Practice Guidelines. Third universal definition of myocardial infarction. Eur Heart J 2012;33(20):2551-2567. 9. Gehrie ER, Reynolds HR, Chen AY, Neelon BH, Roe MT
Gibler WB, Ohman EM, Newby LK, Peterson ED, Hochman JS. Characterization and outcomes of women and men with non-ST-segment elevation myocardial infarction of Unstable Angina Patients Suppress Adverse Outcomes with Early Implementation of the
ACC/AHA Guidelines (CRUSADE) quality improvement initiative. Am Heart J 2009;158(4):688-694. 10. Pasupathy S, Air T, Dreyer RP, Tavella R, Beltrame JF. Systematic review of patients presenting with suspected myocardial infarction and nonobstructive coronary arteries. Circulation 2015;131(10):861-870. 11. Niccoli G, Scalone G, Crea F. Acute
HR, Niessner A, Rosano G, Caforio AL, De Caterina R, Zimarino M, Roffi M, Kjeldsen K, Atar D, Kaski JC, Sechtem U, Tornvall P, on behalf of the WG on Cardiovascular Pharmacotherapy. ESC working group position paper on myocardial infarction with non-obstructive coronary arteries. Eur Heart J 2017;38(3):143-153. 13. Hartley A, Marshall DC,
 Salciccioli JD, Sikkel MB, Maruthappu M, Shalhoub J. Trends in mortality from ischemic heart disease and cerebrovascular disease in Europe: 1980 to 2009. Circulation 2016;133(20):1916-1926. 14. Townsend N, Wilson L, Bhatnagar P, Wickramasinghe K, Rayner M, Nichols M. Cardiovascular disease in Europe: epidemiological update 2016. Eur
Yarzebski J, Spencer F, Lessard D, Goldberg RJ. Recent trends in the incidence, treatment, and outcomes of patients with STEMI and NSTEMI. Am J Med 2011;124(1):40-47. 17. Jernberg T. Swedeheart Annual Report 2015. In: Karolinska University Hospital, Huddinge, 14186 Stockholm; 2016. 18. Widimsky P, Wijns W, Fajadet J, de Belder M, Knot J.
Aaberge L, Andrikopoulos G, Baz JA, Betriu A, Claeys M, Danchin N, Djambazov S, Erne P, Hartikainen J, Huber K, Kala P, Klinceva M, Kristensen SD, Ludman P, Ferre JM, Merkely B, Milicic D, Morais J, Noc M, Opolski G, Ostojic M, Radovanovic D, De Servi S, Stenestrand U, Studencan M, Tubaro M, Vasiljevic Z, Weidinger F, Witkowski A, Zeymer
U, European Association for Percutaneous Cardiovascular Interventions. Reperfusion therapy for ST elevation acute myocardial infarction in Europe: description of the current situation in 30 countries. Eur Heart J 2010;31(8):943-957. 19. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, de Ferranti S, Despres JP, Fullerton HJ
Howard VJ, Huffman MD, Judd SE, Kissela BM, Lackland DT, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Matchar DB, McGuire DK, Mohler ER, 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Willey JZ, Woo D, Yeh RW
Turner MB, American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2015 update: a report from the American Heart Association Statistics Committee. Heart disease and stroke statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 update: a report from the American Heart Association Statistics—2015 
GC, Frishman WH, Panza JA, Bhatt DL. Temporal trends and sex differences in revascularization and outcomes of st-segment elevation myocardial infarction in younger adults in the United States. J Am Coll Cardiol 2015;66(18):1961-1972. 21. Puymirat E, Simon T, Steg PG, Schiele F, Gueret P, Blanchard D, Khalife K, Goldstein P, Cattan S, Vaur L,
Cambou JP, Ferrieres J, Danchin N, USIK USIC 2000 Investigators. Association of changes in clinical characteristics and management with improvement in survival among patients with ST-elevation myocardial infarction. JAMA 2012;308(10):998-1006. 22. Gale CP, Allan V, Cattle BA, Hall AS, West RM, Timmis A, Gray HH,
Deanfield J, Fox KA, Feltbower R. Trends in hospital treatments, including revascularisa- tion, following acute myocardial infarction, 2003-2010: a multilevel and relative survival analysis for the National Institute for Cardiovascular Outcomes Research (NICOR). Heart 2014;100(7):582-589. 23. Kristensen SD, Laut KG, Fajadet J, Kaifoszova Z, Kala P,
Di Mario C, Wijns W, Clemmensen P, Agladze V, Antoniades L, Alhabib KF, De Boer MJ, Claeys MJ, Deleanu D, Dudek D, Erglis A, Gilard M, Goktekin O, Guagliumi G, Gudnason T, Hansen KW, Huber K, James S, Janota T, Jennings S, Kajander O, Kanakakis J, Karamfiloff KK, Kedev S, Kornowski R, Ludman PF, Merkely B, Milicic D, Najafov R, Nicolini
FA, Noc M, Ostojic M, Pereira H, Radovanovic D, Sabate M, Sokolov M, Studencan M, Terzic I, Wahler S, Widimsky P, European Association for Percutaneous Cardiovascular Interventions. Reperfusion ther- apy for ST elevation acute myocardial infarction 2010/2011: current status in 37 ESC countries. Eur Heart J 2014;35(29):1957-1970.
24. Pedersen F, Butrymovich V, Kelbaek H, Wachtell K, Helqvist S, Kastrup J, Holmvang L, Clemmensen P, Engstrom T, Grande P, Saunamaki K, Jorgensen E. Short- and long-term cause of death in patients treated with primary PCI for STEMI. J Am Coll Cardiol 2014;64(20):2101-2108. 25. Fokkema ML, James SK, Albertsson P, Akerblom A, Calais F,
Eriksson P, Jensen J, Nilsson T, de Smet BJ, Sjogren I, Thorvinger B, Lagerqvist B. Population trends in percutaneous coronary intervention: 20-year results from the SCAAR (Swedish Coronary Angiography and Angioplasty Regitz-Zagrosek V,
Oertelt- Prigione S, Prescott E, Franconi F, Gerdts E, Franconi F,
among men and women presenting with ST-elevation myocardial infarction. Am Heart J 2011;161(1):91-97. 29. Diercks DB, Owen KP, Kontos MC, Blomkalns A, Chen AY, Miller C, Wiviott S, Peterson ED. Gender differences in time to presentation for myocardial infarc- tion before and after a national women's cardiovascular awareness campaign:
temporal analysis from the Can Rapid Risk Stratification of Unstable Angina Patients Suppress ADverse Outcomes with Early Implementation Outcomes Network-Get with the Guidelines (NCDR ACTION Registry-GWTG). Am Heart J
2010;160(1):80-87.e3. 30. Kang SH, Suh JW, Yoon CH, Cho MC, Kim YJ, Chae SC, Yoon JH, Gwon HC, Han KR, Kim JH, Ahn YK, Jeong MH, Kim HS, Choi DJ, KAMIR/KorMI Registry. Sex differences in management and mortality of patients with ST-elevation myocardial infarction (from the Korean Acute Myocardial Infarction National Registry). Am
Cardiol 2012;109(6):787-793. 31. Kyto V, Sipila J, Rautava P. Gender and in-hospital mortality of ST-segment ele- vation myocardial infarction (from a multihospital nationwide registry study of 31,689 patients). Am J Cardiol 2015;115(3):303-306. 32. Hvelplund A, Galatius S, Madsen M, Rasmussen JN, Rasmussen J
Thayssen P, Sindby E, Hojbjerg S, Abildstrom SZ. Women with acute coronary syndrome are less invasively examined and subse- quently less treated than men. Eur Heart J 2010;31(6):684-690. 33. Nguyen JT, Berger AK, Duval S, Luepker RV. Gender disparity in cardiac proce- dures and medication use for acute myocardial infarction. Am Heart J
2008;155(5):862-868. 34. de Torbal A, Boersma E, Kors JA, van Herpen G, Deckers JW, van der Kuip DA, Stricker BH, Hofman A, Witteman JC. Incidence of recognized and unrec- ognized myocardial infarction in men and women aged 55 and older: the Rotterdam Study. Eur Heart J 2006;27(6):729-736. 35. Henrikson CA, Howell EE, Bush DE, Miles
JS, Meininger GR, Friedlander T, Bushnell AC, Chandra-Strobos N. Chest pain relief by nitroglycerin does not predict active coronary artery disease. Ann Intern Med 2003;139(12):979-986. 36. Diercks DB, Peacock WF, Hiestand BC, Chen AY, Pollack CV, Jr, Kirk JD, Smith SC, Jr, Gibler WB, Ohman EM, Blomkalns AL, Newby LK, Hochman JS,
 Peterson ED, Roe MT. Frequency and consequences of recording an electro- cardiogram 10 minutes after arrival in an emergency room in non-ST-segment elevation acute coronary syndromes (from the CRUSADE Initiative). Am J Cardiol 2006;97(4):437-442. 37. Tubaro M, Danchin N, Goldstein P, Filippatos G, Hasin Y, Heras M, Jansky P, Norekval
TM, Swahn E, Thygesen K, Vrints C, Zahger D, Arntz HR, Bellou A, De La Coussaye JE, De Luca L, Huber K, Lambert Y, Lettino M, Lindahl B, McLean S, Nibbe L, Peacock WF, Price S, Quinn T, Spaulding C, Tatu-Chitoiu G, Van De Werf F. Pre-hospital treatment of STEMI patients. A scientific state- ment of the Working Group Acute Cardiac Care of
the European Society of Cardiology. Acute Card Care 2011;13(2):56-67. 38. Rokos IC, French WJ, Koenig WJ, Stratton SJ, Nighswonger B, Strunk B, Jewell J, Mahmud E, Dunford JV, Hokanson J, Smith SW, Baran KW, Swor R, Berman A, Wilson BH, Aluko AO, Gross BW, Rostykus PS, Salvucci A, Dev V, McNally B, Manoukian SV, King SB, 3rd.
Integration of pre-hospital electrocardiograms and ST-elevation myocardial infarction receiving center (SRC) networks: impact on door-to-balloon times across 10 independent regions. JACC Cardiovasc Interv 2009;2(4):339-346. 39. Quinn T, Johnsen S, Gale CP, Snooks H, McLean S, Woollard M, Weston C. Effects of prehospital 12-lead ECG on
processes of care and mortality in acute coronary syndrome: a linked cohort study from the Myocardial Ischaemia National Audit Project. Heart 2014;100(12):944-950. 40. Sorensen JT, Terkelsen CJ, Norgaard BL, Trautner S, Hansen TM, Botker HE, Lassen JF, Andersen HR. Urban and rural implementation of pre-hospital diag- nosis and directs
referral for primary percutaneous coronary intervention in patients with acute ST-elevation myocardial infarction. Eur Heart J 2011;32(4):430-436. 41. Chan AW, Kornder J, Elliott H, Brown RI, Dorval JF, Charania J, Zhang R, Ding L, Lalani A, Kuritzky RA, Simkus GJ. Improved survival associated with pre- hospital triage strategy in a large regional
ST-segment elevation myocardial infarction program. JACC Cardiovasc Interv 2012;5(12):1239-46. 42. Dhruva VN, Abdelhadi SI, Anis A, Gluckman W, Hom D, Dougan W, Kaluski E, Haider B, Klapholz M. ST-Segment Analysis Using Wireless Technology in Acute Myocardial Infarction (STAT-MI) trial. J Am Coll Cardiol 2007;50(6):509-513. 43. Lopez
Sendon J, Coma-Canella I, Alcasena S, Seoane J, Gamallo C. Electrocardiographic findings in acute right ventricular infarction: sensitivity and 52 ESC Guidelines Downloaded from by guest on 16 September 2017 53. ...
electrocardiographic alterations in right precordial leads V4R, V3R, V1, V2, and V3. J Am Coll Cardiol 1985;6(6):1273-1279. 44. O'Doherty M, Tayler DI, Quinn E, Vincent R, Chamberlain DA. Five hundred patients with myocardial infarction monitored within one hour of symptoms. BMJ (Clin Res Ed) 1983;286(6375):1405-1408. 45. Mehta RH, Starr
AZ, Lopes RD, Hochman JS, Widimsky P, Pieper KS, Armstrong PW, Granger CB. Incidence of and outcomes associated with ven- tricular tachycardia or fibrillation in patients undergoing primary percutaneous coronary intervention. JAMA 2009;301(17):1779–1789. 46. Rokos IC, Farkouh ME, Reiffel J, Dressler O, Mehran R, Stone GW. Correlation
between index electrocardiographic patterns and pre-intervention angiographic findings: insights from the HORIZONS-AMI trial. Catheter Cardiovasc Interv 2012;79(7):1092-1098. 47. Stribling WK, Kontos MC, Abbate A, Cooke R, Vetrovec GW, Dai D, Honeycutt E, Wang TY, Lotun K. Left circumflex occlusion in acute myocardial infarction (from the
National Cardiovascular Data Registry). Am J Cardiol 2011;108(7):959-963. 48. Dixon WC, 4th, Wang TY, Dai D, Shunk KA, Peterson ED, Roe MT. Anatomic distribution of the culprit lesion in patients with non-ST-segment elevation myocardial infarction undergoing percutaneous coronary intervention: findings from the National Cardiovascular Data
Registry. J Am Coll Cardiol 2008;52(16):1347-1348. 49. Wang TY, Zhang M, Fu Y, Armstrong PW, Newby LK, Gibson CM, Moliterno DJ, Van de Werf F, White HD, Harrington RA, Roe MT. Incidence, distribution, and prognostic impact of occluded culprit arteries among patients with non-ST- elevation acute coronary syndromes undergoing diagnostic
angiography. Am Heart J 2009;157(4):716-723. 50. Sgarbossa EB, Pinski SL, Barbagelata A, Underwood DA, Gates KB, Topol EJ, Califf RM, Wagner GS. Electrocardiographic diagnosis of evolving acute myocar- dial infarction in the presence of left bundle-branch block. GUSTO-1 (Global Utilization of Streptokinase and Tissue Plasminogen Activator
for Occluded Coronary Arteries) Investigators. N Engl J Med 1996;334(8):481-487. 51. Wong CK, French JK, Aylward PE, Stewart RA, Gao W, Armstrong PW, Van De Werf FJ, Simes RJ, Raffel OC, Granger CB, Califf RM, White HD. Patients with prolonged ischemic chest pain and presumed-new left bundle branch block have heterogeneous outcomes
depending on the presence of ST-segment changes. J Am Coll Cardiol 2005;46(1):29-38. 52. Shlipak MG, Lyons WL, Go AS, Chou TM, Evans GT, Browner WS. Should the electrocardiogram be used to guide therapy for patients with left bundle- branch block and suspected myocardial infarction? JAMA 1999;281(8):714-719. 53. Lopes RD, Siha H, Fu Y
Mehta RH, Patel MR, Armstrong PW, Granger CB. Diagnosing acute myocardial infarction in patients with left bundle branch block. Am J Cardiol 2011;108(6):782-788. 54. Chang AM, Shofer FS, Tabas JA, Magid DJ, McCusker CM, Hollander JE. Lack of association between left bundle-branch block and acute myocardial infarction in symptomatic ED
patients. Am J Emerg Med 2009;27(8):916-921. 55. Widimsky P, Rohac F, Stasek J, Kala P, Rokyta R, Kuzmanov B, Jakl M, Poloczek M, Kanovsky J, Bernat I, Hlinomaz O, Belohlavek J, Kral A, Mrazek V, Grigorov V, Djambazov S, Petr R, Knot J, Bilkova D, Fischerova M, Vondrak K, Maly M, Lorencova A. Primary angioplasty in acute myocardial
infarction with right bundle branch block: should new onset right bundle branch block be added to future guidelines as an indication for reperfusion therapy? Eur Heart J 2012;33(1):86-95. 56. Madias JE. The nonspecificity of ST-segment elevation or = 5.0 mm in V1-V3 in the diagnosis of acute myocardial infarction in the presence of ventricular
paced rhythm. J Electrocardiol 2004;37(2):135-139. 57. Sgarbossa EB, Pinski SL, Gates KB, Wagner GS. Early electrocardiographic diag- nosis of acute myocardial infarction in the presence of ventricular paced rhythm. GUSTO-I Investigators. Am J Cardiol 1996;77(5):423-424. 58. Krishnaswamy A, Lincoff AM, Menon V. Magnitude and consequences
of missing the acute infarct-related circumflex artery. Am Heart J 2009;158(5):706-712. 59. From AM, Best PJ, Lennon RJ, Rihal CS, Prasad A. Acute myocardial infarction due to left circumflex artery occlusion and significance of ST-segment elevation. Am J Cardiol 2010;106(8):1081-1085. 60. Yan AT, Yan RT, Kennelly BM, Anderson FA, Jr, Budaj A,
Lopez-Sendon J, Brieger D, Allegrone J, Steg G, Goodman SG. Relationship of ST elevation in lead aVR with angiographic findings and outcome in non-ST elevation acute cor- onary syndromes. Am Heart J 2007;154(1):71-78. 61. Hobl EL, Stimpfl T, Ebner J, Schoergenhofer C, Derhaschnig U, Sunder- Plassmann R, Jilma-Stohlawetz P, Mannhalter C,
Posch M, Jilma B. Morphine decreases clopidogrel concentrations and effects: a randomized, double-blind, placebo-controlled trial. J Am Coll Cardiol 2014;63(7):630-635. 62. Parodi G, Bellandi B, Xanthopoulou I, Capranzano P, Capodanno D, Valenti R, Stavrou K, Migliorini A, Antoniucci D, Tamburino C, Alexopoulos D. Morphine is associated with a
delayed activity of oral antiplatelet agents in patients with ST-elevation acute myocardial infarction undergoing primary percutaneous cor- onary intervention. Circ Cardiovasc Interv 2015;8(1):e001593. 63. Kubica JM, Sroka WD, Stankowska K, Buszko K, Navarese EP, Jilma B, Siller-Matula JM, Marszall
MP, Rosc D, Kozinski M. Morphine delays and attenuates ticagrelor exposure and action in patients with myocardial infarction: the randomized, double-blind, placebo-con- trolled IMPRESSION trial. Eur Heart J 2016;37(3):245-252. 64. Stub D, Smith K, Bernard S, Nehme Z, Stephenson M, Bray JE, Cameron P, Barger B, Ellims AH, Taylor AJ, Mereditha MPRESSION trial.
IT, Kaye DM. Air versus oxygen in ST- segment-elevation myocardial infarction. Circulation 2015;131(24):2143-2150. 65. Cabello JB, Burls A, Emparanza JI, Bayliss S, Quinn T. Oxygen therapy for acute myocardial infarction. Cochrane Database Syst Rev 2013;8:CD007160. 66. Hofmann R, James SK, Svensson L, Witt N, Frick M, Lindahl B, Ostlund O,
Ekelund U, Erlinge D, Herlitz J, Jernberg T. Determination of the role of oxygen in uncomplicated myocardial infarction. BMJ 1976;1(6018):1121-1123. 68. Larsen JM, Ravkilde J. Acute coronary angiography in
patients resuscitated from out-of-hospital cardiac arrest: a systematic review and meta-analysis. Resuscitation 2012;83(12):1427-1433. 69. Garot P, Lefevre T, Eltchaninoff H, Morice MC, Tamion F, Abry B, Lesault PF, Le Tarnec JY, Pouges C, Margenet A, Monchi M, Laurent I, Dumas P, Garot J, Louvard Y. Six-month outcome of emergency
percutaneous coronary interven- tion in resuscitated patients after cardiac arrest complicating ST-elevation myo- cardial infarction. Circulation 2007;115(11):1354-1362. 70. Kern KB, Rahman O. Emergent percutaneous coronary intervention for resusci- tated victims of out-of-hospital cardiac arrest. Catheter Cardiovasc Interv 2010;75(4):616-624
71. Spaulding CM, Joly LM, Rosenberg A, Monchi M, Weber SN, Dhainaut JF, Carli P. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336(23):1629-1633. 72. Dumas F, Carli P. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336(23):1629-1633. 72. Dumas F, Carli P. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336(23):1629-1633. 72. Dumas F, Carli P. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest.
percutaneous coronary intervention is associated with better survival after out-of-hospital cardiac arrest: insights from the PROCAT (Parisian Region Out of hospital Cardiac ArresT) registry. Circ Cardiovasc Interv 2010;3(3):200-207. 73. Noc M, Fajadet J, Lassen JF, Kala P, MacCarthy P, Olivecrona GK, Windecker S, Spaulding C, European
Association for Percutaneous Cardiovascular Interventions, Stent for Life Group. Invasive coronary treatment from the European Association for Percutaneous Cardiovascular Interventions (EAPCI)/Stent for Life (SFL) groups. EuroIntervention 2014;10(1):31-37. 74. Monsieurs KG,
Nolan JP, Bossaert LL, Greif R, Maconochie IK, Nikolaou NI, Perkins GD, Soar J, Truhlar A, Wyllie J, Zideman DA. European Resuscitation 2015;95:1-80. 75. Reynolds JC, Frisch A, Rittenberger JC, Callaway CW. Duration of resuscitation efforts and functional
outcome after out-of-hospital cardiac arrest: when should we change to novel therapies? Circulation 2013;128(23):2488-2494. 76. Moulaert VR, Verbunt JA, van Heugten CM, Wade DT. Cognitive impairments in survivors of out-of-hospital cardiac arrest: a systematic review. Resuscitation 2009;80(3):297-305. 77. Hypothermia after Cardiac Arrest
Study Group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. N Engl J Med 2002;346(8):557-563. 78. Bernard SA, Gray TW, Buist MD, Jones BM, Silvester W, Gutteridge G, Smith K. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. N Engl J Med 2002;346(8):557-563.
