

SECOND EDITION

CLINICAL DECISION-MAKING

# TOOLKIT

ACUTE CARDIOVASCULAR CARE ASSOCIATION



Acute  
Cardiovascular  
Care Association  
A Registered Branch of the ESC



EUROPEAN  
SOCIETY OF  
CARDIOLOGY®

The ACCA Clinical Decision-Making Toolkit is produced by the Acute Cardiovascular Care Association. Developed and distributed through an educational grant from AstraZeneca and Novartis Pharma AG. AstraZeneca and Novartis Pharma AG were not involved in the development of this publication and in no way influenced its contents.



# The Acute Cardiovascular Care Association Clinical Decision-Making TOOLKIT

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## Preface

The best care of patients with acute cardiovascular syndromes relies not only on specialists but also on systems of care that involve many non-cardiologists. Several of these syndromes require immediate diagnosis and decisions on treatment, some of them life-saving. Critical decisions must often be made quickly by professionals with different backgrounds and levels of expertise with limited resources. This poses a significant clinical challenge.

Against this background, the **ACCA Clinical Decision-Making Toolkit** was created as a comprehensive resource encompassing all aspects of acute cardiovascular care but structured as an easy-to-use instrument in environments where initial acute cardiovascular care is typically initiated. Comprehensive tables, clear diagrams and algorithms, based on the ESC clinical practice guidelines as well as in clinical experience should provide diagnostic and therapeutic guidance at a glance.

The Second Edition of the ACCA Toolkit has been updated with the 2014 and 2015 ESC Guidelines, and enriched with a new chapter with up-to-date coverage of drugs most frequently used in acute cardiovascular care. However, it does not replace textbooks and other sources of information that need to be consulted to reach an optimal management of these patients.

The ACCA Toolkit is available through different platforms:

Printed booklet, available at congresses where ESC-ACCA is represented

Web-based pdf file downloadable at [www.escardio.org/ACCA](http://www.escardio.org/ACCA)

Mobile application for smartphones/tablets available in both Apple & Googleplay stores

Héctor Bueno, M.D., PhD., FESC, FAHA  
Editor in Chief

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# CHAPTER I: KEY SYMPTOMS

**I.1 CHEST PAIN** ..... p.2

M. Lettino, F. Schiele

**I.2 DYSPNEA** ..... p.9

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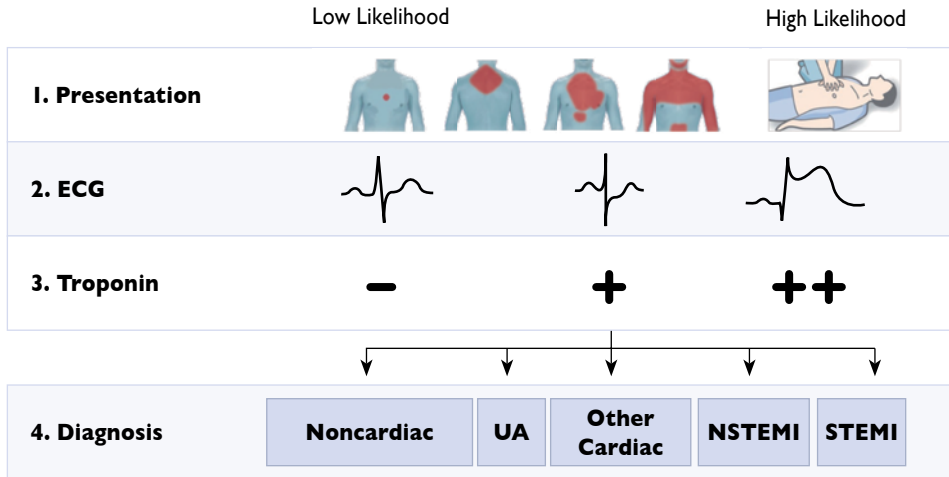
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R. Sutton

## Initial assessment of patients with CHEST PAIN

1.1

p.2



STEMI = ST-elevation myocardial infarction; NSTEMI = non-ST-elevation myocardial infarction; UA = unstable angina.

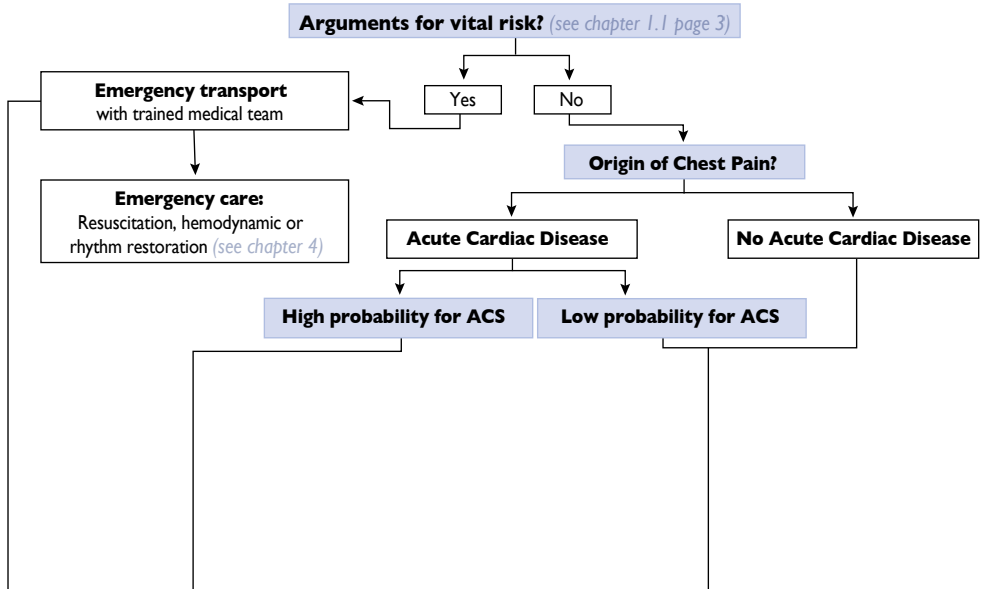
Reference: Roffi et Al. Eur Heart J 2015;eurheartj.ehv320

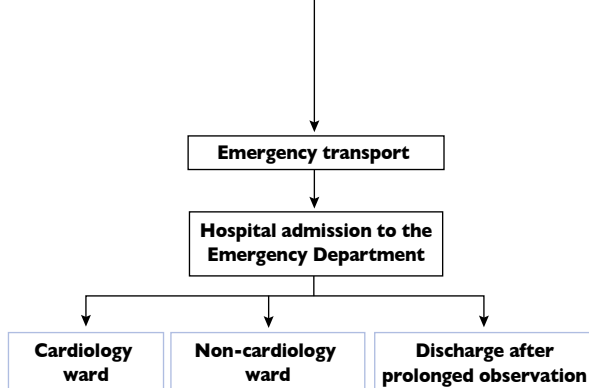
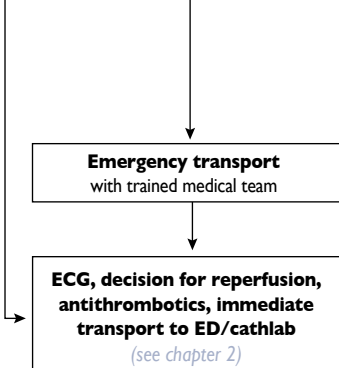


## Factors to be considered in the evaluation after the first call for CHEST PAIN

First call for chest pain	Higher risk / probability	Lower risk / probability
<b>Arguments for vital risk</b>	<ul style="list-style-type: none"> <li>• Cardiorespiratory arrest, syncope / loss of consciousness, neurological defect</li> <li>• Dyspnea</li> <li>• Nausea – vomiting</li> <li>• Arrhythmias – tachycardia</li> </ul>	<ul style="list-style-type: none"> <li>• Normal consciousness</li> <li>• Normal breathing (<i>see chapter 1.1 page 9</i>)</li> <li>• Normal heart rhythm</li> </ul>
<b>Context, CV risk</b>	Age > 40 years, previous CV disease (MI, stroke, PE), modifiable CV risk factors (smoker, HTN, hypercholesterolemia, diabetes), chronic CV treatment	<ul style="list-style-type: none"> <li>• Age &lt; 40 years,</li> <li>• No previous CV disease</li> <li>• No CV risk factors</li> <li>• No chronic treatment</li> </ul>
<b>Chest Pain</b>	Medial / lateral thoracic pain, intense, with dyspnea	<ul style="list-style-type: none"> <li>• Depends on position/ palpation/ movements</li> <li>• Variable intensity, short duration (&lt;1 min)</li> <li>• Hyperthermia</li> </ul>
<b>Cardiac Ischemic Pain</b>	Retro-sternal, constriction, jaw/cervical/arm/back irradiation, spontaneous, prolonged > 20 min + dyspnea, sweating, lightheadedness, nausea	<ul style="list-style-type: none"> <li>• Lateral, abdominal irradiation</li> <li>• No neuro-vegetative symptoms</li> </ul>

