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12th Annual Tehran Heart Center Congress

7th CRITICAL CARDIOVASCULAR CARE

دوازدهمین کنگره سالیانه مرکز قلب تهران

2025

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13 & 14 February

Tehran Heart Center

Tehran, Iran

Mulitvessels management difference in STEMI & NSTEMI

Dr Mehdi Pishgahi

Interventional Cardiologist

Shohadaye tajrish hospital

Factuality member of SBMU

- ***Acute coronary syndrome (ACS)*** encompasses a broad clinical spectrum, span in from patients with ***unstable angina to those experiencing a myocardial infarction, as well as individuals with infarct-related cardiogenic shock and cardiac arrest .***

- ***Acute complete occlusion*** *of a coronary artery due to* ***plaque rupture without significant collateral blood*** *supply to the downstream vascular region typically results in a* ***STEMI,*** *leading to the development of* ***a transmural infarction*** .

- *If there is* ***residual coronary blood flow*** *due to* ***a partial occlusion*** *caused by* ***plaque erosion or sufficient collateral circulation****, this usually results in an* ***NSTEMI*** *with the* ***development of a subendocardial but also sometimes transmural infarction.***

- *The prevalence of **coronary multivessel disease** varies based on the **ACS type**, as well as according to the **patient's risk profile and age .***

- ***NSTEMI,** the prevalence of multivessel disease ranges up to **70%,** depending on the examined cohort . In **STEMI** patients, it is around **50%** . In the case of infarct-related **Cardiogenic shock,** the prevalence is highest, at approximately **80%** .*

(1)Should relevant ***non-culprit lesions be revascularized*** ***in addition to the culprit lesion*** (basic question)?

(2) What is the ***optimal timing*** ***for complete revascularization***: either **immediate** complet revascularization or ***staged*** complete revascularization?

(3) ***If staged revascularization*** is performed, should it be performed either during the ***index hospital stay or at some interval*** within a ***defined time window*** as part of elective readmission?

(4) How should ***complete revascularization be guided***: ***angiographically***, based ***on physiological parameters*** indicating hemodynamic relevance (e.g., ***FFR, RFR***, . . .), or ***base on morphological characteristics*** identifying ***vulnerable plaques (e.g., OCT***)?

(5) Are there ***differences in these strategies*** between patients with ***STEMI, NSTEMI***, an those ***with or without cardiogenic shock?***

Cardiogenic shock

- *broadly defined as* ***insufficient organ perfusion resulting from cardiac dysfunction*** .

- ***Shock Academic Research Consortium (SHARC)*** :

- ***Systolic blood pressure below 90 mm Hg for more than 30 min or the need for inotropes, vasopressors, or mechanical circulatory support (MCS) to maintain adequate blood pressure, alongside evidence of systemic hypoperfusion.***

The SHARC definition also recognises the ***Normotensive cardiogenic shock subtype*** *defined by evidence of* ***hypoperfusion despite systolic blood pressure equal to or greater than 90 mm Hg*** *without the need for vasopressors, inotropes, or MCS, with other potential causes of markers of hypoperfusion excluded.*

- In fact, while ***STEMI–CS*** is associated with ***massive and localized impaired coronary flow with rapid myocardial necrosis***, ***NSTEMI–CS*** is usually characterized by ***diffuse flow-impairment with gradual myocardial injury .***

- *These* ***different characteristics*** *also lead to* ***different treatment strategies*** *which are usually* ***more aggressive and timelier in STEMI patient .***

- *Among patients who developed* ***CS****, those* ***without ST-segment elevation*** *had* ***more frequently several adverse baseline characteristics than those with ST-segment elevation****, such as significantly* ***older age, and a greater frequency of prior infarction, multivessel disease and congestive heart failure .***

Revascularization Strategies of Multivessel CAD in AMI–CS Patients

- more than 80% of patients presenting with ACS and CS have significant stenoses in at least one non-infarct-related artery .
- MVD is an independent predictor of in-hospital mortality , may lead to a diffuse myocardial ischemia involving not only the culprit artery but also non-infarctrelated lesions.

- This may occur through a pan-myocardial inflammatory process combined with systemic hypotension, leading to further coronary hypoperfusion in the non-infarctrelated arteries and creating a vicious circle of further myocardial ischemia and impaired myocardial function.