79. Nikolaou NI, Welsford M, Beygui F, Bossaert L, Ghaemmaghami C, Nonogi H, O'Connor RE, Pichel DR, Scott T, Walters DL, Woolfrey KG. Part 5: Acute coronary syndromes: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation
2015;95:e121-e146. 80. Belliard G, Catez E, Charron C, Caille V, Aegerter P, Dubourg O, Jardin F, Vieillard-Baron A. Efficacy of therapeutic hypothermia after out-of-hospital car- diac arrest due to ventricular fibrillation. Resuscitation 2007;75(2):252-259. 81. Nielsen N, Wetterslev J, Cronberg T, Erlinge D, Gasche Y, Hassager C, Horn J, Hovdenes J
Kjaergaard J, Kuiper M, Pellis T, Stammet P, Wanscher M, Wise MP, Aneman A, Al-Subaie N, Boesgaard S, Bro-Jeppesen J, Lilja G, Moller JE, Rundgren M, Rylander C, Smid O, Werer C, Winkel P, Friberg H, TTM Trial Investigators. Targeted temperature
management at 33 degrees C versus 36 degrees C versus 36 degrees C after cardiac arrest. N Engl J Med 2013;369(23):2197-2206. 82. Vaahersalo J, Hiltunen P, Tiainen M, Kiviniemi O, Silfvast T, Kuisma M, Varpula T, Pettila V. Therapeutic hypothermia after out- of-
hospital cardiac arrest in Finnish intensive care units: the FINNRESUSCI study. Intensive Care Med 2013;39(5):826-837. ESC Guidelines 53 Downloaded from by guest on 16 September 2017 54.
Regueiro A, Ortiz JT, Bosch X, Sabate M, Heras M. Hypothermia in acute coronary syndrome: brain salvage versus stent thrombosis? J Am Coll Cardiol 2013;61(6):686-687. 84. Shah N, Chaudhary R, Mehta K, Agarwal V, Garg J, Freudenberger R, Jacobs L, Cox D, Kern KB, Patel N. Therapeutic hypothermia and stent thrombosis: a nationwide analysis
JACC Cardiovasc Interv 2016;9(17):1801-1811. 85. Garcia-Tejada J, Jurado-Roman A, Rodriguez J, Velazquez M, Hernandez F, Albarran A, Martin-Asenjo R, Granda-Nistal C, Coma R, Tascon J. Post-resusci- tation electrocardiograms, acute coronary findings and in-hospital prognosis of survivors of out-of-hospital cardiac arrest. Resuscitation
2014;85(9):1245-1250. 86. Kim F, Nichol G, Maynard C, Hallstrom A, Kudenchuk PJ, Rea T, Copass MK, Carlbom D, Deem S, Longstreth WT, Jr, Olsufka M, Cobb LA. Effect of preho-spital induction of mild hypothermia on survival and neurological status among adults with cardiac arrest: a randomized clinical trial. JAMA 2014;311(1):45-52. 87
Terkelsen CJ, Sorensen JT, Maeng M, Jensen LO, Tilsted HH, Trautner S, Vach W, Johnsen SP, Thuesen L, Lassen JF. System delay and mortality among patients with STEMI treated with primary percutaneous coronary intervention. JAMA 2010;304(7):763-771. 88. Fordyce CB, Al-Khalidi HR, Jollis JG, Roettig ML, Gu J, Bagai A, Berger PB, Corbett CC
Dauerman HL, Fox K, Garvey JL, Henry TD, Rokos IC, Sherwood MW, Wilson BH, Granger CB, STEMI Systems Accelerator Project. Association of rapid care process implementation on reperfusion times across multiple ST- segment-elevation myocardial infarction networks. Circ Cardiovasc Interv 2017;10(1):e004061. 89. Stowens JC, Sonnad SS
Rosenbaum RA. Using EMS dispatch to trigger STEMI alerts decreases door-to-balloon times. West J Emerg Med 2015;16(3):472-480. 90. Squire BT, Tamayo-Sarver JH, Rashi P, Koenig W, Niemann JT. Effect of preho- spital cardiac catheterization lab activation on door-to-balloon time, mortality, and false-positive activation. Prehosp Emerg Care
2014;18(1):1-8. 91. Nallamothu BK, Normand SL, Wang Y, Hofer TP, Brush JE, Jr, Messenger JC, Bradley EH, Rumsfeld JS, Krumholz HM. Relation between door-to-balloon times and mortality after primary percutaneous coronary intervention over time: a retrospective study. Lancet 2015;385(9973):1114-1122. 92. Bagai A, Jollis JG, Dauerman HL
Peng SA, Rokos IC, Bates ER, French WJ, Granger CB, Roe MT. Emergency department bypass for ST-segment-elevation myocardial infarction patients identified with a prehospital electrocardiogram: a report from the American Heart Association Mission: Lifeline program. Circulation 2013;128(4):352-359. 93. Wang TY, Nallamothu BK, Krumholz
HM, Li S, Roe MT, Jollis JG, Jacobs AK, Holmes DR, Peterson ED, Ting HH. Association of door-in to door-out time with reperfusion delays and outcomes among patients transferred for primary percutaneous coronary intervention. JAMA 2011;305(24):2540-2547. 94. Huber K, De Caterina R, Kristensen SD, Verheugt FW, Montalescot G, Maestro LB
prehospital management of acute ST elevation myocardial infarction: insights from the ASSENT-3 PLUS trial. Heart 2005;91(11):1400-1406. 96. Bjorklund E, Stenestrand U, Lindback J, Svensson L, Wallentin L, Lindahl B. Pre-hospital thrombolysis delivered by paramedics is associated with reduced time delay and mortality in ambulance-transported
real-life patients with ST- elevation myocardial infarction. Eur Heart J 2006;27(10):1146-1152. 97. Steg PG, Bonnefoy E, Chabaud S, Lapostolle F, Dubien PY, Cristofini P, Leizorovicz A, Touboul P, CAPTIM Investigators. Impact of time to treatment on mortality after prehospital fibrinolysis or primary angioplasty: data from the CAPTIM randomized
clinical trial. Circulation 2003;108(23):2851-2856. 98. Bonnefoy E, Steg PG, Boutitie F, Dubien PY, Lapostolle F, Roncalli J, Dissait F, Vanzetto G, Leizorowicz A, Kirkorian G, Mercier C, McFadden EP, Touboul P. Comparison of primary angioplasty and pre-hospital fibrinolysis in acute myo- cardial infarction (CAPTIM) trial: a 5-year follow-up. Eur
Heart J 2009;30(13):1598-1606. 99. Danchin N, Coste P, Ferrieres J, Steg PG, Cottin Y, Blanchard D, Belle L, Ritz B, Kirkorian G, Angioi M, Sans P, Charbonnier B, Eltchaninoff H, Gueret P, Khalife K, Asseman P, Puel J, Goldstein P, Cambou JP, Simon T, FAST-MI Investigators. Comparison of thrombolysis followed by broad use of percutaneous
coronary intervention with primary percutaneous coronary intervention for ST-segment- elevation acute myocardial infarction: Data from the French registry on acute ST-elevation myocardial infarction (FAST-MI). Circulation 2008;118(3):268-276. 100. Kalla K, Christ G, Karnik R, Malzer R, Norman G, Prachar H, Schreiber W, Unger G, Glogar HD, Carnik R, Malzer R, Malze
Kaff A, Laggner AN, Maurer G, Mlczoch J, Slany J, Weber HS, Huber K. Implementation of guidelines improves the standard of care: the Vienna STEMI registry). Circulation 2006;113(20):2398-2405. 101. Henry TD, Sharkey SW, Burke MN, Chavez IJ, Graham KJ, Henry TD, Graham KJ, Henry 
CR, Lips DL, Madison JD, Menssen KM, Mooney MR, Newell MC, Pedersen WR, Poulose AK, Traverse JH, Unger BT, Wang YL, Larson DM. A regional system to pro- vide timely access to percutaneous coronary intervention for ST-elevation myocardial infarction. Circulation 2007;116(7):721-728. 102. Le May MR, So DY, Dionne R, Glover CA, Froeschl
 MP, Wells GA, Davies RF, Sherrard HL, Maloney J, Marquis JF, O'Brien ER, Trickett J, Poirier P, Ryan SC, Ha A, Joseph PG, Labinaz M. A citywide protocol for primary PCI in ST- segment elevation myocardial infarction. N Engl J Med 2008;358(3):231-240. 103. Knot J, Widimsky P, Wijns W, Stenestrand U, Kristensen SD, Van THA, Weidinger F,
M, Norgaard BL, Soerensen JT, van de Wetering H, Thygesen K, Bergsten PA, Digerfeldt C, Potgieter A, Tomer N, Fajadet J. How to set up an effective national primary angioplasty network: lessons learned from five European countries. EuroIntervention 2009;5(3):299,301-309. 104. Nallamothu BK, Krumholz HM, Ko DT, LaBresh KA, Rathore S, Roe
MT, Schwamm L. Development of systems of care for ST-elevation myocardial infarction patients: gaps, barriers, and implications. Circulation 2007;116(2):e68-e72. 105. Rathore SS, Curtis JP, Chen J, Wang Y, Nallamothu BK, Epstein AJ, Krumholz HM, National Cardiovascular Data Registry. Association of door-to-balloon time and mortality in
patients admitted to hospital with ST elevation myocardial infarction: national cohort study. BMJ 2009;338:b1807. 106. Nielsen PH, Terkelsen CJ, Nielsen PH, Terkelsen CJ, Nielsen PH, Thuesen L, Krusell LR, Thayssen P, Kelbaek H, Abildgaard U, Villadsen AB, Andersen HR, Maeng M. System delay and timing of intervention in acute myocardial infarction (from the Danish
Acute Myocardial Infarction-2 [DANAMI-2] trial). Am J Cardiol 2011;108(6):776-781. 107. Pinto DS, Kirtane AJ, Nallamothu BK, Murphy SA, Cohen DJ, Laham RJ, Cutlip DE, Bates ER, Frederick PD, Miller DP, Carrozza JP, Antman EM, Cannon CP, Gibson CM. Hospital delays in reperfusion for ST-elevation myocardial infarc- tion: implications when
selecting a reperfusion strategy. Circulation 2006;114(19):2019-2025. 108. Widimsky P, Fajadet I, Danchin N, Wijns W. Stent 4 Life targeting PCI at all who will benefit the most. A joint project between EAPCI, Euro-PCR, EUCOMED and the ESC Working Group on Acute Cardiac Care. EuroIntervention 2009;4(5):555,557, 109. Steg PG, Cambou IP,
Goldstein P, Durand E, Sauval P, Kadri Z, Blanchard D, Lablanche JM, Gueret P, Cottin Y, Juliard JM, Hanania G, Vaur L, Danchin N, USIC Investigators. Bypassing the emergency room reduces delays and mortal- ity in ST elevation myocardial infarction: the USIC 2000 registry. Heart 2006;92(10):1378-1383. 110. Baran KW, Kamrowski KA,
Westwater JJ, Tschida VH, Alexander CF, Beahrs MM, Biggs TA, Koller PT, Mahoney BD, Murray ST, Raya TE, Rusterholz PK, Valeti US, Wiberg TA. Very rapid treatment of ST-segment-elevation myocar- dial infarction: utilizing prehospital electrocardiograms to bypass the emergency department. Circ Cardiovasc Qual Outcomes 2010;3(4):431-437.
111. Thiemann DR, Coresh J, Oetgen WJ, Powe NR. The association between hos- pital volume and survival after acute myocardial infarction in elderly patients. N Engl J Med 1999;340(21):1640-1648. 112. West RM, Cattle BA, Bouyssie M, Squire I, de Belder M, Fox KA, Boyle R, McLenachan JM, Batin PD, Greenwood DC, Gale CP. Impact of hospital
pro- portion and volume on primary percutaneous coronary intervention perform- ance in England and Wales. Eur Heart J 2011;32(6):706-711. 113. Zijlstra F, Hoorntje JC, de Boer MJ, Reiffers S, Miedema K, Ottervanger JP, van 't Hof AW, Suryapranata H. Long-term benefit of primary angioplasty as com- pared with thrombolytic therapy for acute
myocardial infarction. N Engl J Med 1999;341(19):1413-1419. 114. Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenous throm- bolytic therapy for acute myocardial infarction: a quantitative review of 23 rand- omised trials. Lancet 2003;361(9351):13-20. 115. Widimsky P, Budesinsky T, Vorac D, Groch L, Zelizko M, Aschermann M,
Branny M, St'asek J, Formanek P, 'PRAGUE' Study Group Investigators. Long distance transport for primary angioplasty vs immediate thrombolysis in acute myocardial infarction. Final results of the randomized national multicentre trial—PRAGUE-2. Eur Heart J 2003;24(1):94-104. 116. Andersen HR, Nielsen TT, Rasmussen K, Thuesen L, Kelbaek H,
Thayssen P, Abildgaard U, Pedersen F, Madsen JK, Grande P, Villadsen AB, Krusell LR, Haghfelt T, Lomholt P, Husted SE, Vigholt E, Kjaergard HK, Mortensen LS, DANAMI-2 Investigators. A comparison of coronary angioplasty with fibrino-lytic therapy in acute myocardial infarction. N Engl J Med 2003;349(8):733-742. 117. Nallamothu BK, Bates
ER. Percutaneous coronary intervention versus fibrino-lytic therapy in acute myocardial infarction: is timing (almost) everything? Am J Cardiol 2003;92(7):824-826. 118. Betriu A, Masotti M. Comparison of mortality rates in acute myocardial infarction versus fibrino-lytic therapy in the experimental infarction versus fibrino-lytic therapy in acute myocardial infarc
101. 54 ESC Guidelines Downloaded from by guest on 16 September 2017 55.
                                                                                                                                                                                                                                                             ...119. Boersma E, Primary Coronary Angioplasty vs Thrombolysis Group. Does time matter? A pooled analysis of randomized clinical trials comparing primary per-
cutaneous coronary intervention and in-hospital fibrinolysis in acute myocardial infarction patients. Eur Heart J 2006;27(7):779-788. 120. Pinto DS, Frederick PD, Chakrabarti AK, Kirtane AJ, Ullman E, Dejam A, Miller DP, Henry TD, Gibson CM, National Registry of Myocardial Infarction Investigators. Benefit of transferring ST-segment-elevation
myocardial infarction patients for percutaneous coronary intervention compared with administration of onsite fibrinolytic declines as delays increase. Circulation 2011;124(23):2512-2521. 121. Armstrong PW, Gershlick AH, Goldstein P, Wilcox R, Danays T, Lambert Y, Sulimov V, Rosell Ortiz F, Ostojic M, Welsh RC, Carvalho AC, Nanas J, Arntz HR.
Halvorsen S, Huber K, Grajek S, Fresco C, Bluhmki E, Regelin A, Vandenberghe K, Bogaerts K, Van de Werf F, STREAM Investigative Team. Fibrinolysis or primary PCI in ST-segment elevation myocardial infarction. N Engl J Med 2013;368(15):1379-1387. 122. Task Force on the management of ST-segment elevation myocardial infarction of the
European Society of Cardiology (ESC), Steg PG, James SK, Atar D, Badano LP, Blomstrom-Lundqvist C, Borger MA, Di Mario C, Dickstein K, Ducrocq G, Fernandez-Aviles F, Gershlick AH, Giannuzzi P, Halvorsen S, Huber K, Juni P, Kastrati A, Knuuti J, Lenzen MJ, Mahaffey KW, Valgimigli M, van 't Hof A, Widimsky P, Zahger D. ESC Guidelines for the
management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J 2012;33(20):2569-2619. 123. Morrison LJ, Verbeck PR, McDonald AC, Sawadsky BV, Cook DJ. Mortality and prehospital thrombolysis for acute myocardial infarction: a meta-analysis. JAMA 2000;283(20):2686-2692. 124. Gershlick AH, Stephens-
Lloyd A, Hughes S, Abrams KR, Stevens SE, Uren NG, de Belder A, Davis J, Pitt M, Banning A, Baumbach A, Shiu MF, Schofield P, Dawkins KD, Henderson RA, Oldroyd KG, Wilcox R, REACT Trial Investigators. Rescue angioplasty after failed thrombolytic therapy for acute myocardial infarction. N Engl J Med 2005;353(26):2758-2768. 125. Madan M,
Halvorsen S, Di Mario C, Tan M, Westerhout CM, Cantor WJ, Le May MR, Borgia F, Piscione F, Scheller B, Armstrong PW, Fernandez-Aviles F, Sanchez PL, Graham JJ, Yan AT, Goodman SG. Relationship between time to invasive assessment and clinical outcomes of patients undergoing an early inva- sive strategy after fibrinolysis for ST-segment
elevation myocardial infarction: a patient-level analysis of the randomized early routine invasive clinical trials. JACC Cardiovasc Interv 2015;8(1 Pt B):166-174. 126. Cantor WJ, Fitchett D, Borgundvaag B, Ducas J, Heffernan M, Cohen EA, Morrison LJ, Langer A, Dzavik V, Mehta SR, Lazzam C, Schwartz B, Casanova A, Goodman SG, TRANSFER-AMI
Trial Investigators. Routine early angioplasty after fibrinolysis for acute myocardial infarction. N Engl J Med 2009;360(26):2705-2718. 127. Di Mario C, Dudek D, Piscione F, Mielecki W, Savonitto S, Murena E, Dimopoulos K, Manari A, Gaspardone A, Ochala A, Zmudka K, Bolognese L, Steg PG, Flather M, CARESS AMI Investigators. Immediate
angioplasty versus standard therapy with rescue 3 angioplasty after thrombolysis in the Combined Abciximab REteplase Stent Study in Acute Myocardial Infarction (CARESS-in- AMI): an open, prospective, randomised, multicentre trial. Lancet 2008;371(9612):559-568. 128. Bohmer E, Hoffmann P, Abdelnoor M, Arnesen H, Halvorsen S. Efficacy and
safety of immediate angioplasty versus ischemia-guided management after thrombolysis in acute myocardial infarction in areas with very long transfer dis-tances. Results of the NORDISTEMI (NORwegian study on District treatment of ST-Elevation Myocardial Infarction). J Am Coll Cardiol 2010;55(2):102-110. 129. Borgia F, Goodman SG, Halvorsen
S, Cantor WJ, Piscione F, Le May MR, Fernandez-Aviles F, Sanchez PL, Dimopoulos K, Scheller B, Armstrong PW, Di Mario C. Early routine percutaneous coronary intervention after fibrinolysis vs. standard therapy in ST-segment elevation myocardial infarction: a meta-analysis. Eur Heart J 2010;31(17):2156-2169. 130. D'Souza SP, Mamas MA,
Fraser DG, Fath-Ordoubadi F. Routine early coronary angioplasty versus ischaemia-guided angioplasty ve
suspected myocardial infarc- tion, I Am Coll Cardiol 2012;60(2):96-105, 132, Liakopoulos V. Kellerth T. Christensen K. Left bundle branch block matter? Eur Heart I Acute Cardiovasc Care 2013;2(2):182-189, 133, Schomig A. Mehilli I. Antoniucci D. Ndrepepa G. Markwardt C.