## Approach after first call for out-of-hospital CHEST PAIN

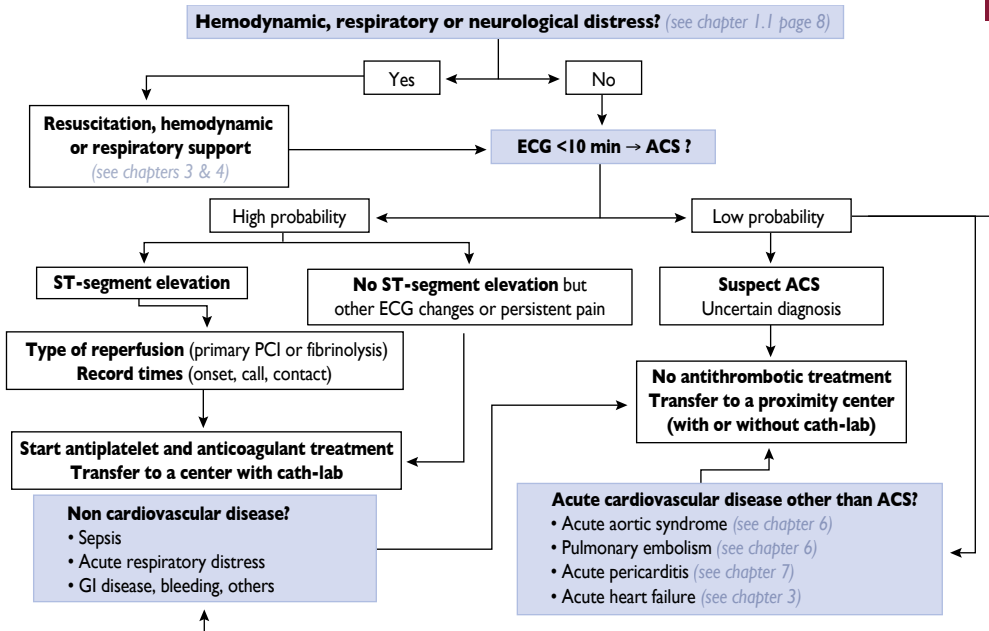




## Factors to be considered in the evaluation during the first medical contact for CHEST PAIN

First medical contact	Higher risk / probability	Lower risk / probability
<b>Hemodynamic, respiratory, neurological distress</b>	<ul style="list-style-type: none"> <li>• Cardiopulmonary arrest, hypotension, tachycardia, shock</li> <li>• Dyspnea, hypoxemia, lung rales (Killip class &gt;2)</li> <li>• ECG: ST segment deviation</li> </ul>	<ul style="list-style-type: none"> <li>• Normal consciousness, no motion defects</li> <li>• Normal HR and BP</li> <li>• Normal breathing and SpO<sub>2</sub>, no loss of pulse</li> </ul>
<b>Probability for ACS</b>	<ul style="list-style-type: none"> <li>• Context, typical symptoms consistent with myocardial ischemia</li> <li>• ECG changes</li> <li>• Bedside Tn</li> </ul>	<ul style="list-style-type: none"> <li>• No CV risk, atypical symptoms, normal ECG</li> <li>• Negative bedside Tn only if onset of pain &gt;6 hours (see chapter 2.1 page 24)</li> </ul>
<b>STEMI NSTEMI Uncertain diagnosis</b> (see chapter 2.1 page 24)	<ul style="list-style-type: none"> <li>• ECG criteria for STEMI (see chapter 2.3 page 35)</li> <li>• ST depression or normal ECG</li> <li>• Normal ECG → Repeat 12-lead ECG recording</li> </ul>	<ul style="list-style-type: none"> <li>• Other ST-segment abnormalities not related to STEMI (see chapter 2.3)</li> </ul>
<b>Type of reperfusion</b>  <b>Time assessment</b>	<ul style="list-style-type: none"> <li>• <b>Primary PCI or thrombolysis?</b> Primary PCI if delay &lt;120 (preferably &lt;90) min or &lt;60 min if onset of pain &lt;120 min Consider age, anterior wall location</li> <li>• <b>Times:</b> Onset of pain, call, first medical contact, ECG, door, balloon inflation or needle (lytic drug) administration</li> </ul>	<ul style="list-style-type: none"> <li>• No reperfusion if delay &gt;12 h, no symptoms, no ST-segment elevation</li> </ul>

## First medical contact in patients with CHEST PAIN (home-ambulance)



## Management of patients with CHEST PAIN (emergency room)

Hemodynamic, respiratory or neurological distress? *(see chapter I.1 page 6)*

Other CVD  
or No ACS

Yes

No

Resuscitation, hemodynamic  
or respiratory support  
*(See chapters 3 & 4)*

STEMI,  
NSTEMACS with persistent pain,  
Hemodynamic distress

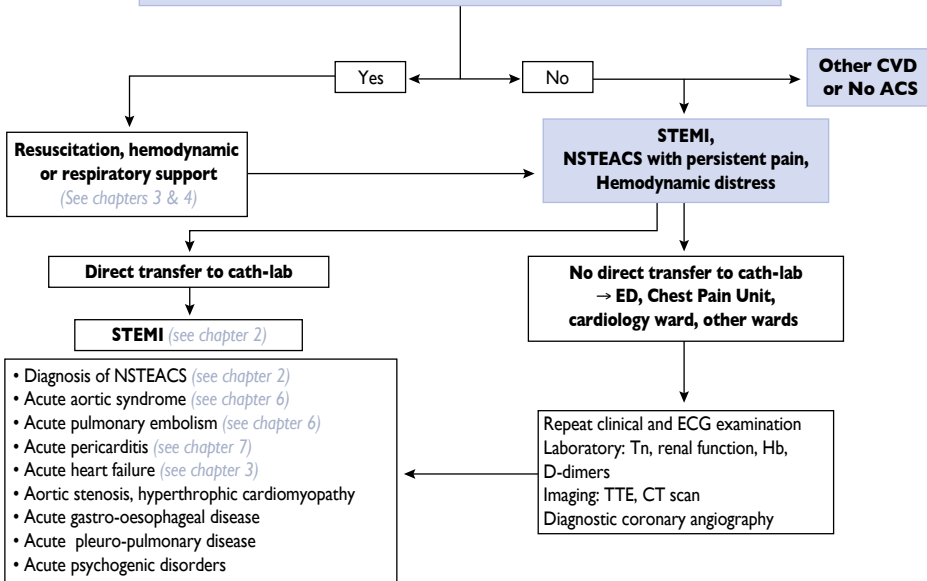
Direct transfer to cath-lab

No direct transfer to cath-lab  
→ ED, Chest Pain Unit,  
cardiology ward, other wards

STEMI *(see chapter 2)*

- Diagnosis of NSTEMACS *(see chapter 2)*
- Acute aortic syndrome *(see chapter 6)*
- Acute pulmonary embolism *(see chapter 6)*
- Acute pericarditis *(see chapter 7)*
- Acute heart failure *(see chapter 3)*
- Aortic stenosis, hypertrophic cardiomyopathy
- Acute gastro-oesophageal disease
- Acute pleuro-pulmonary disease
- Acute psychogenic disorders

Repeat clinical and ECG examination  
Laboratory: Tn, renal function, Hb,  
D-dimers  
Imaging: TTE, CT scan  
Diagnostic coronary angiography



## DYSPNEA: Differential diagnosis

50% have  $\geq 2$  diagnoses, which may result in acute respiratory failure\*!

