# 2023 ESC Guidelines for the management of acute coronary syndromes

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**Authors/Task Force Members:**

**Robert A. Byrne (Chairperson) (Ireland), Borja Ibanez (Chairperson) (Spain),**
Xavier Rossello (Task Force Coordinator) (Spain), J.J. Coughlan (Task Force Coordinator) (Ireland),
Emanuele  Barbato (Italy), Colin Berry (United Kingdom), Alaide Chieffo (Italy), Marc J. Claeys
(Belgium), Gheorghe-Andrei Dan (Romania), Marc R. Dweck (United Kingdom), Mary Galbraith
(United Kingdom), Martine Gilard (France), Lynne Hinterbuchner (Austria), Ewa A. Jankowska
(Poland), Peter Jüni (United Kingdom), Takeshi Kimura (Japan), Vijay Kunadian (United Kingdom),
Margret Leosdottir (Sweden), Roberto Lorusso (Netherlands), Roberto F. E. Pedretti (Italy),
Angelos G. Rigopoulos (Greece), Maria Rubini Gimenez (Germany), Holger Thiele (Germany),
Pascal Vranckx (Belgium), Sven Wassmann (Germany), Nanette Kass Wenger (United States of
America).

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# 2023 ESC Guidelines for the management of acute coronary syndromes

**ESC subspecialty communities having participated in the development of this document:**

**Associations**: Association of Cardiovascular Nursing & Allied Professions (ACNAP), Association for Acute CardioVascular Care (ACVC), European Association of Cardiovascular Imaging (EACVI), European Association of Preventive Cardiology (EAPC), European Association of Percutaneous Cardiovascular Interventions (EAPCI), European Heart Rhythm Association (EHRA) and Heart Failure Association (HFA)

**Working Groups**: Cardiovascular Pharmacotherapy, Cardiovascular Surgery, E-Cardiology, Myocardial and Pericardial Diseases, Thrombosis

**ESC Patient Forum**

# ESC Classes of recommendations

| | Definition | Wording to use |
|---|---|---|
| **Class I** | Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective. | Is recommended or is indicated |
| **Class II** | Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure. | |
| Class IIa | Weight of evidence/opinion is in favour of usefulness/efficacy. | Should be considered |
| Class IIb | Usefulness/efficacy is less well established by evidence/opinion. | May be considered |
| **Class III** | Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful. | Is not recommended |

*Classes of recommendations*

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# ESC Levels of evidence

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| | |
|---|---|
| Level of evidence A | Data derived from multiple randomized clinical trials or meta-analyses. |
| Level of evidence B | Data derived from a single randomized clinical trial or large non-randomized studies. |
| Level of evidence C | Consensus of opinion of the experts and/or small studies, retrospective studies, registries. |

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# Figure 1

## Central illustration

*Animation available online on the European Heart Journal website and in the ESC pocket Guidelines App*
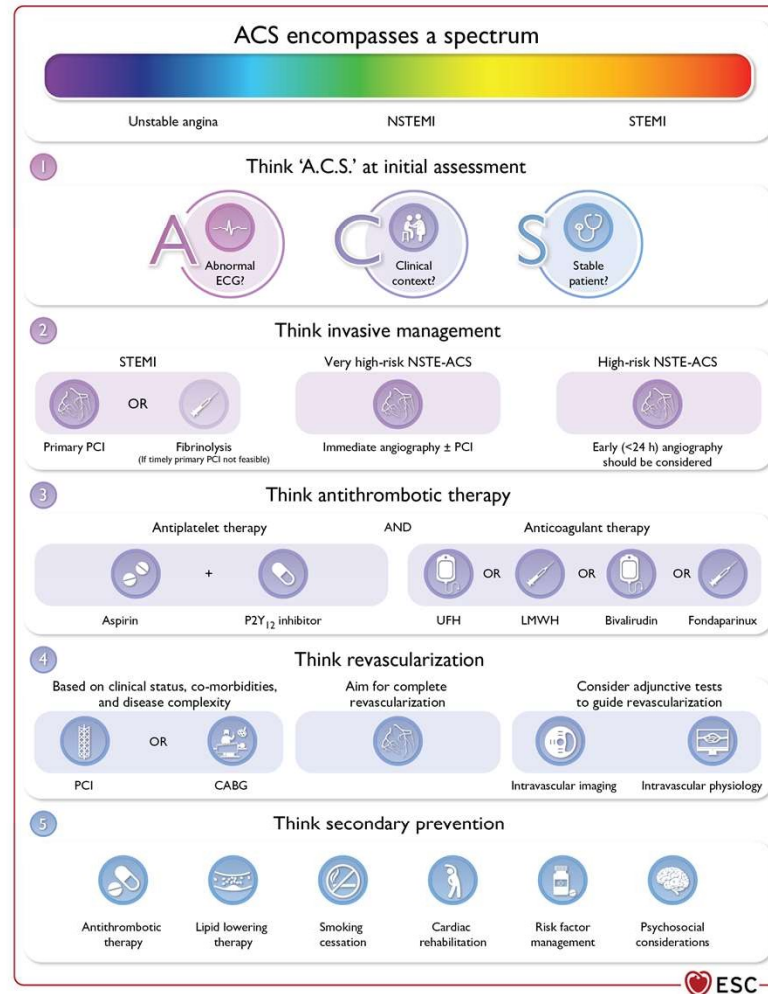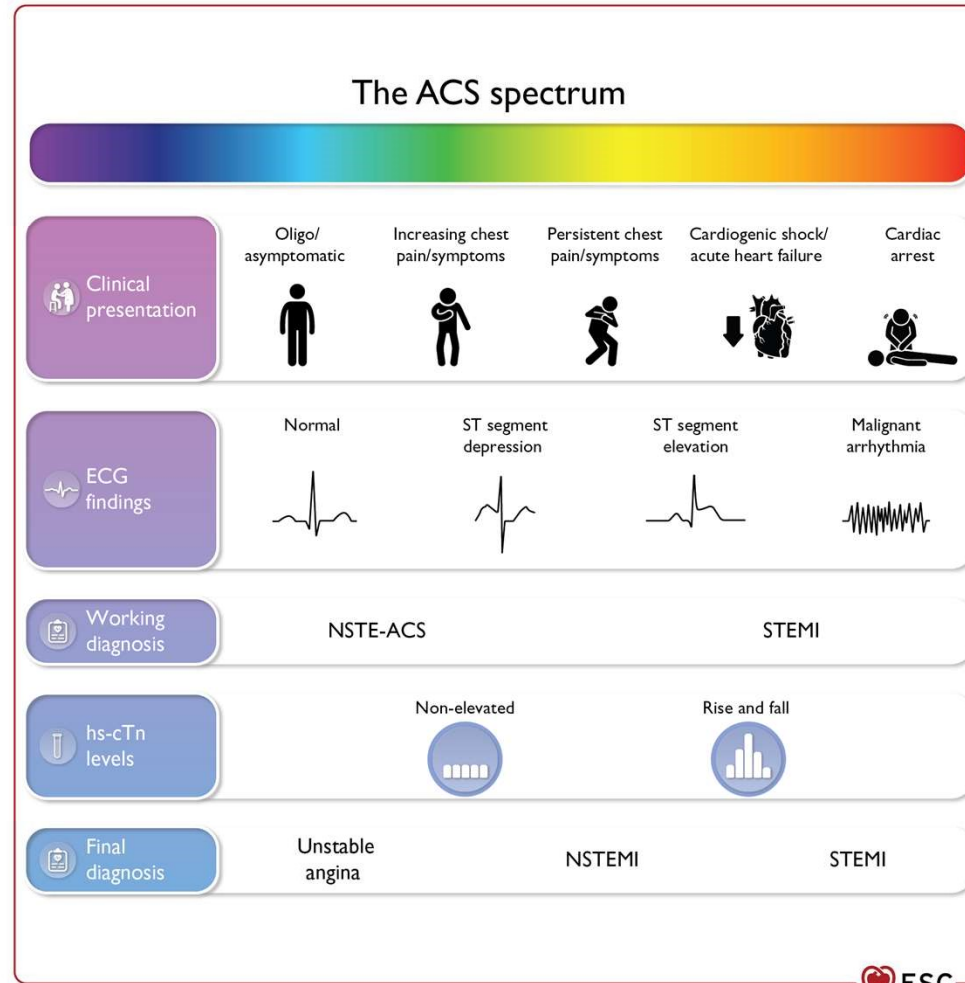
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# Figure 2

**The spectrum of clinical presentations, electrocardiographic findings, and high-sensitivity cardiac troponin levels in patients with acute coronary syndrome**



The ACS spectrum

| | | | | | |
|---|---|---|---|---|---|
| **Clinical presentation** | Oligo/asymptomatic | Increasing chest pain/symptoms | Persistent chest pain/symptoms | Cardiogenic shock/acute heart failure | Cardiac arrest |
| **ECG findings** | Normal | ST segment depression | ST segment elevation | Malignant arrhythmia | |
| **Working diagnosis** | NSTE-ACS | | | STEMI | |
| **hs-cTn levels** | | Non-elevated | Rise and fall | | |
| **Final diagnosis** | Unstable angina | NSTEMI | | STEMI | |

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# Definitions of terms related to invasive strategy and reperfusion therapy commonly used in this guideline (1)

| Term | Definition |
|---|---|
| First medical contact (FMC) | The time point when the patient is initially assessed by a physician, paramedic, nurse, or other trained emergency medical services worker who can obtain and interpret the ECG and deliver initial interventions (e.g. defibrillation). FMC can be either in the pre-hospital setting or upon patient arrival at the hospital (e.g. the emergency department) |
| STEMI diagnosis | The time at which a patient with ischaemic symptoms is interpreted as presenting with ACS and ST-segment elevation (or ST-segment elevation equivalent) |
| Primary PCI | Emergent PCI with balloon, stent, or other approved device, performed on the IRA without previous fibrinolytic treatment |
| Primary PCI strategy | Emergency coronary angiography and PCI of the IRA if indicated |

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# Definitions of terms related to invasive strategy and reperfusion therapy commonly used in this guideline (2)

| Term | Definition |
| --- | --- |
| Rescue PCI | Emergency PCI performed as soon as possible in cases of failed fibrinolytic treatment |
| Routine early PCI strategy after fibrinolysis | Coronary angiography, with PCI of the IRA if indicated, performed between 2 h and 24 h after successful fibrinolysis |
| Pharmaco-invasive strategy | Fibrinolysis combined with rescue PCI (in cases of failed fibrinolysis) or routine early PCI strategy (in cases of successful fibrinolysis) |
| Immediate invasive strategy | Emergency coronary angiography (i.e. as soon as possible) and PCI/CABG of the IRA if indicated |

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# Definitions of terms related to invasive strategy and reperfusion therapy commonly used in this guideline (3)

| Term | Definition |
|---|---|
| Early invasive strategy | Early coronary angiography (<24 h from diagnosis of ACS) and PCI/CABG of the IRA if indicated |
| Selective invasive strategy | Coronary angiography ± PCI/CABG based on clinical assessment and/or non-invasive testing |

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**Figure 3**

**Classification of patients presenting with suspected acute coronary syndrome: from a working to a final diagnosis**
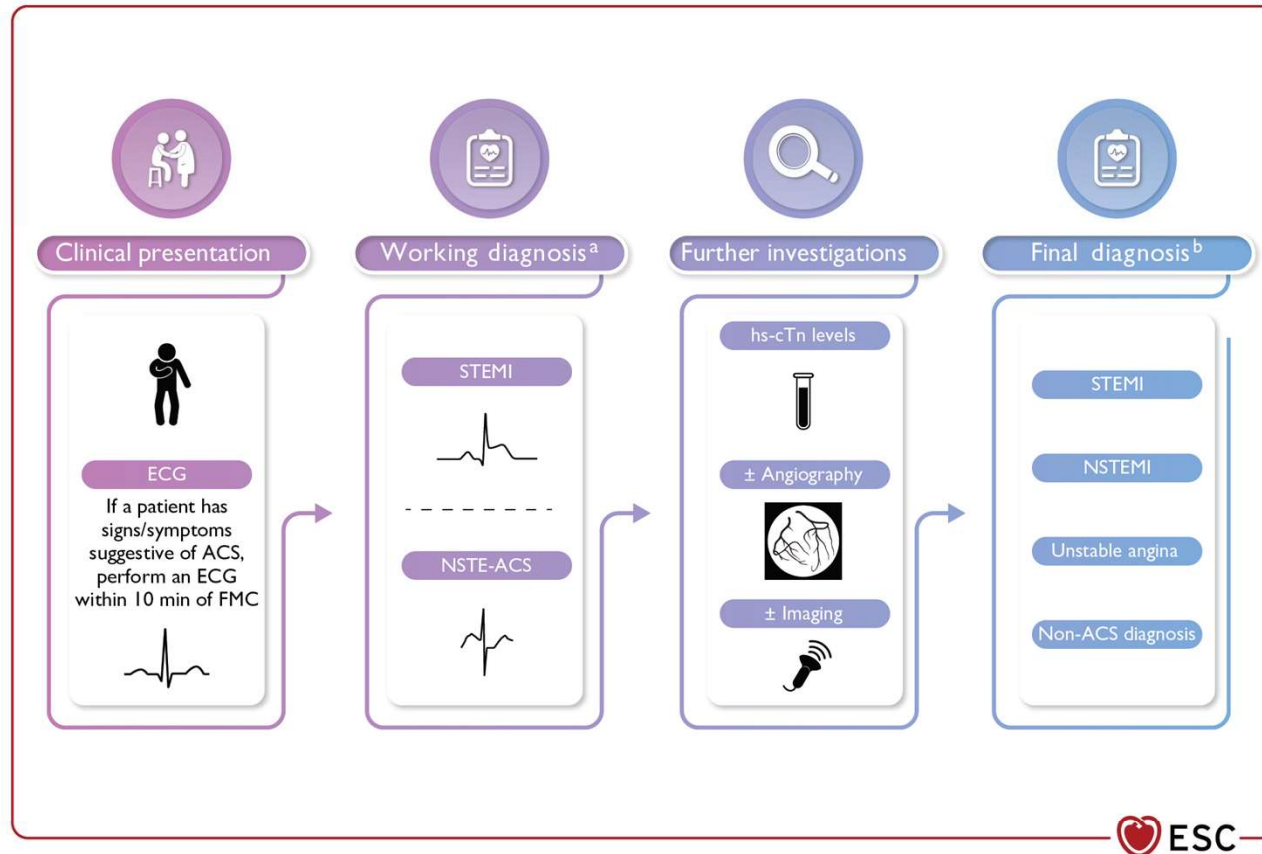
# New recommendations (1)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome* | | |
| If patients presenting with ACS stop DAPT to undergo coronary artery bypass grafting, it is recommended they resume DAPT after surgery for at least 12 months. | I | C |
| In older ACS patients, especially if HBR, clopidogrel as the $P2Y_{12}$ receptor inhibitor may be considered. | IIb | B |
| *Recommendations for alternative antithrombotic therapy regimens* | | |
| In patients who are event-free after 3–6 months of DAPT and who are not high ischaemic risk, single antiplatelet therapy (preferably with a $P2Y_{12}$ receptor inhibitor) should be considered. | IIa | A |
| $P2Y_{12}$ inhibitor monotherapy may be considered as an alternative to aspirin monotherapy for long-term treatment. | IIb | A |

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# New recommendations (2)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for alternative antithrombotic therapy regimens (continued)* | | |
| In HBR patients, aspirin or P2Y$_{12}$ receptor inhibitor monotherapy after 1 month of DAPT may be considered. | IIb | B |
| In patients requiring OAC, withdrawing antiplatelet therapy at 6 months while continuing OAC may be considered. | IIb | B |
| De-escalation of antiplatelet therapy in the first 30 days after an ACS event is not recommended. | III | B |
| *Recommendations for cardiac arrest and out-of-hospital cardiac arrest* | | |
| Evaluation of neurological prognosis (no earlier than 72 h after admission) is recommended in all comatose survivors after cardiac arrest. | I | C |
| Transport of patients with out-of-hospital cardiac arrest to a cardiac arrest centre according to local protocol should be considered. | IIa | C |

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# New recommendations (3)