Di Pede F, Nekolla SG, Schlotterbeck K, Schuhlen H, Pache J, Seyfarth M, Martinoff S, Benzer W, Schmitt C, Dirschinger J, Schwaiger M, Kastrati A, Beyond 12 hours Reperfusion in patients with acute myocardial infarction presenting more than 12 hours from symptom onset: a
randomized controlled trial. JAMA 2005;293(23):2865-2872. 134. Ndrepepa G, Kastrati A, Mehilli J, Antoniucci D, Schomig A. Mechanical reper-fusion and long-term mortality in patients with acute myocardial infarction pre-senting 12 to 48 hours from onset of symptoms. JAMA 2009;301(5):487-488. 135. Hochman JS, Lamas GA, Buller CE, Dzavik V,
Reynolds HR, Abramsky SJ, Forman S, Ruzyllo W, Maggioni AP, White H, Sadowski Z, Carvalho AC, Rankin JM, Renkin JP, Steg PG, Mascette AM, Sopko G, Pfisterer ME, Leor J, Fridrich V, Mark DB, Knatterud GL, Occluded Artery Trial Investigators. Coronary inter- vention for persistent occlusion after myocardial infarction. N Engl J Med
2006;355(23):2395-2407. 136. Menon V, Pearte CA, Buller CE, Steg PG, Forman SA, White HD, Marino PN, Katritsis DG, Caramori P, Lasevitch R, Loboz-Grudzien K, Zurakowski A, Lamas GA, Hochman JS. Lack of benefit from percutaneous intervention of per- sistently occluded infarct arteries after the acute phase of myocardial infarction is time
independent: insights from Occluded Artery Trial. Eur Heart J 2009;30(2):183-191. 137. Ioannidis JP, Katritsis DG. Percutaneous coronary intervention for late reperfu- sion after myocardial infarction in stable patients. Am Heart J 2007;154(6):1065-1071. 138. Boersma E, Maas ACP, Deckers JW, Simoons ML. Early thrombolytic treatment in acute
myocardial infarction: reappraisal of the golden hour. Lancet 1996;348(9030):771-775. 139. Cucherat M, Bonnefoy E, Tremeau G. Primary angioplasty versus intravenous thrombolysis for acute myocardial infarction. Cochrane Database Syst Rev 2003;3:CD001560. 140. Dalby M, Bouzamondo A, Lechat P, Montalescot G. Transfer for primary angio-
plasty versus immediate thrombolysis in acute myocardial infarction: a meta- analysis. Circulation 2003;108(15):1809-1814. 141. Gierlotka M, Gasior M, Wilczek K, Hawranek M, Szkodzinski J, Paczek P, Lekston A, Kalarus Z, Zembala M, Polonski L. Reperfusion by primary percuta- neous coronary intervention in patients with ST-segment elevation
myocardial infarction within 12 to 24 hours of the onset of symptoms (from a prospective national observational study [PL-ACS]). Am J Cardiol 2011;107(4):501-508. 142. Busk M, Kaltoft A, Nielsen SD, Infarct size and
myocardial salvage after primary angioplasty in patients pre- senting with symptoms for 12 h vs. 12-72 h. Eur Heart J 2009;30(11):1322-1330. 143. Valgimigli M, Gagnor A, Calabro P, Frigoli E, Leonardi S, Zaro T, Rubartelli P, Briguori C, Ando G, Repetto A, Limbruno U, Cortese B, Sganzerla P, Lupi A, Galli M, Colangelo S, Ierna S, Ausiello A,
Presbitero P, Sardella G, Varbella F, Esposito G, Santarelli A, Tresoldi S, Nazzaro M, Zingarelli A, de Cesare N, Rigattieri S, Tosi P, Palmieri C, Brugaletta S, Rao SV, Heg D, Rothenbuhler M, Vranckx P, Juni P, MATRIX Investigators. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a
randomised multicentre trial. Lancet 2015;385(9986):2465-2476. 144. Jolly SS, Yusuf S, Cairns J, Niemela M, Valentin V, Lewis BS, Avezum A, Steg PG, Rao SV, Gao P, Afzal R, Joyner CD, Chrolavicius S, Mehta SR, RIVAL Trial Group. Radial versus femoral access for coronary angiography and intervention in
patients with acute coronary syn- dromes (RIVAL): a randomised, parallel group, multicentre trial. Lancet 2011;377(9775):1409-1420. 145. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenza G, Summaria F, Patrizi R, Borghi A, Di Russo C, Moretti C, Agostoni P, Loschiavo P, Lioy E, Sheiban I, Sangiorgi G. Radial versus femoral
randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study. J Am Coll Cardiol 2012;60(24):2481-2489. 146. Nordmann AJ, Hengstler P, Harr T, Young J, Bucher HC. Clinical outcomes of primary stenting versus
balloon angioplasty in patients with myocardial infarc- tion: a meta-analysis of randomized controlled trials. Am J Med 2004;116(4):253-262. 147. Stone GW, Grines CL, Cox DA, Garcia E, Tcheng JE, Griffin JJ, Guagliumi G, Stuckey T, Turco M, Carroll JD, Rutherford BD, Lansky AJ, Controlled Abciximab and Device Investigation to Lower Late
Angioplasty Complications (CADILLAC) Investigators. Comparison of angioplasty with stenting, with or without abciximab, in acute myocardial infarction. N Engl J Med 2002;346(13):957-966. 148. Kastrati A, Dibra A, Spaulding C, Laarman GJ, Menichelli M, Valgimigli M, Di Lorenzo E, Kaiser C, Tierala I, Mehilli J, Seyfarth M, Varenne O, Dirksen MT,
Percoco G, Varricchio A, Pittl U, Syvanne M, Suttorp MJ, Violini R, Schomig A. Meta-analysis of randomized trials on drug-eluting stents vs. bare-metal stents in patients with acute myocardial infarction. Eur Heart J 2007;28(22):2706-2713. 149. Raber L, Kelbaek H, Ostojic M, Baumbach A, Heg D, Tuller D, von Birgelen C, Roffi M, Moschovitis A,
Khattab AA, Wenaweser P, Bonvini R, Pedrazzini G, Kornowski R, Weber K, Trelle S, Luscher TF, Taniwaki M, Matter CM, Meier B, Juni P, Windecker S, COMFORTABLE AMI Trial Investigators. Effect of ESC Guidelines 55 Downloaded from by guest on 16 September 2017 56.
                                                                                                                                                  ..biolimus-eluting stents with biodegradable polymer vs bare-metal stents on car- diovascular events among patients with acute myocardial infarction: the COMFORTABLE AMI randomized trial. JAMA 2012;308(8):777-787. 150. Sabate M,
Cequier A, Iniguez A, Serra A, Hernandez-Antolin R, Mainar V, Valgimigli M, Tespili M, den Heijer P, Bethencourt A, Vazquez N, Gomez- Hospital JA, Baz JA, Martin-Yuste V, van Geuns RJ, Alfonso F, Bordes P, Tebaldi M, Masotti M, Silvestro A, Backx B, Brugaletta S, van Es GA, Serruys PW. Everolimus-eluting stent versus bare-metal stent in ST-
segment elevation myo- cardial infarction (EXAMINATION): 1 year results of a randomised controlled trial. Lancet 2012;380(9852):1482-1490. 151. Sabate M, Brugaletta S, Ceguier A, Iniquez A, Serra A, Jimenez-Quevedo P, Mainar V, Campo G, Tespili M, den Heijer P, Bethencourt A, Vazguez N, van Es GA, Backx B, Valgimigli M, Serruys PW. Clinical
outcomes in patients with ST- segment elevation myocardial infarction treated with everolimus-eluting stents versus bare-metal stents (EXAMINATION): 5-year results of a randomised trial. Lancet 2016;387(10016):357-366. 152. Bonaa KH, Mannsverk J, Wiseth R, Aaberge L, Myreng Y, Nygard O, Nilsen DW, Klow NE, Uchto M, Trovik T, Bendz B,
Stavnes S, Bjornerheim R, Larsen AI, Slette M, Steigen T, Jakobsen OJ, Bleie O, Fossum E, Hanssen TA, Dahl- Eriksen O, Njolstad I, Rasmussen K, Wilsgaard T, Nordrehaug JE, NORSTENT Investigators. Drug-eluting or bare-metal stents for coronary artery disease. N Engl J Med 2016;375(13):1242-1252. 153. Carrick D, Oldroyd KG, McEntegart M,
```

Haig C, Petrie MC, Eteiba H, Hood S, Owens C, Watkins S, Layland J, Lindsay M, Peat E, Rae A, Behan M, Sood A, Hillis WS, Mordi I, Mahrous A, Ahmed N, Wilson R, Lasalle L, Genereux P, Ford I, Berry C. A randomized trial of deferred stenting versus immediate stent-ing to prevent no- or slow-reflow in acute ST-segment elevation myocardial

therapies for pre- and afterload reduction, there is limited evidence for the system- atic use of inotropic and vasopressor agents as well as mechanical support. Similarly, the benefit of routine complete revascularization during the index PCI procedure has not been formally demonstrated. The use of IABP has not met prior expectations of benefit, while

```
Pedersen F, Saunamaki K, De Backer O, Bang LE, Kofoed KF, Lonborg J, Ahtarovski K, Veilstrup N, Botker HE, Terkelsen CJ, Christiansen EH, Ravkilde J, Tilsted HH, Villadsen AB, Aaroe J, Jensen SE, Raungaard B, Jensen LO, Clemmensen P, Grande P, Madsen JK, Torp-Pedersen C, Engstrom T. Deferred versus conventional stent implantation in
patients with ST-segment elevation myocardial infarction (DANAMI 3-DEFER): an open-label, randomised controlled trial. Lancet 2016;387(10034):2199-2206. 156. Burzotta F, De Vita M, Gu YL, Isshiki T, Lefevre T, Kaltoft A, Dudek D, Sardella G, Orrego PS, Antoniucci D, De Luca L, Biondi-Zoccai GG, Crea F, Zijlstra F. Clinical impact of
thrombectomy in acute ST-elevation myocardial infarction: an individual patient-data pooled analysis of 11 trials. Eur Heart J 2009;30(18):2193-2203. 157. Frobert O, Lagerqvist B, Olivecrona GK, Omerovic E, Gudnason T, Maeng M, Aasa M, Angeras O, Calais F, Danielewicz M, Erlinge D, Hellsten L, Jensen U, Johansson AC, Karegren A, Nilsson J
Robertson L, Sandhall L, Sjogren I, Ostlund O, Harnek J, James SK, TASTE Trial. Thrombus aspiration during ST- segment elevation myocardial infarction. N Engl J Med 2013;369(17):1587-1597. 158. Lagerqvist B, Frobert O, Olivecrona GK, Gudnason T, Maeng M, Alstrom P, Andersson J, Calais F, Carlsson J, Collste O, Gotberg M, Hardhammar P,
Ioanes D, Kallryd A, Linder R, Lundin A, Odenstedt J, Omerovic E, Puskar V, Todt T, Zelleroth E, Ostlund O, James SK. Outcomes 1 year after thrombus aspiration for myocardial infarction. N Engl J Med 2014;371(12):1111-1120. 159. Jolly SS, Cairns JA, Yusuf S, Meeks B, Pogue J, Rokoss MJ, Kedev S, Thabane L, Stankovic G, Moreno R, Gershlick A,
Chowdhary S, Lavi S, Niemela K, Steg PG, Bernat I, Xu Y, Cantor WJ, Overgaard CB, Naber CK, Cheema AN, Welsh RC, Bertrand OF, Avezum A, Bhindi R, Pancholy S, Rao SV, Natarajan MK, ten Berg JM, Shestakovska O, Gao P, Widimsky P, Dzavik V, TOTAL Investigators. Randomized trial of primary PCI with or without routine manual thrombec-
tomy. N Engl J Med 2015;372(15):1389-1398. 160. Jolly SS, Cairns JA, Yusuf S, Rokoss MJ, Gao P, Meeks B, Kedev S, Stankovic G, Moreno R, Gershlick A, Chowdhary S, Lavi S, Niemela K, Bernat I, Cantor WJ, Cheema AN, Steg PG, Welsh RC, Sheth T, Bertrand OF, Avezum A, Bhindi R, Natarajan MK, Horak D, Leung RC, Kassam S, Rao SV, El-Omar
M, Mehta SR, Velianou JL, Pancholy S, Dzavik V, TOTAL Investigators. Outcomes after thrombus aspiration for ST elevation myocardial infarction: 1-year follow-up of the prospective randomised TOTAL trial. Lancet 2016;387(10014):127-135. 161. Jolly SS, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Gao P, Hart RG, Kedev S, Stankovic G, Moreno R, Horak D, Cairns JA, Yusuf S, Meeks B, Cairns JA
Kassam S, Rokoss MJ, Leung RC, El-Omar M, Romppanen HO, Alazzoni A, Alak A, Fung A, Alexopoulos D, Schwalm JD, Valettas N, Dzavik V, TOTAL Investigators. Stroke in the TOTAL trial: a randomized trial of routine thrombectomy vs. percutaneous coronary intervention alone in ST elevation myocardial infarction. Eur Heart J 2015;36(35):2364-
2372. 162. Jolly SS, James S, Dzavik V, Cairns JA, Mahmoud KD, Zijlstra F, Yusuf S, Olivecrona GK, Renlund H, Gao P, Lagerqvist B, Alazzoni A, Kedev S, Stankovic G, Meeks B, Frobert O. Thrombus aspiration in ST-segment-elevation myocar-dial infarction. An individual patient meta-analysis: Thrombectomy Trialists Collaboration. Circulation
2017;135(2):143-152. 163. Sorajja P, Gersh BJ, Cox DA, McLaughlin MG, Zimetbaum P, Costantini C, Stuckey T, Tcheng JE, Mehran R, Lansky AJ, Grines CL, Stone GW. Impact of multivessel disease on reperfusion success and clinical outcomes in patients undergoing primary percutaneous coronary intervention for acute myocardial infarction. Eur
Heart J 2007;28(14):1709-1716. 164. Dziewierz A, Siudak Z, Rakowski T, Zasada W, Dubiel JS, Dudek D. Impact of multivessel coronary artery disease and noninfarct-related artery revasculariza- tion on outcome of patients with ST-elevation myocardial infarction transferred for primary percutaneous coronary intervention (from the EUROTRANSFER
Registry). Am J Cardiol 2010;106(3):342-347. 165. Cavender MA, Milford-Beland S, Roe MT, Peterson ED, Weintraub WS, Rao SV. Prevalence, predictors, and in-hospital outcomes of non-infarct artery inter- vention during primary percutaneous coronary intervention for ST-segment elevation myocardial infarction (from the National Cardiovascular
Data Registry). Am J Cardiol 2009;104(4):507-513. 166. Hannan EL, Samadashvili Z, Walford G, Holmes DR, Jr, Jacobs AK, Stamato NJ, Venditti FJ, Sharma S, King SB, 3rd. Culprit vessel percutaneous coronary intervention myocardial infarction patients
with multivessel disease. JACC Cardiovasc Interv 2010;3(1):22-31. 167. Politi L, Sgura F, Rossi R, Monopoli D, Guerri E, Leuzzi C, Bursi F, Sangiorgi GM, Modena MG. A randomised trial of target-vessel versus multi-vessel revas- cularisation in ST-elevation myocardial infarction: major adverse cardiac events during long-term follow-up. Heart
2010;96(9):662-667. 168. Wald DS, Morris JK, Wald NJ, Chase AJ, Edwards RJ, Hughes LO, Berry C, Oldroyd KG, PRAMI Investigators. Randomized trial of preventive angioplasty in myocardial infarction. N Engl J Med 2013;369(12):1115-1123. 169. Gershlick AH, Khan JN, Kelly DJ, Greenwood JP, Sasikaran T, Curzen N, Blackman DJ, Dalby M,
Fairbrother KL, Banya W, Wang D, Flather M, Hetherington SL, Kelion AD, Talwar S, Gunning M, Hall R, Swanton H, McCann GP. Randomized trial of complete versus lesion-only revascularization in patients undergoing primary percutaneous coronary intervention for STEMI and multives- sel disease: the CvLPRIT trial. J Am Coll Cardiol
2015;65(10):963-972. 170. Engstrom T, Kelbaek H, Helqvist S, Hofsten DE, Klovgaard L, Holmvang L, Jorgensen E, Pedersen F, Saunamaki K, Clemmensen P, De Backer O, Ravkilde J, Tilsted HH, Villadsen AB, Aaroe J, Jensen SE, Raungaard B, Kober L, DANAMI- PRIMULTI Investigators. Complete revascularisation versus treatment of the culprit
lesion only in patients with ST-segment elevation myocardial infarction and multivessel disease (DANAMI-3-PRIMULTI): an open-label, randomised controlled trial. Lancet 2015;386(9994):665-671. 171. Smits PC, Abdel-Wahab M, Neumann FJ, Boxma-de Klerk BM, Lunde K, Schotborgh CE, Piroth Z, Horak D, Wlodarczak A, Ong PJ, Hambrecht R,
Angeras O, Richardt G, Omerovic E, Compare-Acute Investigators. Fractional flow reserve-guided multivessel angioplasty in myocardial infarction. N Engl J Med 2017;376(13):1234-1244. 172. Moreno R, Mehta SR. Nonculprit vessel intervention: let's COMPLETE the evi- dence. Rev Esp Cardiol (English Ed) 2017;70:418-420. 173. Bangalore S, Toklu
B, Wetterslev J. Complete versus culprit-only revasculariza- tion for ST-segment-elevation myocardial infarction and multivessel disease: a meta-analysis and trial sequential analysis of randomized trials. Circ Cardiovasc Interv 2015;8(4):e002142. 174. Elgendy IY, Mahmoud AN, Kumbhani DJ, Bhatt DL, Bavry AA. Complete or culprit-only
revascularization for patients with multivessel coronary artery dis- ease undergoing percutaneous coronary intervention: a pairwise and network meta-analysis of randomized trials. JACC Cardiovasc Interv 2017;10(4):315-324. 175. Patel MR, Smalling RW, Thiele H, Barnhart HX, Zhou Y, Chandra P, Chew D, Cohen M, French J, Perera D, Ohman EM.
Intra-aortic balloon counterpulsation and infarct size in patients with acute anterior myocardial infarction without shock: the CRISP AMI randomized trial. JAMA 2011;306(12):1329-1337. 176. Sjauw KD, Engstrom AE, Vis MM, van der Schaaf RJ, Baan J, Jr, Koch KT, de Winter RJ, Piek JJ, Tijssen JG, Henriques JP. A systematic review and meta-
analysis of intra-aortic balloon pump therapy in ST-elevation myocardial infarc- tion: should we change the guidelines? Eur Heart J 2009;30(4):459-468. 177. Thiele H, Zeymer U, Neumann FJ, Ferenc M, Olbrich HG, Hausleiter J, Richardt G, Hennersdorf M, Empen K, Fuernau G, Desch S, Eitel I, Hambrecht R, Fuhrmann J, Bohm M, Ebelt H, Schneider G, Hennersdorf M, Empen K, Fuernau G, Desch S, Eitel I, Hambrecht R, Fuhrmann J, Bohm M, Ebelt H, Schneider G, Hennersdorf M, Empen K, Fuernau G, Desch S, Eitel I, Hambrecht R, Fuhrmann J, Bohm M, Ebelt H, Schneider G, Hennersdorf M, Empen K, Fuernau G, Desch S, Eitel I, Hambrecht R, Fuhrmann FJ, Ferenc M, Olbrich HG, Hausleiter J, Richardt G, Hennersdorf M, Empen K, Fuernau G, Desch S, Eitel I, Hambrecht R, Eitel I, Hambrecht R
S, Schuler G, Werdan K, IABP- SHOCK II Trial Investigators. Intraaortic balloon support for myocardial infarc- tion with cardiogenic shock. N Engl J Med 2012;367(14):1287-1296. 56 ESC Guidelines Downloaded from by guest on 16 September 2017 57.