### Basic measures

- BP, HR, respiratory rate, SpO<sub>2</sub> & temperature
- Start oxygen to target SpO<sub>2</sub> 94-98%
- Start i.v. line & monitor patient

### Criteria for transfer to ICU

(despite treatment for 30 minutes)

- Respiratory rate  $>35$ /min
- SBP  $<90$  mmHg
- SpO<sub>2</sub>  $<85\%$
- HR  $>120$  bpm

### Investigations:

- ECG
- Chest X-ray
- Blood count
- Tn
- BNP
- Venous BG
- D-dimers if suspicion of PE

**Acute heart failure**

**Acute coronary syndrome**

**Pneumonia**

**Exacerbated COPD**  
or other  
chronic lung disease

**Pulmonary embolism**

**Other causes, including**

- Asthma
- Severe sepsis
- Tumor
- Pneumothorax
- Pleural effusion/ascites
- Anxiety disorder
- Anemia
- Bronchitis
- Metabolic acidosis
- Neurologic disease

\* Defined as  $\geq 1$  criterion:

- Respiratory rate  $\geq 25$ /min
- PaO<sub>2</sub>  $\leq 75$  mmHg
- SpO<sub>2</sub>  $\leq 92\%$  in ambient air
- PaCO<sub>2</sub>  $\geq 45$  mmHg with arterial pH  $\leq 7.35$

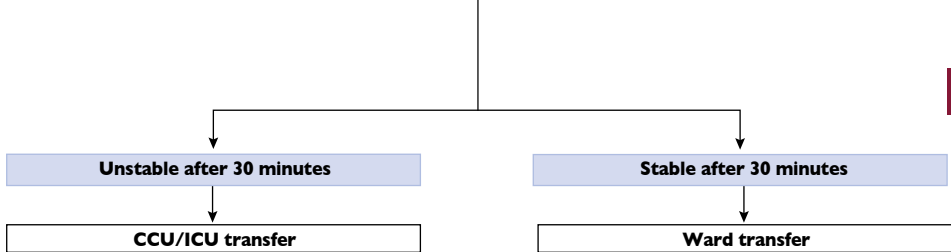
## DYSPNEA: Acute heart failure (see chapter 3.1)

### BASIC WORK-UP

- **Immediate 12-lead ECG, cardiac monitor, BP, respiratory rate, pulse oximetry**
- **Clinical findings**  
Most commonly: lower extremity edema, jugular venous distension, rales; work up for underlying cardiac disease and triggers
- **Laboratory findings**  
Complete blood count, chemistries, cardiac enzymes, BNP, TSH, ABG as needed
- **Chest X-ray (lung ultrasound)**
- **Echocardiogram**  
During admission (earlier if decompensated aortic stenosis or endocarditis are suspected)
- **Coronary angiography**  
Emergent in patients with ACS; delayed in patients with suspected coronary artery disease

- Positioning      Keep head of bed elevated above level of legs
- Oxygen            Up to 12 L/min via non-rebreather; titrate oxygen saturation to 95%
- Nitroglycerin     1-2 SL tablets or 2-3 patches 10 mg (1st choice). In pulmonary edema with severe shortness of breath:  
NTG drip 0.05% (100 mg in 200 ml)
  - Start with 25 µg/min = 3 ml/h, check BP after 5 and 10 min
  - Increase dose per SHO/attending recommendations by 25 µg/min at a time as long as SBP >90 mmHg
  - Additional BP check 5 and 10 min after each increase in dosing
  - Check BP every 20 min once a steady drip rate is reached
- Furosemide        40-120 mg i.v. (adjust based on kidney function and clinical findings; monitor creatinine)
- Morphine           2 mg i.v. (preceded by 10 mg i.v. metoclopramide PRN)
- Consider digoxin 0.5 (-1.0) mg i.v. in patients with atrial fibrillation
- Anticoagulation    Therapeutic dosing in ACS and atrial fibrillation: Enoxaparin 1 mg/kg body weight as 1st dose





## DYSPNEA: Acute pulmonary embolism (see chapter 6.2)

1.2

p.12

**Priorities: 1. Vital signs 2. Diagnostic screening dependent upon clinical stratification**

ABG, ECG, chest X-ray plus clinical assessment of PE probability (risk factors) plus monitoring

**Hemodynamically unstable**

**Initiate transfer to ICU**

Immediate TTE (if available)

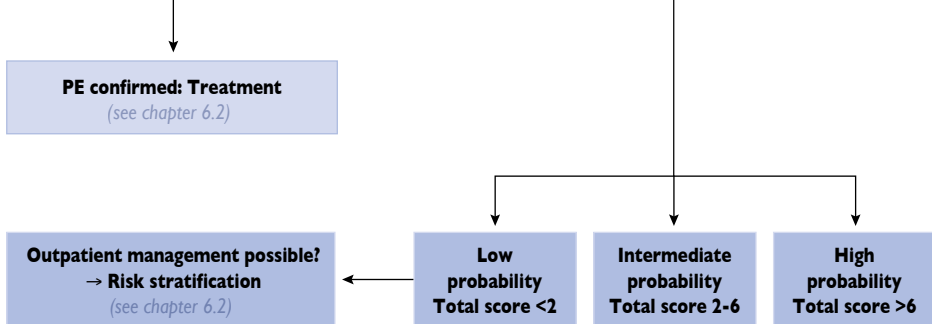
Result  
inconclusive  
→ CT-angio

Right  
ventricular  
dysfunction

**Hemodynamically stable**

**Wells criteria for PE:**

	<b>Score</b>
• Clinical signs and symptoms of deep vein thrombosis (DVT)	+ 3.0
• No alternative diagnosis (or alternative diagnosis less likely than PE)	+ 3.0
• Heart rate >100/min	+ 1.5
• Immobilization or operation within the last 4 weeks	+ 1.5
• Previous DVT or PE	+ 1.5
• Hemoptysis	+ 1.0
• Malignant tumor with treatment within the last 6 months or palliative care	+ 1.0



## DYSPNEA: COPD exacerbation

- **Verify diagnosis (DD: PE, acute heart failure, pneumothorax)**
- **Oxygen administration** → SpO<sub>2</sub> target 88-92% (**Beware of carbonarcosis: ABC after 1 h**)

### Definition:

- Known COPD and/or
- Progressive dyspnea and/or
  - Change in quantity and color of sputum and/or
  - Heavy coughing

- COPD classification (GOLD)

- Etiology

- History, clinical examination (blood pressure, pulse, oxygen saturation, vigilance)

- Laboratory findings: Blood count, coagulation, ProCT, perhaps BNP, D-Dimers
- Chest X-ray; ECG (exclusion of differential diagnoses)
- Sputum cultures (always in case of hospitalisation or previous outpatient antibiotic treatment)

- Hospitalisation indicated?

- Evaluate ICU criteria
- NIV indicated?

- **Oxygen therapy** 2-(4) l; target saturation 90%
- **Salbutamol/ipratropium inhalations** ≥4-6 x/d, if needed long-term inhalation
- **Systemic steroids** prednisone 0.5 mg/kg of body weight for 5 days
- Antibiotic treatment should be considered; always indicated in stage Gold IV
- Physiotherapy

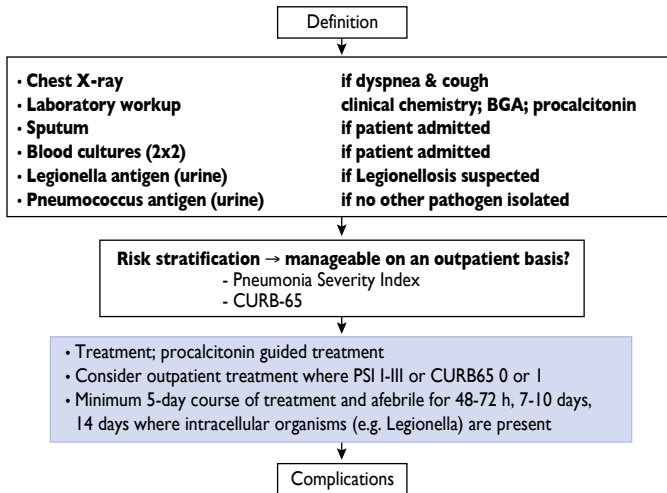
- Follow-up

## DYSPNEA: Community-acquired pneumonia

1.2

p.15

Objective: diagnostics, risk stratification & empirical immediate treatment <2(-4) hrs.



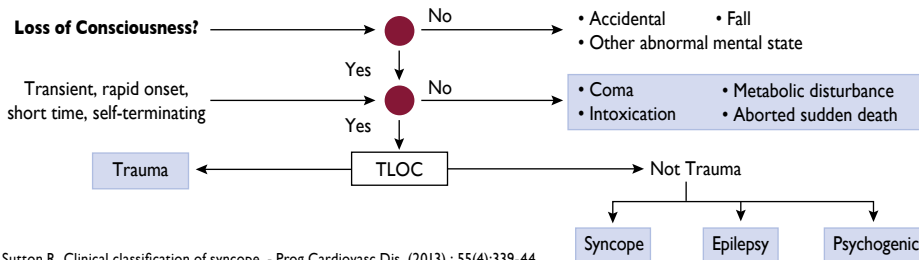
## SYNCOPE: Assessment of patients with transient loss of consciousness (TLOC)

Syncope is a transient loss of consciousness due to global cerebral hypoperfusion (usually, itself due to a period of low blood pressure) characterised by rapid onset, short duration, spontaneous and complete recovery.

The differentiation between syncope and non-syncopal conditions with real or apparent LOC can be achieved in most cases with a **detailed clinical history** but sometimes can be extremely difficult. The following questions should be answered:

- Was LOC complete?
- Was LOC transient with rapid onset and short duration?
- Did the patient recover spontaneously, completely and without sequelae?
- Did the patient lose postural tone?

If the answers to these questions are positive, the episode has a high likelihood of being syncope. If the answer to one or more of these questions is negative, exclude other forms of LOC before proceeding with syncope evaluation.