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| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for technical aspects of invasive strategies* | | |
| In patients with spontaneous coronary artery dissection, PCI is recommended only for patients with symptoms and signs of ongoing myocardial ischaemia, a large area of myocardium in jeopardy, and reduced antegrade flow. | I | C |
| Intravascular imaging should be considered to guide PCI. | IIa | A |
| Intravascular imaging (preferably optical coherence tomography) may be considered in patients with ambiguous culprit lesions. | IIb | C |
| *Recommendations for multivessel disease in ACS patients presenting in cardiogenic shock* | | |
| Staged PCI of non-IRA should be considered. | IIa | C |
| *Recommendations for multivessel disease in haemodynamically stable STEMI patients undergoing primary PCI* | | |
| It is recommended that PCI of the non-IRA is based on angiographic severity. | I | B |
| Invasive epicardial functional assessment of non-culprit segments of the IRA is not recommended during the index procedure. | III | C |

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# New recommendations (4)

| Recommendations | Class | Level |
|---|---|---|
| **Recommendations for acute coronary syndrome complications** | | |
| Implantation of a permanent pacemaker is recommended when high-degree AV block does not resolve within a waiting period of at least 5 days after MI. | I | C |
| Cardiac magnetic resonance should be considered in patients with equivocal echocardiographic images or in cases of high clinical suspicion of LV thrombus. | IIa | C |
| Following an acute anterior MI, a contrast echocardiogram may be considered for the detection of LV thrombus if the apex is not well visualized on echocardiography. | IIb | C |
| In selected patients with high-degree AV block in the context of an anterior wall MI and acute heart failure, early device implantation (cardiac resynchronization therapy – defibrillator/pacemaker;) may be considered. | IIb | C |
| In patients with recurrent life-threatening ventricular arrhythmias, sedation or general anaesthesia to reduce sympathetic drive may be considered. | IIb | C |

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# New recommendations (5)

| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for acute coronary syndrome comorbid conditions* | | |
| It is recommended to base the choice of long-term glucose-lowering treatment on the presence of comorbidities, including heart failure, chronic kidney disease, and obesity. | I | A |
| For frail older patients with comorbidities, a holistic approach is recommended to individualize interventional and pharmacological treatments after careful evaluation of the risks and benefits. | I | B |
| An invasive strategy is recommended in cancer patients presenting with high-risk ACS with expected survival ≥6 months. | I | B |
| A temporary interruption of cancer therapy is recommended in patients in whom the cancer therapy is suspected to be a contributing cause of ACS. | I | C |
| A conservative non-invasive strategy should be considered in ACS patients with poor cancer prognosis (i.e. with expected life survival <6 months) and/or very high bleeding risk. | IIa | C |

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# New recommendations (6)

| Recommendations | Class | Level |
|---|---|---|
| ***Recommendations for acute coronary syndrome comorbid conditions (continued)*** | | |
| Aspirin is not recommended in cancer patients with a platelet count <10 000/μL. | III | C |
| Clopidogrel is not recommended in cancer patients with a platelet count <30 000/μL. | III | C |
| In ACS patients with cancer and <50 000/μL platelet count, prasugrel or ticagrelor are not recommended. | III | C |
| ***Recommendations for long-term management*** | | |
| It is recommended to intensify lipid-lowering therapy during the index ACS hospitalization for patients who were on lipid-lowering therapy before admission. | I | C |
| Low-dose colchicine (0.5 mg once daily) may be considered, particularly if other risk factors are insufficiently controlled or if recurrent cardiovascular disease events occur under optimal therapy. | IIb | A |
| Combination therapy with a high-dose statin plus ezetimibe may be considered during index hospitalization. | IIb | B |

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# New recommendations (7)

| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for patient perspectives in acute coronary syndrome care* | | |
| Patient-centred care is recommended by assessing and adhering to individual patient preferences, needs and beliefs, ensuring that patient values are used to inform all clinical decisions. | I | B |
| It is recommended to include ACS patients in decision-making (as much as their condition allows) and to inform them about the risk of adverse events, radiation exposure, and alternative options. Decision aids should be used to facilitate the discussion. | I | B |
| It is recommended to assess symptoms using methods that help patients to describe their experience. | I | C |
| Use of the 'teach back' technique for decision support during the securing of informed consent should be considered. | IIa | B |

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# New recommendations (8)

| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for patient perspectives in acute coronary syndrome care (continued)* | | |
| Patient discharge information should be provided in both written and verbal formats prior to discharge. Adequate preparation and education for patient discharge using the teach back technique and/or motivational interviewing, giving information in chunks, and checking for understanding, should be considered. | IIa | B |
| Assessment of mental well-being using a validated tool and onward psychological referral when appropriate should be considered. | IIa | B |

# Revised recommendations (1)

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| **Recommendations for imaging for patients with suspected NSTE-ACS** | | | | | |
| In patients with no recurrence of chest pain, normal ECG findings, and normal levels of cardiac troponin (preferably high sensitivity), but still with suspected ACS, a non-invasive stress test (preferably with imaging) for inducible ischaemia or CCTA is recommended before deciding on an invasive approach. | I | B | In patients with suspected ACS, non-elevated (or uncertain) hs-cTn, no ECG changes and no recurrence of pain, incorporating CCTA or a non-invasive stress imaging test as part of the initial workup should be considered. | IIa | A |

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# Revised recommendations (2)

**ESC**

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| *Recommendations for timing of invasive strategy in NSTE-ACS* | | | | | |
| An early invasive strategy within 24 h is recommended in patients with any of the following high-risk criteria:<br>• Diagnosis of NSTEMI suggested by the diagnostic algorithm recommended in guidelines<br>• Dynamic or presumably new contiguous ST/T-segment changes suggesting ongoing ischaemia<br>• Transient ST-segment elevation.<br>• GRACE risk score >140 | I | A | An early invasive strategy within 24 h should be considered in patients with at least one of the following high-risk criteria:<br>• Confirmed diagnosis of NSTEMI based on current recommended ESC hs-cTn algorithms<br>• Dynamic ST-segment or T wave changes<br>• Transient ST-segment elevation<br>• GRACE risk score >140 | IIa | A |

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# Revised recommendations (3)

**ESC**

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| *Recommendations for antiplatelet and anticoagulant therapy in STEMI* | | | | | |
| A potent P2Y$_{12}$ inhibitor (prasugrel or ticagrelor), or clopidogrel if these are not available or are contraindicated, is recommended before (or at latest at the time of) PCI, and maintained over 12 months, unless there are contraindications such as excessive risk of bleeding. | I | A | Pre-treatment with a P2Y$_{12}$ receptor inhibitor may be considered in patients undergoing a primary PCI strategy. | IIb | B |

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# Revised recommendations (4)

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| *Recommendations for long-term antithrombotic therapy* | | | | | |
| After stent implantation in patients undergoing a strategy of DAPT, stopping aspirin after 3–6 months should be considered, depending on the balance between the ischaemic and bleeding risks. | IIa | A | In patients who are event-free after 3–6 months of DAPT and who are not high ischaemic risk, SAPT (preferably with a P2Y$_{12}$ receptor inhibitor) should be considered. | IIa | A |

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# Revised recommendations (5)

**ESC**

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| *Recommendations for cardiac arrest and out-of-hospital cardiac arrest* | | | | | |
| Delayed as opposed to immediate angiography should be considered among haemodynamically stable patients without ST-segment elevation successfully resuscitated after out-of-hospital cardiac arrest. | IIa | B | Routine immediate angiography after resuscitated cardiac arrest is not recommended in haemodynamically stable patients without persistent ST-segment elevation (or equivalents). | III | A |
| Targeted temperature management (also called therapeutic hypothermia), aiming for a constant temperature between 32 and 36 C for at least 24 h, is indicated in patients who remain unconscious after resuscitation from cardiac arrest (of presumed cardiac cause). | I | B | Temperature control (i.e. continuous monitoring of core temperature and active prevention of fever [i.e. >37.7°C]) is recommended after either out-of-hospital or in-hospital cardiac arrest for adults who remain unresponsive after return of spontaneous circulation. | I | B |

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# Revised recommendations (6)

**ESC**

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| *Recommendations for in-hospital management* | | | | | |
| When echocardiography is suboptimal/inconclusive, an alternative imaging method (CMR preferably) should be considered. | IIa | C | When echocardiography is suboptimal/inconclusive, CMR imaging may be considered. | IIb | C |

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# Revised recommendations (7)

| 2017 and 2020 | Class | Level | 2023 | Class | Level |
|---|---|---|---|---|---|
| **Recommendations for management of multivessel disease in haemodynamically stable STEMI patients undergoing primary PCI** | | | | | |
| Routine revascularization of non-IRA lesions should be considered in STEMI patients with multivessel disease before hospital discharge. | IIa | A | Complete revascularization is recommended either during the index PCI procedure or within 45 days. | I | A |
| **Recommendations for acute coronary syndrome comorbid conditions** | | | | | |
| Glucose-lowering therapy should be considered in ACS patients with blood glucose >10 mmol/L (>180 mg/dL), with the target adapted to comorbidities, while episodes of hypoglycaemia should be avoided. | IIa | B | Glucose-lowering therapy should be considered in patients with ACS with persistent hyperglycaemia, while episodes of hypoglycaemia should be avoided. | IIa | C |

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**Figure 4** An overview of the initial triage, management and investigation of patients who present with signs and symptoms potentially consistent with acute coronary syndrome
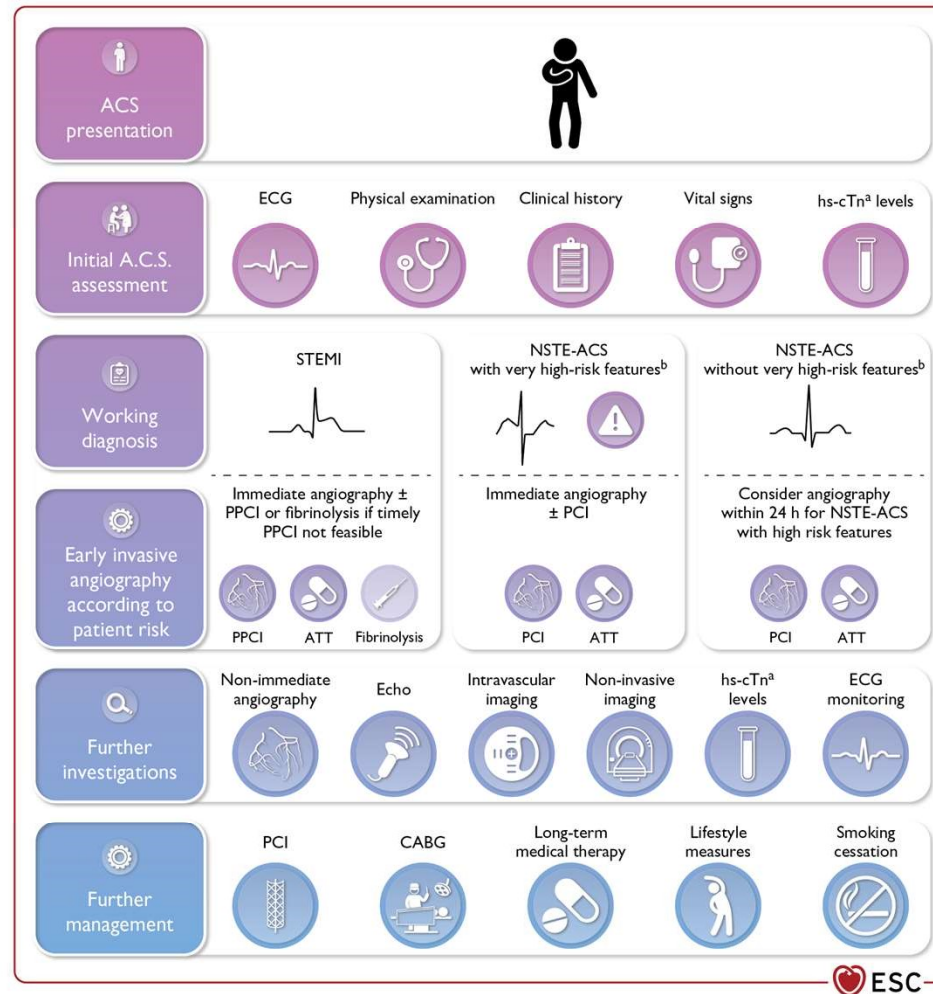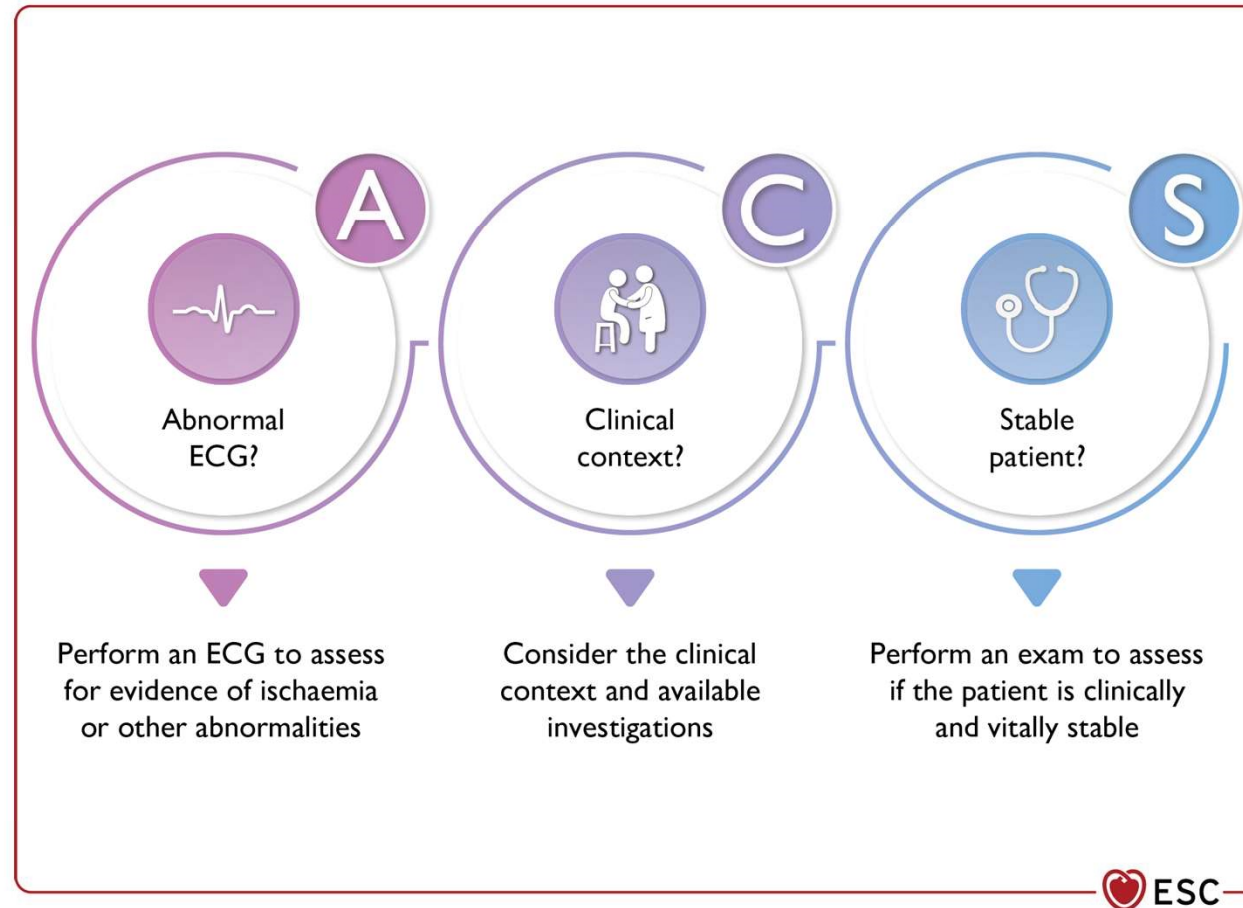
**Figure 5**

The A.C.S. assessment for the initial evaluation of patients with suspected acute coronary syndrome

A — Abnormal ECG? — Perform an ECG to assess for evidence of ischaemia or other abnormalities

C — Clinical context? — Consider the clinical context and available investigations

S — Stable patient? — Perform an exam to assess if the patient is clinically and vitally stable