                                                                                                                                         .178. Stefanini GG, Byrne RA, Serruys PW, de Waha A, Meier B, Massberg S, Juni P, Schomig A, Windecker S, Kastrati A. Biodegradable polymer drug-eluting stents reduce the risk of stent thrombosis at 4 years in patients undergoing
              ous coronary intervention: a pooled analysis of individual patient data from the ISAR-TEST 3, ISAR-TEST 4, and LEADERS randomized trials. Eur Heart J 2012;33(10):1214-1222. 179. Palmerini T, Biondi-Zoccai G, Della Riva D, Mariani A, Sabate M, Valgimigli M, Frati G, Kedhi E, Smits PC, Kaiser C, Genereux P, Galatius S, Kirtane AJ
Stone GW. Clinical outcomes with drug-eluting and bare-metal stents in patients with ST-segment elevation myocardial infarction: evidence from a comprehensive network meta-analysis. J Am Coll Cardiol 2013;62(6):496-504. 180. Karrowni W, Vyas A, Giacomino B, Schweizer M, Blevins A, Girotra S, Horwitz PA. Radial versus femoral access for
primary percutaneous interventions in ST- segment elevation myocardial infarction patients: a meta-analysis of randomized controlled trials. JACC Cardiovasc Interv 2013;6(8):814-823. 181. Zeymer U, Hohlfeld T, Vom Dahl J, Erbel R, Munzel T, Zahn R, Roitenberg A, Breitenstein S, Pap AF, Trenk D. Prospective, randomized trial of the time
dependent antiplatelet effects of 500 mg and 250 mg acetylsalicylic acid i. v. and 300 mg p. o. in ACS (ACUTE). Thromb Haemost 2017;117(3):625-635. 182. Montalescot G, van 't Hof AW, Lapostolle F, Silvain J, Lassen JF, Bolognese L, Cantor WJ, Cequier A, Chettibi M, Goodman SG, Hammett CJ, Huber K, Janzon M, Merkely B, Storey RF, Zeymer U
Stibbe O, Ecollan P, Heutz WM, Swahn E, Collet JP, Willems FF, Baradat C, Licour M, Tsatsaris A, Vicaut E, Hamm CW, ATLANTIC Investigators. Prehospital ticagrelor in ST-segment ele-vation myocardial infarction. N Engl J Med 2014;371(11):1016-1027. 183. Koul S, Smith JG, Schersten F, James S, Lagerqvist B, Erlinge D. Effect of upstream
clopidogrel treatment in patients with ST-segment elevation myocar- dial infarction undergoing primary percutaneous coronary intervention. Eur Heart J 2011;32(23):2989-2997. 184. Dorler J, Edlinger M, Alber HF, Altenberger J, Benzer W, Grimm G, Huber K, Pachinger O, Schuchlenz H, Siostrzonek P, Zenker G, Weidinger F, Austrian Acute PC
Investigators. Clopidogrel pre-treatment is associated with reduced in-hospital mortality in primary percutaneous coronary intervention for acute ST-elevation myocardial infarction. Eur Heart J 2011;32(23):2954-1961. 185. Zeymer U, Arntz HR, Mark B, Fichtlscherer S, Werner G, Scholler R, Zahn R, Diller F, Darius H, Dill T, Huber K. Efficacy and
safety of a high loading dose of clopidogrel administered prehospitally to improve primary percutaneous coro- nary intervention in acute myocardial infarction: the randomized CIPAMI trial. Clin Res Cardiol 2012;101(4):305-312. 186. Wiviott SD, Braunwald E, McCabe CH, Montalescot G, Ruzyllo W, Gottlieb S, Neumann FJ, Ardissino D, De Servi S
Murphy SA, Riesmeyer J, Weerakkody G, Gibson CM, Antman EM, TRITON-TIMI 38 Investigators. Prasugrel versus clopidogrel in patients with acute coronary syndromes. N Engl J Med 2007;357(20):2001–2015. 187. Wallentin L, Becker RC, Budaj A, Cannon CP, Emanuelsson H, Held C, Horrow J, Husted S, James S, Katus H, Mahaffey KW, Scirica
BM, Skene A, Steg PG, Storey RF, Harrington RA, PLATO Investigators Freij A, Thorsen M. Ticagrelor versus clopidogrel in patients with acute coronary syndromes. N Engl J Med 2009;361(11):1045-1057. 188. Roe MT, Armstrong PW, Fox KA, White HD, Prabhakaran D, Goodman SG, Cornel JH, Bhatt DL, Clemmensen P, Martinez F, Ardissino D,
Nicolau JC, Boden WE, Gurbel PA, Ruzyllo W, Dalby AJ, McGuire DK, Leiva-Pons JL, Parkhomenko A, Gottlieb S, Topacio GO, Hamm C, Pavlides G, Goudev AR, Oto A, Tseng CD, Merkely B, Gasparovic V, Corbalan R, Cinteza M, McLendon RC, Winters KJ, Brown EB, Lokhnygina Y, Aylward PE, Huber K, Hochman JS, Ohman EM, TRILOGY ACS
Investigators. Prasugrel versus clopidogrel for acute coronary syn- dromes without revascularization. N Engl J Med 2012;367(14):1297-1309. 189. Storey RF, Becker RC, Harrington RA, Husted S, James SK, Cools F, Steg PG, Khurmi NS, Emanuelsson H, Cooper A, Cairns R, Cannon CP, Wallentin L. Characterization of dyspnoea in PLATO study
patients treated with ticagrelor or clopidogrel and its association with clinical outcomes. Eur Heart J 2011;32(23):2945-2953. 190. Mehta SR, Tanguay JF, Eikelboom JW, Jolly SS, Joyner CD, Granger CB, Faxon DP, Rupprecht HJ, Budaj A, Avezum A, Widimsky P, Steg PG, Bassand JP, Montalescot G, Macaya C, Di Pasquale G, Niemela K, Ajani AE
White HD, Chrolavicius S, Gao P, Fox KA, Yusuf S, CURRENT-OASIS Trial Investigators. Double-dose versus standard-dose clopidogrel and high-dose versus low-dose aspirin in individuals undergoing percutaneous coronary intervention for acute coronary syndromes (CURRENT-OASIS 7): a randomised factorial trial. Lancet 2010;376(9748):1233-
1243. 191. Bhatt DL, Lincoff AM, Gibson CM, Stone GW, McNulty S, Montalescot G, Kleiman NS, Goodman SG, White HD, Mahaffey KW, Pollack CV, Jr, Manoukian SV, Widimsky P, Chew DP, Cura F, Manukov I, Tousek F, Jafar MZ, Arneja J, Skerjanec S, Harrington RA, CHAMPION PLATFORM Investigators. Intravenous platelet blockade with
cangrelor during PCI. N Engl J Med 2009;361(24):2330-2341. 192. Harrington RA, Stone GW, McNulty S, White HD, Lincoff AM, Gibson CM, Pollack CV, Jr, Montalescot G, Mahaffey KW, Kleiman NS, Goodman SG, Amine M, Angiolillo DJ, Becker RC, Chew DP, French WJ, Leisch F, Parikh KH, Skerjanec S, Bhatt DL. Platelet inhibition with cangrelor
in patients undergoing PCI. N Engl J Med 2009;361(24):2318-2329. 193. Bhatt DL, Stone GW, Mahaffey KW, Gibson CM, Steg PG, Hamm CW, Price MJ, Leonardi S, Gallup D, Bramucci E, Radke PW, Widimsky P, Tousek F, Tauth J, Spriggs D, McLaurin BT, Angiolillo DJ, Genereux P, Liu T, Prats J, Todd M, Skerjanec S, White HD, Harrington RA,
CHAMPION PHOENIX Investigators. Effect of platelet inhibition with cangrelor during PCI on ischemic events. N Engl J Med 2013;368(14):1303-1313. 194. Steg PG, Bhatt DL, Hamm CW, Stone GW, Gibson CM, Mahaffey KW, Leonardi S, Liu T, Skerjanec S, Day JR, Iwaoka RS, Stuckey TD, Gogia HS, Gruberg L, French WJ, White HD, Harrington RA
CHAMPION Investigators. Effect of cangrelor on periprocedural outcomes in percutaneous coronary interventions: a pooled analysis of patient-level data. Lancet 2013;382(9909):1981-1992. 195. Ellis SG, Tendera M, de Belder MA, van Boven AJ, Widimsky P, Janssens L, Andersen HR, Betriu A, Savonitto S, Adamus J, Peruga JZ, Kosmider M, Katz O,
Neunteufl T, Jorgova J, Dorobantu M, Grinfeld L, Armstrong P, Brodie BR, Herrmann HC, Montalescot G, Neumann FJ, Effron MB, Barnathan ES, Topol EJ, FINESSE Investigators. Facilitated PCI in patients with ST-elevation myocardial infarction. N Engl J Med 2008;358(21):2205-2217. 196. ten Berg JM, van 't Hof AW, Dill T, Heestermans T, van
Werkum JW, Mosterd A, van Houwelingen G, Koopmans PC, Stella PR, Boersma E, Hamm C. Effect of early, pre-hospital initiation of high bolus dose tirofiban in patients with ST- segment elevation myocardial infarction on short- and long-term clinical out- come. J Am Coll Cardiol 2010;55(22):2446-2455. 197. Stone GW, Witzenbichler B, Guagliumi G,
Peruga JZ, Brodie BR, Dudek D, Kornowski R, Hartmann F, Gersh BJ, Pocock SJ, Dangas G, Wong SC, Kirtane AJ, Parise H, Mehran R, HORIZONS-AMI Trial Investigators. Bivalirudin during primary PCI in acute myocardial infarction. N Engl J Med 2008;358(21):2218-2230. 198. Friedland S, Eisenberg MJ, Shimony A. Meta-analysis of randomized
controlled trials of intracoronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention for acute coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous coronary versus intravenous administration of glycoprotein IIb/IIIa inhibitors during percutaneous administration of glycoprotein IIb/IIIa inhibit
OASIS-6 Trial Group. Effects of fondaparinux on mortality and reinfarction in patients with acute ST- segment elevation myocardial infarction: the OASIS-6 randomized trial. JAMA 2006;295(13):1519-1530. 200. Montalescot G, Zeymer U, Silvain J, Boulanger B, Cohen M, Goldstein P, Ecollan P, Combes X, Huber K, Pollack C, Jr, Benezet JF, Stibbe O,
Filippi E, Teiger E, Cayla G, Elhadad S, Adnet F, Chouihed T, Gallula S, Greffet A, Aout M, Collet JP, Vicaut E, ATOLL Investigators. Intravenous enoxaparin or unfrac-tionated heparin in primary percutaneous coronary intervention for ST- elevation myocardial infarction: the international randomised open-label ATOLL trial. Lancet
2011;378(9792):693-703. 201. Collet JP, Huber K, Cohen M, Zeymer U, Goldstein P, Pollack C, Jr, Silvain J, Henry P, Varenne O, Carrie D, Coste P, Angioi M, Le Breton H, Cayla G, Elhadad S, Teiger E, Filippi E, Aout M, Vicaut E, Montalescot G, ATOLL Investigators. A direct comparison of intravenous enoxaparin with unfractio- nated heparin in
primary percutaneous coronary intervention (from the ATOLL trial). Am J Cardiol 2013;112(9):1367-1372. 202. Silvain J, Beygui F, Barthelemy O, Pollack C, Jr, Cohen M, Zeymer U, Huber K, Goldstein P, Cayla G, Collet JP, Vicaut E, Montalescot G. Efficacy and safety of enoxaparin versus unfractionated heparin during percutaneous coronary intervention (from the ATOLL trial).
vention: systematic review and meta-analysis. BMJ 2012;344:e553. 203. Steg PG, van 't Hof A, Hamm CW, Clemmensen P, Lapostolle F, Coste P, Ten Berg J, Van Grunsven P, Eggink GJ, Nibbe L, Zeymer U, Campo dell' Orto M, Nef H, Steinmetz J, Soulat L, Huber K, Deliargyris EN, Bernstein D, Schuette D, Prats J, Clayton T, Pocock S, Hamon M,
Goldstein P, EUROMAX Investigators. Bivalirudin started during emergency transport for primary PCI. N Engl J Med 2013;369(23):2207-2217. 204. Schulz S, Richardt G, Laugwitz KL, Morath T, Neudecker J, Hoppmann P, Mehran R, Gershlick AH, Tolg R, Anette Fiedler K, Abdel-Wahab M, Kufner S, Schneider S, Schunkert H, Ibrahim T, Mehilli J
Kastrati A, Bavarian Reperfusion Alternatives Evaluation Investigators. Prasugrel plus bivalirudin vs. clopidogrel plus heparin in patients with ST-segment elevation myocardial infarction. Eur Heart J 2014;35(34):2285-2294. 205. Shahzad A, Kemp I, Mars C, Wilson K, Roome C, Cooper R, Andron M, Appleby C, Fisher M, Khand A, Kunadian B, Mills
JD, Morris JL, Morrison WL, Munir S, Palmer ND, Perry RA, Ramsdale DR, Velavan P, Stables RH, HEAT- PPCI Trial Investigators. Unfractionated heparin versus bivalirudin in primary ESC Guidelines 57 Downloaded from by guest on 16 September 2017 58.
                                                                                                                                        ..percutaneous coronary intervention (HEAT-PPCI): an open-label, single centre, randomised controlled trial. Lancet 2014;384(9957):1849-1858. 206. Han Y, Guo J, Zheng Y, Zang H, Su X, Wang Y, Chen S, Jiang T, Yang P, Chen J, Jiang D, Jing Q,
Liang Z, Liu H, Zhao X, Li J, Li Y, Xu B, Stone GW, BRIGHT Investigators. Bivalirudin vs heparin with or without tirofiban during primary percutaneous coronary intervention in acute myocardial infarction: the BRIGHT randomized clinical trial. JAMA 2015;313(13):1336-1346. 207. Zeymer U, van 't Hof A, Adgey J, Nibbe L, Clemmensen P, Cavallini C,
ten Berg J, Coste P, Huber K, Deliargyris EN, Day J, Bernstein D, Goldstein P, Hamm C, Steg PG. Bivalirudin is superior to heparins alone with bailout GP IIb/IIIa inhibitors in patients with ST-segment elevation myocardial infarction transported emergently for primary percutaneous coronary intervention: a pre-specified analysis from the EUROMAX infarction transported emergently for primary percutaneous coronary intervention: a pre-specified analysis from the EUROMAX infarction transported emergently for primary percutaneous coronary intervention: a pre-specified analysis from the EUROMAX infarction transported emergently for primary percutaneous coronary intervention: a pre-specified analysis from the EUROMAX infarction transported emergently for primary percutaneous coronary intervention: a pre-specified analysis from the EUROMAX infarction transported emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary intervention in patients and the pre-specified emergently for primary percutaneous coronary in patients and the p
trial. Eur Heart J 2014;35(36):2460-2467. 208. Capodanno D, Gargiulo G, Capranzano P, Mehran R, Tamburino C, Stone GW. Bivalirudin versus heparin with or without glycoprotein IIb/IIIa inhibitors in patients from five randomized clinical trials. Eur Heart J Acute
Cardiovasc Care 2016;5(3):253-262. 209. Valgimigli M, Frigoli E, Leonardi S, Rothenbuhler M, Gagnor A, Calabro P, Garducci S, Rubartelli P, Briguori C, Ando G, Repetto A, Limbruno U, Garbo R, Sganzerla P, Russo F, Lupi A, Cortese B, Ausiello A, Ierna S, Esposito G, Presbitero P, Santarelli A, Sardella G, Varbella F, Tresoldi S, de Cesare N,
Rigattieri S, Zingarelli A, Tosi P, van 't Hof A, Boccuzzi G, Omerovic E, Sabate M, Heg D, Juni P, Vranckx P, MATRIX Investigators. Bivalirudin or unfractio- nated heparin in acute coronary syndromes. N Engl J Med 2015;373(11):997-1009. 210. Leonardi S, Frigoli E, Rothenbuhler M, Navarese E, Calabro P, Bellotti P, Briguori C, Ferlini M, Cortese B,
Lupi A, Lerna S, Zavallonito-Parenti D, Esposito G, Tresoldi S, Zingarelli A, Rigattieri S, Palmieri C, Liso A, Abate F, Zimarino M, Comeglio M, Investigators M. Bivalirudin or unfractionated heparin in patients with acute coronary syndromes
managed invasively with and without ST elevation (MATRIX): randomised con- trolled trial. BMJ 2016;354:i4935. 211. Kastrati A, Neumann FJ, Mehilli J, Byrne RA, Iijima R, Buttner HJ, Khattab AA, Schulz S, Blankenship JC, Pache J, Minners J, Seyfarth M, Graf I, Skelding KA, Dirschinger J, Richardt G, Berger PB, Schomig A, ISAR-REACT 3 Trial
Investigators. Bivalirudin versus unfractionated heparin during percutaneous coronary intervention. N Engl J Med 2008;359(7):688-696. 212. Ndrepepa G, Schulz S, Keta D, Mehilli J, Birkmeier A, Massberg S, Laugwitz KL, Neumann FJ, Seyfarth M, Berger PB, Schomig A, Kastrati A. Bleeding after per- cutaneous coronary intervention with
Bivalirudin or unfractionated Heparin and one-year mortality. Am J Cardiol 2010;105(2):163-167. 213. ISIS-2 (Second International Study of Infarct Survival) Collaborative Group. Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2. Lancet 1988;2(8607):349-105.
360. 214. Patrono C, Andreotti F, Arnesen H, Badimon L, Baigent C, Collet JP, De Caterina R, Gulba D, Huber K, Husted S, Kristensen SD, Morais J, Neumann FJ, Rasmussen LH, Siegbahn A, Steg PG, Storey RF, Van de Werf F, Verheugt F. Antiplatelet agents for the treatment and prevention of atherothrombosis. Eur Heart J 2011;32(23):2922-2932.
215. Cavender MA, Sabatine MS. Bivalirudin versus heparin in patients planned for percutaneous coronary intervention: a meta-analysis of randomised controlled trials. Lancet 2014;384(9943):599-606. 216. Stone GW, Selker HP, Thiele H, Patel MR, Udelson JE, Ohman EM, Maehara A, Eitel I, Granger CB, Jenkins PL, Nichols M, Ben-Yehuda O.
Relationship between infarct size and outcomes following primary PCI: patient-level analysis from 10 randomized trials. J Am Coll Cardiol 2016;67(14):1674-1683. 217. Ibanez B, Heusch G, Ovize M, Van de Werf F. Evolving therapies for myocardial ischemia/reperfusion injury. J Am Coll Cardiol 2015;65(14):1454-1471. 218. Niccoli G, Scalone G,
Lerman A, Crea F. Coronary microvascular obstruction in acute myocardial infarction. Eur Heart J 2016;37(13):1024-1033. 219. Hausenloy DJ, Botker HE, Engstrom T, Erlinge D, Heusch G, Ibanez B, Kloner RA, Ovize M, Yellon DM, Garcia-Dorado D. Targeting reperfusion injury in patients with ST-segment elevation myocardial infarction: trials and
tribulations. Eur Heart J 2017;38(13):935-941. 220. Fibrinolytic Therapy Trialists' (FTT) Collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. Lancet 1994;343(8893):311-322. 221
White HD. Thrombolytic therapy in the elderly. Lancet 2000;356(9247): 2028-2030. 222. Bonnefoy E, Lapostolle F, Leizorovicz A, Steg G, McFadden EP, Dubien PY, Cattan S, Boullenger E, Machecourt J, Lacroute JM, Cassagnes J, Dissait F, Touboul P, Comparison of Angioplasty and Prehospital Thromboysis in Acute Myocardial Infarction Study
Group. Primary angioplasty versus prehospital fibrinolysis in acute myocardial infarction: a randomised study. Lancet 2002;360(9336):825-829. 223. Assessment of the Safety and Efficacy of a New Thrombolytic (ASSENT-2) Investigators, Van de Werf F, Adgey J, Ardissino D, Armstrong PW, Aylward P, Barbash G, Betriu A, Binbrek AS, Califf R, Diaz R
Fanebust R, Fox K, Granger C, Heikkila J, Husted S, Jansky P, Langer A, Lupi E, Maseri A, Meyer J, Mocceti D, Myburgh D, Oto A, Paolasso E, Pehrsson K, Seabra-Gomes R, Soares-Piegas L, Sugrue D, Tendera M, Topol E, Toutouzas P, Vahanian A, Verheugt F, Wallentin L, White H. Single-bolus tenecteplase compared with front-loaded
alteplase in acute myocardial infarction: the ASSENT-2 double- blind randomized trial. Lancet 1999;354(9180):716-722. 224. The GUSTO Investigators. An international randomized trial comparing four thrombolytic strategies for acute myocardial infarction. N Engl J Med 1993;329(10):673-682. 225. Chen ZM, Jiang LX, Chen YP, Xie JX, Pan HC, Peto
R, Collins R, Liu LS, COMMIT (Clopidogrel and Metoprolol in Myocardial Infarction Trial) Collaborative Group. Addition of clopidogrel to aspirin in 45,852 patients with acute myocardial infarction in 45,852 patients with acute myocardial infarction. Trial) Collaborative Group. Addition of clopidogrel to aspirin in 45,852 patients with acute myocardial infarction in 45,852 patients with acute myocardial infarction.