## **SYNCOPE: Diagnostic criteria (I)**

### **Diagnostic criteria with initial evaluation**

**Vasovagal syncope** is diagnosed if syncope is precipitated by emotional distress or orthostatic stress and is associated with typical prodrome.

**Situational syncope** is diagnosed if syncope occurs during or immediately after specific triggers.

**Orthostatic syncope** is diagnosed when it occurs after standing up and there is documentation of orthostatic hypotension.

**Arrhythmia related syncope** is diagnosed by ECG when there is:

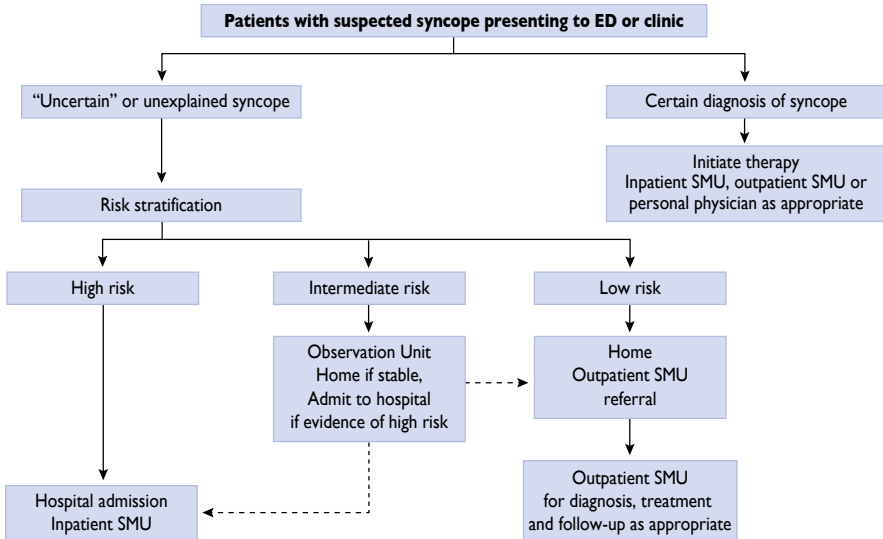
- Persistent sinus bradycardia <40 bpm in awake or repetitive sinoatrial block or sinus pauses >3 s
- Mobitz II 2nd or 3rd degree AV block
- Alternating left and right BBB
- VT or rapid paroxysmal SVT
- Non-sustained episodes of polymorphic VT and long or short QT interval
- Pacemaker or ICD malfunction with cardiac pauses

**Cardiac ischemia related syncope** is diagnosed when syncope presents with ECG evidence of acute ischemia with or without myocardial infarction.

**Cardiovascular syncope** is diagnosed when syncope presents in patients with prolapsing atrial myxoma, severe aortic stenosis, pulmonary hypertension, pulmonary embolus or acute aortic dissection.

## SYNCOPE: Evaluation and risk stratification of patients with suspected syncope

Once syncope is considered to be the likely diagnosis, risk stratification is required to determine further management.





## SYNCOPE: Diagnostic criteria (2)

### Diagnostic criteria with provocation maneuvers

Carotid sinus massage	Orthostatic Hypotension
<p><b>Indications</b></p> <ul style="list-style-type: none"> <li>• CSM is indicated in patients &gt;40 years with syncope of unknown aetiology after initial evaluation;</li> <li>• CSM should be avoided in patients with previous MI, TIA or stroke within the past 3 months and in patients with carotid bruits (except if carotid Doppler studies excluded significant stenosis)</li> </ul>	<p><b>Recommendations: Active standing Indications</b></p> <ul style="list-style-type: none"> <li>• Manual intermittent determination with sphygmomanometer of BP supine and, when OH is suspected, during active standing for 3 min is indicated as initial evaluation;</li> <li>• Continuous beat-to-beat non-invasive pressure measurement may be helpful in cases of doubt</li> </ul>
<p><b>Diagnostic criteria</b></p> <ul style="list-style-type: none"> <li>• CSM is diagnostic if syncope is reproduced in presence of asystole longer than 3 s and/or a fall in systolic BP &gt;50 mmHg</li> </ul>	<p><b>Diagnostic criteria</b></p> <ul style="list-style-type: none"> <li>• The test is diagnostic when there is a symptomatic fall in systolic BP from baseline value <math>\geq 20</math> mmHg or diastolic BP <math>\geq 10</math> mmHg or a decrease in systolic BP to &lt;90 mmHg;</li> <li>• The test should be considered diagnostic when there is an asymptomatic fall in systolic BP from baseline value <math>\geq 20</math> mmHg or diastolic BP &gt;10 mmHg or a decrease in systolic BP to &lt;90 mmHg</li> </ul>

## Treatment according to type of SYNCOPE (1)

Treatment of reflex syncope	Treatment of orthostatic hypotension
<ul style="list-style-type: none"><li>• Explanation of the diagnosis, provision of reassurance and explanation of risk of recurrence are in all patients</li><li>• Isometric PCM are indicated in patients with prodrome</li><li>• Cardiac pacing should be considered in patients with dominant cardioinhibitory CSS</li><li>• Cardiac pacing should be considered in patients with frequent recurrent reflex syncope, age &gt; 40 years and documented spontaneous cardioinhibitory response during monitoring</li><li>• Midodrine may be indicated in patients with VVS refractory to lifestyle measures</li><li>• Tilt training may be useful for education of patients but long-term benefit depends on compliance</li><li>• Cardiac pacing may be indicated in patients with tilt-induced cardioinhibitory response with recurrent frequent unpredictable syncope and age &gt; 40 after alternative therapy has failed</li><li>• Triggers or situations inducing syncope must be avoided as much as possible</li><li>• Hypotensive drugs must be modified or discontinued</li><li>• Cardiac pacing is not indicated in the absence of a documented cardioinhibitory reflex</li><li>• Beta-adrenergic blocking drugs are not indicated</li><li>• Fluid consumption and salt in the diet should be increased</li></ul>	<ul style="list-style-type: none"><li>• Adequate hydration and salt intake must be maintained</li><li>• Midodrine should be administered as adjunctive therapy if needed</li><li>• Fludrocortisone should be administered as adjunctive therapy if needed</li><li>• PCM may be indicated</li><li>• Abdominal binders and/or support stockings to reduce venous pooling may be indicated</li><li>• Head-up tilt sleeping (<math>&gt;10^{\circ}</math>) to increase fluid volume may be indicated</li><li>• Triggers or situations inducing syncope must be avoided as much as possible</li><li>• Hypotensive drugs administered for concomitant conditions must be discontinued or reduced</li></ul>

### Treatment of arrhythmic syncope

#### Cardiac Pacing

- Pacing is indicated in patients with sinus node disease in whom syncope is demonstrated to be due to sinus arrest (symptom-ECG correlation) without a correctable cause
- Pacing is indicated in sinus node disease patients with syncope and abnormal CSNRT
- Pacing is indicated in sinus node disease patients with syncope and asymptomatic pauses > 3 sec. (with possible exceptions of young trained persons, during sleep and in medicated patients)
- Pacing is indicated in patients with syncope and 2nd degree Mobitz II, advanced or complete AV block
- Pacing is indicated in patients with syncope, BBB and positive EPS
- Pacing should be considered in patients with unexplained syncope and BBB
- Pacing may be indicated in patients with unexplained syncope and sinus node disease with persistent sinus bradycardia itself asymptomatic
- Pacing is not indicated in patients with unexplained syncope without evidence of any conduction disturbance

#### Catheter ablation

- Catheter ablation is indicated in patients with symptom/arrhythmia ECG correlation in both SVT and VT in the absence of structural heart disease (with exception of atrial fibrillation)
- Catheter ablation may be indicated in patients with syncope due to the onset of rapid atrial fibrillation

#### Antiarrhythmic drug therapy

- Antiarrhythmic drug therapy, including rate control drugs, is indicated in patients with syncope due to onset of rapid atrial fibrillation
- Drug therapy should be considered in patients with symptom/arrhythmia ECG correlation in both SVT and VT when catheter ablation cannot be undertaken or has failed