# Recommendations for clinical and diagnostic tools for patients with suspected acute coronary syndrome (1)

| Recommendations | Class | Level |
|---|---|---|
| It is recommended to base the diagnosis and initial short-term risk stratification of ACS on a combination of clinical history, symptoms, vital signs, other physical findings, ECG, and hs-cTn. | I | B |
| *ECG* | | |
| Twelve-lead ECG recording and interpretation is recommended as soon as possible at the point of FMC, with a target of <10 min. | I | B |
| Continuous ECG monitoring and the availability of defibrillator capacity is recommended as soon as possible in all patients with suspected STEMI, in suspected ACS with other ECG changes or ongoing chest pain, and once the diagnosis of MI is made. | I | B |
| The use of additional ECG leads (V3R, V4R, and V7–V9) is recommended in cases of inferior STEMI or if total vessel occlusion is suspected and standard leads are inconclusive. | I | B |
| An additional 12-lead ECG is recommended in cases with recurrent symptoms or diagnostic uncertainty. | I | C |

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# Recommendations for clinical and diagnostic tools for patients with suspected acute coronary syndrome (2)

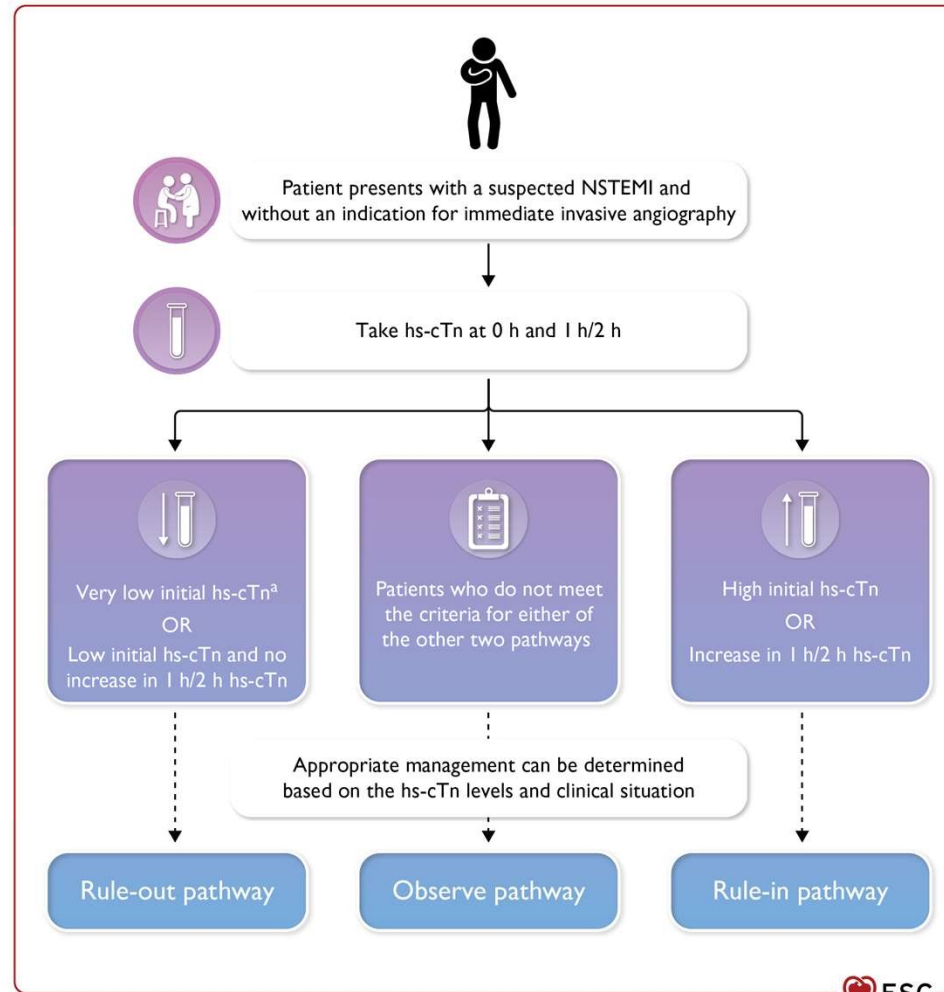| Recommendations | Class | Level |
|---|---|---|
| **Blood sampling** | | |
| It is recommended to measure cardiac troponins with high-sensitivity assays immediately after presentation and to obtain the results within 60 min of blood sampling. | I | B |
| It is recommended to use an ESC algorithmic approach with serial hs-cTn measurements (0 h/1 h or 0 h/2 h) to rule in and rule out NSTEMI. | I | B |
| Additional testing after 3 h is recommended if the first two hs-cTn measurements of the 0 h/1 h algorithm are inconclusive and no alternative diagnoses explaining the condition have been made. | I | B |
| The use of established risk scores (e.g. GRACE risk score) for prognosis estimation should be considered. | IIa | B |

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# Recommendations for clinical and diagnostic tools for patients with suspected acute coronary syndrome (3)

| Recommendations | Class | Level |
|---|---|---|
| *Triage for emergency reperfusion strategy* | | |
| It is recommended that patients with suspected STEMI are immediately triaged for an emergency reperfusion strategy. | I | A |

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# Figure 6

The 0 h/1 h or 0 h/2 h rule-out and rule-in algorithms using high-sensitivity cardiac troponin assays in patients presenting to the emergency department with suspected NSTEMI and without an indication for immediate invasive angiography



Patient presents with a suspected NSTEMI and without an indication for immediate invasive angiography

Take hs-cTn at 0 h and 1 h/2 h

Very low initial hs-cTn[a]
OR
Low initial hs-cTn and no increase in 1 h/2 h hs-cTn

Patients who do not meet the criteria for either of the other two pathways

High initial hs-cTn
OR
Increase in 1 h/2 h hs-cTn

Appropriate management can be determined based on the hs-cTn levels and clinical situation

Rule-out pathway

Observe pathway

Rule-in pathway

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# Recommendations for non-invasive imaging in the initial assessment of patients with suspected acute coronary syndrome

| Recommendations | Class | Level |
|---|---|---|
| Emergency TTE is recommended in patients with suspected ACS presenting with cardiogenic shock or suspected mechanical complications. | I | C |
| In patients with suspected ACS, non-elevated (or uncertain) hs-cTn levels, no ECG changes and no recurrence of pain, incorporating CCTA or a non-invasive stress imaging test as part of the initial workup should be considered. | IIa | A |
| Emergency TTE should be considered at triage in cases of diagnostic uncertainty but this should not result in delays in transfer to the cardiac catheterization laboratory if there is suspicion of an acute coronary artery occlusion. | IIa | C |
| Routine, early CCTA in patients with suspected ACS is not recommended. | III | B |

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# Recommendations for the initial management of patients with acute coronary syndrome (1)

| Recommendations | Class | Level |
|---|---|---|
| **_Hypoxia_** | | |
| Oxygen is recommended in patients with hypoxaemia (SaO$_2$ <90%). | I | C |
| Routine oxygen is not recommended in patients without hypoxaemia (SaO$_2$ >90%). | III | A |
| **_Symptoms_** | | |
| Intravenous opioids should be considered to relieve pain. | IIa | C |
| A mild tranquilizer should be considered in very anxious patients. | IIa | C |
| **_Intravenous beta-blockers_** | | |
| Intravenous beta-blockers (preferably metoprolol) should be considered at the time of presentation in patients undergoing PPCI with no signs of acute heart failure, an SBP >120 mmHg, and no other contraindications. | IIa | A |

# Recommendations for the initial management of patients with acute coronary syndrome (2)

| Recommendations | Class | Level |
|---|---|---|
| ***Pre-hospital logistics of care*** | | |
| It is recommended that the pre-hospital management of patients with a working diagnosis of STEMI is based on regional networks designed to deliver reperfusion therapy expeditiously and effectively, with efforts made to make PPCI available to as many patients as possible. | I | B |
| It is recommended that PPCI-capable centres deliver a 24/7 service and are able to perform PPCI without delay. | I | B |
| It is recommended that patients transferred for PPCI bypass the emergency department and CCU/ICU and are transferred directly to the catheterization laboratory. | I | B |
| It is recommended that EMS transfer patients with suspected STEMI to a PCI-capable centre, bypassing non-PCI centres. | I | C |

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# Recommendations for the initial management of patients with acute coronary syndrome (3)

| Recommendations | Class | Level |
|---|---|---|
| *Pre-hospital logistics of care (continued)* | | |
| It is recommended that ambulance teams are trained and equipped to identify ECG patterns suggestive of acute coronary occlusion and to administer initial therapy, including defibrillation, and fibrinolysis when applicable. | I | C |
| It is recommended that all hospitals and EMS participating in the care of patients with suspected STEMI record and audit delay times and work together to achieve and maintain quality targets. | I | C |

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# Figure 7

**Modes of presentation and pathways to invasive management and myocardial revascularization in patients presenting with STEMI**
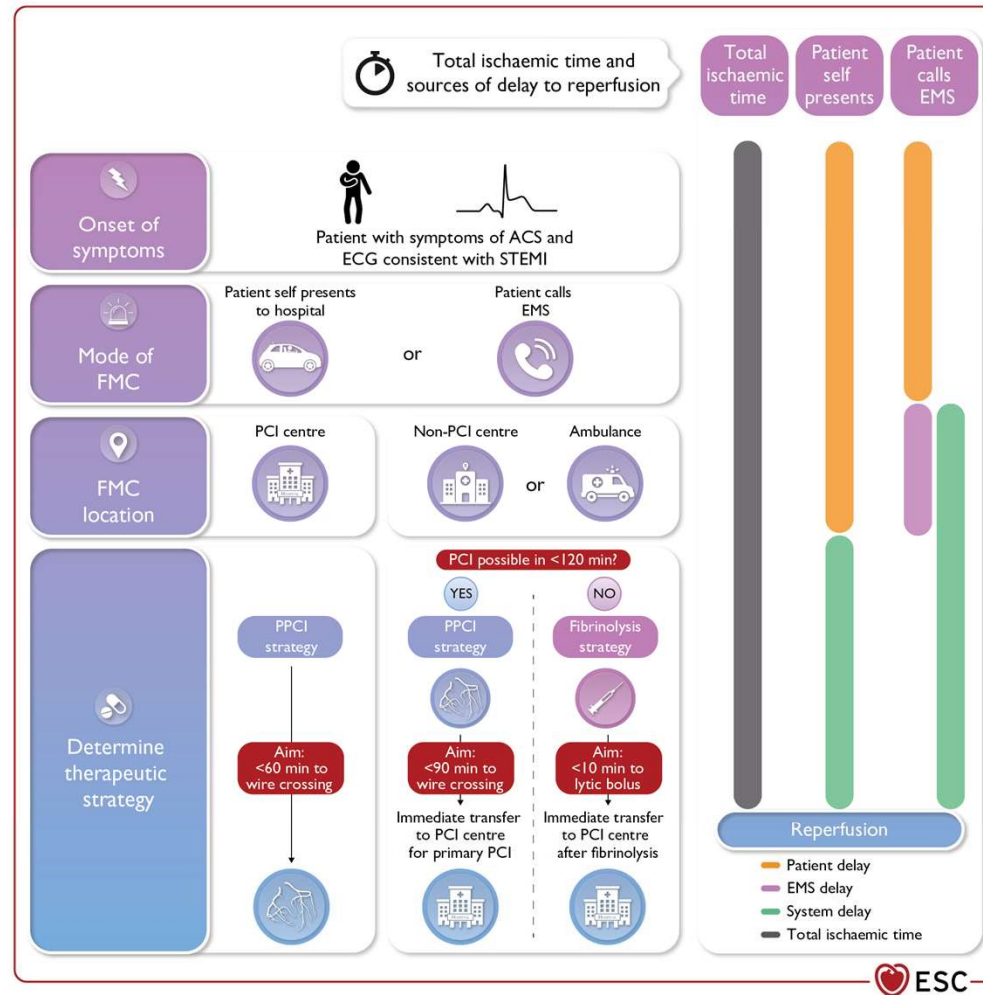
# Figure 8

**Selection of invasive strategy and reperfusion therapy in patients presenting with NSTE-ACS**
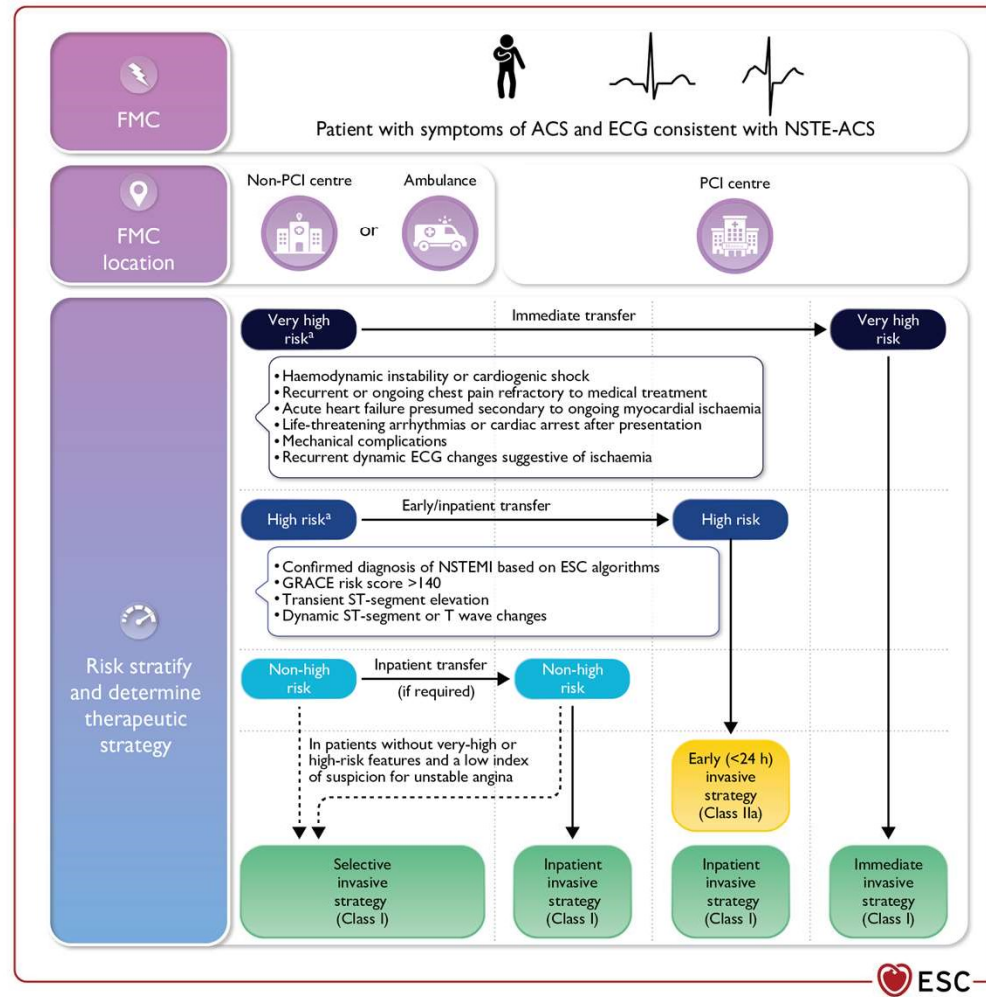
# Recommendations for reperfusion therapy and timing of invasive strategy (1)

| Recommendations | Class | Level |
|---|---|---|
| *Recommendations for reperfusion therapy for patients with STEMI* | | |
| Reperfusion therapy is recommended in all patients with a working diagnosis of STEMI (persistent ST-segment elevation or equivalents) and symptoms of ischaemia of ≤12 h duration. | I | A |
| A PPCI strategy is recommended over fibrinolysis if the anticipated time from diagnosis to PCI is <120 min. | I | A |
| If timely PPCI (<120 min) cannot be performed in patients with a working diagnosis of STEMI, fibrinolytic therapy is recommended within 12 h of symptom onset in patients without contraindications. | I | A |
| Rescue PCI is recommended for failed fibrinolysis (i.e. ST-segment resolution <50% within 60–90 min of fibrinolytic administration) or in the presence of haemodynamic or electrical instability, worsening ischaemia, or persistent chest pain. | I | A |