Theroux P, Claeys MJ, Cools F, Hill KA, Skene AM, McCabe CH, Braunwald E, CLARITY-TIMI 28 Investigators. Addition of clopidogrel to aspirin and fibrino-lytic therapy for myocardial infarction with ST-segment elevation. N Engl J Med 2005;352(12):1179-1189. 227. Assessment of the Safety and Efficacy of a New Thrombolytic Regimen (ASSENT)-3
Investigators. Efficacy and safety of tenecteplase in combination with enoxaparin, abciximab, or unfractionated heparin: the ASSENT-3 rando-mised trial in acute myocardial infarction. Lancet 2001;358(9282):605-613. 228. Wallentin L, Goldstein P, Armstrong PW, Granger CB, Adgey AAJ, Arntz HR, Bogaerts K, Danays T, Lindahl B, Makijarvi M,
2003;108(2):135-142. 229. Giraldez RR, Nicolau JC, Corbalan R, Gurfinkel EP, Juarez U, Lopez-Sendon J, Parkhomenko A, Molhoek P, Mohanavelu S, Morrow DA, Antman EM. Enoxaparin is superior to unfractionated heparin in patients with ST elevation myocardial infarction undergoing fibrinolysis regardless of the choice of lytic: an ExTRACT-TIMI
25 analysis. Eur Heart J 2007;28(13):1566-1573. 230. White HD, Braunwald E, Murphy SA, Jacob AJ, Gotcheva N, Polonetsky L, Antman EM. Enoxaparin vs. unfractionated heparin with fibrinolysis for ST- elevation myocardial infarction in elderly and younger patients: results from ExTRACT-TIMI 25. Eur Heart J 2007;28(9):1066-1071. 231. Ross AM
therapy (HART II). Circulation 2001;104(6):648-652. 232. Antman EM, Louwerenburg HW, Baars HF, Wesdorp JCL, Hamer B, Bassand JP, Bigonzi F, Pisapia G, Gibson CM, Heidbuchel H, Braunwald E, Van de Werf F. Enoxaparin as adjunctive antithrombin therapy for ST-elevation myocardial infarction: results of the ENTIRE-thrombolysis in
myocardial infarction (TIMI) 23 trial. Circulation 2002;105(14):1642-1649. 233. Peters RJ, Joyner C, Bassand JP, Afzal R, Chrolavicius S, Mehta SR, Oldgren J, Wallentin L, Budaj A, Fox KA, Yusuf S, OASIS-6 Investigators. The role of fon- daparinux as an adjunct to thrombolytic therapy in acute myocardial infarction: a subgroup analysis of the OASIS-6
trial. Eur Heart J 2008;29(3):324-331. 234. Fernandez-Aviles F, Alonso JJ, Castro-Beiras A, Vazquez F, Calvo I, Martinez-Elbal L, San Roman JA, Ramos B, GRACIA (Grupo de Analisis de la Cardiopatia Isque mica Aguda) Group. Routine invasive strategy within 24 hours of thrombolysis
versus ischaemia-guided conservative approach for acute myocardial infarction with ST-segment elevation (GRACIA-1): a randomised controlled trial. Lancet 2004;364(9439):1045-1053. 235. Hochman JS, Sleeper LA, White HD, Dzavik V, Wong SC, Menon V, Webb JG, Steingart R, Picard MH, Menegus MA, Boland J, Sanborn T, Buller CE, Modur S,
Forman R, Desvigne-Nickens P, Jacobs AK, Slater JN, LeJemtel TH, SHOCK Investigators. One-year survival following early revascularization for cardiogenic shock. JAMA 2001;285(2):190-192. 236. Ellis SG, da Silva ER, Heyndrickx G, Talley JD, Cernigliaro C, Steg G, Spaulding C, Nobuyoshi M, Erbel R, Vassanelli C, Topol EJ, RESCUE Investigators
                                                                                                                                        ..237. Assessment of the Safety and Efficacy of a New Treatment Strategy with Percutaneous Coronary Intervention (ASSENT-4 PCI) Investigators. Primary versus tenecteplase-facilitated percutaneous coronary intervention in patients with ST-
segment elevation acute myocardial infarction (ASSENT-4 PCI): rando- mised trial. Lancet 2006;367(9510):569-578. 238. Sinnaeve PR, Armstrong PW, Gershlick AH, Goldstein P, Wilcox R, Lambert Y, Danays T, Soulat L, Halvorsen S, Ortiz FR, Vandenberghe K, Regelin A, Bluhmki E, Bogaerts K, Van de Werf F, STREAM Investigators. ST-segment-
elevation myocardial infarction patients randomized to a pharmaco-invasive strategy or primary percutaneous coronary intervention: Strategic Reperfusion Early After Myocardial Infarction (STREAM) 1-year mortality follow-up. Circulation 2014;130(14):1139-1145. 239. Scheller B, Hennen B, Walle J, Hofer C, Hilpert V, Winter H,
Nickenig G, Bohm M, SIAM III Study Group. Beneficial effects of immediate stenting after thrombolysis in acute myocardial infarction. J Am Coll Cardiol 2003;42(4):634-641. 240. Le May MR, Wells GA, Labinaz M, Davies RF, Turek M, Leddy D, Maloney J, McKibbin T, Quinn B, Beanlands RS, Glover C, Marquis JF, O'Brien ER, Williams WL, Higginson
LA. Combined angioplasty and pharmacological intervention versus thrombolysis alone in acute myocardial infarction (CAPITAL AMI study). J Am Coll Cardiol 2005;46(3):417-424. 241. Abdel-Qadir H, Yan AT, Tan M, Borgia F, Piscione F, Di Mario C, Halvorsen S, Cantor WJ, Westerhout CM, Scheller B, Le May MR, Fernandez-Aviles F, Sanchez PL,
Lee DS, Goodman SG. Consistency of benefit from an early invasive strategy after fibrinolysis: a patient-level meta-analysis. Heart 2015;101(19):1554-1561. 242. Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos I, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos I, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos I, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Ancillo P, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Sanz JJ, Alonso-Briales JH, Bosa F, Santos II, Sanchez PL, Gimeno F, Sanz JJ, Sanchez PL, Sanchez PL, Sanz JJ, Sanchez PL, Sanche
paclitaxel-eluting stent and tirofiban in patients with ST-elevation myocardial infarction undergoing postfibrinolysis angioplasty: the GRACIA-3 randomized clinical trial. Circ Cardiovasc Interv 2010;3(4):297-307. 243. White HD, Hirulog and Early Reperfusion or Occlusion (HERO)-2 Trial Investigators. Thrombin-specific anticoagulation with
bivalirudin versus heparin in patients receiving fibrinolytic therapy for acute myocardial infarction: the HERO-2 randomised trial. Lancet 2001;358(9296):1855-1863. 244. Fernandez-Ra, Castro-Beiras A, Gabriel R, Gibson CM, Sanchez PL
GRACIA-2 (Groupo de Analisis de Cardiopatia Isque mica Aguda) Investigators. Primary angioplasty vs. early routine post- fibrinolysis angioplasty for acute myocardial infarction with ST-segment eleva- tion: the GRACIA-2 non-inferiority, randomized, controlled trial. Eur Heart J 2007;28(8):949-960. 245. Van de Werf F, Barron HV, Armstrong PW
Granger CB, Berioli S, Barbash G, Pehrsson K, Verheugt FW, Meyer J, Betriu A, Califf RM, Li X, Fox NL, ASSENT- 2 Investigators, Assessment of the safety and efficacy of a new thrombolytic. Incidence and predictors of bleeding events after fibrinolytic therapy with fibrin-specific agents: a comparison of TNK-tPA and rt-PA. Eur Heart J
2001;22(24):2253-2261. 246. The Global Use of Strategies to Open Occluded Coronary Arteries (GUSTO III) Investigators. A comparison of reteplase with alteplase for acute myocardial infarction. N Engl J Med 1997;337(16):1118-1123. 247. Bottiger BW, Arntz HR, Chamberlain DA, Bluhmki E, Belmans A, Danays T, Carli PA, Adgey JA, Bode C,
Wenzel V, TROICA Trial Investigators, European Resuscitation Council Study Group. Thrombolysis during resuscitation for out- of-hospital cardiac arrest. N Engl J Med 2008;359(25):2651-2662. 248. Hochman JS, Sleeper LA, Webb JG, Sanborn TA, White HD, Talley JD, Buller CE, Jacobs AK, Slater JN, Col J, McKinlay SM, LeJemtel TH. Early
revasculariza- tion in acute myocardial infarction complicated by cardiogenic shock. SHOCK Investigators. Should We Emergently Revascularize Occluded Coronaries for Cardiogenic Shock. N Engl J Med 1999;341(9):625-634. 249. Weiss ES, Chang DD, Joyce DL, Nwakanma LU, Yuh DD. Optimal timing of coronary artery bypass after acute
myocardial infarction: a review of California discharge data. J Thorac Cardiovasc Surg 2008;135(3):503-511. 250. Hansson EC, Jideus L, Aberg B, Bjursten H, Dreifaldt M, Holmgren A, Ivert T, Nozohoor S, Barbu M, Svedjeholm R, Jeppsson A. Coronary artery bypass grafting-related bleeding complications in patients treated with ticagrelor or
clopidogrel: a nationwide study. Eur Heart J 2016;37(2):189-197. 251. Deja MA, Kargul T, Domaradzki W, Stacel T, Mazur W, Wojakowski W, Gocol R, Gaszewska-Zurek E, Zurek P, Pytel A, Wos S. Effects of preoperative aspirin in coronary artery bypass grafting: a double-blind, placebo-controlled, random- ized trial. J Thorac Cardiovasc Surg
2012;144(1):204-209. 252. Lim E, Ali Z, Ali A, Routledge T, Edmonds L, Altman DG, Large S. Indirect com- parison meta-analysis of aspirin therapy after coronary surgery. BMJ 2003;327(7427):1309. 253. Gavaghan TP, Gebski V, Baron DW. Immediate postoperative aspirin improves vein graft patency early and late after coronary artery bypass graft
surgery. A placebo-controlled, randomized study. Circulation 1991;83(5):1526-1533. 254. Hasin Y, Danchin N, Filippatos GS, Heras M, Janssens U, Leor J, Nahir M, Parkhomenko A, Thygesen K, Tubaro M, Wallentin LC, Zakke I. Recommendations for the structure, organization, and operation of intensive cardiac care units. Eur Heart J
2005;26(16):1676-1682. 255. Spencer FA, Lessard D, Gore JM, Yarzebski J, Goldberg RJ. Declining length of hospital stay for acute myocardial infarction and postdischarge outcomes: a community-wide perspective. Arch Intern Med 2004;164(7):733-740. 256. Berger AK, Duval S, Jacobs DR, Jr, Barber C, Vazquez G, Lee S, Luepker RV. Relation of
length of hospital stay in acute myocardial infarction to postdi- scharge mortality. Am J Cardiol 2008;101(4):428-434. 257. Grines CL, Marsalese DL, Brodie B, Griffin J, Donohue B, Costantini CR, Balestrini C, Stone G, Wharton T, Esente P, Spain M, Moses J, Nobuyoshi M, Ayres M, Jones D, Mason D, Sachs D, Grines LL, O'Neill W. Safety and cost-
Prognostic assessment of patients with acute myocardial infarction treated with primary angioplasty: implications for early discharge. Circulation 2004;109(22):2737-2743. 259. Azzalini L, Sole E, Sans J, Vila M, Duran A, Gil-Alonso D, Santalo M, Garcia-Moll X, Sionis A. Feasibility and safety of an early discharge strategy after low-risk acute
myocardial infarction treated with primary percutaneous coronary inter- vention: the EDAMI pilot trial. Cardiology 2015;130(2):120-129. 260. Melberg T, Jorgensen M, Orn S, Solli T, Edland U, Dickstein K. Safety and health status following early discharge in patients with acute myocardial infarction treated with primary PCI: a randomized trial. Eur
Prev Cardiol 2015;22(11):1427-1434. 261. Noman A, Zaman AG, Schechter C, Balasubramaniam K, Das R. Early discharge after primary percutaneous coronary intervention for ST-elevation myocardial infarction. Eur Heart J Acute Cardiovasc Care 2013;2(3):262-269. 262. Jones DA, Rathod KS, Howard JP, Gallagher S, Antoniou S, De Palma R,
Guttmann O, Cliffe S, Colley J, Butler J, Ferguson E, Mohiddin S, Kapur A, Knight CJ, Jain AK, Rothman MT, Mathur A, Timmis AD, Smith EJ, Wragg A. Safety and feasibility of hospital discharge 2 days following primary percutane- ous intervention for ST-segment elevation myocardial infarction. Heart 2012;98(23):1722-1727. 263. Estevez-Loureiro R
Calvino-Santos R, Vazquez JM, Barge-Caballero E, Salgado- Fernandez J, Pineiro M, Freire-Tellado M, Varela-Portas J, Martinez L, Gomez S, Rodriguez JA, Vazquez N, Castro-Beiras A. Safety and feasibility of returning patients early to their originating centers after transfer for primary percutane- ous coronary intervention. Rev Esp Cardiol
2009;62(12):1356-1364. 264. Morrow DA, Antman EM, Charlesworth A, Cairns R, Murphy SA, de Lemos JA, Giugliano RP, McCabe CH, Braunwald E. TIMI risk score for ST-elevation myo- cardial infarction: A convenient, bedside, clinical score for ST-elevation myo- cardial infarction myo- cardial infarc
substudy. Circulation 2000;102(17):2031-2037. 265. Newby LK, Hasselblad V, Armstrong PW, Van de Werf F, Mark DB, White HD, Topol EJ, Califf RM. Time-based risk assessment after myocardial infarction. Implications for timing of discharge and applications to medical decision-making. Eur Heart J 2003;24(2):182-189. 266. Dans AL, Connolly SJ,
Wallentin L, Yang S, Nakamya J, Brueckmann M, Ezekowitz M, Oldgren J, Eikelboom JW, Reilly PA, Yusuf S. Concomitant use of antiplatelet therapy with dabigatran or warfarin in the Randomized Evaluation of Long-Term Anticoagulation Therapy (RE-LY) trial. Circulation 2013;127(5):634-640. 267. Sorensen R, Hansen ML, Abildstrom SZ, Hvelplund
A, Andersson C, Jorgensen C, Madsen JK, Hansen PR, Kober L, Torp-Pedersen C, Gislason GH. Risk of bleeding in patients with acute myocardial infarction treated with different com- binations of aspirin, clopidogrel, and vitamin K antagonists in Denmark: a retro- spective analysis of nationwide registry data. Lancet 2009;374(9706):1967-1974. 268
Hansen ML, Sorensen R, Clausen MT, Fog-Petersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen SS, Schramm TK, Abildstrom SZ, Poulsen HE, Kober L, Torp-Pedersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen ML, Raunso J, Gadsboll N, Gislason GH, Folke F, Andersen ML, Folk
1441. 269. Oldgren J, Budaj A, Granger CB, Khder Y, Roberts J, Siegbahn A, Tijssen JG, Van de Werf F, Wallentin L, Investigators R-D. Dabigatran vs. placebo in patients with acute coronary syndromes on dual antiplatelet therapy: a random- ized, double-blind, phase II trial. Eur Heart J 2011;32(22):2781-2789. 270. Barnes GD, Gu X, Haymart B, Kline
Rogers E, Almany S, Kozlowski J, Besley D, Krol GD, Froehlich JB, Kaatz S. The predictive ability of the CHADS2 and CHA2DS2-VASc scores for bleeding risk in atrial fibrillation: the MAQI(2) experience. Thromb Res 2014;134(2):294-299. 271. Roldan V, Marin F, Manzano-Fernandez S, Gallego P, Vilchez JA, Valdes M, Vicente V, Lip GY. The HAS-
BLED score has better prediction accuracy for ESC Guidelines 59 Downloaded from by guest on 16 September 2017 60. ...
                                                                                                                                                                                                                                                                                                  major bleeding than CHADS2 or CHA2DS2-VASc scores in anticoagulated patients with atrial fibrillation. J Am Coll Cardiol.
2013;62(23):2199-2204. 272. Gibson CM, Mehran R, Bode C, Halperin J, Verheugt FW, Wildgoose P, Birmingham M, Ianus J, Burton P, van Eickels M, Korjian S, Daaboul Y, Lip GY, Cohen M, Husted S, Peterson ED, Fox KA. Prevention of bleeding in patients with atrial fibrillation undergoing PCI. N Engl J Med 2016;375(25):2423-2434. 273. Toleva O
Ibrahim Q, Brass N, Sookram S, Welsh R. Treatment choices in eld- erly patients with ST: elevation myocardial infarction-insights from the Vital Heart Response registry. Open Heart 2015;2(1):e000235. 274. Malkin CJ, Prakash R, Chew DP. The impact of increased age on outcome from a strategy of early invasive management and revascularisation in
patients with acute coronary syndromes: retrospective analysis study from the ACACIA registry. BMJ Open 2012;2(1):e000540. 275. Alexander KP, Chen AY, Roe MT, Newby LK, Gibson CM, Allen-LaPointe NM, Pollack C, Gibler WB, Ohman EM, Peterson ED, CRUSADE Investigators. Excess dosing of antiplatelet and antithrombin agents in the
treatment of non- ST-segment elevation acute coronary syndromes. JAMA 2005;294(24):3108-3116. 276. Bueno H, Betriu A, Heras M, Alonso JJ, Cequier A, Garcia EJ, Lopez-Sendon JL, Macaya C, Hernandez-Antolin R, TRIANA Investigators. Primary angioplasty vs. fibrinolysis in very old patients with acute myocardial infarction: TRIANA
(TRatamiento del Infarto Agudo de miocardio eN Ancianos) randomized trial and pooled analysis with previous studies. Eur Heart J 2011;32(1):51-60. 277. Szummer K, Lundman P, Jacobson SH, Schon S, Lindback J, Stenestrand U, Wallentin L, Jernberg T, SWEDEHEART. Relation between renal function, presentation, use of therapies and in-hospital
complications in acute coronary syndrome: data from the SWEDEHEART register. J Intern Med 2010;268(1): 40-49. 278. Timmer JR, Ottervanger CB, Zijlstra F, Primary Coronary Angioplasty vs Thrombolysis-2 Trialists Collaborators Group. Primary percutaneous coronary
intervention compared with fibrinolysis for myocardial infarction in diabetes mellitus: results from the Primary Coronary Angioplasty vs Thrombolysis-2 trial. Arch Intern Med 2007;167(13):1353-1359. 279. Alderman EL, Kip KE, Whitlow PL, Bashore T, Fortin D, Bourassa MG, Lesperance J, Schwartz L, Stadius M, Bypass Angioplasty Revascularization
Investigation. Native coronary disease progression exceeds failed revascularization investigation (BARI). J Am Coll Cardiol 2004;44(4):766-774. 280. James S, Angiolillo DJ, Cornel JH, Erlinge D, Husted S, Kontny F, Maya J, Nicolau JC, Spinar J, Storey RF, Stevens SR,
Wallentin L, PLATO Study Group. Ticagrelor vs. clopidogrel in patients with acute coronary syndromes and diabe- tes: a substudy from the PLATelet inhibition and patient Outcomes (PLATO) trial. Eur Heart J 2010;31(24):3006-3016. 281. NICE-SUGAR Study Investigators, Finfer S, Chittock DR, Su SY, Blair D, Foster D, Dhingra V, Bellomo R, Cook D
Dodek P, Henderson WR, Hebert PC, Heritier S, Heyland DK, McArthur C, McDonald E, Mitchell I, Myburgh JA, Norton R, Potter J, Robinson BG, Ronco JJ. Intensive versus conventional glu-cose control in critically ill patients. N Engl J Med 2009;360(13):1283-1297. 282. Senthinathan A, Kelly V, Dzingina M, Jones D, Baker M, Longson D, Guideline
Development Group. Hyperglycaemia in acute coronary syndromes: summary of NICE guidance. BMJ 2011;343:d6646. 283. Fox KA, Dabbous OH, Goldberg RJ, Pieper KS, Eagle KA, Van de Werf F, Avezum A, Goodman SG, Flather MD, Anderson FA, Jr, Granger CB. Prediction of risk of death and myocardial infarction in the six months after pre
sentation with acute coronary syndrome: prospective multinational observatio- nal study (GRACE). BMJ 2006;333(7578):1091. 284. Fox KA, Fitzgerald G, Puymirat E, Huang W, Carruthers K, Simon T, Coste P, Monsegu J, Gabriel Steg P, Danchin N, Anderson F. Should patients with acute coronary disease be stratified for management according to
their risk? Derivation, external validation and outcomes using the updated GRACE risk score. BMJ Open 2014;4(2):e004425. 285. van Loon RB, Veen G, Baur LH, Kamp O, Bronzwaer JG, Twisk JW, Verheugt FW, van Rossum AC. Improved clinical outcome after invasive management of patients with recent myocardial infarction and proven myocardial
viability: pri- mary results of a randomized controlled trial (VIAMI-trial). Trials 2012;13:1. 286. van Loon RB, Veen G, Baur LH, Twisk JW, van Rossum AC. Long-term follow- up of the viability guided angioplasty after acute myocardial infarction (VIAMI) trial. Int J Cardiol 2015;186:111-116. 287. Neskovic AN, Bojic M, Popovic AD. Detection of
significant residual stenosis of the infarct-related artery after thrombolysis by high-dose dipyridamole echo- cardiography test: is it detected often enough? Clin Cardiol 1997;20(6):569-572. 288. Kim RJ, Wu E, Rafael A, Chen EL, Parker MA, Simonetti O, Klocke FJ, Bonow RO, Judd RM. The use of contrast-enhanced magnetic resonance imaging to
identify reversible myocardial dysfunction. N Engl J Med 2000;343(20): 1445-1453. 289. La Canna G, Rahimtoola SH, Visioli O, Giubbini R, Alfieri O, Zognio M, Milan E, Ceconi C, Gargano M, Lo Russo R, Ferrari R. Sensitivity, specificity, and predic-tive accuracies of non-invasive tests, singly and in combination, for diagnosis of hibernating
myocardium. Eur Heart J 2000;21(16):1358-1367. 290. Gerber BL, Rousseau MF, Ahn SA, le Polain de Waroux JB, Pouleur AC, Phlips T, Vancraeynest D, Pasquet A, Vanoverschelde JL. Prognostic value of myocar-dial viability by delayed-enhanced magnetic resonance in patients with coronary artery disease and low ejection fraction: impact of
revascularization therapy. J Am Coll Cardiol 2012;59(9):825-835. 291. Shah DJ, Kim HW, James O, Parker M, Wu E, Bonow RO, Judd RM, Kim RJ. Prevalence of regional myocardial thinning and relationship with myocardial scarring in patients with coronary artery disease. JAMA 2013;309(9):909-918. 292. Beanlands RS, Nichol G, Huszti E, Humen D
Racine N, Freeman M, Gulenchyn KY, Garrard L, deKemp R, Guo A, Ruddy TD, Benard F, Lamy A, Iwanochko RM, PARR-2 Investigators. F-18-fluorodeoxyglucose positron emission tomog- raphy imaging-assisted management of patients with severe left ventricular dys- function and suspected coronary disease: a randomized, controlled trial (PARR-2)
J Am Coll Cardiol 2007;50(20):2002-2012. 293. Allman KC, Shaw LJ, Hachamovitch R, Udelson JE. Myocardial viability testing and impact of revascularization on prognosis in patients with coronary artery disease and left ventricular dysfunction: a meta-analysis. J Am Coll Cardiol 2002;39(7):1151-1158. 294. Eitel I, de Waha S, Wohrle J, Fuernau G,
European Association of Cardiovascular Imaging. Emergency echocardiography: the European Association of Cardiovascular Imaging 2013;14(1):1-11. 296. Soholm H, Lonborg J, Andersen MJ, Vejlstrup N, Engstrom T, Moller JE, Hassager C. Repeated echocardiography after first ever ST-segment
elevation myocardial infarction treated with primary percutaneous coronary intervention - is it necessary? Eur Heart J Acute Cardiovasc Care 2015;4(6):528-536. 297. St John Sutton M, Plappert T, Rouleau JL, Moye LA, Dagenais GR, Lamas GA, Klein M, Sussex B, Goldman S, Menapace FJ, Jr, Parker JO, Lewis S, Sestier F, Gordon DF,
echocardiography for risk stratification after myocardial infarction. Circulation 1997;95(6):1402-1410. 299. Brown KA, Heller GV, Landin RS, Shaw LJ, Beller GA, Pasquale MJ, Haber SB. Early dipyridamole (99m)Tc-sestamibi single photon emission computed tomo- graphic imaging 2 to 4 days after acute myocardial infarction predicts in-hospital and
postdischarge cardiac events: comparison with submaximal exercise imag- ing. Circulation 1999;100(20):2060-2066. 300. Bulluck H, White SK, Frohlich GM, Casson SG, O'Meara C, Newton A, Nicholas J, Weale P, Wan SM, Sirker A, Moon JC, Yellon DM, Groves A, Menezes L, Hausenloy DJ. Quantifying the area at risk in reperfused ST- segment-
elevation myocardial infarction patients using hybrid cardiac positron emission tomography-magnetic resonance imaging 2016;9(3):e003900. 301. Chow CK, Jolly S, Rao-Melacini P, Fox KA, Anand SS, Yusuf S. Association of diet, exercise, and smoking modification with risk of early cardiovascular events after acute coronary
syndromes. Circulation 2010;121(6):750-758. 302. Thomson CC, Rigotti NA. Hospital- and clinic-based smoking cessation inter- ventions for smokers with cardiovascular disease. Prog Cardiovasc Dis 2003;45(6):459-479. 303. Rigotti NA, Clair C, Munafo MR, Stead LF. Interventions for smoking cessation in hospitalised patients. Cochrane Database
Syst Rev 2012;5:CD001837. 304. Critchley JA, Capewell S. Mortality risk reduction associated with smoking ces- sation in patients with coronary heart disease: a systematic review. JAMA 2003;290(1):86-97. 305. Rallidis LS, Pavlakis G. The fundamental importance of smoking cessation in those with premature ST-segment elevation acute myocardial
infarction. Curr Opin Cardiol 2016;31(5):531-536. 306. Stead LF, Koilpillai P, Fanshawe TR, Lancaster T. Combined pharmacotherapy and behavioural interventions for smoking cessation. Cochrane Database Syst Rev 2016;3:CD008286. 307. McRobbie H, Bullen C, Hartmann-Boyce J, Hajek P. Electronic cigarettes for smoking cessation and reduction
Cochrane Database Syst Rev 2014;12:CD010216. 308. Global BMI Mortality Collaboration, Di Angelantonio E, Bhupathiraju Sh N, Wormser D, Gao P, Kaptoge S, Berrington de Gonzalez A, Cairns BJ, Huxley R, 60 ESC Guidelines Downloaded from by guest on 16 September 2017 61.