#### Implantable Cardioverter Defibrillator (ICD)

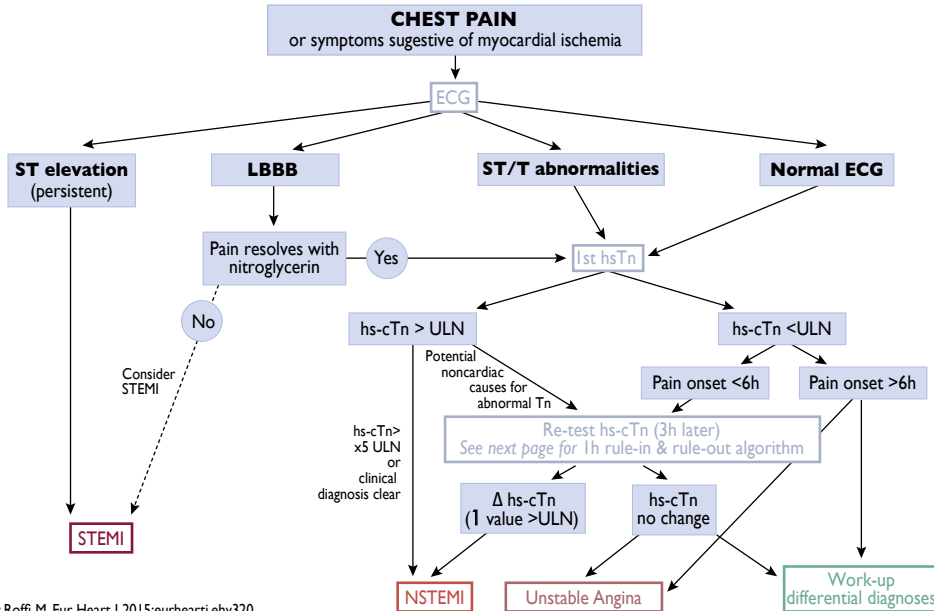
- ICD is indicated in patients with documented VT and structural heart disease
- ICD is indicated when sustained monomorphic VT is induced at EPS in patients with previous myocardial infarction
- ICD should be considered in patients with documented VT and inherited cardiomyopathies or channelopathies



# CHAPTER 2: ACUTE CORONARY SYNDROMES

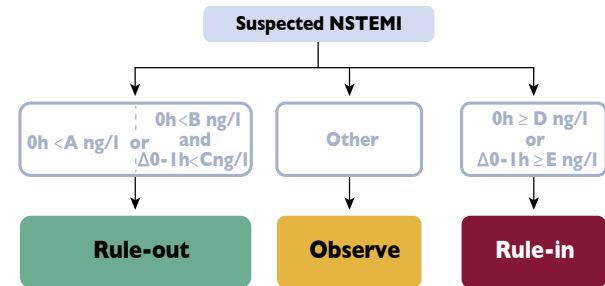
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D. Zahger, P. Clemmensen

## ACUTE CORONARY SYNDROMES: Diagnosis (I)



## ACUTE CORONARY SYNDROMES: Diagnosis (2)

### 0-1 H Rule-in & rule out test for NSTEMI



	A	B	C	D	E
hs-cTnT (Elecsys)*	5	12	3	52	5
hs-cTnI (Architect)*	2	5	2	52	6
hs-cTnI (Dimension Vista)*	0.5	5	2	107	19

\*Cut-off levels are assay-specific.

- NSTEMI can be ruled-out at presentation, if hs-cTn concentration is very low
- NSTEMI can be ruled out by the combination of low baseline levels and the lack of a relevant increase within 1 h
- NSTEMI is highly likely if initial hs-cTn concentration is at least moderately elevated or hs-cTn concentrations show a clear rise within the first hour

## ACUTE CORONARY SYNDROMES: Differential diagnosis (I)

<b>Causes of chest pain Not related to ACS</b>	<b>Causes of troponin elevation Not related to ACS</b>
<p><b>Primary cardiovascular</b></p> <ul style="list-style-type: none"> <li>• Acute pericarditis, pericardial effusion</li> <li>• Acute myocarditis</li> <li>• Severe hypertensive crisis</li> <li>• Stress cardiomyopathy (Tako-Tsubo syndrome)</li> <li>• Hypertrophic cardiomyopathy, aortic stenosis</li> <li>• Severe acute heart failure</li> <li>• Acute aortic syndrome (dissection, hematoma)</li> <li>• Pulmonary embolism, pulmonary infarction</li> <li>• Cardiac contusion</li> </ul>	<p><b>Primary cardiovascular</b></p> <ul style="list-style-type: none"> <li>• Acute myo(pericarditis)</li> <li>• Severe hypertensive crisis</li> <li>• Pulmonary edema or severe congestive heart failure</li> <li>• Stress cardiomyopathy (Tako-Tsubo syndrome)</li> <li>• Post- tachy- or bradyarrhythmias</li> <li>• Cardiac contusion or cardiac procedures (ablation, cardioversion, or endomyocardial biopsy)</li> <li>• Aortic dissection, aortic valve disease or hypertrophic cardiomyopathy</li> <li>• Pulmonary embolism, severe pulmonary hypertension</li> </ul>
<p><b>Primary non-cardiovascular</b></p> <ul style="list-style-type: none"> <li>• Oesophageal spasm, oesophagitis, Gastro Esophageal Reflux (GER)</li> <li>• Peptic ulcer disease, cholecystitis, pancreatitis</li> <li>• Pneumonia, bronchitis, asthma attack</li> <li>• Pleuritis, pleural effusion, pneumothorax</li> <li>• Pulmonary embolism, severe pulmonary hypertension</li> <li>• Thoracic trauma</li> <li>• Costochondritis, rib fracture</li> <li>• Cervical / thoracic vertebral or discal damage</li> <li>• Herpes Zoster</li> </ul>	<p><b>Primary non-cardiovascular</b></p> <ul style="list-style-type: none"> <li>• Renal dysfunction (acute or chronic)</li> <li>• Critical illness (sepsis, respiratory failure...)</li> <li>• Acute neurological damage (i.e. stroke, subarachnoid hemorrhage)</li> <li>• Severe burns (affecting &gt;30% of body surface area)</li> <li>• Rhabdomyolysis</li> <li>• Drug toxicity (chemotherapy with adriamycin, 5-fluorouracil, herceptin, snake venoms...)</li> <li>• Inflammatory or degenerative muscle diseases</li> <li>• Hypothyroidism</li> <li>• Infiltrative diseases (amyloidosis, hemochromatosis, sarcoidosis)</li> <li>• Scleroderma</li> </ul>



## ACUTE CORONARY SYNDROMES: Differential diagnosis (2)

### Causes of repolarisation abnormalities in the ECG not related to ACS

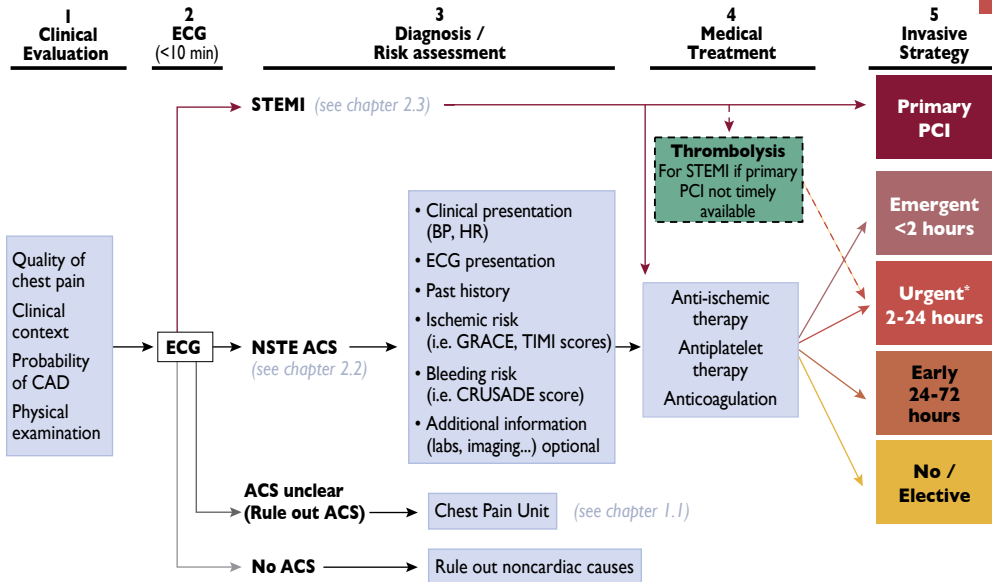
ST-segment elevation	Negative T waves
<p><b>Fixed</b></p> <ul style="list-style-type: none"> <li>• LV aneurysm</li> <li>• LBBB, WPW, hypertrophic cardiomyopathy, LVH</li> <li>• Pacemaker stimulation</li> <li>• Early repolarisation (elevated J-point)</li> </ul> <p><b>Dynamic</b></p> <ul style="list-style-type: none"> <li>• Acute (myo)pericarditis</li> <li>• Pulmonary embolism</li> <li>• Electrolyte disturbances (hyperkalemia)</li> <li>• Acute brain damage (stroke, subarachnoid haemorrhage)</li> <li>• Tako Tsubo syndrome</li> </ul>	<ul style="list-style-type: none"> <li>• Normal variants, i.e. women (right precordial leads), children, teenagers</li> <li>• Evolutionary changes post myocardial infarction</li> <li>• Chronic ischemic heart disease</li> <li>• Acute (myo)pericarditis, cardiomyopathies</li> <li>• BBB, LVH, WPW</li> <li>• Post-tachycardia or pacemaker stimulation</li> <li>• Metabolic or ionic disturbances</li> </ul>
ST-segment depression	Prominent T waves
<p><b>Fixed</b></p> <ul style="list-style-type: none"> <li>• Abnormal QRS (LBBB, WPW, pacemaker stimulation...)</li> <li>• LVH, hypertrophic cardiomyopathy</li> <li>• Chronic ischemic heart disease</li> </ul> <p><b>Dynamic</b></p> <ul style="list-style-type: none"> <li>• Acute (myo)pericarditis</li> <li>• Acute pulmonary hypertension</li> <li>• Electrolyte disturbances (hyperkalemia)</li> <li>• Intermittent LBBB, WPW, pacing</li> <li>• Post-tachycardia / cardioversion</li> </ul>	<ul style="list-style-type: none"> <li>• Normal variants, i.e. early repolarisation</li> <li>• Metabolic or ionic disturbances (i.e. hyperkalemia)</li> <li>• Acute neurological damage (stroke, subarachnoid haemorrhage)</li> </ul>