# Recommendations for reperfusion therapy and timing of invasive strategy (2)

| Recommendations | Class | Level |
|---|---|---|
| **Recommendations for reperfusion therapy for patients with STEMI (continued)** | | |
| In patients with a working diagnosis of STEMI and a time from symptom onset >12 h, a PPCI strategy is recommended in the presence of ongoing symptoms suggestive of ischaemia, haemodynamic instability, or life-threatening arrhythmias. | I | C |
| A routine PPCI strategy should be considered in STEMI patients presenting late (12–48 h) after symptom onset. | IIa | B |
| Routine PCI of an occluded IRA is not recommended in STEMI patients presenting >48 h after symptom onset and without persistent symptoms. | III | A |

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# Recommendations for reperfusion therapy and timing of invasive strategy (3)

| Recommendations | Class | Level |
|---|---|---|
| ***Transfer/interventions after fibrinolysis*** | | |
| Transfer to a PCI-capable centre is recommended in all patients immediately after fibrinolysis. | I | A |
| Emergency angiography and PCI of the IRA, if indicated is recommended in patients with new-onset or persistent heart failure/shock after fibrinolysis. | I | A |
| Angiography and PCI of the IRA, if indicated, is recommended between 2 and 24 h after successful fibrinolysis. | I | A |
| ***Invasive strategy in NSTE-ACS*** | | |
| An invasive strategy during hospital admission is recommended in NSTE-ACS patients with high-risk criteria or a high index of suspicion for unstable angina. | I | A |
| A selective invasive approach is recommended in patients without very high- or high-risk NSTE-ACS criteria and with a low index of suspicion for NSTE-ACS. | I | A |

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# Recommendations for reperfusion therapy and timing of invasive strategy (4)

| Recommendations | Class | Level |
|---|---|---|
| **Invasive strategy in NSTE-ACS (continued)** | | |
| An immediate invasive strategy is recommended in patients with a working diagnosis of NSTE-ACS and with at least one of the following very high-risk criteria:<br>• Haemodynamic instability or cardiogenic shock<br>• Recurrent or refractory chest pain despite medical treatment<br>• In-hospital life-threatening arrhythmias<br>• Mechanical complications of MI<br>• Acute heart failure presumed secondary to ongoing myocardial ischaemia<br>• *Recurrent* dynamic ST-segment or T wave changes, particularly intermittent ST-segment elevation. | I | C |

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# Recommendations for reperfusion therapy and timing of invasive strategy (5)

| Recommendations | Class | Level |
|---|---|---|
| ***Invasive strategy in NSTE-ACS (continued)*** | | |
| An early invasive strategy within 24 h should be considered in patients with at least one of the following high-risk criteria:<br>• Confirmed diagnosis of NSTEMI based on current recommended ESC hs-cTn algorithms<br>• Dynamic ST-segment or T wave changes<br>• Transient ST-segment elevation<br>• GRACE risk score >140 | IIa | A |

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# Dose regimen of antiplatelet and anticoagulant drugs in acute coronary syndrome patients (1)

| Antiplatelet drugs | |
|---|---|
| Aspirin | LD of 150–300 mg orally or 75–250 mg i.v. if oral ingestion is not possible, followed by oral MD of 75–100 mg o.d.; no specific dose adjustment in CKD patients. |
| **P2Y$_{12}$ receptor inhibitors (oral or i.v.)** | |
| Clopidogrel | LD of 300–600 mg orally, followed by an MD of 75 mg o.d.; no specific dose adjustment in CKD patients.<br>Fibrinolysis: at the time of fibrinolysis an initial dose of 300 mg (75 mg for patients older than 75 years of age). |
| Prasugrel | LD of 60 mg orally, followed by an MD of 10 mg o.d. In patients with body weight <60 kg, an MD of 5 mg o.d. is recommended. In patients aged ≥75 years, prasugrel should be used with caution, but a MD of 5 mg o.d. should be used if treatment is deemed necessary. No specific dose adjustment in CKD patients. Prior stroke is a contraindication for prasugrel. |

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# Dose regimen of antiplatelet and anticoagulant drugs in acute coronary syndrome patients (2)

| Antiplatelet drugs | |
|---|---|
| **P2Y$_{12}$ receptor inhibitors (oral or i.v.) (continued)** | |
| Ticagrelor | LD of 180 mg orally, followed by an MD of 90 mg b.i.d.; no specific dose adjustment in CKD patients. |
| Cangrelor | Bolus of 30 mcg/kg i.v. followed by 4 mcg/kg/min infusion for at least 2 h or the duration of the procedure (whichever is longer).<br><br>In the transition from cangrelor to a thienopyridine, the thienopyridine should be administered immediately after discontinuation of cangrelor with an LD (clopidogrel 600 mg or prasugrel 60 mg); to avoid a potential DDI, prasugrel may also be administered 30 min before the cangrelor infusion is stopped. Ticagrelor (LD 180 mg) should be administered at the time of PCI to minimize the potential gap in platelet inhibition during the transition phase. |

# Dose regimen of antiplatelet and anticoagulant drugs in acute coronary syndrome patients (3)

| Antiplatelet drugs | |
|---|---|
| **GP IIb/IIIa receptor inhibitors (i.v.)** | |
| Eptifibatide | Double bolus of 180 mcg/kg i.v. (given at a 10-min interval) followed by an infusion of 2.0 mcg/kg/min for up to 18 h. For CrCl 30–50 mL/min: first LD, 180 mcg/kg i.v. bolus (max 22.6 mg); maintenance infusion, 1 mcg/kg/min (max 7.5 mg/h). Second LD (if PCI), 180 mcg/kg i.v. bolus (max 22.6 mg) should be administered 10 min after the first bolus. Contraindicated in patients with end-stage renal disease and with prior ICH, ischaemic stroke within 30 days, fibrinolysis, or platelet count <100 000/mm$^3$. |
| Tirofiban | Bolus of 25 mcg/kg i.v. over 3 min, followed by an infusion of 0.15 mcg/kg/min for up to 18 h. For CrCl ≤60 mL/min: LD, 25 mcg/kg i.v. over 5 min followed by a maintenance infusion of 0.075 mcg/kg/min continued for up to 18 h. Contraindicated in patients with prior ICH, ischaemic stroke within 30 days, fibrinolysis, or platelet count <100 000/mm$^3$. |

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# Dose regimen of antiplatelet and anticoagulant drugs in acute coronary syndrome patients (4)

| Anticoagulant drugs | |
|---|---|
| UFH | Initial treatment: i.v. bolus 70–100 U/kg followed by i.v. infusion titrated to achieve an aPTT of 60–80 s.<br>During PCI: 70–100 U/kg i.v. bolus or according to ACT in case of UFH pretreatment. |
| Enoxaparin | Initial treatment: For treatment of ACS 1 mg/kg b.i.d. subcutaneously for a minimum of 2 days and continued until clinical stabilization. In patients whose CrCl is below 30 mL per minute (by Cockcroft–Gault equation), the enoxaparin dosage should be reduced to 1 mg per kg o.d.<br>During PCI: For patients managed with PCI, if the last dose of enoxaparin was given less than 8 h before balloon inflation, no additional dosing is needed. If the last s.c. administration was given more than 8 h before balloon inflation, an i.v. bolus of 0.3 mg/kg enoxaparin sodium should be administered. |

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# Dose regimen of antiplatelet and anticoagulant drugs in acute coronary syndrome patients (5)

| Anticoagulant drugs (continued) | |
| --- | --- |
| Bivalirudin | During PPCI: 0.75 mg/kg i.v. bolus followed by i.v. infusion of 1.75 mg/kg/h for 4 h after the procedure. In patients whose CrCl is below 30 mL/min (by Cockcroft–Gault equation), maintenance infusion should be reduced to 1 mg/kg/h. |
| Fondaparinux | Initial treatment: 2.5 mg/d subcutaneously. During PCI: A single bolus of UFH is recommended. Avoid if CrCl <20 mL/min. |

# Figure 9

**Antithrombotic treatments in acute coronary syndrome: pharmacological targets**
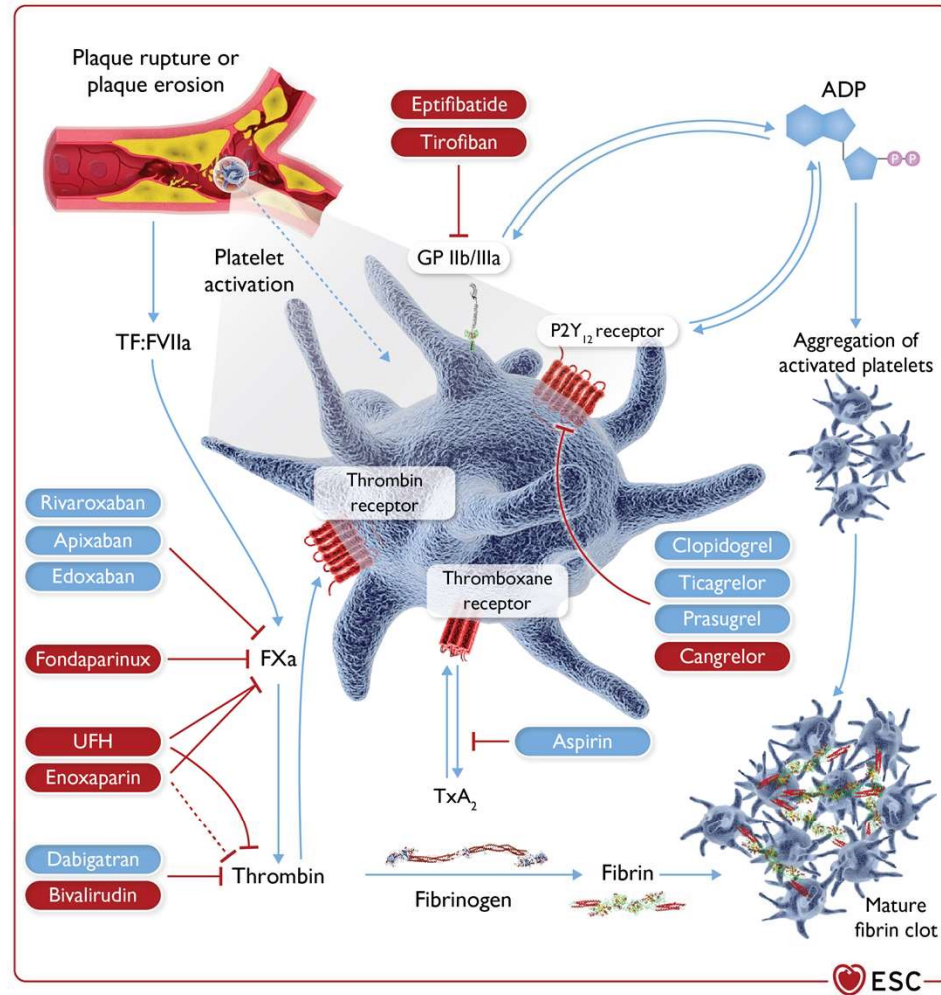
# Figure 10

**Recommended default antithrombotic therapy regimens in acute coronary syndrome patients without an indication for oral anticoagulation**
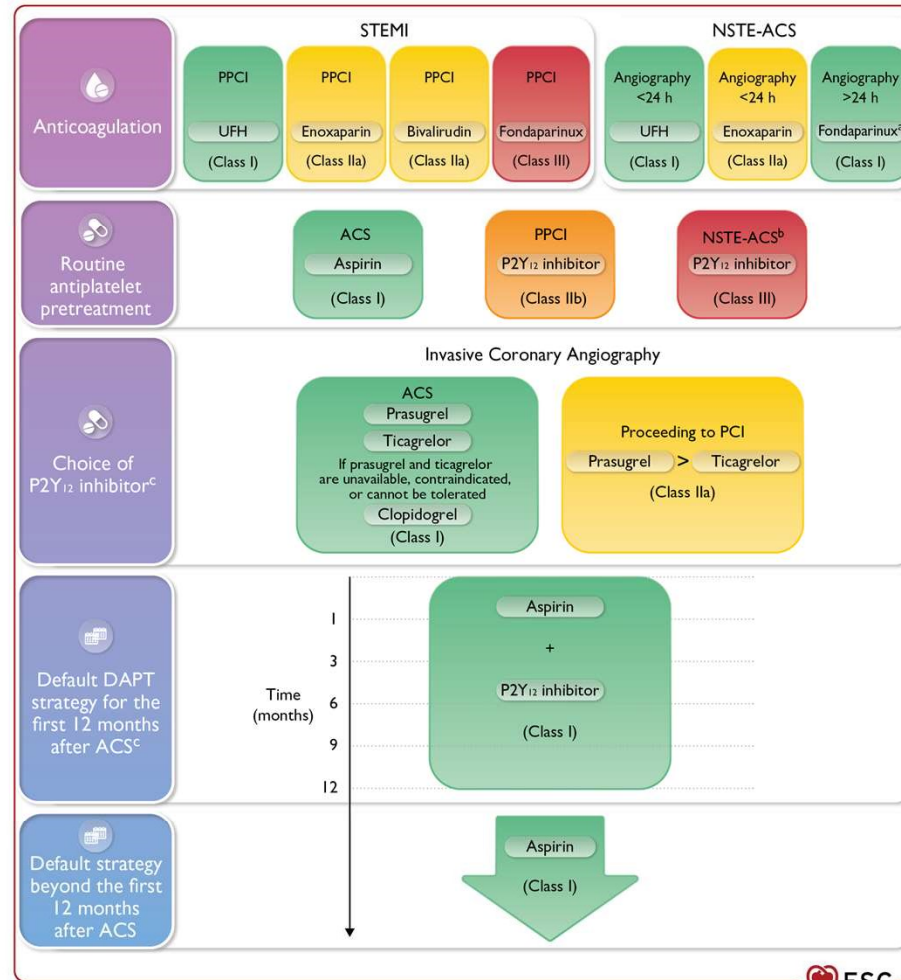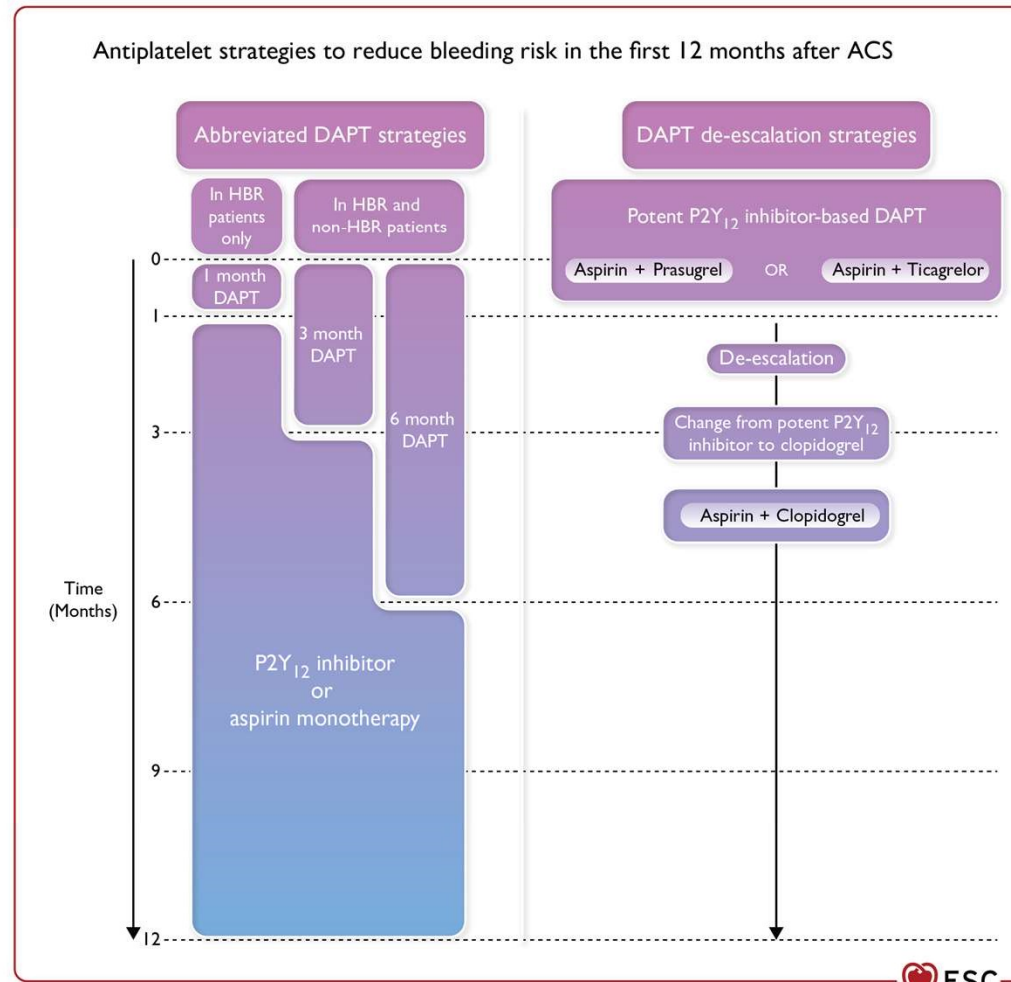
# Figure 11