Early Revascularization in Infarct-Related Cardiogenic Shock

- *The management of CS should* ***start*** ***as early as*** ***possible*** *because of the* ***reversible effects*** *of* ***tissue hypoperfusion (cellular and tissue hypoxia resulting in cellular death) in early stages****, while a* ***delay*** *in diagnosis and treatment usually leads to* ***irreversible changes****, resulting in multi-organ failure and death .*

- *Previous data have shown a* ***short-lived window*** *of opportunity to attempt* ***to avert the development of CS****, with a* ***median time of 11 h*** *from the beginning of symptoms and an* ***irreversible shock stage*** *.*

- ***Once the diagnosis of AMI–CS is confirmed*** *, a* ***timely reperfusion*** *of the infarct-related artery must be performed, in the setting of both STEMI and NSTEMI .*

Definitions of Complete Revascularization

- ***Multi vessel disease & incomplete revascularization*** ***(both anatomical and functional) has been identified as a strong independent predictor of cardiovascular outcomes in ACS .***

- ***The presence or absence of untreated residual CAD after treatment*** (with coronary artery by-pass graft, CABG, or PCI) ***defines the completeness*** *of revascularization and has important prognostic implications .*

Two main definitions of complete revascularization

- ***Anatomic complete revascularization***, *usually defined as successful treatment of all lesions with a* ***diameter stenosis ≥50% or ≥70% in vessels with a reference diameter ≥1.5/2.0 mm,*** *with slight differences in cut-off values among different studies.*

- *Other authors refer to anatomic complete revascularization* ***when a residual SYNTAX score of 0 is achieved****. This latter definition provides a* ***more objective and standardized*** *parameter which was linked to a* ***better post-procedural outcome*** *prediction.*

- ***Ischemic (i.e., functional) complete revascularization****, defined as successful treatment of* ***all flow-limiting lesions****, responsible for either resting or stress-induced ischemia or pathological* ***fractional flow reserve values***

- ***when the criteria** for complete revascularization **are not met,** **incomplete revascularization** is present,*
- *defined as **"reasonable" when functional but not anatomic completerevascularization is achieved .***

- *The **optimal management** of multiple significant stenoses in a CS setting remains **challenging**.*

- *On one hand, a **complete coronary revascularization should improve cardiac perfusion and output**; on the other hand, a multivessel PCI may be associated with **increased procedural time and higher procedural complications and contrast-induced nephropathy risks***

- ***Differently from*** *the hemodynamically* ***stable*** *setting,* ***in the case of AMI–CS****, the* ***current guidelines contraindicate*** *the* ***routine immediate revascularization of non-culprit lesions during PCI in patients presenting with both STEMI and NSTEMI (Class III recommendation) .***

- ***At 1-year follow up****, in the* ***immediate MV-PCI*** *group,* ***mortality still tended to be higher****, with* ***no difference between rates at 30 days and 1 year****, but with* ***a lower occurrence of heart failure rehospitalization and repeat revascularization*** *.*
- *Importantly, the* ***SYNTAX score*** *was an* ***independent predictor of adverse outcomes****, with* ***higher absolute risk with left main or proximal left anterior descending*** *involvement and with* ***no interaction between the SYNTAX score and the revascularization strategy .***