- Severe hypertensive crisis
- Drug effects (digoxin)
- Shock, pancreatitis
- Hyperventilation
- Tako Tsubo syndrome

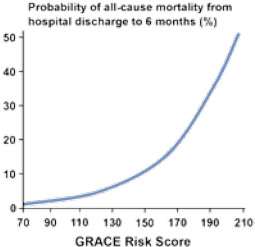
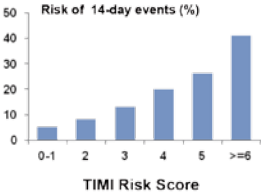
## General approach to the patient with chest pain/suspected ACS

2.1

p.28



\* 3-12 hours after thrombolysis.

Ischemic risk	
Grace risk score	Timi risk score
<p><b>Predictive Factors</b></p> <ul style="list-style-type: none"> <li>• Age</li> <li>• HR*</li> <li>• SBP*</li> <li>• Creatinine (mg/dl)*</li> <li>• Killip class*</li> <li>• Cardiac arrest*</li> <li>• ST-segment deviation</li> <li>• Elevated cardiac markers</li> </ul> <p><b>Outcomes</b> In-hospital, 6-month, 1-year and 3-year mortality 1-year death/MI</p>	<p><b>Predictive Factors</b></p> <ul style="list-style-type: none"> <li>• Age <math>\geq 65</math> years</li> <li>• At least 3 risk factors for CAD</li> <li>• Significant (<math>&gt;50\%</math>) coronary stenosis</li> <li>• ST deviation</li> <li>• Severe anginal symptoms (<math>&gt;2</math> events in last 24 h)</li> <li>• Use of aspirin in last 7 days</li> <li>• Elevated serum cardiac markers</li> </ul> <p><b>Outcome</b> All-cause mortality / new or recurrent MI / severe recurrent ischemia requiring urgent revascularisation at 14 days</p>
 <p style="font-size: small;">Probability of all-cause mortality from hospital discharge to 6 months (%)</p> <p style="font-size: small;">GRACE Risk Score</p>	 <p style="font-size: small;">Risk of 14-day events (%)</p> <p style="font-size: small;">TIMI Risk Score</p>

\* At admission.

## NON ST-SEGMENT ELEVATION ACS: Risk stratification (2)

2.2

p.30

### Bleeding risk

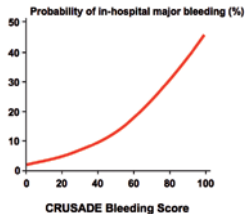
#### Crusade risk score

##### Predictive Factors

- Sex
- HR\*
- SBP\*
- Creatinine (mg/dl)\*
- Baseline hematocrit\*
- GFR: Cockcroft-Gault\*
- Diabetes
- Prior vascular disease
- Signs of congestive heart failure\*

##### Outcome

In-hospital major bleeding



\*At admission.

Copyrights: Eagle KA et al. A validated prediction model for all forms of acute coronary syndrome: estimating the risk of 6-month post-discharge death in an international registry. JAMA. (2004) ;291(22):2727-33.

Antman EM, et al. The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision making. JAMA. (2000);284(7):835-42.

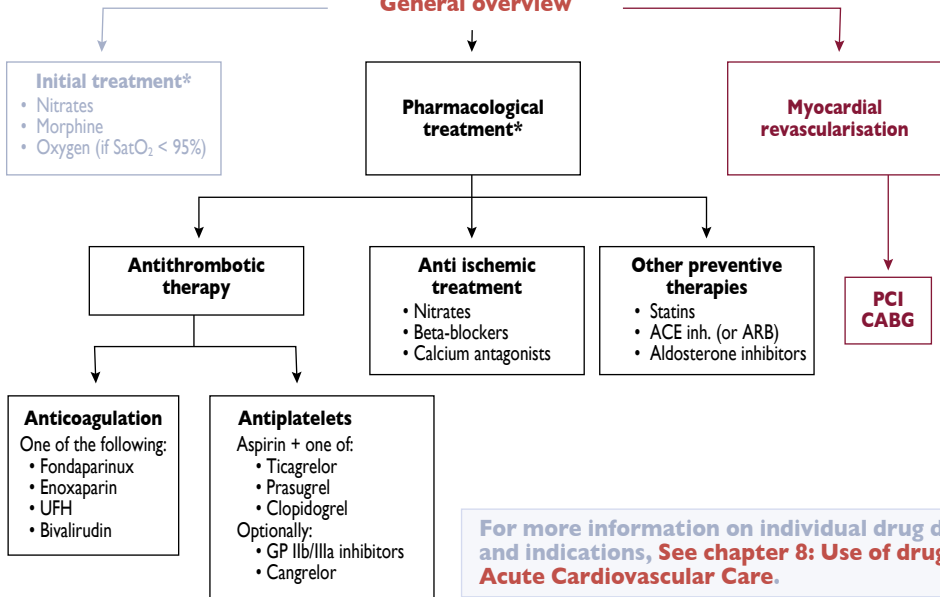
Subherwal S, et al. Baseline risk of major bleeding in non-ST-segment-elevation myocardial infarction: the CRUSADE (Can Rapid risk stratification of Unstable angina patients Suppress Adverse outcomes with Early implementation of the ACC/AHA Guidelines) Bleeding Score. Circulation (2009) ;119(14):1873-82.

## NON ST-SEGMENT ELEVATION ACS: Treatment (I)

2.2

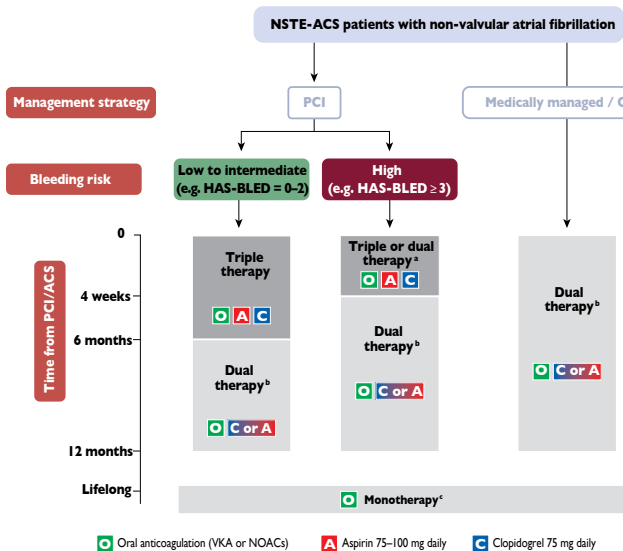
p.31

### General overview



## NON ST-SEGMENT ELEVATION ACS: Treatment (2)

### Antithrombotic strategies in patients with NSTEMI-ACS and non-valvular atrial fibrillation



CHA2DS2-VASc = Cardiac failure, Hypertension, Age ≥ 75 [2 points], Diabetes, Stroke [2 points] – Vascular disease, Age 65–74, Sex category.

<sup>a</sup> Dual therapy with oral anticoagulation and clopidogrel may be considered in selected patients (low ischaemic risk).

<sup>b</sup> Aspirin as an alternative to clopidogrel may be considered in patients on dual therapy (i.e., oral anticoagulation plus single antiplatelet); triple therapy may be considered up to 12 months in patients at very high risk for ischaemic events.

<sup>c</sup> Dual therapy with oral anticoagulation and one antiplatelet agent (aspirin or clopidogrel) beyond one year may be considered in patients at very high risk of coronary events.