**Alternative antiplatelet strategies to reduce bleeding risk in the first 12 months after an ACS**



Antiplatelet strategies to reduce bleeding risk in the first 12 months after ACS

©ESC

# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (1)

| Recommendations | Class | Level |
|---|---|---|
| **Antiplatelet therapy** | | |
| Aspirin is recommended for all patients without contraindications at an initial oral LD of 150–300 mg (or 75–250 mg i.v.) and an MD of 75–100 mg o.d. for long-term treatment. | I | A |
| In all ACS patients, a P2Y$_{12}$ receptor inhibitor is recommended in addition to aspirin, given as an initial oral LD followed by an MD for 12 months unless there is HBR. | I | A |
| A proton pump inhibitor in combination with DAPT is recommended in patients at high risk of gastrointestinal bleeding. | I | A |
| Prasugrel is recommended in P2Y$_{12}$ receptor inhibitor-naïve patients proceeding to PCI (60 mg LD, 10 mg o.d. MD, 5 mg o.d. MD for patients aged ≥75 years or with a body weight <60 kg). | I | B |
| Ticagrelor is recommended irrespective of the treatment strategy (invasive or conservative) (180 mg LD, 90 mg b.i.d. MD). | I | B |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (2)

| Recommendations | Class | Level |
|---|---|---|
| **Antiplatelet therapy (continued)** | | |
| Clopidogrel (300–600 mg LD, 75 mg o.d. MD) is recommended when prasugrel or ticagrelor are not available, cannot be tolerated, or are contraindicated. | I | C |
| If patients presenting with ACS stop DAPT to undergo CABG, it is recommended they resume DAPT after surgery for at least 12 months. | I | C |
| Prasugrel should be considered in preference to ticagrelor for ACS patients who proceed to PCI. | IIa | B |
| GP IIb/IIIa receptor antagonists should be considered if there is evidence of no-reflow or a thrombotic complication during PCI. | IIa | C |
| In P2Y$_{12}$ receptor inhibitor-naïve patients undergoing PCI, cangrelor may be considered. | IIb | A |
| In older ACS patients, especially if HBR, clopidogrel as the P2Y$_{12}$ receptor inhibitor may be considered. | IIb | B |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (3)

| Recommendations | Class | Level |
|---|---|---|
| **Antiplatelet therapy (continued)** | | |
| Pretreatment with a P2Y$_{12}$ receptor inhibitor may be considered in patients undergoing a primary PCI strategy. | IIb | B |
| Pretreatment with a P2Y$_{12}$ receptor inhibitor may be considered in NSTE-ACS patients who are not expected to undergo an early invasive strategy (<24 h) and do not have HBR. | IIb | C |
| Pretreatment with a GP IIb/IIIa receptor antagonist is not recommended. | III | A |
| Routine pretreatment with a P2Y$_{12}$ receptor inhibitor in NSTE-ACS patients in whom coronary anatomy is not known and early invasive management (<24 h) is planned is not recommended. | III | A |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (4)

| Recommendations | Class | Level |
|---|---|---|
| *Anticoagulant therapy* | | |
| Parenteral anticoagulation is recommended for all patients with ACS at the time of diagnosis. | I | A |
| Routine use of a UFH bolus (weight-adjusted i.v. bolus during PCI of 70–100 IU/kg) is recommended in patients undergoing PCI. | I | C |
| Intravenous enoxaparin at the time of PCI should be considered in patients pretreated with subcutaneous enoxaparin. | IIa | B |
| Discontinuation of parenteral anticoagulation should be considered immediately after an invasive procedure. | IIa | C |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (5)

| Recommendations | Class | Level |
|---|---|---|
| **Patients with STEMI** | | |
| Enoxaparin should be considered as an alternative to UFH in patients with STEMI undergoing PPCI. | IIa | A |
| Bivalirudin with a full-dose post PCI infusion should be considered as an alternative to UFH in patients with STEMI undergoing PPCI. | IIa | A |
| Fondaparinux is not recommended in patients with STEMI undergoing PPCI. | III | B |
| **Patients with NSTE-ACS** | | |
| For patients with NSTE-ACS in whom early invasive angiography (i.e. within 24 h) is not anticipated, fondaparinux is recommended. | I | B |
| For patients with NSTE-ACS in whom early invasive angiography (i.e. within 24 h) is anticipated, enoxaparin should be considered as an alternative to UFH. | IIa | B |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (6)

| Recommendations | Class | Level |
|---|---|---|
| *Combining antiplatelets and OAC* | | |
| As the default strategy for patients with atrial fibrillation and CHA$_2$DS$_2$-VASc score ≥1 in men and ≥2 in women, after up to 1 week of triple antithrombotic therapy following the ACS event, dual antithrombotic therapy using a NOAC at the recommended dose for stroke prevention and a single oral antiplatelet agent (preferably clopidogrel) for up to 12 months is recommended. | I | A |
| During PCI, a UFH bolus is recommended in any of the following circumstances:<br>- if the patient is on a NOAC<br>- if the INR is <2.5 in VKA-treated patients. | I | C |
| In patients with an indication for OAC with VKA in combination with aspirin and/or clopidogrel, careful regulation of the dose intensity of VKA with a target INR of 2.0–2.5 and a time in the therapeutic range >70% should be considered. | IIa | B |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (7)

| Recommendations | Class | Level |
|---|---|---|
| **Combining antiplatelets and OAC (continued)** | | |
| When rivaroxaban is used and concerns about HBR prevail over ischaemic stroke, rivaroxaban 15 mg o.d. should be considered in preference to rivaroxaban 20 mg o.d. for the duration of concomitant SAPT or DAPT. | IIa | B |
| In patients at HBR, dabigatran 110 mg b.i.d. should be considered in preference to dabigatran 150 mg b.i.d. for the duration of concomitant SAPT or DAPT, to mitigate bleeding risk. | IIa | B |
| In patients requiring anticoagulation and treated medically, a single antiplatelet agent in addition to an OAC should be considered for up to 1 year. | IIa | B |
| In patients treated with an OAC, aspirin plus clopidogrel for longer than 1 week and up to 1 month should be considered in those with high ischaemic risk or with other anatomical/procedural characteristics that are judged to outweigh the bleeding risk. | IIa | C |

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# Recommendations for antiplatelet and anticoagulant therapy in acute coronary syndrome (8)

| Recommendations | Class | Level |
|---|---|---|
| **Combining antiplatelets and OAC (continued)** | | |
| In patients requiring OAC, withdrawing antiplatelet therapy at 6 months while continuing OAC may be considered. | IIb | B |
| The use of ticagrelor or prasugrel as part of triple antithrombotic therapy is not recommended. | III | C |

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# Recommendations for alternative antithrombotic therapy regimens (1)

| Recommendations | Class | Level |
|---|---|---|
| **Shortening/de-escalation of antithrombotic therapy** | | |
| In patients who are event-free after 3–6 months of DAPT and who are not high ischaemic risk, single antiplatelet therapy (preferably with a P2Y$_{12}$ receptor inhibitor) should be considered. | IIa | A |
| De-escalation of P2Y$_{12}$ receptor inhibitor treatment (e.g. with a switch from prasugrel/ticagrelor to clopidogrel) may be considered as an alternative DAPT strategy to reduce bleeding risk. | IIb | A |
| In HBR patients, aspirin or P2Y$_{12}$ receptor inhibitor monotherapy after 1 month of DAPT may be considered. | IIb | B |
| De-escalation of antiplatelet therapy in the first 30 days after an ACS event is not recommended. | III | B |

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# Recommendations for alternative antithrombotic therapy regimens (2)

**⊕ESC**

| Recommendations | Class | Level |
|---|---|---|
| ***Prolonging antithrombotic therapy*** | | |
| Discontinuation of antiplatelet treatment in patients treated with an OAC is recommended after 12 months. | I | B |
| Adding a second antithrombotic agent to aspirin for extended long-term secondary prevention should be considered in patients with high ischaemic risk and without HBR. | IIa | A |
| Adding a second antithrombotic agent to aspirin for extended long-term secondary prevention may be considered in patients with moderate ischaemic risk and without HBR. | IIb | A |
| P2Y$_{12}$ inhibitor monotherapy may be considered as an alternative to aspirin monotherapy for long-term treatment. | IIb | A |

# Suggested strategies to reduce bleeding risk related to percutaneous coronary intervention (1)

| Strategies |
|---|
| • Anticoagulant doses adjusted to body weight and renal function, especially in women and older patients |
| • Radial artery approach as default vascular access |
| • Proton pump inhibitors in patients on dual antiplatelet therapy at higher-than-average risk of gastrointestinal bleeds (i.e. history of gastrointestinal ulcer/haemorrhage, anticoagulant therapy, chronic non-steroidal anti-inflammatory drug/corticosteroid use), or two or more of:<br>    a. Age ≥65 years<br>    b. Dyspepsia<br>    c. Gastro-oesophageal reflux disease<br>    d. *Helicobacter pylori* infection<br>    e. Chronic alcohol use |

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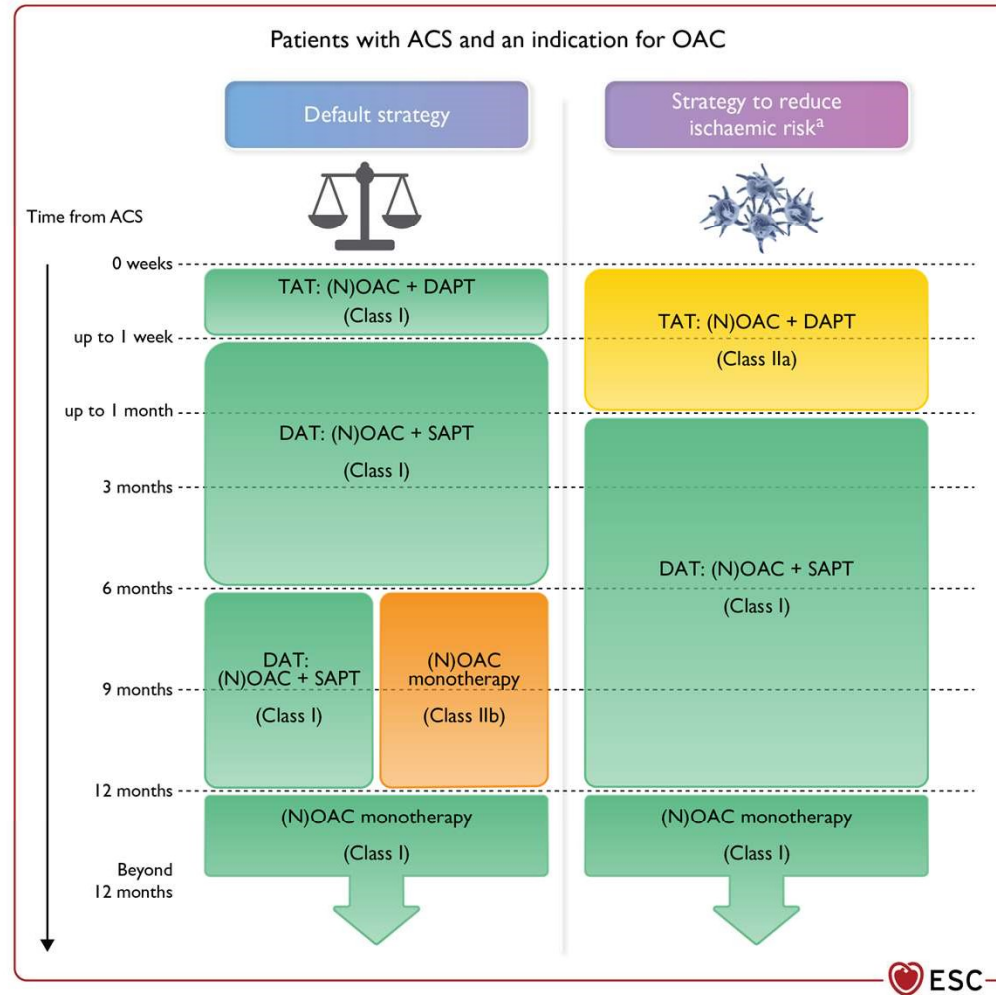# Suggested strategies to reduce bleeding risk related to percutaneous coronary intervention (2)

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| Strategies (continued) |
| --- |
| •    In patients on OAC:<br>     a.  PCI performed without interruption of VKAs or NOACs<br>     b.  In patients on VKAs, do not administer UFH if INR >2.5<br>     c.  In patients on NOACs, regardless of the timing of the last administration of NOACs, add low-dose parenteral anticoagulation (e.g. enoxaparin 0.5 mg/kg i.v. or UFH 60 IU/kg) |
| •    Aspirin is indicated but avoid pretreatment with P2Y$_{12}$ receptor inhibitors |
| •    GP IIb/IIIa receptor inhibitors only for bailout or peri-procedural complications |

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# Figure 12

**Antithrombotic regimens in patients with acute coronary syndrome and an indication for oral anticoagulation**



Patients with ACS and an indication for OAC

Default strategy

Strategy to reduce ischaemic risk[a]

Time from ACS

0 weeks
up to 1 week
up to 1 month
3 months
6 months
9 months
12 months
Beyond 12 months

TAT: (N)OAC + DAPT (Class I)

DAT: (N)OAC + SAPT (Class I)

DAT: (N)OAC + SAPT (Class I)

(N)OAC monotherapy (Class IIb)

(N)OAC monotherapy (Class I)

TAT: (N)OAC + DAPT (Class IIa)

DAT: (N)OAC + SAPT (Class I)

(N)OAC monotherapy (Class I)

# Recommendations for fibrinolytic therapy (1)

| Recommendations | Class | Level |
|---|---|---|
| *Fibrinolytic therapy* | | |
| When fibrinolysis is the reperfusion strategy, it is recommended to initiate this treatment as soon as possible after diagnosis in the pre-hospital setting (aim for target of <10 min to lytic bolus). | I | A |
| A fibrin-specific agent (i.e. tenecteplase, alteplase, or reteplase) is recommended. | I | B |
| A half-dose of tenecteplase should be considered in patients >75 years of age. | IIa | B |
| *Antiplatelet co-therapy with fibrinolysis* | | |
| Aspirin and clopidogrel are recommended. | I | A |

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# Recommendations for fibrinolytic therapy (2)

| Recommendations | Class | Level |
|---|---|---|
| ***Anticoagulation co-therapy with fibrinolysis*** | | |
| Anticoagulation is recommended in patients treated with fibrinolysis until revascularization (if performed) or for the duration of hospital stay (up to 8 days). | I | A |
| Enoxaparin i.v. followed by s.c. is recommended as the preferred anticoagulant. | I | A |
| When enoxaparin is not available, UFH is recommended as a weight-adjusted i.v. bolus, followed by infusion. | I | B |
| In patients treated with streptokinase, an i.v. bolus of fondaparinux followed by an s.c. dose 24 h later should be considered. | IIa | B |

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# Recommendations for cardiac arrest and out-of-hospital cardiac arrest (1) ❤ESC

| Recommendations | Class | Level |
|---|---|---|
| **_Cardiac arrest and OHCA_** | | |
| A PPCI strategy is recommended in patients with resuscitated cardiac arrest and an ECG with persistent ST-segment elevation (or equivalents). | I | B |
| Routine immediate angiography after resuscitated cardiac arrest is not recommended in haemodynamically stable patients without persistent ST-segment elevation (or equivalents). | III | A |
| **_Temperature control_** | | |
| Temperature control (i.e. continuous monitoring of core temperature and active prevention of fever [i.e. >37.7ºC]) is recommended after either out-of-hospital or in-hospital cardiac arrest for adults who remain unresponsive after return of spontaneous circulation. | I | B |