                                                                                                                                      Jackson Ch L, Joshy G, Lewington S, Manson JE, Murphy N, Patel AV, Samet JM, Woodward M, Zheng W, Zhou M, Bansal N, Barricarte A, Carter B, Cerhan JR, Smith GD, Fang X, Franco OH, Green J, Halsey J, Hildebrand JS, Jung KJ, Korda RJ,
McLerran DF, Moore SC, O'Keeffe LM, Paige E, Ramond A, Reeves GK, Rolland B, Sacerdote C, Sattar N, Sofianopoulou E, Stevens J, Thun M, Ueshima H, Yang L, Yun YD, Willett WC, Thompson SG, Danesh J, Hu FB. Body-mass index and all-
cause mortality: individual- participant-data meta-analysis of 239 prospective studies in four continents. Lancet 2016;388(10046):776-786. 309. Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, Taylor RS. Exercise-based cardiac rehabilitation for coronary heart disease: Cochrane systematic review and meta-analysis. J Am Coll
Moxham T, Taylor RS. Home based versus centre based cardiac rehabilitation: Cochrane systematic review and meta-analysis. BMJ 2010;340:b5631. 312. European Association of Cardiovascular Prevention and Rehabilitation: Cochrane systematic review and meta-analysis. BMJ 2010;340:b5631. 312. European Association of Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corra U, Piepoli MF, Carre F, Heuschmann P, Hoffmann U, Verschuren M, Halcon Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corra U, Piepoli MF, Carre F, Heuschmann P, Hoffmann U, Verschuren M, Halcon Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corra U, Piepoli MF, Carre F, Heuschmann P, Hoffmann U, Verschuren M, Halcon Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corra U, Piepoli MF, Carre F, Heuschmann P, Hoffmann U, Verschuren M, Halcon Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corra U, Piepoli MF, Carre F, Heuschmann P, Hoffmann U, Verschuren M, Halcon Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corra U, Piepoli MF, Carre F, Heuschmann P, Hoffmann U, Verschuren Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines (Cardiovascular Prevention C
J, Document R, Giannuzzi P, Saner H, Wood D, Piepoli MF, Corra U, Benzer W, Bjarnason-Wehrens B, Dendale P, Gaita D, McGee H, Mendes M, Niebauer J, Zwisler AD, Schmid JP. Secondary prevention through cardiac rehabilitation: physical activity counsel- ling and exercise training: key components of the position paper from the Cardiac
 Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. Eur Heart J 2010;31(16):1967-1974. 313. Dreyer RP, Xu X, Zhang W, Du X, Strait KM, Bierlein M, Bucholz EM, Geda M, Fox J, D'Onofrio G, Lichtman JH, Bueno H, Spertus JA, Krumholz HM. Return to work after acute myocardial infarction:
comparison between young women and men. Circ Cardiovasc Qual Outcomes 2016;9(2 Suppl 1):S45-S52. 314. Smith D, Toff W, Joy M, Dowdall N, Johnston R, Clark L, Gibbs S, Boon N, Hackett D, Aps C, Anderson M, Cleland J. Fitness to fly for passengers with car- diovascular disease. Heart 2010;96(Suppl 2):ii1-ii16. 315. SPRINT Research Group
 Wright JT, Jr, Williamson JD, Whelton PK, Snyder JK, Sink KM, Rocco MV, Reboussin DM, Rahman M, Oparil S, Lewis CE, Kimmel PL, Johnson KC, Goff DC, Jr, Fine LJ, Cutler JA, Cushman WC, Cheung AK, Ambrosius WT. A randomized trial of intensive versus standard blood-pressure control. N Engl J Med 2015;373(22):2103-2116. 316. Lonn EM,
Bosch J, Lopez-Jaramillo P, Zhu J, Liu L, Pais P, Diaz R, Xavier D, Sliwa K, Dans A, Avezum A, Piegas LS, Keltai M, Chazova I, Peters RJ, Held C, Yusoff K, Lewis BS, Jansky P, Parkhomenko A, Khunti K, Toff WD, Reid CM, Varigos J, Leiter LA, Molina DI, McKelvie R, Pogue J, Wilkinson J, Jung H, Dagenais G, Yusuf S, HOPE-3 Investigators.
Blood-pressure lowering in intermediate-risk persons without cardiovascular disease. N Engl J Med 2016;374(21):2009-2020. 317. Simpson SH, Eurich DT, Majumdar SR, Padwal RS, Tsuyuki RT, Varney J, Johnson JA. A meta-analysis of the association between adherence to drug ther- apy and mortality. BMJ 2006;333(7557):15. 318. Faridi KF,
Peterson ED, McCov LA, Thomas L. Enriquez I, Wang TY, Timing of first postdischarge follow-up and medication adherence after acute myocardial infarction, IAMA Cardiol 2016;1(2):147-155, 319, Naderi SH, Bestwick IP, Wald DS, Adherence to drugs that prevent cardiovas- cular disease; meta-analysis on 376,162 patients, Am I Med
2012;125(9):882-887 e1. 320. Marcum ZA, Sevick MA, Handler SM. Medication nonadherence: a diagnosable and treatable medical condition. JAMA 2013;309(20):2105-2106. 321. Castellano JM, Sanz G, Fernandez Ortiz A, Garrido E, Bansilal S, Fuster V. A polypill strategy to improve global secondary cardiovascular prevention: from concept to
reality. J Am Coll Cardiol 2014;64(6):613-621. 322. Thom S, Poulter N, Field J, Patel A, Prabhakaran D, Stanton A, Grobbee DE, Bots ML, Reddy KS, Cidambi R, Bompoint S, Billot L, Rodgers A, UMPIRE Collaborative Group. Effects of a fixed-dose combination strategy on adher- ence and risk factors in patients with or at high risk of CVD: the UMPIRE
randomized clinical trial, JAMA 2013;310(9):918-929, 323, Castellano JM, Sanz G, Penalvo JL, Bansilal S, Fernandez-Ortiz A, Alvarez L, Guzman L, Linares JC, Garcia F, D'Aniello F, Arnaiz JA, Varea S, Martinez F, Lorenzatti A, Imaz I, Sanchez-Gomez LM, Roncaglioni MC, Baviera M, Smith SC, Jr, Taubert K, Pocock S, Brotons C, Farkouh ME, Fuster
V. A polypill strategy to improve adherence: results from the FOCUS project. J Am Coll Cardiol 2014;64(20):2071-2082. 324. Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keepanasseril A, Agoritsas T, Mistry N, Iorio A, Jack S, Sivaramalingam B, Iserman E, Mustafa RA, Jedraszewski D, Cotoi C, Haynes RB. Interventions for enhancing
medication adherence. Cochrane Database Syst Rev 2014;11:CD000011. 325. Cahill K, Stevens S, Perera R, Lancaster T. Pharmacological interventions for smoking cessation.
Cochrane Database Syst Rev 2007;1:CD000031. 327. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane systematic reviews. Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane Database Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease Syst Rev 2012;4:CD006103. 328. Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease Rehabilitation for people with he
2014;12:CD011273. 329. Antithrombotic Trialists Collaboration, Baigent C, Blackwell L, Collins R, Emberson J, Godwin J, Peto R, Buring J, Hennekens C, Kearney P, Meade T, Patrono C, Roncaglioni MC, Zanchetti A. Aspirin in the primary and secondary prevention of vascular disease: collaborative meta-analysis of individual participant data from
randomised trials. Lancet 2009;373(9678): 1849-1860. 330. CURRENT-OASIS 7 Investigators, Mehta SR, Bassand JP, Chrolavicius S, Diaz R, Eikelboom JW, Fox KA, Granger CB, Jolly S, Joyner CD, Rupprecht HJ, Widimsky P, Afzal R, Poque J, Yusuf S. Dose comparisons of clopidogrel and aspirin in acute coronary syndromes. N Engl J Med
2010;363(10):930-942. 331. Valgimigli M, Ariotti S, Costa F. Duration of dual antiplatelet therapy after drug- eluting stent implantation: will we ever reach a consensus? Eur Heart J 2015;36(20):1219-1222. 332. Costa F, Tijssen JG, Ariotti S, Giatti S, Moscarella E, Guastaroba P, De Palma R, Ando G, Oreto G, Zijlstra F, Valgimigli M. Incremental value
of the CRUSADE, ACUITY, and HAS-BLED risk scores for the prediction of hemorrhagic events after coronary stent implantation in patients undergoing long or short duration of dual antiplatelet therapy. J Am Heart Assoc 2015;4(12):e002524. 333. Bonaca MP, Bhatt DL, Cohen M, Steg PG, Storey RF, Jensen EC, Magnani G, Bansilal S, Fish MP, Im K,
Bengtsson O, Oude Ophuis T, Budaj A, Theroux P, Ruda M, Hamm C, Goto S, Spinar J, Nicolau JC, Kiss RG, Murphy SA, Wiviott SD, Held P, Braunwald E, Sabatine MS, PEGASUS-TIMI 54 Steering Committee and Investigators. Long-term use of ticagrelor in patients with prior myocardial infarction. N Engl J Med 2015;372(19):1791-1800. 334. Mauri
L, Kereiakes DJ, Yeh RW, Driscoll-Shempp P, Cutlip DE, Steq PG, Normand SL, Braunwald E, Wiviott SD, Cohen DJ, Holmes DR, Jr, Krucoff MW, Hermiller J, Dauerman HL, Simon DI, Kandzari DE, Garratt KN, Lee DP, Pow TK, Ver Lee P, Rinaldi MJ, Massaro JM, DAPT Study Investigators. Twelve or 30 months of dual antiplatelet therapy after drug-
eluting stents. N Engl J Med 2014;371(23):2155-2166. 335. Agewall S, Cattaneo M, Collet JP, Andreotti F, Lip GY, Verheugt FW, Huber K, Grove EL, Morais J, Husted S, Wassmann S, Rosano G, Atar D, Pathak A, Kjeldsen K, Storey RF, ESC Working Group on Cardiovascular Pharmacology and Drug Therapy and ESC Working Group on Thrombosis.
Expert position paper on the use of proton pump inhibitors in patients with cardiovascular dis- ease and antithrombotic therapy. Eur Heart J 2013;34(23):1708-1713, 1713a-1713b. 336. Bhatt DL, Cryer BL, Contant CF, Cohen M, Lanas A, Schnitzer TJ, Shook TL, Lapuerta P, Goldsmith MA, Laine L, Scirica BM, Murphy SA, Cannon CP, COGENT
Investigators. Clopidogrel with or without omegrazole in coronary artery disease. N Engl J Med 2010;363(20):1909-1917. 337. Gargiulo G, Costa F, Ariotti S, Biscaglia S, Campo G, Esposito G, Leonardi S, Vranckx P, Windecker S, Valgimigli M. Impact of proton pump inhibitors on clinical outcomes in patients treated with a 6- or 24-month dual-
antiplatelet therapy duration: Insights from the PROlonging Dual-antiplatelet treatment after Grading stent-induced Intimal hyperplasia study trial. Am Heart J 2016;174:95-102. 338. Mega JL, Braunwald E, Wiviott SD, Bassand JP, Bhatt DL, Bode C, Burton P, Cohen M, Cook-Bruns N, Fox KA, Goto S, Murphy SA, Plotnikov AN, Schneider D, Sun X,
Verheugt FW, Gibson CM, ATLAS ACS 2-TIMI 51 Investigators. Rivaroxaban in patients with a recent acute coronary syndrome. N Engl J Med 2012;366(1):9-19. 339. Palmerini T, Sangiorgi D, Valgimigli M, Biondi-Zoccai G, Feres F, Abizaid A, Costa RA, Hong MK, Kim BK, Jang Y, Kim HS, Park KW, Mariani A, Della Riva D, Genereux P, Leon MB,
Bhatt DL, Bendetto U, Rapezzi C, Stone GW. Short- versus long-term dual antiplatelet therapy after drug-eluting stent implantation: an individual patient data pairwise and network meta-analysis. J Am Coll Cardiol 2015;65(11):1092-1102. 340. Palmerini T, Della Riva D, Benedetto U, Bacchi Reggiani L, Feres F, Abizaid A, Gilard M, Morice MC,
Valgimigli M, Hong MK, Kim BK, Jang Y, Kim HS, Park KW, Colombo A, Chieffo A, Sangiorgi D, Biondi-Zoccai G, Genereux P, Angelini GD, Pufulete M, White J, Bhatt DL, Stone GW. Three, six, or twelve months of dual antiplatelet therapy after DES implantation in patients with or ESC Guidelines 61 Downloaded from by guest on 16 September 2017
                                                                                                                                             without acute coronary syndromes: an individual patient data pairwise and net-work meta-analysis of six randomized trials and 11 473 patients. Eur Heart I 2017;38(14):1034-1043, 341, Reeder GS, Lengyel M, Tajik AI, Seward IB, Smith
HC, Danielson GK. Mural thrombus in left ventricular aneurysm: incidence, role of angiography, and rela-tion between anticoagulation and embolization. Mayo Clin Proc 1981;56(2):77-81. 342. Keeley EC, Hillis LD. Left ventricular mural thrombus after acute myocardial infarction. Clinical Cardiology 1996;19(2):83-86. 343. Turpie AG, Robinson JG,
Doyle DJ, Mulji AS, Mishkel GJ, Sealey BJ, Cairns JA, Skingley L, Hirsh J, Gent M. Comparison of high-dose with low-dose subcutane- ous heparin to prevent left ventricular mural thrombosis in patients with acute transmural anterior myocardial infarction. N Engl J Med 1989;320(6):352-357. 344. Chen ZM, Pan HC, Chen YP, Peto R, Collins R, Jiang
LX, Xie JX, Liu LS, COMMIT Collaborative Group. Early intravenous then oral metoprolol in 45,852 patients with acute myocardial infarction: randomised placebo- controlled trial. Lancet 2005;366(9497):1622-1632. 345. Pfisterer M, Cox JL, Granger CB, Brener SJ, Naylor CD, Califf RM, van de Werf F, Stebbins AL, Lee KL, Topol EJ, Armstrong PW
Atenolol use and clinical out-comes after thrombolysis for acute myocardial infarction: the GUSTO-I experi-ence. Global Utilization of Streptokinase and TPA (alteplase) for Occluded Coronary Arteries. J Am Coll Cardiol 1998;32(3):634-640. 346. Chatterjee S, Chaudhuri D, Vedanthan R, Fuster V, Ibanez B, Bangalore S, Mukherjee D. Early
intravenous beta-blockers in patients with acute coronary syndrome—a meta-analysis of randomized trials. Int J Cardiol 2013;168(2):915-921. 347. Ibanez B, Macaya C, Sanchez-Brunete V, Pizarro G, Fernandez-Friera L, Mateos A, Fernandez-Ortiz A, Garcia-Ruiz JM, Garcia-Alvarez A, Iniquez A, Jimenez-Borrequero J, Lopez-Romero P, Fernandez-Friera L, Mateos A, Fernandez-Ortiz A, Garcia-Ruiz JM, Garcia-Alvarez A, Iniquez A, Jimenez-Borrequero J, Lopez-Romero P, Fernandez-Friera L, Mateos A, Fernandez-Ortiz A, Garcia-Ruiz JM, Garcia-Alvarez A, Iniquez A, Jimenez-Brunete V, Pizarro G, Fernandez-Friera L, Mateos A, Fernandez-Friera L, Mat
Jimenez R, Goicolea J, Ruiz-Mateos B, Bastante T, Arias M, Iglesias-Vazquez JA, Rodriguez MD, Escalera N, Acebal C, Cabrera JA, Valenciano J, Perez de Prado A, Fernandez-Antolin R, Albarran A, Fernandez-Vazquez F, de la Torre-Hernandez JM, Pocock S,
Sanz G, Fuster V. Effect of early metoprolol on infarct size in ST-segment-elevation myo- cardial infarction (METOCARD-CNIC) trial. Circulation 2013;128(14):1495–1503. 348. Pizarro G, Fernandez-
Friera L, Fuster V, Fernandez-Jimenez R, Garcia-Ruiz JM, Garci
Albarran A, Goicolea J, Escaned J, Pocock S, Iniguez A, Fernandez-Ortiz A, Sanchez- Brunete V, Macaya C, Ibanez B. Long-term benefit of early pre-reperfusion metoprolol in Cardioprotection During an Acute Myocardial
Infarction). J Am Coll Cardiol 2014;63(22): 2356-2362. 349. Garcia-Prieto J, Villena-Gutierrez R, Gomez M, Bernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Garcia-Ruiz JM, Del Valle AS, Sanz-Rosa D, Pizarro G, Fernandez-Jimenez R, Fernandez-Jimenez R, Fernandez-Jimenez R, Fernandez-Jimenez R, Fernandez-Jimenez R, Fernandez-Jimenez R, Fernandez-Jim
by metoprolol reduces infarct size. Nat Commun 2017;8:14780. 350. Roolvink V, Ibanez B, Ottervanger JP, Pizarro G, van Royen N, Mateos A, Dambrink JH, Escalera N, Lipsic E, Albarran A, Fernandez-Ortiz A,
van Leeuwen M, Nijveldt R, Postma S, Kolkman E, Gosselink M, de Smet B, Rasoul S, Piek JJ, Fuster V, van 't Hof AW, EARLY-BAMI Investigators. Early intravenous beta-blockers in patients with ST-segment elevation myocardial infarction before primary percu- taneous coronary intervention. J Am Coll Cardiol 2016;67(23):2705–2715. 351. Halkin A,
Grines CL, Cox DA, Garcia E, Mehran R, Tcheng JE, Griffin JJ, Guagliumi G, Brodie B, Turco M, Rutherford BD, Aymong E, Lansky AJ, Stone GW. Impact of intravenous beta-blockade before primary angioplasty on sur- vival in patients undergoing mechanical reperfusion therapy for acute myocar- dial infarction. J Am Coll Cardiol 2004;43(10):1780-
1787. 352. Harjai KJ, Stone GW, Boura J, Grines L, Garcia E, Brodie B, Cox D, O'Neill WW, Grines C. Effects of prior beta-blocker therapy on clinical outcomes after primary coronary angioplasty for acute myocardial infarction. Am J Cardiol 2003;91(6):655-660. 353. Freemantle N, Cleland J, Young P, Mason I, Harrison I. Beta blockade after myo-
cardial infarction: systematic review and meta regression analysis. BMJ 1999;318(7200):1730-1737. 354. Goldberger JJ, Bonow RO, Cuffe M, Liu L, Rosenberg Y, Shah PK, Smith SC, Jr, Subacius H, OBTAIN Investigators. Effect of beta-blocker dose on survival after acute myocardial infarction. J Am Coll Cardiol 2015;66(13):1431-1441. 355.