Multivessel PCI in Cardiogenic Shock
European and American Recommendations 2017

CULPRIT-SHOCK

Multivessel coronary artery disease present in up to 80% → higher mortality

Guidelines

ESC

I IIa IIb III
C

ACC/AHA/SCAI

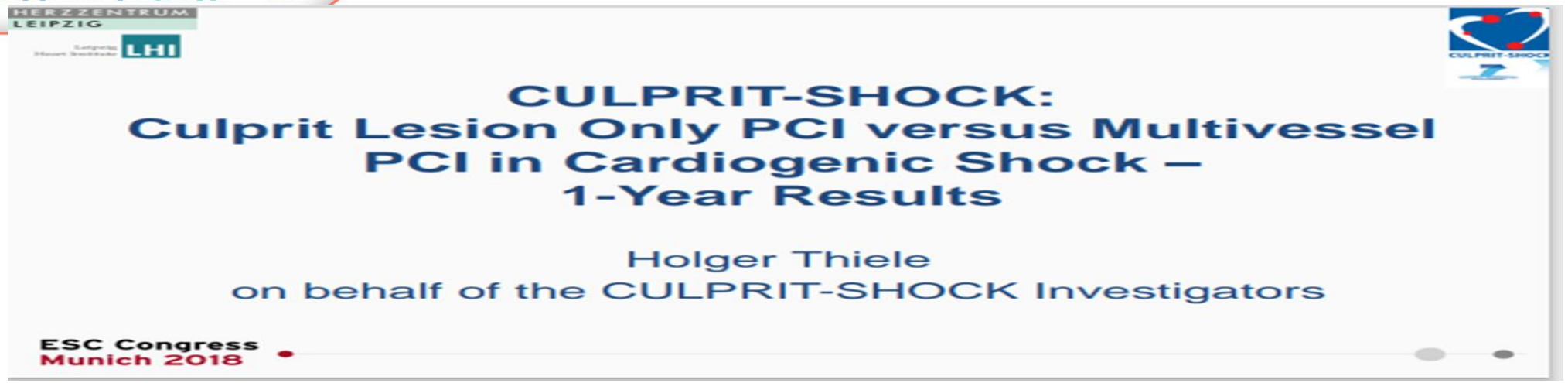
No recommendation

Appropriate Use Criteria

ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS

A (9)

Ibanez et al. Eur Heart J 2018;39:119-177
Levine et al. J Am Coll Cardiol 2016;67:1235-1250
Patel et al. J Am Coll Cardiol 2017;69:570-591



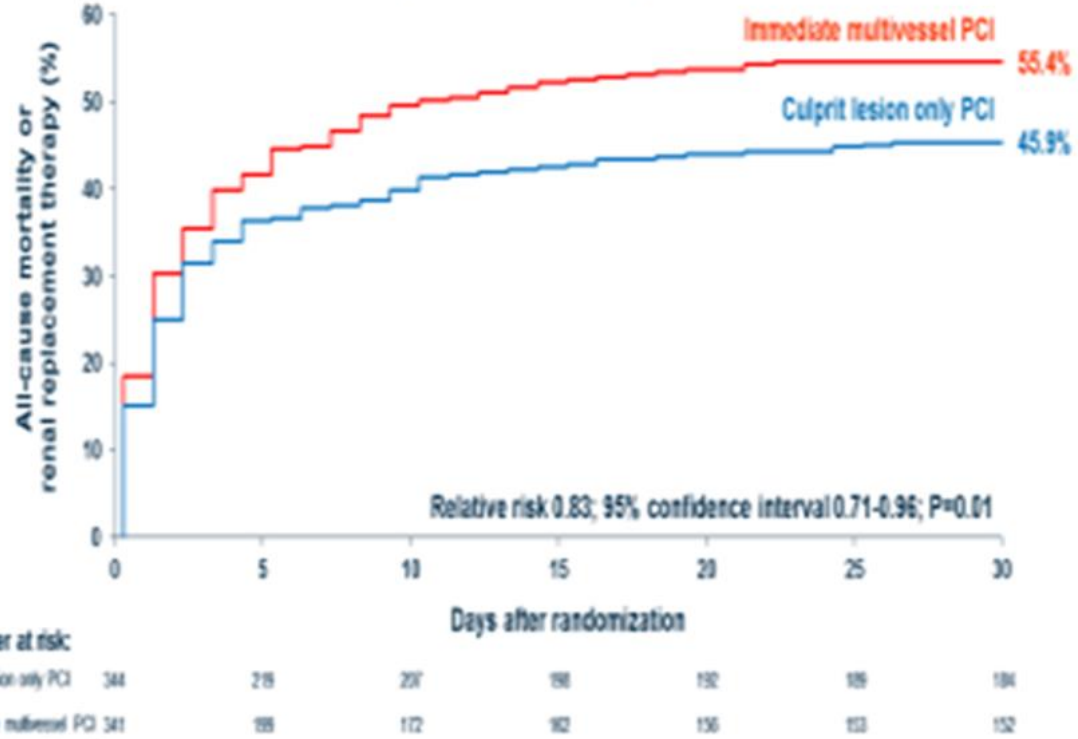
- Based on the Culprit Lesion Only PCI versus Multivessel PCI in Cardiogenic Shock (CULPRIT-SHOCK) trial including ACS patients (both with and without ST-segment elevation or equivalent), ***PCI during the index procedure should be restricted to the IRA only***

- ***A significant reduction in all-cause death or renal replacement therapy at 30-day follow-up***

- ***At 1-year follow-up, mortality did not differ significantly between the two groups***