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# Recommendations for cardiac arrest and out-of-hospital cardiac arrest (2) ❤ESC

| Recommendations | Class | Level |
|---|---|---|
| **Systems of care** | | |
| It is recommended that healthcare systems implement strategies to facilitate transfer of all patients in whom ACS is suspected after resuscitated cardiac arrest directly to a hospital offering 24/7 PPCI via one specialized EMS. | I | C |
| Transport of patients with OHCA to a cardiac arrest centre according to local protocols should be considered. | IIa | C |
| **Evaluation of neurological prognosis** | | |
| Evaluation of neurological prognosis (no earlier than 72 h after admission) is recommended in all comatose survivors after cardiac arrest. | I | C |

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# Recommendations for cardiogenic shock

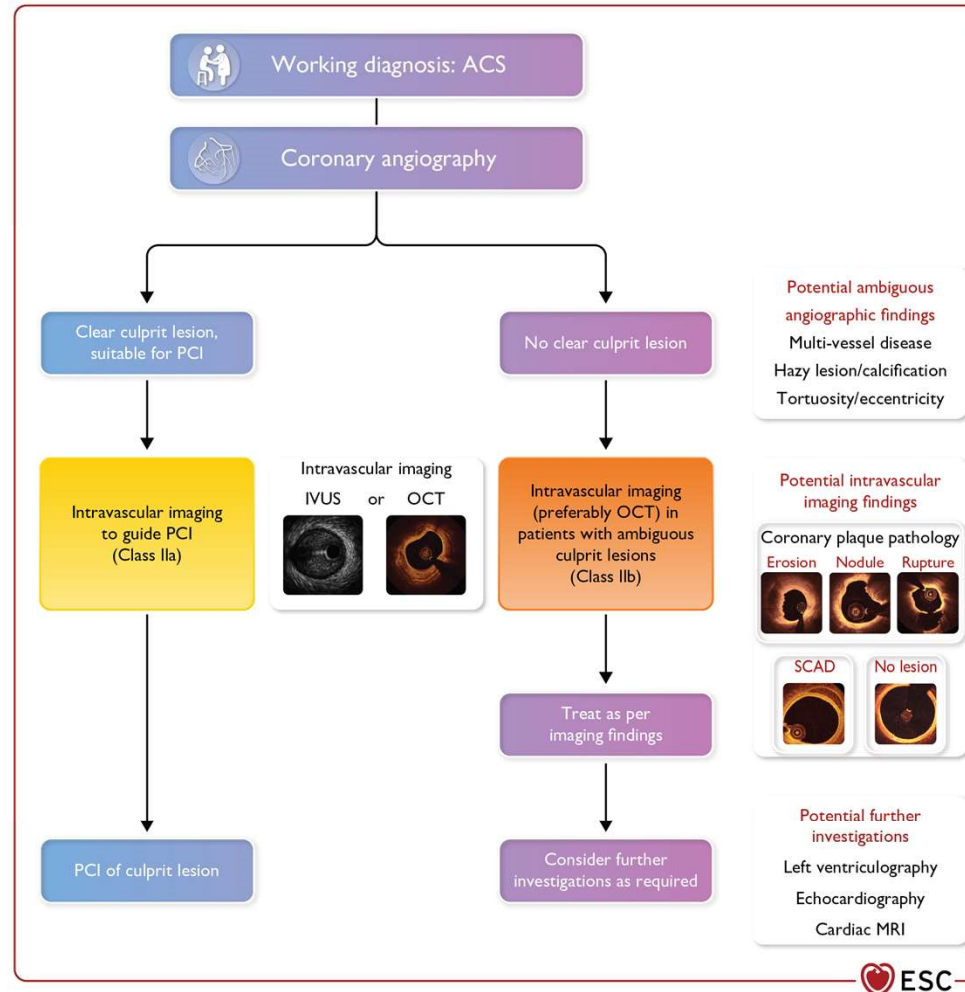| Recommendations | Class | Level |
|---|---|---|
| Immediate coronary angiography and PCI of the IRA (if indicated) is recommended in patients with CS complicating ACS. | I | B |
| Emergency CABG is recommended for ACS-related CS if PCI of the IRA is not feasible/unsuccessful. | I | B |
| In cases of haemodynamic instability, emergency surgical/catheter-based repair of mechanical complications of ACS is recommended, based on Heart Team discussion. | I | C |
| Fibrinolysis should be considered in STEMI patients presenting with CS if a PPCI strategy is not available within 120 min from the time of STEMI diagnosis and mechanical complications have been ruled out. | IIa | C |
| In patients with ACS and severe/refractory CS, short-term mechanical circulatory support may be considered. | IIb | C |
| The routine use of an IABP in ACS patients with CS and without mechanical complications is not recommended. | III | B |

# Recommendations for in-hospital management (1)

| Recommendations | Class | Level |
|---|---|---|
| *Logistical issues for hospital stay* | | |
| It is recommended that all hospitals participating in the care of high-risk patients have an ICCU/CCU equipped to provide all required aspects of care, including treatment of ischaemia, severe heart failure, arrhythmias, and common comorbidities. | I | C |
| It is recommended that high-risk patients (including all STEMI patients and very high-risk NSTE-ACS patients) have ECG monitoring for a minimum of 24 h. | I | C |
| It is recommended that high-risk patients with successful reperfusion therapy and an uncomplicated clinical course (including all STEMI patients and very high-risk NSTE-ACS patients) 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 additional 24–48 h. | I | C |
| Discharge of selected high-risk patients within 48–72 h should be considered if early rehabilitation and adequate follow-up are arranged. | IIa | A |

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# Recommendations for in-hospital management (2)

| Recommendations | Class | Level |
|---|---|---|
| *Logistical issues for hospital stay (continued)* | | |
| Same-day transfer in selected stable patients after successful and uneventful PCI should be considered. | IIa | C |
| *Imaging* | | |
| Routine echocardiography is recommended during hospitalization to assess regional and global LV function, detect mechanical complications, and exclude LV thrombus. | I | C |
| When echocardiography is suboptimal/inconclusive, CMR imaging may be considered. | IIb | C |

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**Figure 13**

A practical algorithm to guide intravascular imaging in acute coronary syndrome patients

2023 ESC Guidelines for the management of acute coronary syndromes
(European Heart Journal; 2023 – doi:10.1093/eurheartj/ehad191)

# Recommendations for technical aspects of invasive strategies (1)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| Radial access is recommended as the standard approach, unless there are overriding procedural considerations. | I | A |
| PCI with stent deployment in the IRA during the index procedure is recommended in patients undergoing PPCI. | I | A |
| Drug-eluting stents are recommended in preference to bare metal stents in all cases. | I | A |
| In patients with spontaneous coronary artery dissection, PCI is recommended only for patients with symptoms and signs of ongoing myocardial ischaemia, a large area of myocardium in jeopardy, and reduced antegrade flow. | I | C |
| Intravascular imaging should be considered to guide PCI. | IIa | A |
| Coronary artery bypass grafting should be considered in patients with an occluded IRA when PPCI is not feasible/unsuccessful and there is a large area of myocardium in jeopardy. | IIa | C |

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# Recommendations for technical aspects of invasive strategies (2)

**ESC**

| Recommendations (continued) | Class | Level |
|---|---|---|
| Intravascular imaging (preferably optical coherence tomography) may be considered in patients with ambiguous culprit lesions. | IIb | C |
| The routine use of thrombus aspiration is not recommended. | III | A |

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**Figure 14**

**Algorithm for the management of acute coronary syndrome patients with multivessel coronary artery disease**

Patient with ACS undergoing PCI of IRA with an angiographically significant stenosis in ≥ 1 non-IRA

Cardiogenic shock

STEMI

NSTE-ACS

Immediate PCI of IRA only (Class I)

Staged complete revascularization (Class IIa)

Complete revascularization, either during the index procedure or within 45 days[a] (Class I)

Complete revascularization[b] (Class IIa)

Functional invasive evaluation of the non-IRA during the index procedure (Class IIb)

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# Recommendations for management of patients with multivessel disease (1)  ESC

| Recommendations | Class | Level |
|---|---|---|
| It is recommended to base the revascularization strategy (IRA PCI, multivessel PCI/CABG) on the patient's clinical status and comorbidities, as well as their disease complexity, according to the principles of management of myocardial revascularization. | I | B |
| *Multivessel disease in ACS patients presenting in cardiogenic shock* | | |
| IRA-only PCI during the index procedure is recommended. | I | B |
| Staged PCI of non-IRA should be considered. | IIa | C |

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# Recommendations for management of patients with multivessel disease (2)   ❤️ESC

| Recommendations | Class | Level |
|---|---|---|
| *Multivessel disease in haemodynamically stable STEMI patients undergoing PPCI* | | |
| Complete revascularization is recommended either during the index PCI procedure or within 45 days. | I | A |
| It is recommended that PCI of the non-IRA is based on angiographic severity. | I | B |
| Invasive epicardial functional assessment of non-culprit segments of the IRA is not recommended during the index procedure. | III | C |
| *Multivessel disease in haemodynamically stable NSTE-ACS patients undergoing PCI* | | |
| In patients presenting with NSTE-ACS and MVD, complete revascularization should be considered, preferably during the index procedure. | IIa | C |
| Functional invasive evaluation of non-IRA severity during the index procedure may be considered. | IIb | B |

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# Figure 15

**Underlying causes for patients with a working diagnosis of myocardial infarction with non-obstructive coronary arteries**



**Coronary causes**

- Coronary embolism
- Coronary microvascular dysfunction
- Coronary spasm
- Coronary thrombosis
- Myocardial bridging
- Plaque rupture/erosion
- Spontaneous coronary artery dissection

**Non-coronary, cardiac causes**

- Cardiac trauma
- Cardiomyopathy
- Cardiotoxins
- Myocarditis
- Strenuous exercise
- Takotsubo cardiomyopathy
- Transplant rejection

**Non-cardiac causes**

- Acute respiratory distress syndrome
- Allergic/hypersensitivity reactions
- End-stage renal failure
- Inflammation
- Pulmonary embolism
- Sepsis
- Stroke

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# Figure 16

**Evaluation of patients with a working diagnosis of MINOCA**
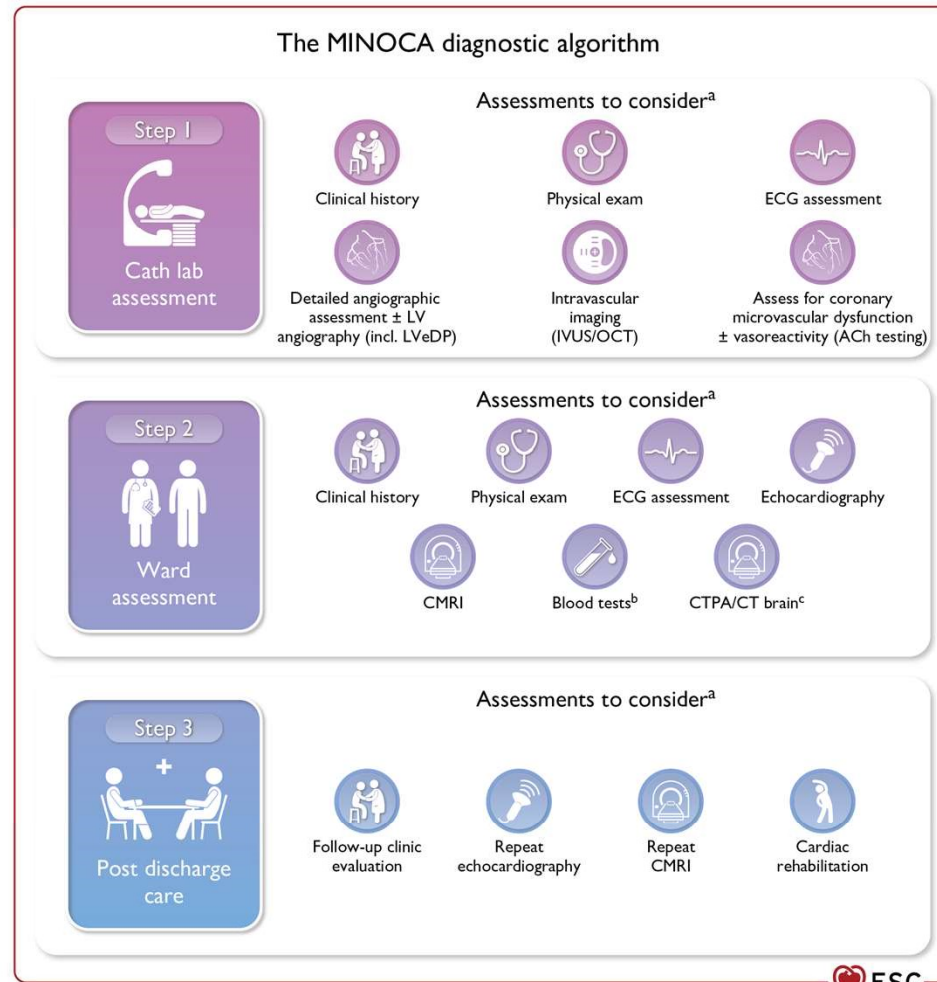
# Recommendations for myocardial infarction with non-obstructive coronary arteries

| Recommendations | Class | Level |
|---|---|---|
| In patients with a working diagnosis of MINOCA, CMR imaging is recommended after invasive angiography if the final diagnosis is not clear. | I | B |
| Management of MINOCA according to the final established underlying diagnosis is recommended, consistent with the appropriate disease-specific guidelines. | I | B |
| In all patients with an initial working diagnosis of MINOCA, it is recommended to follow a diagnostic algorithm to determine the underlying final diagnosis. | I | C |

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# Recommendations for acute coronary syndrome complications (1)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| *Heart failure* | | |
| IABP should be considered in patients with haemodynamic instability/cardiogenic shock due to ACS-related mechanical complications. | IIa | C |
| *LV thrombus* | | |
| CMR imaging should be considered in patients with equivocal echocardiographic images or in cases of high clinical suspicion of LV thrombus. | IIa | C |
| Oral anticoagulant therapy (VKA or NOAC) should be considered for 3–6 months in patients with confirmed LV thrombus. | IIa | C |
| Following an acute anterior MI, a contrast echocardiogram may be considered for the detection of LV thrombus if the apex is not well visualized on echocardiography. | IIb | C |

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# Recommendations for acute coronary syndrome complications (2)

| Recommendations | Class | Level |
|---|---|---|
| *Atrial fibrillation* | | |
| Intravenous beta-blockers are recommended when rate control is needed in the absence of acute HF or hypotension. | I | C |
| Intravenous amiodarone is recommended when rate control is needed in the presence of acute HF and no hypotension. | I | C |
| Immediate electrical cardioversion is recommended in patients with ACS and haemodynamic instability and when adequate rate control cannot be achieved promptly with pharmacological agents. | I | C |
| Intravenous amiodarone is recommended to facilitate electrical cardioversion and/or decrease risk for early recurrence of AF after electrical cardioversion in unstable patients with recent-onset AF. | I | C |

©ESC

# Recommendations for acute coronary syndrome complications (3)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| *Atrial fibrillation (continued)* | | |
| In patients with documented *de novo* AF during the acute phase of ACS, long-term oral anticoagulation should be considered depending on the CHA$_2$DS$_2$-VASc score, after taking the HAS-BLED score and the need for concomitant antiplatelet therapy into consideration. NOACs are the preferred drugs. | IIa | C |
| *Ventricular arrythmias* | | |
| ICD therapy is recommended to reduce sudden cardiac death in patients with symptomatic HF (NYHA 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 |
| Intravenous beta-blocker and/or amiodarone treatment is recommended for patients with polymorphic VT and/or VF unless contraindicated. | I | B |

©ESC

# Recommendations for acute coronary syndrome complications (4)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| **Ventricular arrythmias (continued)** | | |
| Prompt and complete revascularization is recommended to treat myocardial ischaemia that may be present in patients with recurrent VT and/or VF. | I | C |
| Transvenous catheter pacing termination and/or overdrive pacing should be considered if VT cannot be controlled by repeated electrical cardioversion. | IIa | C |
| Radiofrequency catheter ablation at a specialized ablation centre followed by ICD implantation should be considered in patients with recurrent VT, VF, or electrical storm despite complete revascularization and optimal medical therapy. | IIa | C |
| Treatment of recurrent VT with haemodynamic relevance (despite repeated electrical cardioversion) with lidocaine may be considered if beta-blockers, amiodarone, and overdrive stimulation are not effective/applicable. | IIb | C |
| In patients with recurrent life-threatening ventricular arrhythmias, sedation or general anaesthesia to reduce sympathetic drive may be considered. | IIb | C |