Andersson C, Shilane D, Go AS, Chang TI, Kazi D, Solomon MD, Boothroyd DB, Hlatky MA. Beta-blocker therapy and cardiac events among patients with newly diagnosed coronary heart disease. J Am Coll Cardiol 2014;64(3):247-252. 356. Bangalore S, Steg G, Deedwania P, Crowley K, Eagle KA, Goto S, Ohman EM, Cannon CP, Smith SC, Zeymer U,
Hoffman EB, Messerli FH, Bhatt DL, REACH Registry Investigators. Beta-blocker use and clinical outcomes in stable outpatients with and without coronary artery disease. JAMA 2012;308(13):1340-1349. 357. Dargie HJ. Effect of carvedilol on outcome after myocardial infarction in patients with left-ventricular dysfunction: the CAPRICORN
randomised trial. Lancet 2001;357(9266):1385-1390. 358. The Cardiac Insufficiency Bisoprolol Study II (CIBIS-II): a randomised trial. Lancet 1999;353(9146):9-13. 359. Packer M, Coats AJ, Fowler MB, Katus HA, Krum H, Mohacsi P, Rouleau JL, Tendera M, Castaigne A, Roecker EB, Schultz MK, DeMets DL, Carvedilol Prospective Randomized
Cumulative Survival Study Group. Effect of carvedilol on survival in severe chronic heart failure. N Engl J Med 2001;344(22):1651-1658. 360. Effect of metoprolol CR/XL in chronic heart failure: Metoprolol CR/XL Randomised Intervention Trial in Congestive Heart Failure (MERIT-HF). Lancet 1999;353(9169):2001-2007. 361. Flather MD, Shibata MC,
Coats AJ, Van Veldhuisen DJ, Parkhomenko A, Borbola J, Cohen-Solal A, Dumitrascu D, Ferrari R, Lechat P, Soler-Soler J, Tavazzi L, Spinarova L, Toman J, Bohm M, Anker SD, Thompson SG, Poole-Wilson PA, SENIORS Investigators. Randomized trial to determine the effect of nebivolol on mortality and cardiovascular hospital admission in elderly
patients with heart failure (SENIORS). Eur Heart J 2005;26(3):215-225. 362. Bugiardini R, Cenko E, Ricci B, Vasiljevic Z, Dorobantu M, Kedev S, Vavlukis M, Kalpak O, Puddu PE, Gustiene O, Trninic D, Knezevic B, Milicic D, Gale CP, Manfrini O, Koller A, Badimon L. Comparison of early versus delayed oral beta blockers in acute coronary syndromes
and effect on outcomes. Am J Cardiol 2016;117(5):760-767. 363. Baigent C, Keech A, Kearney PM, Blackwell L, Buck G, Pollicino C, Kirby A, Sourjina T, Peto R, Collins R, Simes R, Cholesterol Treatment Trialists Collaborators. Efficacy and safety of cholesterol-lowering treatment: prospec-tive meta-analysis of data from 90,056 participants in 14
randomised trials of statins. Lancet 2005;366(9493):1267-1278. 364. Cannon CP, Braunwald E, McCabe CH, Rader DJ, Rouleau JL, Belder R, Joyal SV, Hill KA, Pfeffer MA, Skene AM, Pravastatin or Atorvastatin evaluation and Infection Therapy-Thrombolysis in Myocardial Infarction 22 Investigators. Intensive versus moderate lipid lowering with
statins after acute coronary syn- dromes. N Engl J Med 2004;350(15):1495-1504. 365. Schwartz GG, Olsson AG, Ezekowitz MD, Ganz P, Oliver MF, Waters D, Zeiher A, Chaitman BR, Leslie S, Stern T, Myocardial Ischemia Reduction with Aggressive Cholesterol Lowering Study Investigators. Effects of atorvastatin on early recurrent ischemic events in
acute coronary syndromes: the MIRACL study: a randomized controlled trial. JAMA 2001;285(13):1711-1718. 366. Cholesterol Treatment Trialists' (CTT) Collaboration, Baigent C, Blackwell L, Emberson J, Holland LE, Reith C, Bhala N, Peto R, Barnes EH, Keech A, Simes J, Collins R. Efficacy and safety of more intensive lowering of LDL cholesterol: a
meta-analysis of data from 170,000 participants in 26 randomised trials. Lancet 2010;376(9753):1670-1681. 367. Boekholdt SM, Hovingh GK, Mora S, Arsenault BJ, Amarenco P, Pedersen TR, LaRosa JC, Waters DD, DeMicco DA, Simes RJ, Keech AC, Colquhoun D, Hitman GA, Betteridge DJ, Clearfield MB, Downs JR, Colhoun HM, Gotto AM, Jr, Ridker
PM, Grundy SM, Kastelein JJ. Very low levels of atherogenic lipopro- teins and the risk for cardiovascular events: a meta-analysis of statin trials. J Am Coll Cardiol 2014;64(5):485-494. 368. LaRosa JC, Grundy SM, Waters DD, Shear C, Barter P, Fruchart JC, Gotto AM, Greten H, Kastelein JJ, Shepherd J, Wenger NK, Treating to New Targets
```

Investigators. Intensive lipid lowering with atorvastatin in patients with stable coronary disease. N Engl J Med 2005;352(14):1425-1435. 369. Cholesterol Treatment Trialists C, Fulcher J, O'Connell R, Voysey M, Emberson J, Blackwell L, Mihaylova B, Simes J, Collins R, Kirby A, Colhoun H, Braunwald E, La Rosa J, Pedersen TR, Tonkin A, Davis B,

infarction (DEFER-STEMI). J Am Coll Cardiol 2014;63(20):2088-2098. 154. Belle L, Motreff P, Mangin L, Range G, Marcaggi X, Marie A, Ferrier N, Dubreuil O, Zemour G, Souteyrand G, Caussin C, Amabile N, Isaaz K, Dauphin R, Koning R, Robin C, Faurie B, Bonello L, Champin S, Delhaye C, Cuilleret F, Mewton N, Genty C, Viallon M, Bosson JL, Croisille P, MIMI Investigators. Comparison of immediate with delayed stenting using the minimalist immediate mechanical infarction: the MIMI Study. Circ Cardiovasc Interv 2016;9(3):e003388. 155. Kelbaek H, Hofsten DE, Kober L, Helqvist S, Klovgaard L, Holmvang L, Jorgensen E,

```
Sleight P, Franzosi MG, Baigent C, Keech A. Efficacy and safety of LDL-lowering therapy among men and women: meta-analysis of individual data from 174,000 participants in 27 randomised trials. Lancet 2015;385(9976):1397-1405. 370. Shrivastava AK, Singh HV, Raizada A, Singh SK. Serial measurement of lipid pro- file and inflammatory markers
in patients with acute myocardial infarction. EXCLI J 2015;14:517-526. 371. Pitt B, Loscalzo J, Ycas J, Raichlen JS. Lipid levels after acute coronary syn- dromes. J Am Coll Cardiol 2008;51(15):1440-1445. 372. Sidhu D, Naugler C. Fasting time and lipid levels in a community-based popula- tion: a cross-sectional study. Arch Intern Med
2012;172(22):1707-1710. 373. Food and Drug Administration. FDA Drug Safety Communication: New restrictions, and dose limitations for Zocor (simvastatin) to 62 ESC Guidelines Downloaded from by guest on 16 September 2017 63.
                                                                                                          ..reduce the risk of muscle injury. 256581.htm, accessed July 26, 2017. 374. Pedersen TR, Cater NB, Faergeman O, Kastelein JJ, Olsson AG, Tikkanen MJ, Holme I, Larsen ML, Lindahl C, Szarek M. Comparison of atorvastatin 80 mg/day versus
 simvastatin 20 to 40 mg/day on frequency of cardiovascular events late (five years) after acute myocardial infarction (from the Incremental Decrease in End Points through Aggressive Lipid Lowering [IDEAL] trial). Am J Cardiol 2010;106(3):354-359. 375. Tikkanen MJ, Szarek M, Fayyad R, Holme I, Cater NB, Faergeman O, Kastelein JJ, Olsson AG,
Larsen ML, Lindahl C, Pedersen TR, IDEAL Investigators. Total cardiovascular disease burden: comparing intensive with moderate statin ther- apy insights from the IDEAL (Incremental Decrease in End Points Through Aggressive Lipid Lowering) trial. J Am Coll Cardiol 2009;54(25):2353-2357. 376. Cannon CP, Blazing MA, Giugliano RP, McCagg A
White JA, Theroux P, Darius H, Lewis BS, Ophuis TO, Jukema JW, De Ferrari GM, Ruzyllo W, De Lucca P, Im K, Bohula EA, Reist C, Wiviott SD, Tershakovec AM, Musliner TA, Braunwald E, Califf RM, IMPROVE-IT Investigators. Ezetimibe added to statin therapy after acute coronary syndromes. N Engl J Med 2015;372(25):2387-2397. 377. Li C, Lin L,
Zhang W, Zhou L, Wang H, Luo X, Luo H, Cai Y, Zeng C. Efficiency and safety of proprotein convertase subtilisin/kexin 9 monoclonal antibody on hypercholesterolemia: a meta-analysis of 20 randomized controlled trials. J Am Heart Assoc 2015;4(6):e001937. 378. Zhang XL, Zhu QQ, Zhu L, Chen JZ, Chen QH, Li GN, Xie J, Kang LN, Xu B. Safety and
efficacy of anti-PCSK9 antibodies: a meta-analysis of 25 randomized, controlled trials. BMC Med 2015;13:123. 379. Sabatine MS, Giugliano RP, Wiviott SD, Raal FJ, Blom DJ, Robinson J, Ballantyne CM, Somaratne R, Legg J, Wasserman SM, Scott R, Koren MJ, Stein EA, Open- Label Study of Long-Term Evaluation against LDL Cholesterol (OSLER)
Investigators. Efficacy and safety of evolocumab in reducing lipids and cardiovas- cular events. N Engl J Med 2015;372(16):1500-1509. 380. Robinson JG, Farnier M, Krempf M, Bergeron J, Luc G, Averna M, Stroes ES, Langslet G, Raal FJ, El Shahawy M, Koren MJ, Lepor NE, Lorenzato C, Pordy R, Chaudhari U, Kastelein JJ, ODYSSEY LONG TERM
Investigators. Efficacy and safety of alirocumab in reducing lipids and cardiovascular events. N Engl J Med 2015;372(16):1489-1499. 381. Navarese EP, Kolodziejczak M, Schulze V, Gurbel PA, Tantry U, Lin Y, Brockmeyer M, Kandzari DE, Kubica JM, D'Agostino RB, Sr., Kubica JM, O'Agostino RB, Sr., Kubica JM, O'Agostino RB, Sr., Kubica JM, Cardiovascular events. N Engl J Med 2015;372(16):1489-1499.
convertase subtilisin/ kexin type 9 antibodies in adults with hypercholesterolemia: a systematic review and meta-analysis. Ann Intern Med 2015;163(1):40-51. 382. Sabatine MS, Giugliano RP, Keech AC, Honarpour N, Wiviott SD, Murphy SA, Kuder JF, Wang H, Liu T, Wasserman SM, Sever PS, Pedersen TR, FOURIER Steering Committee and
Investigators. Evolocumab and clinical outcomes in patients with cardiovascular disease. N Engl J Med 2017;376(18):1713-1722. 383. ISIS-4: a randomised factorial trial assessing early oral captopril, oral mononitrate, and intravenous magnesium sulphate in 58,050 patients
with suspected acute myocardial infarction. Lancet 1995;345(8951):669-685. 384. Yusuf S, Held P, Furberg C. Update of effects of calcium antagonists in myocardial infarction or angina in light of the second Danish Verapamil Infarction Trial (DAVIT-II) and other recent studies. Am J Cardiol 1991;67(15):1295-1297. 385. Held PH, Yusuf S, Furberg
CD. Calcium channel blockers in acute myocardial infarction and unstable angina: an overview. BMJ 1989;299(6709):1187-1192. 386. Effect of verapamil Infarction Trial II-DAVIT II). Am J Cardiol 1990;66(10):779-785. 387. Furberg CD, Psaty BM, Meyer JV.
Nifedipine. Dose-related increase in mortality in patients with coronary heart disease. Circulation 1995;92(5):1326-1331. 388. Poole-Wilson PA, Lubsen J, Kirwan BA, van Dalen FJ, Wagener G, Danchin N, Just H, Fox KA, Pocock SJ, Clayton TC, Motro M, Parker JD, Bourassa MG, Dart AM, Hildebrandt P, Hjalmarson A, Kragten JA, Molhoek GP,
Otterstad JE, Seabra-Gomes R, Soler-Soler J, Weber S, Coronary Disease Trial Investigating Outcome with Nifedipine Gastrointestinal Therapeutic System Investigators. Effect of long-acting nifedipine on mortality and cardiovascular morbidity in patients with stable angina requiring treatment (ACTION trial): randomised controlled trial. Lancet
2004;364(9437):849-857. 389. Pfeffer MA, Greaves SC, Arnold JM, Glynn RJ, LaMotte FS, Lee RT, Menapace FJ, Jr, Rapaport E, Ridker PM, Rouleau JL, Solomon SD, Hennekens CH. Early versus delayed angiotensin-converting enzyme inhibition therapy in acute myo- cardial infarction. The healing and early afterload reducing therapy trial.
Circulation 1997;95(12):2643-2651. 390. Kober L, Torp-Pedersen C, Carlsen JE, Bagger H, Eliasen P, Lyngborg K, Videbaek J, Cole DS, Auclert L, Pauly NC. A clinical trial of the angiotensin- converting-enzyme inhibitor trandolapril in patients with left ventricular dys- function after myocardial infarction. Trandolapril Cardiac Evaluation (TRACE)
Study Group. N Engl J Med 1995;333(25):1670-1676. 391. Ball SG, Hall AS, Murray GD. ACE inhibition, atherosclerosis and myocardial infarction—the AIRE Study in practice. Acute Infarction—the AIRE Study in practice. Acute Infarction—the AIRE Study in practice. Acute Infarction—the AIRE Study in practice.
BR, Geltman EM, Goldman S, Flaker GC, Klein M, Lamas GA, Packer M, Rouleau JL, Rutherford J, Wertheimer JH, Hawkins CM, SAVE Investigators. Effect of captopril on mortality and morbidity in patients with left ventricular dysfunction after myocardial infarction. Results of the survival and ventricular enlargement trial. The SAVE
On reduction of cardiac events with Perindopril in sta- ble coronary Artery disease Investigators. Efficacy of perindopril in reduction of cardiovascular events among patients with Stable coronary Artery disease: rand- omised, double-blind, placebo-controlled, multicentre trial (the EUROPA study). Lancet 2003;362(9386):782-788. 395. Yusuf S, Sleight
P, Pogue J, Bosch J, Davies R, Dagenais G. Effects of an angiotensin-converting-enzyme inhibitor, ramipril, on cardiovascular events in high-risk patients. The Heart Outcomes Prevention Evaluation Study Investigators. N Engl J Med 2000;342(3):145–153. 396. Pfeffer MA, McMurray JJ, Velazquez EJ, Rouleau JL, Kober L, Maggioni AP, Solomon SD,
Swedberg K, Van de Werf F, White H, Leimberger JD, Henis M, Edwards S, Zelenkofske S, Sellers MA, Califf RM, Valsartan in Acute Myocardial Infarction Trial Investigators. Valsartan, captopril, or both in myocardial infarction Trial Investigators. Valsartan, captopril, or both in myocardial infarction Trial Investigators. Valsartan in Acute Myocardial Infarction Trial Investigators. Valsartan in Acute Myocardial Infarction Trial Investigators.
 Remme W, Zannad F, Neaton J, Martinez F, Roniker B, Bittman R, Hurley S, Kleiman J, Gatlin M, Eplerenone Post-Acute Myocardial Infarction Heart Failure Efficacy and Survival Study Investigators. Eplerenone, a selective aldosterone blocker, in patients with left ventricular dysfunction after myocar-dial infarction. N Engl J Med 2003;348(14):1309
1321. 398. Pitt B, Zannad F, Remme WJ, Cody R, Castaigne A, Perez A, Palensky J, Wittes J. The effect of spironolactone on morbidity and mortality in patients with severe heart failure. Randomized Aldactone Evaluation Study Investigators. N Engl J Med 1999;341(10):709-717. 399. Zannad F, McMurray JJ, Krum H, van Veldhuisen DJ, Swedberg K,
Shi H, Vincent J, Pocock SJ, Pitt B, EMPHASIS-HF Study Group. Eplerenone in patients with systolic heart failure and mild symptoms. N Engl J Med 2011;364(1):11-21. 400. Girerd N, Collier T, Pocock S, Krum H, McMurray JJ, Swedberg K, Van Veldhuisen DJ, Vincent J, Pitt B, Zannad F. Clinical benefits of eplerenone in patients with systolic heart
failure and mild symptoms when initiated shortly after hospital discharge: analysis from the EMPHASIS-HF trial. Eur Heart J 2015;36(34):2310-2317. 401. Montalescot G, Pitt B, Lopez de Sa E, Hamm CW, Flather M, Verheugt F, Shi H, Turgonyi E, Orri M, Vincent J, Zannad F, REMINDER Investigators. Early eplere- none treatment in patients with
acute ST-elevation myocardial infarction with- out heart J 2014;35(34):2295-2302. 402. Beygui F, Cayla G, Roule V, Roubille F, Delarche N, Silvain J, Van Belle E, Belle L, Galinier M, Motreff P, Cornillet L, Collet JP, Furber A, Goldstein P, Ecollan P, Legallois D, Lebon A, Rousseau H,
Machecourt J, Zannad F, Vicaut E, Montalescot G, ALBATROSS Investigators. Early aldosterone blockade in acute myocardial infarction: the ALBATROSS Randomized Clinical Trial. J Am Coll Cardiol 2016;67(16):1917-1927. 403. Garcia-Ruiz JM, Fernandez-Jimenez R, Garcia-Alvarez A, Pizarro G, Galan- Arriola C, Fernandez-Friera L, Mateos A, Nuno
Ayala M, Aguero J, Sanchez- Gonzalez J, Garcia-Prieto J, Lopez-Melgar B, Martinez-Tenorio P, Lopez-Martin GJ, Macias A, Perez-Asenjo B, Cabrera JA, Fernandez-Ortiz A, Fuster V, Ibanez B. Impact of the timing of metoprolol administration during STEMI on infarct size and ventricular function. J Am Coll Cardiol 2016;67(18):2093-2104. 404.
Bangalore S, Makani H, Radford M, Thakur K, Toklu B, Katz SD, DiNicolantonio JJ, Devereaux PJ, Alexander KP, Wetterslev J, Messerli FH. Clinical outcomes with beta-blockers for myocardial infarction: a meta-analysis of randomized tri- als. Am J Med 2014;127(10):939-53. 405. Huang BT, Huang FY, Zuo ZL, Liao YB, Heng Y, Wang PJ, Gui YY, Xia
TL, Xin ZM, Liu W, Zhang C, Chen SJ, Pu XB, Chen M, Huang DJ. Meta-analysis of rela- tion between oral beta-blocker therapy and outcomes in patients with acute myocardial infarction who underwent percutaneous coronary intervention. Am J Cardiol 2015;115(11):1529-1538. 406. Authors/Task Force Members, Catapano AL, Graham I, De Backer
G, Wiklund O, Chapman MJ, Drexel H, Hoes AW, Jennings CS, Landmesser U, Pedersen TR, Reiner Z, Riccardi G, Taskinen MR, Tokgozoglu L, Verschuren WM, Vlachopoulos C, Wood DA, Zamorano JL. 2016 ESC/EAS Guidelines for the Management of Dyslipidaemias: The Task Force for the Management of ESC Guidelines 63 Downloaded from by
                                                                                                                                           ..Dyslipidaemias of the European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS) Developed with the special contribution of the European Assocciation for Cardiovascular Prevention
 Rehabilitation (EACPR). Atherosclerosis 2016;253:281-344. 407. Dickstein K, Kjekshus J, Optimaal Steering Committee of the OPTIMAAL Study Group. Effects of losartan and captopril on mortality and morbidity in high-risk patients after acute myocardial infarction: the OPTIMAAL randomised trial. Optimal Trial in Myocardial Infarction with
Angiotensin II Antagonist Losartan. Lancet 2002;360(9335):752-760. 408. Iakobishvili Z, Cohen E, Garty M, Behar S, Shotan A, Sandach A, Gottlieb S, Mager A, Battler A, Hasdai D, Heart Failure survey in Isarel Investigators. Use of intravenous morphine for acute decompensated heart failure in patients with and without acute coronary syndromes.