CULPRIT-SHOCK Trial – 30-Day Results

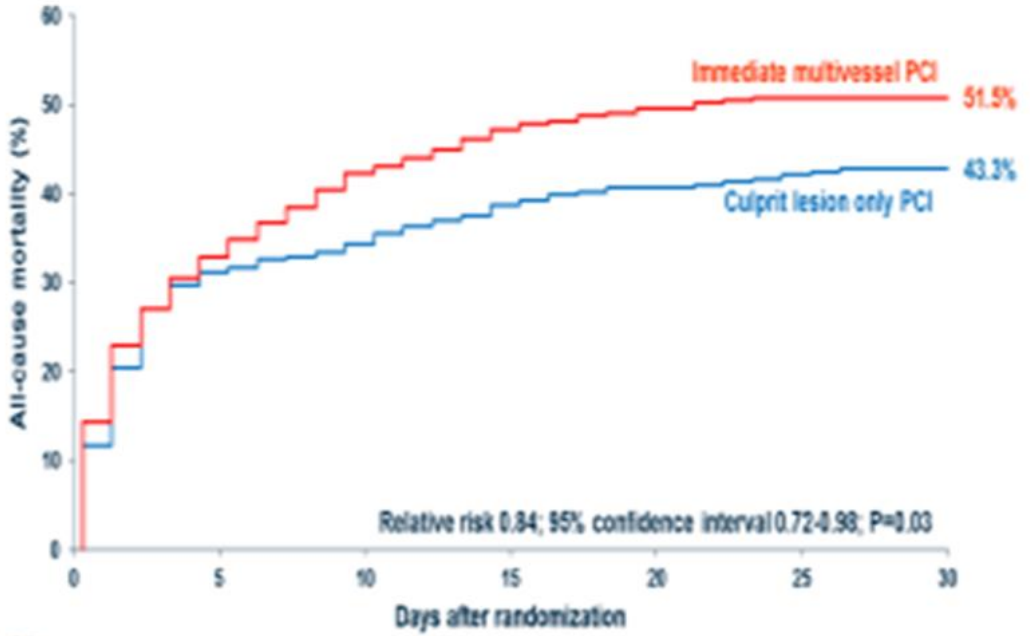
Primary study endpoint – 30 days
All-cause mortality or renal replacement therapy



Number at risk:

Culprit lesion only PCI	344	218	207	198	192	189	184
Immediate multivessel PCI	341	188	172	162	156	153	152

All-cause mortality – 30 days



Number at risk:

Culprit lesion only PCI	344	257	226	211	203	196	193
Immediate multivessel PCI	341	229	197	179	170	166	165

ESC Congress
Munich 2018

Thiele et al. NEJM 2017; 377:2419-2432

- *Current international* ***clinical guidelines strongly recommend emerging coronary angiography and PCI*** *of the* ***culprit lesion*** *for patients with cardiogenic shock due to* ***STEMI or NSTE–ACS****,* ***independent of the time delay of symptom onset****,* ***if coronary anatomy is amenable to PCI*** *(****Class I, LOE B****);*

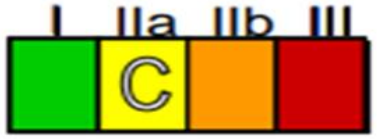
- *Otherwise, emergency* ***CABG*** *is the recommended* ***alternative****, especially for patients with* ***severe and diffuse CAD with no obvious culprit lesion*** *.*

Multivessel PCI in Shock - Guideline Evolution

CULPRIT-SHOCK

ESC STEMI Guidelines 2017 → Revascularization Guidelines 2018

STEMI (NSTEMI), Cardiogenic Shock

2017	2018
	

ESC Congress
Munich 2018

Ibanez et al. Eur Heart J 2018;39:119-177
Neumann et al. Eur Heart J 2018;epub 25.08.2018

CHANGES IN STEMI & MVD PCI (no CS setting)

- ***Among acute myocardial infarction (AMI)*** *patients,* ***about 50% present*** *with an accompanying* ***nonculprit vessel stenosis*** *and have been shown to experience* ***worse clinical outcomes***

- *The* ***previous consensus*** *based on nonrandomized observational studies* ***was to revascularize only the culprit lesion in patients with AMI***

- *However,* ***recent randomized trials*** *showed* ***better clinical outcomes when both culprit and nonculprit vessels underwent revascularization in contrast to culprit vessel only (associated with a reduced composite of CV death or new MI)***

