AMI-STEMI
2017 Guidelines for the Management of Acute Myocardial Infarction in Patients Presenting with ST-Segment Elevation
2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation*

The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC)

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Key messages

Epidemiology of STEMI
Although the rate of mortality associated with ischaemic heart disease has decreased 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 are decreasing and increasing, respectively. Despite the decline in acute and long-term death associated with STEMI, 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%.

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.

ECG and STEMI diagnosis
In some cases, patients may have coronary artery occlusion/global ischaemia in the absence of characteristic 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 compatible with ongoing myocardial ischaemia, a primary PCI strategy (i.e. urgent angiography and PCI if indicated) should be followed.

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 patients should undergo a primary PCI strategy unless the anticipated absolute time from STEMI diagnosis to PCI-mediated reperfusion (i.e. wire crossing) is >120 min, when fibrinolysis should be initiated immediately (i.e. within 10 min of STEMI diagnosis).

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 strategy. Patient transfer to the PCI centre should bypass the emergency department.
Key messages

Cardiac arrest and reperfusion strategy
Patients with ST-elevation on post-resuscitation ECG have to undergo a primary PCI strategy. In cases without ST-segment elevation on post-resuscitation ECG but with a high suspicion of ongoing myocardial ischaemia, urgent angiography should be considered 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.

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.

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).

Antithrombotic therapy
Anticoagulants and DAPT are the cornerstones of the pharmacological approach in the acute phase of STEMI. Primary PCI: unfractionated heparin (enoxaparin or bivalirudin may be alternatives), and loading dose of aspirin and prasugrel/ticagrelor. Fibrinolysis: enoxaparin (unfractionated heparin may be alternative), and loading dose of aspirin and clopidogrel. Maintenance therapy in the majority of patients is based on one year DAPT in the form of aspirin plus prasugrel/ticagrelor.

Early care
After reperfusion therapy, patients should be monitored for at least 24 h. 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.

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 additional attention.
Key messages

Imaging in STEMI
Non-invasive imaging is very important for the acute investigation of patients with an unclear diagnosis or suspicion of STEMI complications and for long-term management of STEMI patients after reperfusion.

MINOCA
A sizeable proportion of STEMI patients do not present significant coronary artery stenosis on urgent angiography. It is important to perform additional diagnostic tests in these patients to identify the aetiology and tailor appropriate therapy, which may be different from typical STEMI.

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.
Main gaps in evidence and areas for future research

Despite the great advances in STEMI management over recent decades, important areas of uncertainty persist that should be explored in the future. Here, we identify some, but not all, specific areas that should be addressed within the next few years.

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 predictors of long-term adverse events in STEMI survivors. The introduction of a specific infarct-limiting therapy in clinical practice might have a massive 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 experimental and small-scale clinical trials, but to date no large trial has demonstrated 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 questions 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 and what are the best strategies for i.v. antithrombotic therapies? What is the role of potent 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 as single or multiple antithrombotic regimens?
Main gaps in evidence and areas for future research

Beta-blockers and ACE-inhibitors
Although research regarding these classes of drugs was intense several 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-blockers is still not well established. The role of maintenance 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 maintenance ACE-inhibitors.

Post-STEMI risk stratification
The optimal therapeutic strategy to minimize the risk of sudden death in patients who develop VT or VF during or early after STEMI is not entirely clear. Despite 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 stratification 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 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 negative prognostic predictors in patients with STEMI. In addition to urgent revascularization of IRA and standard medical therapies for pre- and afterload reduction, there is limited evidence for the systematic use of inotropic and vasopressor agents as well as mechanical support. Similarly, the benefit of routine complete revascularization during the index PCI procedure in shock patients has not been formally demonstrated. The use of IABP has not met prior expectations of benefit, while LV assist devices and ECMO are increasingly popular but have not been sufficiently evaluated in clinical trials. Systematic evaluation of pharmacological 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 these to be strong grounds to translate studies into clinically relevant animal models and finally into humans.
Main gaps in evidence and areas for future research

Need for observational data and real-world evidence
In order to understand shortcomings and challenges in clinical practice, for quality assessment and for benchmarking, unselected and validated registries and clinical databases are needed. In this document, we have specified quality indicators intended to measure and compare the quality of health service provision and serve as a foundation for quality improvement initiatives. Their effects on procedural and clinical outcomes need to be evaluated.

Need for pragmatic real-life clinical trials
One major limitation of highly selective controlled clinical trials is their applicability in the real world. Strict inclusion criteria, tailored management, and very close follow-up results in a bias that precludes universal implementation. An opportunity is the implementation of pragmatic clinical trials including registry-based randomized clinical trials. These trials are less selective and less expensive alternatives to classical ones, especially for therapies used in clinical practice.