 Acute Card Care 2011;13(2):76-80. 409. Peacock WF, Hollander JE, Diercks DB, Lopatin M, Fonarow G, Emerman CL. Morphine and outcomes in acute decompensated heart failure: an ADHERE analysis. Emerg Med J 2008;25(4):205-209. 410. Weng CL, Zhao YT, Liu QH, Fu CJ, Sun F, Ma YL, Chen YW, He QY. Meta- analysis: noninvasive ventilation
in acute cardiogenic pulmonary edema. Ann Intern Med 2010;152(9):590-600. 411. Vital FM, Ladeira MT, Atallah AN. Non-invasive positive pressure ventilation (CPAP or bilevel NPPV) for cardiogenic pulmonary oedema. Cochrane Database Syst Rev 2013;5:CD005351. 412. McAlister FA, Stewart S, Ferrua S, McMurray JJ. Multidisciplinary strategies
for the management of heart failure patients at high risk for admission: a systematic review of rami- pril on mortality and morbidity of survivors of acute myocardial infarction with clinical evidence of heart failure.
metoprolol on total mortality, hospitalizations, and well-being in patients with heart failure: the Metoprolol CR/XL Randomized Intervention Trial in conges- tive heart failure (MERIT-HF). MERIT-HF Study Group. JAMA 2000;283(10):1295-1302. 415. Packer M, Bristow MR, Cohn JN, Colucci WS, Fowler MB, Gilbert EM, Shusterman NH. The effect of
carvedilol on morbidity and mortality in patients with chronic heart failure. U.S. Carvedilol Heart Failure Study Group. N Engl J Med 1996;334(21):1349-1355. 416. Packer M, Fowler MB, Roecker EB, Coats AJ, Katus HA, Krum H, Mohacsi P, Rouleau JL, Tendera M, Staiger C, Holcslaw TL, Amann-Zalan I, DeMets DL, Carvedilol Prospective
Nicholl J, 3CPO Study Investigators. A multicentre randomised con- trolled trial of the emergency department with severe acute cardiogenic pulmonary oedema: the 3CPO trial. Health Technol Assess
2009;13(33):1-106. 418. Park M, Sangean MC, Volpe Mde S, Feltrim MI, Nozawa E, Leite PF, Passos Amato MB, Lorenzi-Filho G. Randomized, prospective airway pressure by face mask in acute cardiogenic pulmonary edema. Crit Care Med 2004;32(12):2407-2415. 419. Gray
A, Goodacre S, Newby DE, Masson M, Sampson F, Nicholl J, 3CPO Trialists. Noninvasive ventilation in acute cardiogenic pulmonary edema. N Engl J Med 2008;359(2):142-51. 420. Harjola VP, Mebazaa A, Celutkiene J, Bueno H, Chioncel O, Crespo- Leiro MG, Falk V, Filippatos G, Gibbs S, Leite-Moreira A, Lassus J, Masip J, Mueller C,
Mullens W, Naeije R, Nordegraaf AV, Parissis J, Riley JP, Ristic A, Rosano G, Rudiger A, Ruschitzka F, Seferovic P, Sztrymf B, Vieillard-Baron A, Yilmaz MB, Konstantinides S. Contemporary management of acute right ventric- ular failure: a statement from the Heart Failure Association and the Working Group on Pulmonary Circulation and Right
Ventricular Function of the European Society of Cardiology. Eur J Heart Fail 2016;18(3):226-241. 421. Goldberg RJ, Spencer FA, Gore JM, Lessard D, Yarzebski J. Thirty-year trends (1975 to 2005) in the magnitude of, management of, and hospital death rates associated with cardiogenic shock in patients with acute myocardial infarction a population.
based perspective. Circulation 2009;119(9):1211-1219. 422. Picard MH, Davidoff R, Sleeper LA, Mendes LA, Thompson CR, Dzavik V, Steingart R, Gin K, White HD, Hochman JS, SHOCK Trial. Echocardiographic predictors of survival and response to early revascularization in cardiogenic shock. Circulation 2003;107(2):279-284. 423. Engstrom AE
Vis MM, Bouma BJ, van den Brink RBA, Baan J, Claessen B, Kikkert WJ, Sjauw KD, Meuwissen M, Koch KT, de Winter RJ, Tijssen JGP, Piek JJ, Henriques JPS. Right ventricular dysfunction is an independent predictor for mortality in ST-elevation myocardial infarction patients presenting with cardio- genic shock on admission. Eur J Heart Fail
2010;12(3):276-282. 424. Jeger RV, Lowe AM, Buller CE, Pfisterer ME, Dzavik V, Webb JG, Hochman JS, Jorde UP, SHOCK Investigators. Hemodynamic parameters are prognostically important in cardiogenic shock but similar following early revascularization or initial medical stabilization: a report from the SHOCK trial. Chest 2007;132(6):1794-
1803. 425. Hochman JS, Alexander JH, Reynolds HR, Stebbins AL, Dzavik V, Harrington RA, de Werf FV, TRIUMPH Investigators. Effect of tilarginine acetate in patients with acute myocardial infarction and cardiogenic shock: the TRIUMPH Investigators. Effect of tilarginine acetate in patients with acute myocardial infarction and cardiogenic shock: the TRIUMPH random- ized controlled trial. JAMA 2007;297(15):1657-1666. 426. Lancellotti P, Price S, Edvardsen T, Cosyns
B, Neskovic AN, Dulgheru R, Flachskampf FA, Hassager C, Pasquet A, Gargani L, Galderisi M, Cardiovascular care: Recommendations of the European Association of Cardiovascular Imaging and the Acute Cardiovascular Care
Association. Eur Heart J Acute Cardiovasc Care 2015;4(1):3-5. 427. Hussain F, Philipp RK, Ducas RA, Elliott J, Dzavik V, Jassal DS, Tam JW, Roberts D, Garber PJ, Ducas J. The ability to achieve complete revascularization is asso-ciated with improved in-hospital survival in cardiogenic shock due to myocardial infarction: Manitoba cardiogenic SHOCK
Registry investigators. Catheter Cardiovasc Interv 2011;78(4):540-548. 428. De Backer D, Biston P, Devriendt J, Madl C, Chochrad D, Aldecoa C, Brasseur A, Defrance P, Gottignies P, Vincent JL, SOAP II Investigators. Comparison of dopamine and norepinephrine in the treatment of shock. N Engl J Med 2010;362(9):779-789. 429. Ouweneel DM,
Eriksen E, Sjauw KD, van Dongen IM, Hirsch A, Packer EJ, Vis MM, Wykrzykowska JJ, Koch KT, Baan J, de Winter RJ, Piek JJ, Lagrand WK, de Mol BA, Tijssen JG, Henriques JP. Percutaneous mechanical circulatory support versus intra-aortic balloon pump in cardiogenic shock after acute myocardial infarction. J Am Coll Cardiol 2017;69(3):278-287
430. Cheng JM, den Uil CA, Hoeks SE, van der Ent M, Jewbali LS, van Domburg RT, Serruys PW. Percutaneous left ventricular assist devices vs. intra-aortic balloon pump counterpulsation for treatment of cardiogenic shock: a meta-analysis of controlled trials. Eur Heart J 2009;30(17):2102-2108. 431. Starling RC, Naka Y, Boyle AJ, Gonzalez-Stawinski
G, John R, Jorde U, Russell SD, Conte JV, Aaronson KD, McGee EC, Cotts WG, DeNofrio D, Duc TP, Farrar DJ, Pagani FD. Results of the post-US Food and Drug Administration. A prospective study using the INTERMACS (Interagency Registry for
Mechanically Assisted Circulatory Support). J Am Coll Cardiol 2011;57(19):1890-1898. 432. Sheu JJ, Tsai TH, Lee FY, Fang HY, Sun CK, Leu S, Yang CH, Chen SM, Hang CL, Hsieh YK, Chen CJ, Wu CJ, Yip HK. Early extracorporeal membrane oxygenator-assisted primary percutaneous coronary intervention improved 30- day clinical outcomes in
patients with ST-segment elevation myocardial infarc- tion complicated with profound cardiogenic shock. Crit Care Med 2010;38(9):1810–1817. 433. Shah MR, Hasselblad V, Stevenson LW, Binanay C, O'Connor CM, Sopko G, Califf RM. Impact of the pulmonary artery catheter in critically ill patients: meta-analysis of randomized clinical trials. JAMA
2005;294(13):1664-1670. 434. Bart BA, Goldsmith SR, Lee KL, Givertz MM, O'Connor CM, Bull DA, Redfield MM, Deswal A, Rouleau JL, LeWinter MM, Ofli EO, Stevenson LW, Semigran MJ, Felker GM, Chen HH, Hernandez AF, Anstrom KJ, McNulty SE, Velazquez EJ, Ibarra JC, Mascette AM, Braunwald E, Heart Failure Clinical Research Network.
Ultrafiltration in decompensated heart failure with cardiorenal syn- drome. N Engl J Med 2012;367(24):2296-2304. 435. Costanzo MR, Guglin ME, Saltzberg MT, Jessup ML, Bart BA, Teerlink JR, Jaski BE, Fang JC, Feller ED, Haas GJ, Anderson AS, Schollmeyer MP, Sobotka PA, UNLOAD Trial Investigators. Ultrafiltration versus intravenous diuretics
for patients hospitalized for acute decompensated heart failure. J Am Coll Cardiol 2007;49(6):675-683. 436. Costanzo MR, Saltzberg MT, Jessup M, Teerlink JR, Sobotka PA, Ultrafiltration Versus Intravenous Diuretics for Patients Hospitalized for Acute Decompensated Heart Failure (UNLOAD) Investigators. Ultrafiltration is asso-ciated with fewer
rehospitalizations than continuous diuretic infusion in patients with decompensated heart failure: results from UNLOAD. J Card Fail 2010;16(4):277-284. 437. Buerke M, Prondzinsky R, Lemm H, Dietz S, Buerke U, Ebelt H, Bushnaq H, Silber RE, Werdan K. Intra-aortic balloon counterpulsation in the treatment of infarction-related cardiogenic shock-
review of the current evidence. Artif Organs 2012;36(6):505-511. 64 ESC Guidelines Downloaded from by guest on 16 September 2017 65. ...
Kirchhof P, Kuck KH, Kudaiberdieva G, Lin T, Raviele A, Santini M, Tilz RR, Valgimigli M, Vos MA, Vrints C, Zeymer U, Lip GY, Potpara T, Fauchier L, Sticherling C, Roffi M, Widimsky P, Mehilli J, Lettino M, Schiele F, Sinnaeve P, Boriani G, Lane D, Savelieva I, European Heart Rhythm Association, Acute Cardiovascular Care Association, European
Association of Percutaneous Cardiovascular Interventions. Cardiac arrhythmias in acute coronary syn- dromes: position paper from the joint EHRA, ACCA, and EAPCI task force. Europace 2014;16(11):1655-1673. 439. Piccini JP, Schulte PJ, Pieper KS, Mehta RH, White HD, Van de Werf F, Ardissino D, Califf RM, Granger CB, Ohman EM, Alexander JH.
Antiarrhythmic drug therapy for sustained ventricular arrhythmias complicating acute myocar- dial infarction. Crit Care Med 2011;39(1):78-83. 440. Piers SR, Wijnmaalen AP, Borleffs CJ, van Huls van Taxis CF, Thijssen J, van Rees JB, Cannegieter SC, Bax JJ, Schalij MJ, Zeppenfeld K. Early reperfusion therapy affects inducibility, cycle length, and
occurrence of ventricular tachycar- dia late after myocardial infarction. Circ Arrhythm Electrophysiol 2011;4(2):195-201. 441. Nalliah CJ, Zaman S, Narayan A, Sullivan J, Kovoor P. Coronary artery reperfusion for ST elevation myocardial infarction is associated with shorter cycle length ventricular tachycardia and fewer spontaneous arrhythmias
Europace 2014;16(7):1053-1060. 442. Liang JJ, Fender EA, Cha YM, Lennon RJ, Prasad A, Barsness GW. Long-term outcomes in survivors of early ventricular arrhythmias after acute ST-elevation myocardial infarction treated with percutaneous coro- nary intervention. Am J Cardiol 2016;117(5):709-713. 443. Danchin N, Fauchier
L, Marijon E, Barnay C, Furber A, Mabo P, Bernard P, Blanc JJ, Jouven X, Le Heuzey JY, Charbonnier B, Ferrieres J, Simon T, French registry of Acute ST-elevation and non-ST-elevation at the acute stage of myocardial infarction: data
from the FAST-MI register. Heart 2010;96(22):1809-1814. 444. Schmitt J, Duray G, Gersh BJ, Hohnloser SH. Atrial fibrillation in acute myocar- dial infarctions. Eur Heart J 2009;30(9):1038-1045. 445. Batra G, Svennblad B, Held C, Jernberg T, Johanson P, Wallentin L
Oldgren J. All types of atrial fibrillation in the setting of myocardial infarction are associ- ated with impaired outcome. Heart 2016;102(12):926-933. 446. Nilsson KR, Jr, Al-Khatib SM, Zhou Y, Pieper K, White HD, Maggioni AP, Kober L, Granger CB, Lewis EF, McMurray JJ, Califf RM, Velazquez EJ. Atrial fibrillation management strategies and early
mortality after myocardial infarction: results from the Valsartan in Acute Myocardial Infarction (VALIANT) Trial. Heart 2010;96(11):838-842. 447. Jabre P, Jouven X, Adnet F, Thabut G, Bielinski SJ, Weston SA, Roger VL. Atrial fibrillation and death after myocardial infarction: a community study. Circulation 2011;123(19):2094-100. 448. Siu CW, Jim
MH, Ho HH, Miu R, Lee SW, Lau CP, Tse HF. Transient atrial fibrillation complicating acute inferior myocardial infarction: implications for future risk of ischemic stroke. Chest 2007;132(1):44-49. Segal JB, McNamara RL, Miller MR, Kim N, Goodman SN, Powe NR, Robinson K, Yu D, Bass EB. The evidence regarding the drugs used for future risk of ischemic stroke.
ventricular rate control. J Fam Pract 2000;49(1):47-59. 450. Hou ZY, Chang MS, Chen CY, Tu MS, Lin SL, Chiang HT, Woosley RL. Acute treatment of recent-onset atrial fibrillation and flutter with a tailored dosing regimen of intravenous amiodarone. A randomized, digoxin-controlled study. Eur Heart J 1995;16(4):521-528. 451. Metawee M, Charnigo
R, Morales G, Darrat Y, Sorrell V, Di Biase L, Natale A, Delisle B, Elayi CS; Magic Investigators. Digoxin and short term mortality after acute STEMI: results from the MAGIC trial. Int J Cardiol 2016;218:176-180. 452. Jordaens L, Trouerbach J, Calle P, Tavernier R, Derycke E, Vertongen P, Bergez B, Vandekerckhove Y. Conversion of atrial fibrillation
to sinus rhythm and rate control by digoxin in comparison to placebo. Eur Heart J 1997;18(4):643-648. 453. Thomas SP, Guy D, Wallace E, Crampton R, Kijvanit P, Eipper V, Ross DL, Cooper MJ. Rapid loading of sotalol or amiodarone for management of recent onset symptomatic atrial fibrillation: a randomized, digoxin-controlled trial. Am Heart J
2004;147(1):E3. 454. Piccini JP, Hranitzky PM, Kilaru R, Rouleau JL, White HD, Aylward PE, Van de Werf F, Solomon SD, Califf RM, Velazquez EJ. Relation of mortality to failure to prescribe beta blockers acutely in patients with sustained ventricular fibrillation following acute myocardial infarction (from the VALsartan In
 Acute myocardial iNfarcTion trial [VALIANT] Registry). Am J Cardiol 2008;102(11):1427-1432. 455. Zafari AM, Zarter SK, Heggen V, Wilson P, Taylor RA, Reddy K, Backscheider AG, Dudley SC, Jr. A program encouraging early defibrillation results in improved in-hospital resuscitation efficacy. J Am Coll Cardiol 2004;44(4):846-852. 456. Wolfe CL,
Nibley C, Bhandari A, Chatterjee K, Scheinman M. Polymorphous ventricular tachycardia associated with acute myocardial infarction. Circulation 1991;84(4):1543-1551. 457. Mehta RH, Yu J, Piccini JP, Tcheng JE, Farkouh ME, Reiffel J, Fahy M, Mehran R, Stone GW. Prognostic significance of postprocedural sustained ventricular tachycardia or
fibrillation in patients undergoing primary percutaneous coro- nary intervention (from the HORIZONS-AMI Trial). Am J Cardiol 2012;109(6):805-812. 458. Masuda M, Nakatani D, Hikoso S, Suna S, Usami M, Matsumoto S, Kitamura T, Minamiguchi H, Okuyama Y, Uematsu M, Yamada T, Iwakura K, Hamasaki T, Sakata Y, Sato H, Nanto S, Hori M,
Komuro I, Sakata Y, OACIS investigators. Clinical impact of ventricular tachycardia and/or fibrillation during the acute phase of acute myocardial infarction on in-hospital and 5-year mortality rates in the percutaneous coronary intervention era. Circ J 2016;80(7):1539-1547. 459. Haissaguerre M, Vigmond E, Stuyvers B, Hocini M, Bernus O.
Ventricular arrhythmias and the His-Purkinje system. Nat Rev Cardiol 2016;13(3):155-166, 460. Enjoji Y, Mizobuchi M, Muranishi H, Miyamoto C, Utsunomiya M, Funatsu A, Kobayashi T, Nakamura S. Catheter ablation of fatal ventricular tachyarrhyth- mias storm in acute coronary syndrome—role of Purkinje fiber network, I Interv Card
Electrophysiol 2009;26(3):207-215. 461. Peichl P, Cihak R, Kozeluhova M, Wichterle D, Vancura V, Kautzner J. Catheter ablation of arrhythmic storm triggered by monomorphic ectopic beats in patients with coronary artery disease. J Interv Card Electrophysiol 2010;27(1):51-59. 462. Nademanee K, Taylor R, Bailey WE, Rieders DE, Kosar EM.
Treating electrical storm: sympathetic blockade versus advanced cardiac life support-guided ther- apy. Circulation 2000;102(7):742-747. 463. Miwa Y, Ikeda T, Mera H, Miyakoshi M, Hoshida K, Yanagisawa R, Ishiguro H, Tsukada T, Abe A, Yusu S, Yoshino H. Effects of landiolol, an ultra-short-acting beta1-selective blocker, on electrical storm
refractory to class III antiarrhythmic drugs. Circ J 2010;74(5):856-863. 464. Hine LK, Laird N, Hewitt P, Chalmers TC. Meta-analytic evidence against pro-phylactic use of lidocaine in acute myocardial infarction. Arch Intern Med 1989;149(12):2694-2698. 465. Huikuri HV, Castellanos A, Myerburg RJ. Sudden death due to cardiac arrhyth-mias. N
Engl J Med 2001;345(20):1473-1482. 466. Moss AJ, Zareba W, Hall WJ, Klein H, Wilber DJ, Cannom DS, Daubert JP, Higgins SL, Brown MW, Andrews ML, Multicenter Automatic Defibrillator in patients with myocardial infarction and reduced ejection fraction. N Engl J Med
2002;346(12):877-883. 467. Bardy GH, Lee KL, Mark DB, Poole JE, Packer DL, Boineau R, Domanski M, Troutman C, Anderson J, Johnson G, McNulty SE, Clapp-Channing N, Davidson- Ray LD, Fraulo ES, Fishbein DP, Luceri RM, Ip JH, Sudden Cardiac Death in Heart Failure Trial Investigators. Amiodarone or an implantable cardioverter-defibrillator
for congestive heart failure. N Engl J Med 2005;352(3):225-237. 468. Chen A, Ashburn MA. Cardiac effects of opioid therapy. Pain Med 2015;16(Suppl 1):S27-31. 469. Brignole M, Auricchio A, Baron-Esquivias G, Bordachar P, Boriani G, Breithardt OA, Cleland J, Deharo JC, Delgado V, Elliott PM, Gorenek B, Israel CW, Leclercq C, Linde C, Mont L,
Padeletti L, Sutton R, Vardas PE. 2013 ESC Guidelines on cardiac pacing and resynchronization therapy of the European Society of Cardiology (ESC). Developed in collaboration with the European Heart Rhythm Association (EHRA). Eur Heart J 2013;34(29):2281-2329. 470.
Caforio AL, Pankuweit S, Arbustini E, Basso C, Gimeno-Blanes J, Felix SB, Fu M, Helio T, Heymans S, Jahns R, Klingel K, Linhart A, Maisch B, McKenna W, Mogensen J, Pinto YM, Ristic A, Schultheiss HP, Seggewiss H, Tavazzi L, Thiene G, Yilmaz A, Charron P, Elliott PM, European Society of Cardiology Working Group on Myocardial and Pericardial
Diseases. Current state of knowledge on aetiology, diagnosis, management, and therapy of myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocarditis: a position state- ment of the European Society of Cardiology Working Group on Myocardial and European Society of Cardiology Working Group on Myocardial and European Society of Cardiology Working Group on Myocardial 
T, Kreitner KF, Cardiac MR enables diagnosis in 90% of patients with acute chest pain, elevated biomarkers and unobstructed coronary arteries, Br J Radiol 2015;88(1049):20150025, 472. Pathik B, Raman B, Mohd Amin NH, Mahadayan D, Rajendran S, McGavigan AD, Grover S, Smith E, Mazhar J, Bridgman C, Ganesan AN, Selvanayagam JB.
Troponin-positive chest pain with unobstructed coronary arteries: incremental diagnostic value of cardiovascular magnetic resonance imaging. Eur Heart J Cardiovasc Imaging 2016;17(10):1146-1152. 473. Dastidar AG, Rodrigues JC, Johnson TW, De Garate E, Singhal P, Baritussio A, Scatteia A, Strange J, Nightingale AK, Angelini GD, Baumbach A,
Klein W, Brieger D, Steg PG, Dabbous O, Avezum A. Management of acute coronary syndromes. Variations in practice and outcome; findings from the Global Registry of Acute Coronary Events (GRACE). Eur Heart J 2002;23(15):1177-1189. 475. Lenfant C. Shattuck lecture - clinical practice - lost in trans- lation? N Engl J Med
2003;349(9):868-874. 476. Schiele F, Gale CP, Bonnefoy E, Capuano F, Claeys MJ, Danchin N, Fox KA, Huber K, Iakobishvili Z, Lettino M, Quinn T, Rubini Gimenez M, Botker HE, Swahn E, Timmis A, Tubaro M, Vrints C, Walker D, Zahger D, Zeymer U, Bueno H. Quality indicators for acute myocardial infarction: A position paper of the Acute
Cardiovascular Care Association. Eur Heart J Acute Cardiovasc Care 2017;6(1):34-59. 477. Ford I, Norrie J. Pragmatic trials. N Engl J Med 2016;375(5):454-463. 66 ESC Guidelines Downloaded from by guest on 16 September 2017
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