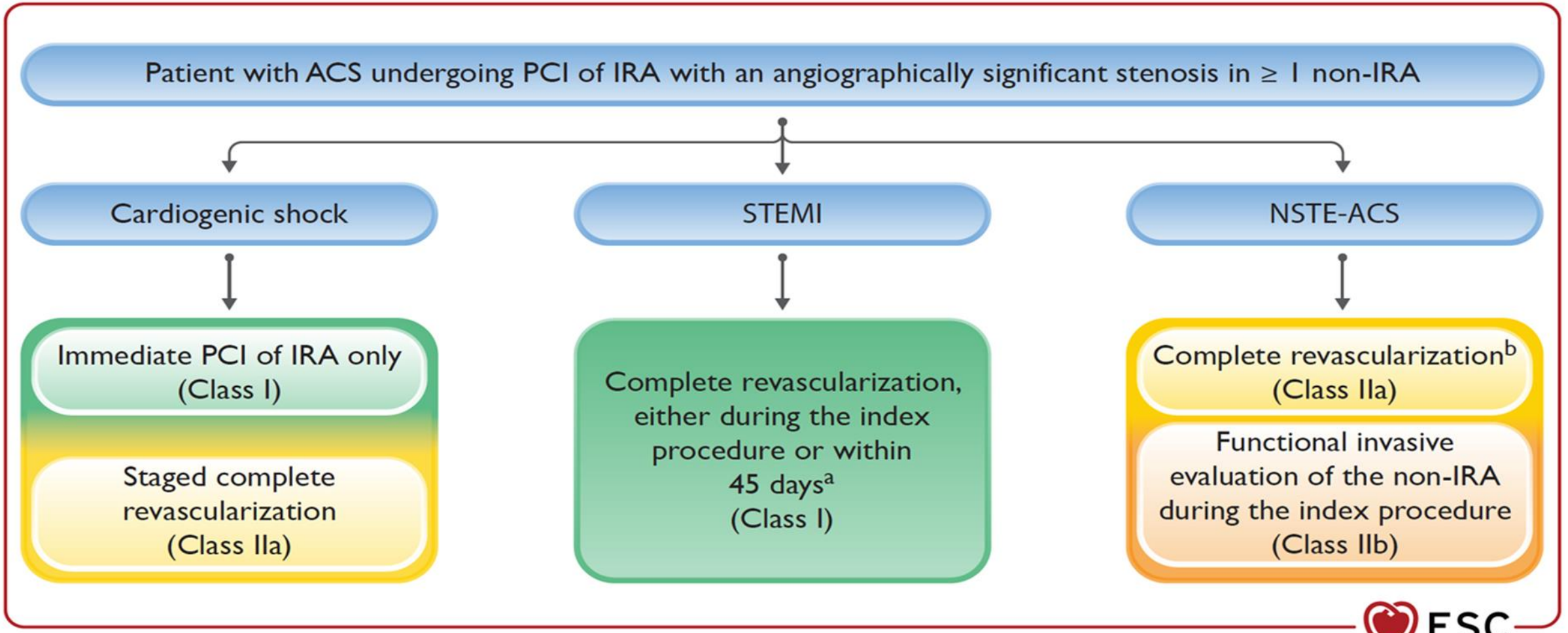
ESC European Society of Cardiology
European Heart Journal (2023) 00, 1–107
https://doi.org/10.1093/eurheartj/ehad191
ESC GUIDELINES

2023 ESC Guidelines for the management of acute coronary syndromes

Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC)

Authors/Task Force Members: Robert A. Byrne *†, (Chairperson) (Ireland), Xavier Rossello ‡, (Task Force Co-ordinator) (Spain), J.J. Coughlan ‡, (Task Force Co-ordinator) (Ireland), Emanuele Barbato (Italy), Colin Berry (United Kingdom), Alaide Chieffo (Italy), Marc J. Claeys (Belgium), Gheorghe-Andrei Dan (Romania), Marc R. Dweck (United Kingdom),