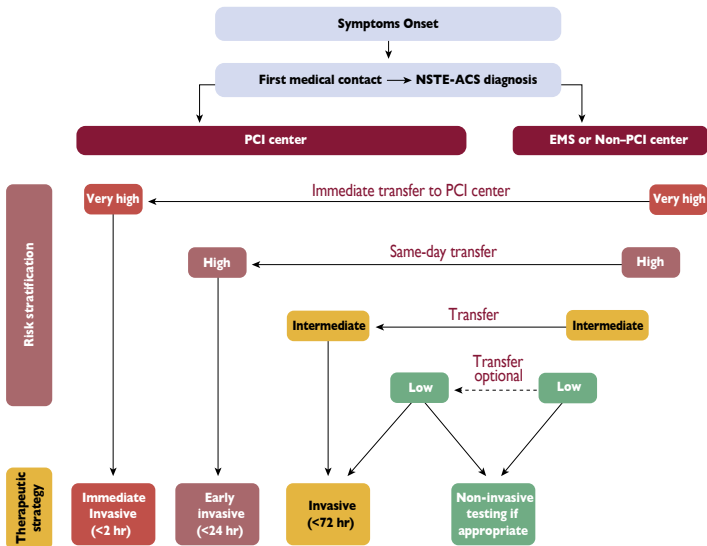
<sup>d</sup> In patients undergoing coronary stenting, dual antiplatelet therapy may be an alternative to triple or a combination of anticoagulants and single antiplatelet therapy if the CHA2DS2-VASc score is 1 (males) or 2 (females).

## NON ST-SEGMENT ELEVATION ACS: Treatment (3)

### Risk criteria mandating invasive strategy in NSTEMI-ACS

<b>Very-high-risk criteria</b>	<ul style="list-style-type: none"><li>• Haemodynamic instability or cardiogenic shock</li><li>• Recurrent or ongoing chest pain refractory to medical treatment</li><li>• Life-threatening arrhythmias or cardiac arrest</li><li>• Mechanical complications of MI</li><li>• Acute heart failure</li><li>• Recurrent dynamic ST-T wave changes, particularly with intermittent ST-elevation</li></ul>
<b>High-risk criteria</b>	<ul style="list-style-type: none"><li>• Rise or fall in cardiac troponin compatible with MI</li><li>• Dynamic ST- or T-wave changes (symptomatic or silent)</li><li>• GRACE score &gt;140</li></ul>
<b>Intermediate-risk criteria</b>	<ul style="list-style-type: none"><li>• Diabetes mellitus</li><li>• Renal insufficiency (eGFR &lt;60 mL/min/1.73 m<sup>2</sup>)</li><li>• LVEF &lt;40% or congestive heart failure</li><li>• Early post-infarction angina</li><li>• Prior PCI</li><li>• Prior CABG</li><li>• GRACE risk score &gt;109 and &lt;140</li></ul>
<b>Low-risk criteria</b>	<ul style="list-style-type: none"><li>• Any characteristics not mentioned above</li></ul>

## NON ST-SEGMENT ELEVATION ACS: Treatment (4) Timing and strategy for invasive management





STEMI is diagnosed according to the presence of the following acute ischemic ECG changes:

### In the absence of LVH and LBBB:

- New ST elevation at the J point in 2 contiguous leads with  $\geq 0.2$  mV in men or  $\geq 0.15$  mV in women in leads  $V_2$ - $V_3$  and/or  $\geq 0.1$  mV in other leads
  - Contiguous leads mean lead groups such as anterior leads ( $V_1$ - $V_6$ ), inferior leads (II, III, aVF) or lateral/apical leads (I, aVL).

### In the presence LBBB or ST depression:

- New LBBB, and symptoms suggestive of ACS
- ST depression in leads  $V_1$ - $V_3$  indicate inferobasal myocardial ischemia (especially when the terminal T-wave is positive)

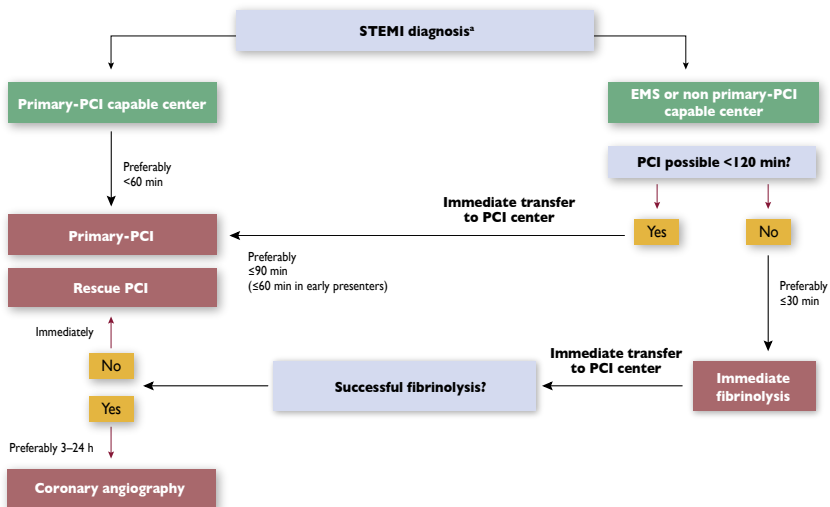
### In suspected posterior (circumflex artery- related) or right ventricle-related infarction:

- ST elevation in  $V_7$  (at the left posterior axillary line),  $V_8$  (at the left midscapular line), and  $V_9$  (at the left paraspinous border), using a cut-point  $> 0.05$  mV
  - Capture an overlooked left dominant circumflex using posterior leads in the fifth interspace
- ST elevation in right precordial leads ( $V_3R$  and  $V_4R$ ), using a cut-off point  $> 0.05$  mV, and  $> 0.1$  mV in men  $< 30$  years
  - Capture suspected right ventricular infarction using right precordial leads

## STEMI: Treatment (I) General overview of initial management

2.3

p.36



## STEMI: Treatment (2)

### Primary PCI - First 24 hours and days 2-7

For more information on individual drug doses and indications, See chapter 8: Use of drugs in Acute Cardiovascular Care.

Pre hospital	PCI	CCU/ICCU	Medication Titration Day 2-7																																													
<table border="1"> <tr> <td>Acetylsalicylic Acid</td> <td>300 mg</td> </tr> <tr> <td>Heparin</td> <td>70 IU/kg</td> </tr> </table> <table border="1"> <tr> <td>Ticagrelor</td> <td>180 mg</td> </tr> <tr> <td>or Prasugrel</td> <td>60 mg</td> </tr> <tr> <td>or Clopidogrel</td> <td>600 mg</td> </tr> </table>	Acetylsalicylic Acid	300 mg	Heparin	70 IU/kg	Ticagrelor	180 mg	or Prasugrel	60 mg	or Clopidogrel	600 mg	<table border="1"> <tr> <td>Bivalirudin</td> <td></td> </tr> <tr> <td>or GPI:</td> <td>Eptifibatide</td> </tr> <tr> <td></td> <td>Tirofiban</td> </tr> <tr> <td></td> <td>Abxiciimab</td> </tr> <tr> <td colspan="2">Follow local in-lab instruction / dosing</td> </tr> </table> <table border="1"> <tr> <td>Metoprolol</td> <td>25 mg x 2</td> </tr> <tr> <td>or carvedilol</td> <td>3,25 mg x 2</td> </tr> <tr> <td>or bisoprolol</td> <td>2,5 mg x 2</td> </tr> </table> <table border="1"> <tr> <td>Atorvastatin</td> <td>80 mg x 1</td> </tr> <tr> <td>or Rosuvastatin</td> <td>40 mg x 1</td> </tr> </table>	Bivalirudin		or GPI:	Eptifibatide		Tirofiban		Abxiciimab	Follow local in-lab instruction / dosing		Metoprolol	25 mg x 2	or carvedilol	3,25 mg x 2	or bisoprolol	2,5 mg x 2	Atorvastatin	80 mg x 1	or Rosuvastatin	40 mg x 1	<table border="1"> <tr> <td>Acetylsalicylic Acid</td> <td>75 mg x 1</td> </tr> <tr> <td>Ticagrelor</td> <td>90 mg x 2</td> </tr> <tr> <td>or Prasugrel</td> <td>10/5 mg x 1</td> </tr> <tr> <td>or Clopidogrel</td> <td>75 mg x 1</td> </tr> </table> <table border="1"> <tr> <td>Metoprolol</td> <td>200mg x 1</td> </tr> <tr> <td>or carvedilol</td> <td>25 mg x 2</td> </tr> <tr> <td>or bisoprolol</td> <td>5 mg x 2</td> </tr> <tr> <td>or Ca-antagonist</td> <td>(see chapter 2.2)</td> </tr> </table> <p>Start ACE-i or ARB in DM, LVSD, CHF, or to control BP</p> <p>Aldosterone RB</p> <p>Start or continue anti-diabetic medication</p>	Acetylsalicylic Acid	75 mg x 1	Ticagrelor	90 mg x 2	or Prasugrel	10/5 mg x 1	or Clopidogrel	75 mg x 1	Metoprolol	200mg x 1	or carvedilol	25 mg x 2	or bisoprolol	5 mg x 2	or Ca-antagonist	(see chapter 2.2)
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Reference: Steg G et al. Eur Heart J. (2012);33:2569-619 <sup>(7)</sup>.