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# Recommendations for acute coronary syndrome complications (5)

**ESC**

| Recommendations | Class | Level |
|---|---|---|
| *Ventricular arrythmias (continued)* | | |
| ICD implantation or the 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 |
| Treatment of asymptomatic and haemodynamically irrelevant ventricular arrhythmias with anti-arrhythmic drugs is not recommended. | III | C |
| *Bradyarrhythmias* | | |
| In cases of sinus bradycardia with haemodynamic intolerance or high-degree AV block without stable escape rhythm: | | |
| • i.v. positive chronotropic medication (adrenaline, vasopressin, and/or atropine) is recommended. | I | C |
| • temporary pacing is recommended in cases of failure to respond to atropine. | I | C |

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# Recommendations for acute coronary syndrome complications (6)

ESC

| Recommendations | Class | Level |
|---|---|---|
| **Bradyarrhythmias (continued)** | | |
| • urgent angiography with a view to revascularization is recommended if the patient has not received previous reperfusion therapy. | I | C |
| Implantation of a permanent pacemaker is recommended when high-degree AV block does not resolve within a waiting period of at least 5 days after MI. | I | C |
| In selected patients with high-degree AV block in the context of an anterior wall MI and acute HF, early device implantation (CRT-D/CRT-P) may be considered. | IIb | C |
| Pacing is not recommended if high-degree AV block resolves after revascularization or spontaneously. | III | B |

©ESC

# Recommendations for acute coronary syndrome comorbid conditions (1) ⬮ESC

| Recommendations | Class | Level |
|---|---|---|
| **Chronic kidney disease** | | |
| The use of low- or iso-osmolar contrast media (at the lowest possible volume) is recommended for invasive strategies. | I | A |
| It is recommended to assess kidney function using eGFR in all patients with ACS. | I | C |
| It is recommended to apply the same diagnostic and therapeutic strategies in patients with CKD (dose adjustment may be necessary) as in patients with normal kidney function. | I | C |
| Hydration during and after angiography should be considered in patients at risk of contrast-induced nephropathy, especially in patients with acute kidney injury and/or CKD with eGFR <30 mL/min/1.73m². | IIa | B |

# Recommendations for acute coronary syndrome comorbid conditions (2)  ❤ESC

| Recommendations | Class | Level |
|---|---|---|
| **Diabetes** | | |
| It is recommended to base the choice of long-term glucose-lowering treatment on the presence of comorbidities, including heart failure, CKD, and obesity. | I | A |
| It is recommended to assess glycaemic status at initial evaluation in all patients with ACS. | I | B |
| It is recommended to frequently monitor blood glucose levels in patients with known diabetes mellitus or hyperglycaemia (defined as glucose levels ≥11.1 mmol/L or ≥200 mg/dL). | I | C |
| Glucose-lowering therapy should be considered in patients with ACS with persistent hyperglycaemia, while episodes of hypoglycaemia should be avoided. | IIa | C |

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# Recommendations for acute coronary syndrome comorbid conditions (3)  ❤ESC

| Recommendations | Class | Level |
|---|---|---|
| *Older adults* | | |
| It is recommended to apply the same diagnostic and treatment strategies in older patients as in younger patients. | I | B |
| It is recommended to adapt the choice and dosage of antithrombotic agent, as well as of secondary prevention medications, to renal function, co-medications, comorbidities, frailty, cognitive function, and specific contraindications. | I | B |
| For frail older patients with comorbidities, a holistic approach is recommended to individualize interventional and pharmacological treatments after careful evaluation of the risks and benefits. | I | B |

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# Recommendations for acute coronary syndrome comorbid conditions (4)  ❤ESC

| Recommendations | Class | Level |
|---|---|---|
| **Patients with cancer** | | |
| An invasive strategy is recommended in cancer patients presenting with high-risk ACS with expected survival ≥6 months. | I | B |
| A temporary interruption of cancer therapy is recommended in patients in whom the cancer therapy is suspected to be a contributing cause of ACS. | I | C |
| A conservative non-invasive strategy should be considered in ACS patients with poor cancer prognosis (i.e. with expected survival <6 months) and/or very high bleeding risk. | IIa | C |
| Aspirin is not recommended in cancer patients with a platelet count <10 000/µL. | III | C |
| Clopidogrel is not recommended in cancer patients with a platelet count <30 000/µL. | III | C |
| In ACS patients with cancer and <50 000/µL platelet count, prasugrel or ticagrelor are not recommended. | III | C |

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# Figure 17

**Long-term management after acute coronary syndrome**
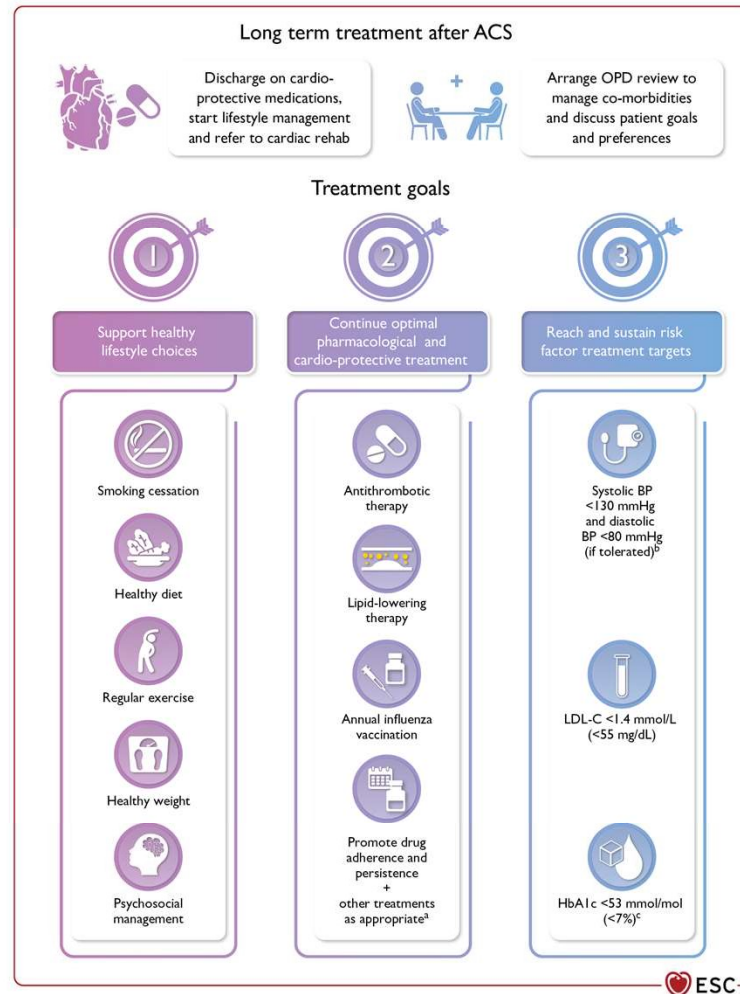
# Figure 18

## Lipid-lowering therapy in ACS patients

©ESC

# Recommendations for long-term management (1)

| Recommendations | Class | Level |
|---|---|---|
| *Cardiac rehabilitation* | | |
| It is recommended that all ACS patients participate in a medically supervised, structured, comprehensive, multidisciplinary exercise-based cardiac rehabilitation and prevention programme. | I | A |
| *Lifestyle management* | | |
| It is recommended that ACS patients adopt a healthy lifestyle, including:<br>• stopping all smoking of tobacco<br>• healthy diet (Mediterranean style)<br>• alcohol restriction<br>• regular aerobic physical activity and resistance exercise<br>• reduced sedentary time | I | B |
| In smokers, offering follow-up support, nicotine replacement therapy, varenicline or bupropion, individually or in combination, should be considered. | IIa | A |

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**ESC**

| Recommendations | Class | Level |
|---|---|---|
| **Pharmacological treatment** | | |
| *Lipid-lowering therapy* | | |
| It is recommended that high-dose statin therapy is initiated or continued as early as possible, regardless of initial LDL-C values. | I | A |
| It is recommended to aim to achieve an LDL-C level of <1.4 mmol/L (<55 mg/dL) and to reduce LDL-C by ≥50% from baseline. | I | A |
| If the LDL-C goal is not achieved despite maximally tolerated statin therapy after 4–6 weeks, the addition of ezetimibe is recommended. | I | B |
| If the LDL-C goal is not achieved despite maximally tolerated statin therapy and ezetimibe after 4–6 weeks, the addition of a PCSK9 inhibitor is recommended. | I | A |
| It is recommended to intensify lipid-lowering therapy during the index ACS hospitalization for patients who were on lipid-lowering therapy before admission. | I | C |

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# Recommendations for long-term management (3)

| Recommendations | Class | Level |
|---|---|---|
| **Pharmacological treatment** | | |
| *Lipid-lowering therapy (continued)* | | |
| For patients with a recurrent atherothrombotic event (recurrence within 2 years of first ACS episode) while taking maximally tolerated statin-based therapy, an LDL-C goal of <1.0 mmol/L (<40 mg/dL) may be considered. | IIb | B |
| Combination therapy with high-dose statin plus ezetimibe may be considered during index hospitalization. | IIb | B |
| *Beta-blockers* | | |
| Beta-blockers are recommended in ACS patients with LVEF ≤40% regardless of HF symptoms. | I | A |
| Routine beta-blockers for all ACS patients regardless of LVEF should be considered. | IIa | B |

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# Recommendations for long-term management (4)

| Recommendations | Class | Level |
|---|---|---|
| **Pharmacological treatment** | | |
| *RAAS system inhibitors* | | |
| Angiotensin-converting enzyme (ACE) inhibitors are recommended in ACS patients with HF symptoms, LVEF ≤40%, diabetes, hypertension, and/or CKD. | I | A |
| Mineralocorticoid receptor antagonists are recommended in ACS patients with an LVEF ≤40% and HF or diabetes. | I | A |
| Routine ACE inhibitors for all ACS patients regardless of LVEF should be considered. | IIa | A |
| **Adherence to medication** | | |
| A polypill should be considered as an option to improve adherence and outcomes in secondary prevention after ACS. | IIa | B |

# Recommendations for long-term management (5)

| Recommendations | Class | Level |
|---|---|---|
| *Imaging* | | |
| In patients with pre-discharge LVEF ≤40%, repeat evaluation of the LVEF 6–12 weeks after an ACS (and after complete revascularization and the institution of optimal medical therapy) is recommended to assess the potential need for sudden cardiac death primary prevention ICD implantation. | I | C |
| Cardiac magnetic resonance imaging should be considered as an adjunctive imaging modality in order to assess the potential need for primary prevention ICD implantation. | IIa | C |
| *Vaccination* | | |
| Influenza vaccination is recommended for all ACS patients. | I | A |
| *Anti-inflammatory drugs* | | |
| Low-dose colchicine (0.5 mg once daily) may be considered, particularly if other risk factors are insufficiently controlled or if recurrent cardiovascular disease events occur under optimal therapy. | IIb | A |

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# Figure 19

**A person-centred approach to the ACS journey**



Taking a person-centred approach to the ACS journey

At every stage, consider physical and psychosocial needs

Premorbid condition

Consider all risk factors

Establish medical history and prior medications

Consider psychosocial factors

Hospital admission

Individualize care at triage

Perform a person-centred clinical assessment

Employ shared decision-making

Preparing for discharge

Explain regarding long-term treatment

Educate about lifestyle modification

Consider mental and emotional health

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**Figure 20**

**Acute coronary syndrome patient expectations**

ACS patients expect…

…their ACS symptoms to be recognised

…high quality, effective and safe care delivered by professionals

…the right care at the right time

…their physical, mental and emotional wellbeing to be considered

…clear, comprehensible information

…shared decision making and respect for their preferences

…consideration of, and support for, their family and carers

…attention to both their physical and environmental needs

…a clean and safe hospital environment

# Recommendations for patient perspectives in acute coronary syndrome care (1)



**ESC**

| Recommendations | Class | Level |
|---|---|---|
| Patient-centred care is recommended by assessing and adhering to individual patient preferences, needs and beliefs, ensuring that patient values are used to inform all clinical decisions. | I | B |
| It is recommended to include ACS patients in decision-making (as much as their condition allows) and to inform them about the risk of adverse events, radiation exposure, and alternative options. Decision aids can be used to facilitate the discussion. | I | B |
| It is recommended to assess symptoms using methods that help patients to describe their experience. | I | C |
| Use of the 'teach back' technique for decision support during the securing of informed consent should be considered. | IIa | B |

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# Recommendations for patient perspectives in acute coronary syndrome care (2)

| Recommendations (continued) | Class | Level |
|---|---|---|
| Patient discharge information should be provided in both written and verbal formats prior to discharge. Adequate preparation and education for patient discharge using the teach back technique and/or motivational interviewing, giving information in chunks, and checking for understanding should be considered. | IIa | B |
| Assessment of mental well-being using a validated tool and onward psychological referral when appropriate should be considered. | IIa | B |

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**Figure S1**

**Symptoms at presentation in acute coronary syndrome in women and men**

Chest pain or pressure

80% of women and men with ACS present with chest pain or pressure

Diaphoresis — Epigastric pain/ Indigestion — Shoulder/ Arm pain

Other symptoms, like diaphoresis, indigestion/epigastric pain and shoulder/arm pain occur commonly in both women and men with ACS

Dizziness — Nausea/ Vomiting — Jaw/Neck pain — Shortness of breath

Some symptoms may be more common in women with ACS, including:
- Dizziness/Syncope
- Nausea/Vomiting
- Jaw/Neck pain
- Shortness of breath
- Pain between the shoulder blades
- Palpitations
- Fatigue

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**Electrocardiographic abnormalities in patients with STEMI and ECG findings that, if present, may prompt triage for immediate reperfusion therapy**
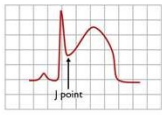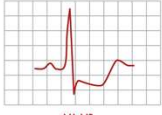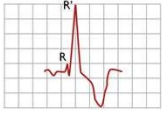


| ECG pattern | Criteria | Signifying | Figure |
|---|---|---|---|
| i STEMI | New ST-elevation at the J-point in ≥ 2 contiguous leads[a] ≥2.5 mm in men <40 years, ≥2 mm in men ≥40 years, or ≥1.5 mm in women regardless of age in leads V2–V3 and/or ≥1 mm in the other leads (in the absence of LV hypertrophy or left bundle branch block) [a]Including V3R and V4R | Ongoing acute coronary artery occlusion | |
| ii Posterior STEMI | ST-segment depression in leads V1–V3, especially when the terminal T-wave is positive (ST-segment elevation equivalent), and concomitant ST-segment elevation ≥0.5 mm recorded in leads V7–V9 | Posterior STEMI | V1-V3 |
| iii LCx occlusion/ right ventricular MI | ST-segment elevation in V7–V9 and V3R and V4R, respectively | Left circumflex (LCX) artery occlusion or right ventricular MI | V7-V9, V3R and V4R |
| iv Multivessel ischaemia/ left main obstruction | ST depression ≥1mm in six or more surface leads (inferolateral ST depression), coupled with ST-segment elevation in aVR and/or V1 | Multivessel ischaemia or left main coronary artery obstruction, particularly if the patient presents with haemodynamic compromise | ST depression ≥ 1 mm in six or more surface leads / ST elevation in aVR and/or V1 |
| v Left bundle branch block/ paced rhythm | QRS duration greater than 120 ms Absence of Q wave in leads I, V5 and V6 Monomorphic R wave in I, V5 and V6 ST and T wave displacement opposite to the major deflection of the QRS complex | Patients with a high clinical suspicion of ongoing myocardial ischaemia should be managed in a similar way to STEMI patients | |
| vi Right bundle branch block | QRS duration greater than 120 ms rsR' "bunny ear" pattern in the anterior precordial leads (leads V1-V3) Slurred S waves in leads I, aVL and frequently V5 and V6 | Patients with a high clinical suspicion of ongoing myocardial ischaemia should be managed in a similar way to STEMI patients | |