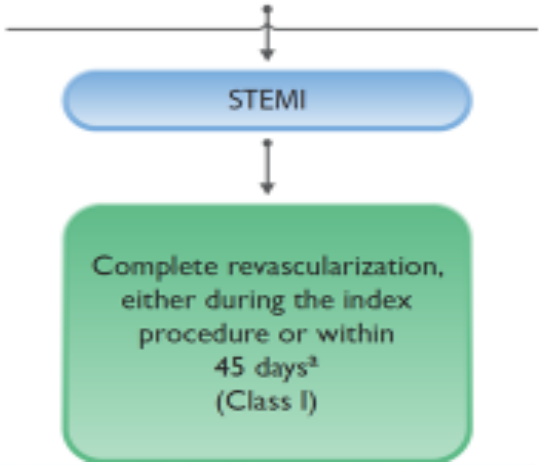
Algorithm for the management of acute coronary syndrome patients with multivessel coronary artery disease



Timing of non-infarct-related arter revascularization in acute coronary syndrome Patients presenting with ST-elevation myocardial infarction and multivessel coronary artery disease

- ***The previous ESC STEMI Guidelines recommended non-IRA PCI during the index procedure***

- *Given that the* ***optimal timing*** ***of revascularization (immediate vs. staged)*** *has still not been investigated in adequately sized randomized trials with a superiority design,* ***no recommendation in favor of an immediate vs. a staged (i.e. either during index hospitalization or within 45 days of discharge)*** *non-IRA PCI strategy can be formulated*



Rev Esp Cardiol. 2025;78(2):127–137

Original article

Timing of multivessel revascularization in stable patients with STEMI: a systematic review and network meta-analysis

Felix Voll,[a] Constantin Kuna,[a] Maria Scalamogna,[a,b] Thorsten Kessler,[a,c] Sebastian Kufner,[a] Tobias Rheude,[a] Hendrik B. Sager,[a,c] Erion Xhepa,[a] Jens Wiebe,[a] Michael Joner,[a,c] Robert A. Byrne,[d,e] Heribert Schunkert,[a,c] Gjin Ndrepepa,[a] Barbara E. Stähli,[f] Adnan Kastrati,[a,c] and Salvatore Cassese[a,*]

- ***An immediate multivessel PCI approach may also reduce the amount of total contrast volume and radiation exposure and may avoid the need for an additional arterial puncture, later revascularization procedures, or a second hospitalization, thereby potentially shortening the overall length of hospital stay.***

- ***In addition, immediate multivessel PCI may be preferred by some patients because delaying the treatment of nonculprit lesions may be worrisome to them .***

FOR INDEX PCI …

- *However, **several challenges exist**, including :*

- ***severity of non–infarct-related coronary lesions** (**the percentage of the artery diameter blocked by the lesion and whether the stenosis is due to a discrete lesion or diffuse lesion**);*
- ***the burden of coronary artery disease** (1 vs. >1 non–infarct-related coronary stenosis);*
- ***the complexity of anatomies** in coronary artery disease, including **left main** coronary artery disease, **bifurcation** disease, severe calcification, or **chronic total occlusions**;*
- ***the size and severity of the infarcted myocardium** in the index STEMI;*

- ***Additional considerations***, *including patient* ***age***, *serum* ***creatinine*** *level (if it is known at time of the index STEMI),* ***patient comfort***, *patient* ***perspective***, *and the* ***appropriate and timely use of physiological testing and intravascular imaging***, *will be imperative to understand.*

- ***Newly* added to the European Society of Cardiology (ESC) guidelines** *is the recommendation that* **PCI of the remaining stenoses should be *guided by angiographic severity*.** *This is primarily attribute to the* **FLOWER-MI study**, *which* **showed *no advantage of fractional flow reserve (FFR) guided PCI* over purely angiography-guided PCI for non-culprit lesions** *in STEMI patients with multivessel disease .*

- ***In a subanalysis of this trial, non-treatment of angiographically relevant stenoses with a negative FFR measurement (>0.80) was associated with a higher event rate .***

- ***This could be because FFR might be a false negative in the setting of acute MI .***

- ***It was found that in the acute phase, 15% of stenoses were hemodynamically relevant compared to 26% of the stenoses at follow-up (1 month later) .***

- ***Blunted acute hyperemic response correlated with the infarct size derived from cardiac magnetic resonance imaging.***

- *The optical coherence tomography* ***(OCT)*** *substudy of the COMPLETE trial showed* ***angiographically relevant lesions more commonly exhibiting vulnerable plaque morphology like a thin-cap fibroatheroma than non-obstructive lesions .***

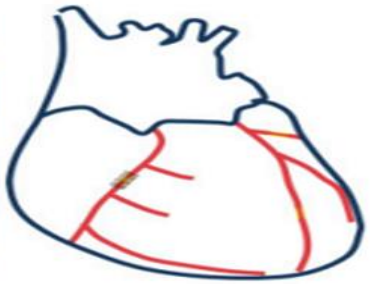
- *In FFR-guided complete revascularization, 31% of angiographically relevant stenoses (i.e., stenosis > 50%) were deferred due to FFR>0.8 .*

- *Importance of plaque morphology beyond acute functional relevance for avoiding future cardiovascular events.*

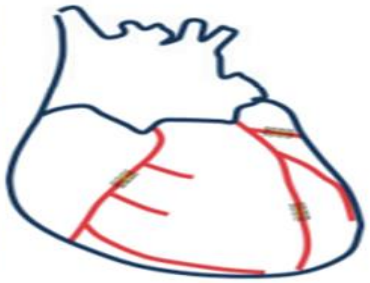
- *The angiographic significance could be a surrogate for vulnerable plaque morphology(by OCT), suggesting that angiography-guided PCI with consequent plaque sealing might be superior to FFR-guided PCI of non-culprit lesions.*

1) Basis question

culprit-lesion-only revascularization



Complete revascularization



2) Timing

staged complete revascularization

Evidence: immediate complete revascularization not inferior

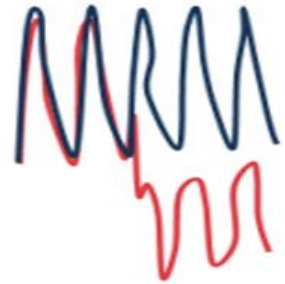
immediate complete revascularization

3) Guidance

angiography-guided

Evidence: inconclusive

physiological-guided



NSTEMI

Evidence: no data available

Guideline: complete revascularization (class IIa)

STEMI

Evidence: complete revascularization

Guideline: complete revascularization (class I)

. *Multivessel PCI in NSTEMI :*

NSTE-ACS is the most common form of ACS, accounting for approximately 70% of all cases .

According to the recently revised ESC guidelines for ACS, released in August 2023 :

complete revascularization should be considered in patients with NSTE-ACS and multivessel disease

unlike STEMI, currently, no randomized data exist

- As already stressed above, ***not only do the clinical characteristics of patients with STEMI differ from those with NSTEMI, but often, also the plaque morphology***

- ***Intravascular OCT*** has shown ***increased plaque vulnerability (i.e., more plaque ruptures***)in ***STEMI patients compared to NSTEMI patients*** . *Therefore, the results of STEMI patients cannot be extrapolated to NSTEMI patients, even though* ***observational studies*** *also indicate a benefit with complete revascularization in NSTEMI patients*

NSTEMI & MVD …

- *In the **SMILE** (Impact of Different Treatment in Multivessel Non ST Elevation Myocardial Infarction Patients: **One Stage Versus Multistaged Percutaneous Coronary Intervention**) trial:*

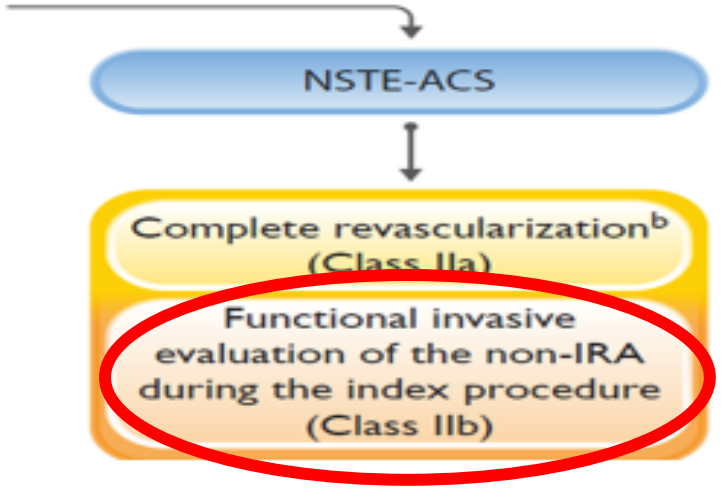
- *In **multivessel non–ST-segment elevation myocardial infarction** patients, **complete 1-stage coronary revascularization is superior to multistage PCI in terms of major adverse cardiovascular and cerebrovascular events***

- ***Recently, the so-called FIRE trial has been published. This trial showed the benefit of physiologically-guided complete revascularization of non-culprit lesions over culprit lesion PCI .***
-