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# Figure S3

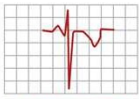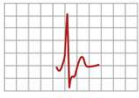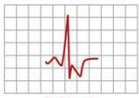**Electrocardiographic abnormalities in patients with non-ST-segment elevation acute coronary syndrome**
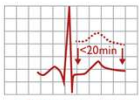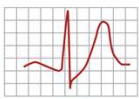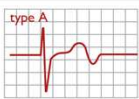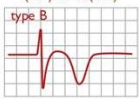


| ECG pattern | Criteria | Signifying | Figure |
|---|---|---|---|
| **a** Isolated T-wave inversion | T-wave inversion >1 mm in ≥5 leads including I, II, aVL, and V2–V6 | Only mildly impaired prognosis | I, II, aVL, or V2 to V6 |
| **b** ST-segment depression | J point depressed by ≥0.05 mm in leads V2 and V3 or ≥1 mm in all other leads  followed by a horizontal or downsloping ST-segment for ≥0.08 s in ≥1 leads (except aVR) | More severe ischaemia | ≥ 1 leads  ≥ 1 leads |
| **c** Transient ST-segment elevation | ST segment elevation in ≥2 contiguous leads of ≥2.5 mm in men <40 years, ≥2 mm in men ≥40 years, or ≥1.5 mm in women regardless of age in leads V2–V3 and/or ≥1 mm in the other leads lasting <20 min | Only mildly impaired prognosis | <20min  ≥ 2 contiguous leads |
| **d** De Winter ST-T | 1–3 mm upsloping ST-segment depression at the J point in leads V1–V6 that continue into tall, positive, and symmetrical T waves | Proximal LAD occlusion/ severe stenosis | V1–V6 |
| **e** Wellens sign | Isoelectric or minimally elevated J point (<1 mm) + biphasic T wave in leads V2 and V3 (type A) or symmetric and deeply inverted T waves in leads V2 and V3, occasionally in leads V1, V4, V5, and V6 (type B) | Proximal LAD occlusion/ severe stenosis | type A  (V1-)V2-V3(-V4)  type B  (V1-)V2-V3(-V4) |

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# Figure S4

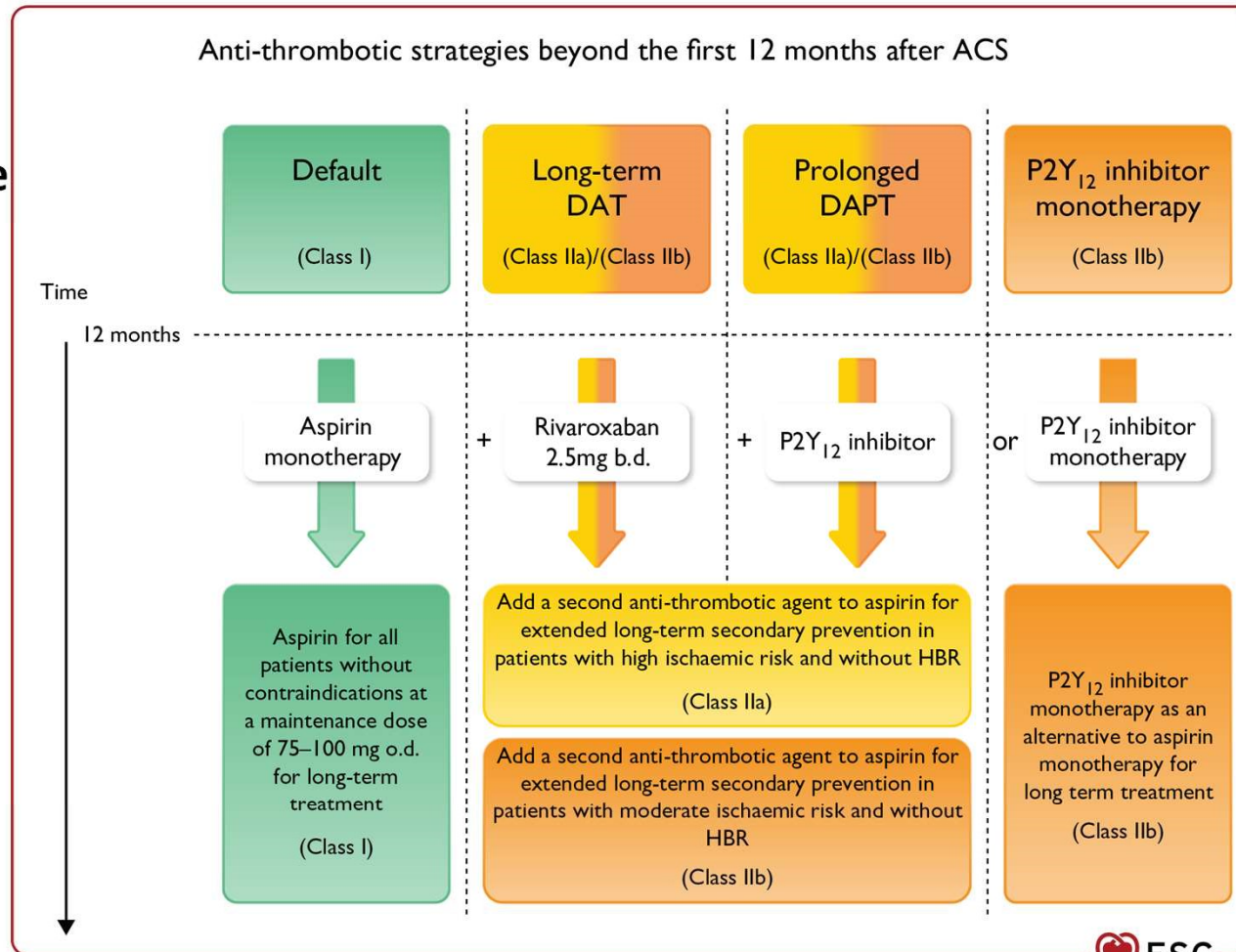**Antithrombotic strategies beyond the first 12 months after ACS**



Anti-thrombotic strategies beyond the first 12 months after ACS

| Default (Class I) | Long-term DAT (Class IIa)/(Class IIb) | Prolonged DAPT (Class IIa)/(Class IIb) | P2Y$_{12}$ inhibitor monotherapy (Class IIb) |
|---|---|---|---|

Time
12 months

Aspirin monotherapy → Aspirin for all patients without contraindications at a maintenance dose of 75–100 mg o.d. for long-term treatment (Class I)

+ Rivaroxaban 2.5mg b.d. → Add a second anti-thrombotic agent to aspirin for extended long-term secondary prevention in patients with high ischaemic risk and without HBR (Class IIa)

+ P2Y$_{12}$ inhibitor → Add a second anti-thrombotic agent to aspirin for extended long-term secondary prevention in patients with moderate ischaemic risk and without HBR (Class IIb)

or P2Y$_{12}$ inhibitor monotherapy → P2Y$_{12}$ inhibitor monotherapy as an alternative to aspirin monotherapy for long term treatment (Class IIb)

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# Figure S5

**Information for patients on how to optimize their 'heart health' after an acute coronary syndrome**



How can I improve my heart health after an acute coronary syndrome?

**Don't smoke**
If you smoke, discuss with your doctor or nurse how they can support you to stop

**Eat healthily**
Try to eat a balanced Mediterranean-type diet, with lots of fruit and vegetables

**Avoid alcohol**
Not drinking alcohol is best. If you do drink, discuss with your doctor or nurse how to cut down

**Exercise regularly**
Try to exercise to the point of breathlessness, aiming for 150 min a week, spread over 5 days

**See your doctor**
Make sure to see your doctor regularly to get a check-up

**Take your medications**
Take the medications that your doctor has prescribed for you

**Get your flu vaccine**
Make sure to get your flu vaccine each year

**Know your numbers**
Know your BMI, LDL (bad) cholesterol and blood pressure. Discuss with your doctor/nurse how to reach your goals

**Manage your stress**
If you are feeling stressed, discuss with your doctor how you can try to manage this

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**Figure S6**

**Informed consent process using the 'teach back' technique**
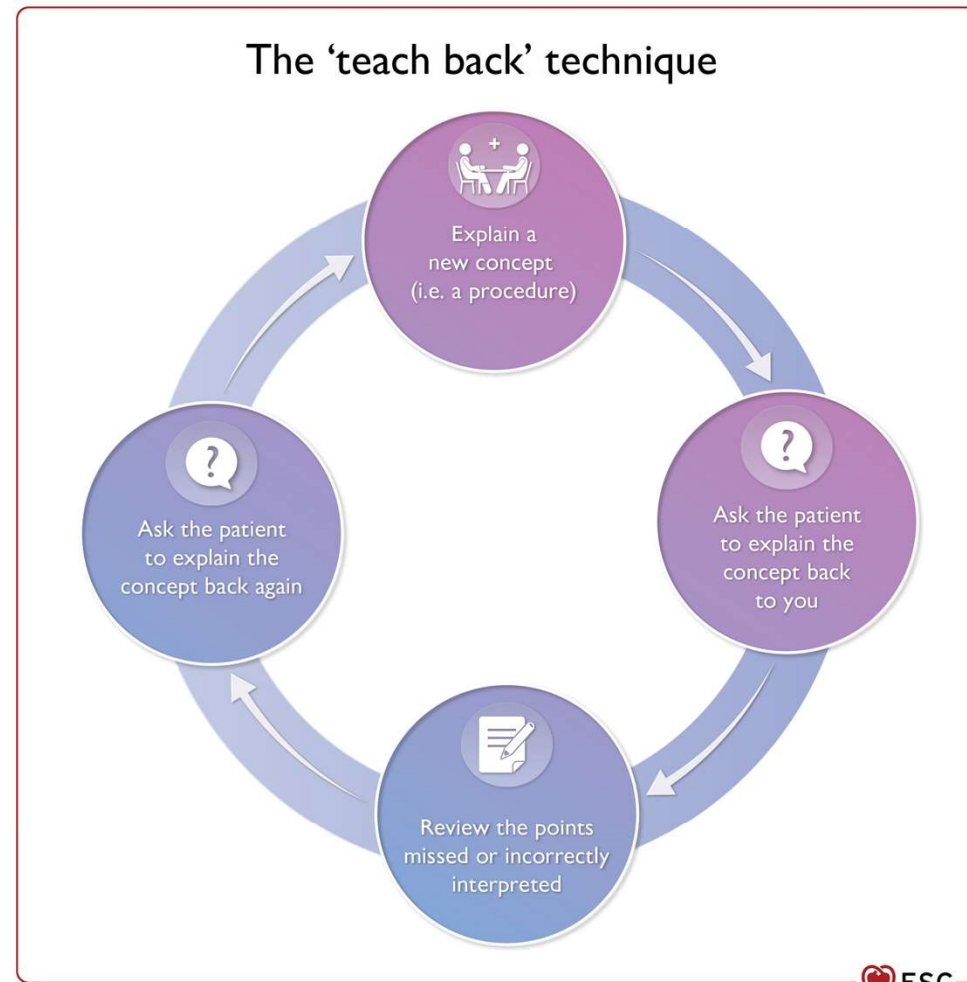
The 'teach back' technique

- Explain a new concept (i.e. a procedure)
- Ask the patient to explain the concept back to you
- Review the points missed or incorrectly interpreted
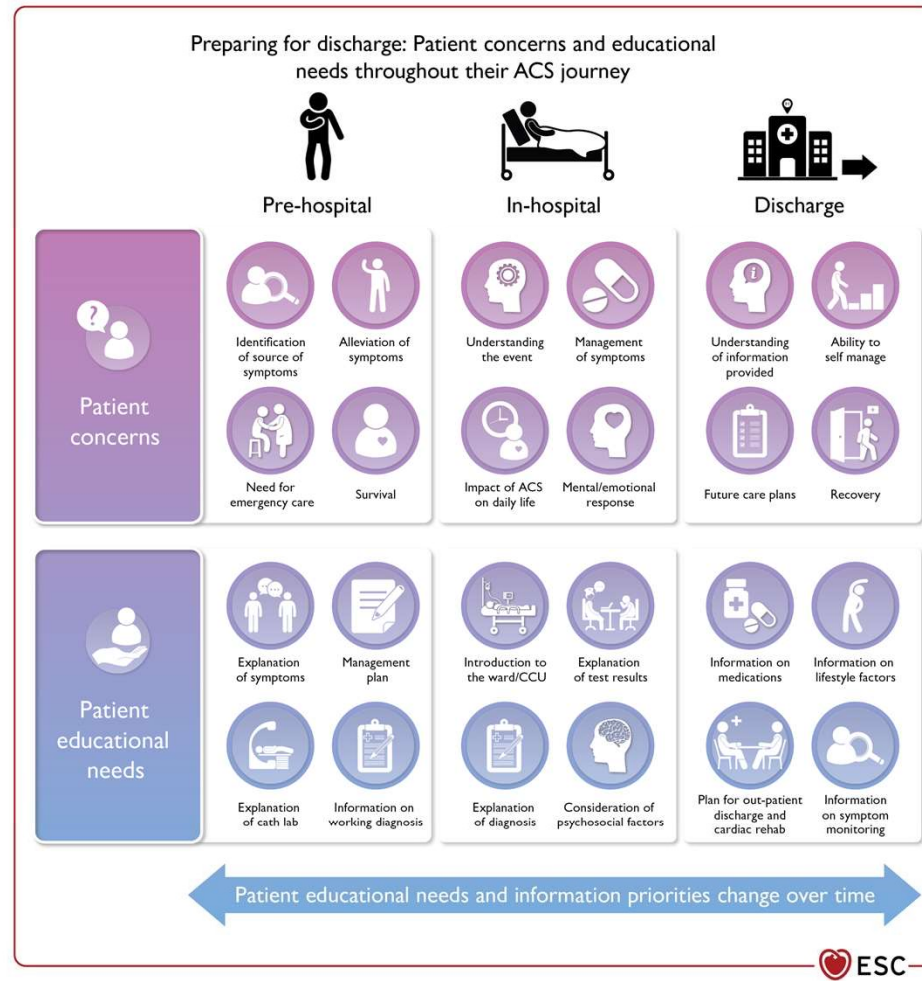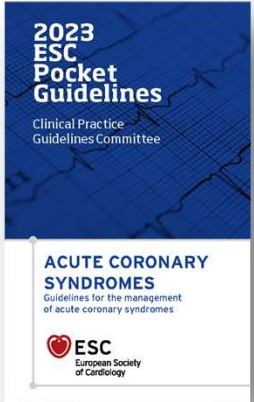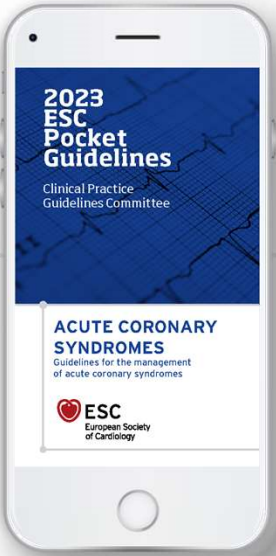- Ask the patient to explain the concept back again

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# Figure S7

**Patient concerns and educational needs throughout their ACS journey**

Preparing for discharge: Patient concerns and educational needs throughout their ACS journey

Pre-hospital · In-hospital · Discharge

**Patient concerns**
- Identification of source of symptoms
- Alleviation of symptoms
- Need for emergency care
- Survival
- Understanding the event
- Management of symptoms
- Impact of ACS on daily life
- Mental/emotional response
- Understanding of information provided
- Ability to self manage
- Future care plans
- Recovery

**Patient educational needs**
- Explanation of symptoms
- Management plan
- Explanation of cath lab
- Information on working diagnosis
- Introduction to the ward/CCU
- Explanation of test results
- Explanation of diagnosis
- Consideration of psychosocial factors
- Information on medications
- Information on lifestyle factors
- Plan for out-patient discharge and cardiac rehab
- Information on symptom monitoring

Patient educational needs and information priorities change over time

2023 ESC Guidelines for the management of acute coronary syndromes
(European Heart Journal; 2023 – doi:10.1093/eurheartj/ehad191)

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**Pocket Guidelines**

**Essential Messages**
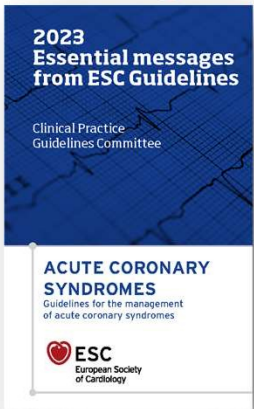
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