Timing of non-infarct-related artery revascularization in acute coronary syndrome Patients presenting with non-ST-elevation acute coronary syndrome and multivessel coronary artery disease While there are a large

- *complete revascularization is associated with fewer deaths and MACE during follow-up in comparison to IRA-only PCI*

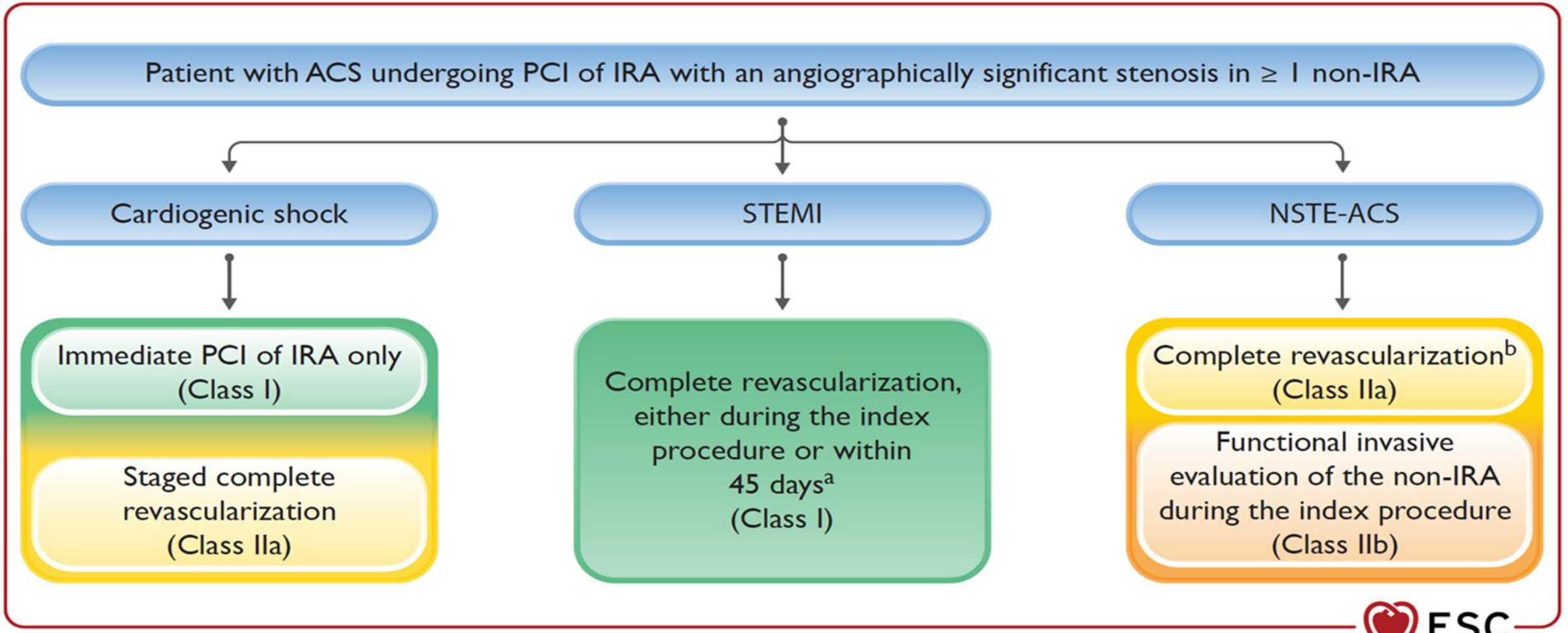
However, based on the study design, complete revascularization could also be performed during a separate staged procedure as early as possible before hospital discharge and within 5 days of the initial procedure



Recommendation Table 12 — Recommendations for management of patients with multivessel disease

Recommendations	Class[a]	Level[b]
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.[480,481]	I	B
Multivessel disease in ACS patients presenting in cardiogenic shock		
IRA-only PCI during the index procedure is recommended.[404,505]	I	B
Staged PCI of non-IRA should be considered.[c]	IIa	C
Multivessel disease in haemodynamically stable STEMI patients undergoing PPCI		
Complete revascularization is recommended either during the index PCI procedure or within 45 days.[508–511,531]	I	A
It is recommended that PCI of the non-IRA is based on angiographic severity.[511,524]	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.[513,514]	IIa	C
Functional invasive evaluation of non-IRA severity during the index procedure may be considered.[518,527,528,532]	IIb	B

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



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Thank You