Pre-hospital management of patients with chest pain and/or dyspnoea of cardiac origin. A position paper of the Acute Cardiovascular Care Association (ACCA) of the ESC - European Heart Journal: Acute Cardiovascular Care August 27, 2015 2048872615604119.



## CHAPTER 3: ACUTE HEART FAILURE

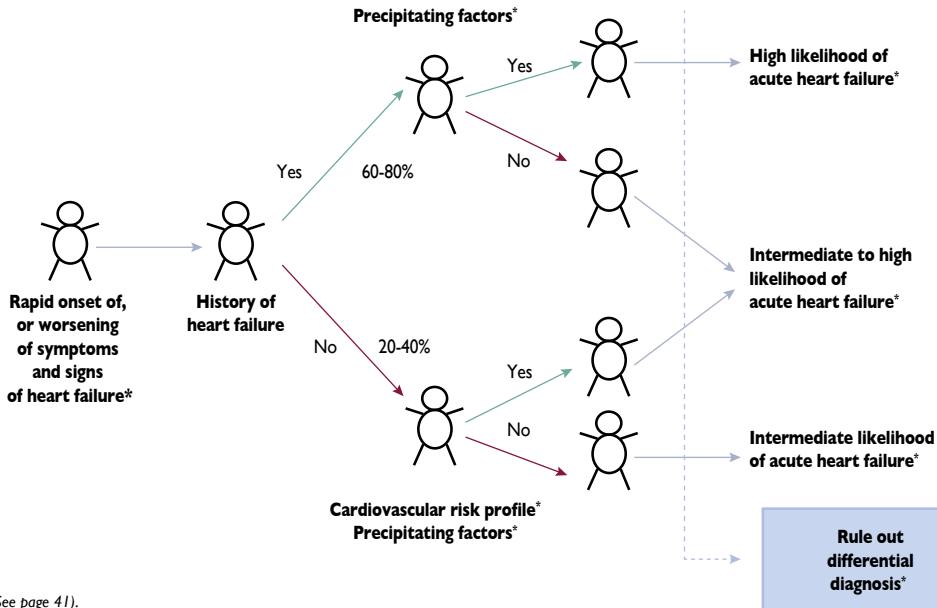
### 3.1 HEART FAILURE AND PULMONARY OEDEMA ..... p.40

I.C.C. van der Horst, G. Filippatos

### 3.2 CARIOGENIC SHOCK ..... p.52

P. Vranckx, U. Zeymer

## ACUTE HEART FAILURE: Diagnosis and causes (I)



\* (See page 41).

- 1• **Symptoms:** Dyspnea (on effort or at rest)/breathlessness, fatigue, orthopnea, cough, weight gain/ankle swelling
- 2• **Signs:** Tachypnea, tachycardia, low or normal blood pressure, raised jugular venous pressure, 3<sup>rd</sup>/4<sup>th</sup> heart sound, rales, oedema, intolerance of the supine position
- 3• **Cardiovascular risk profile:** Older age, HTN, diabetes, smoking, dyslipidemia, family history, history of CVD
- 4• **Precipitating factors:** Myocardial ischemia, rhythm disturbances, medication (NSAID, negative inotropic agents), infection, noncompliance
- 5• **Differential diagnosis:** Exacerbated pulmonary disease, pneumonia, pulmonary embolism, pneumothorax, acute respiratory distress syndrome, (severe) anaemia, hyperventilation (acidosis), sepsis/septic shock, redistributive/hypovolemic shock
- 6• **Likelihood:** Depending on the site of presentation the underlying cause of acute heart failure is likely to differ. Cardiologists see more often worsening heart failure and physicians at the Emergency Department more often see patients with preserved systolic left ventricular function

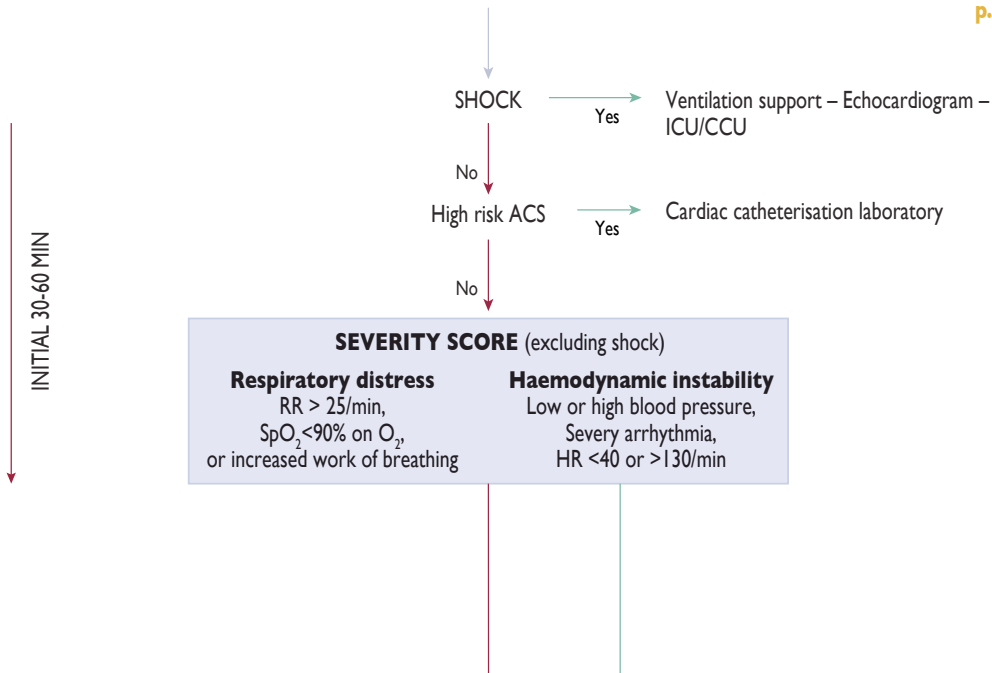
### MAIN CAUSES OF ACUTE HEART FAILURE

- Coronary artery disease
- Hypertension
- Cardiomyopathy (familial, acquired)
- Valvular heart disease
- Peri-/endocardial disease
- Congenital heart disease
- Arrhythmia (tachy-, brady-)
- Conduction disorder (blocks)
- Volume overload (renal, iatrogenic)
- Tumor
- Pleural effusion
- Anxiety disorder
- Neurologic disease

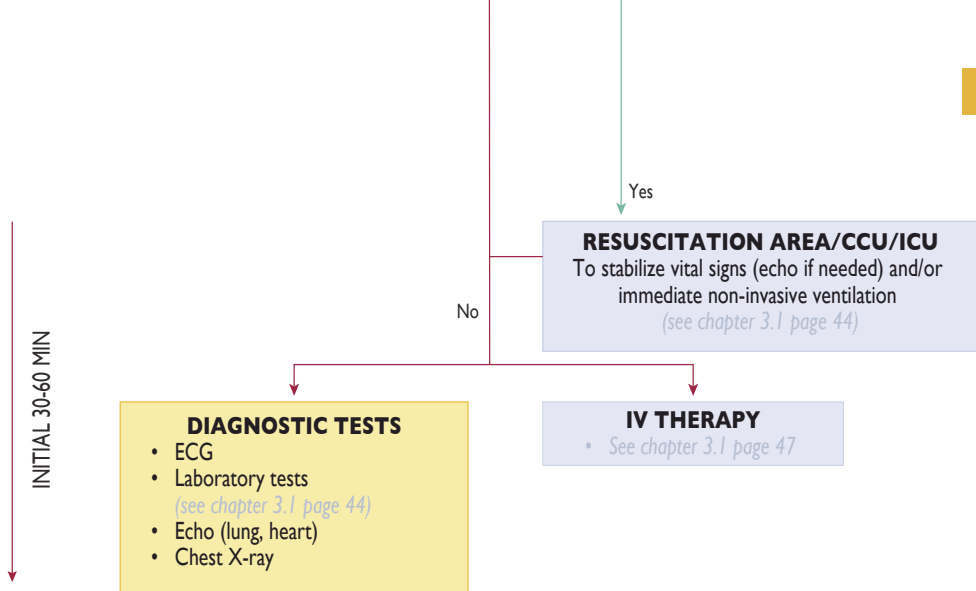
## SUSPECTED ACUTE HEART FAILURE

3.1

p.42

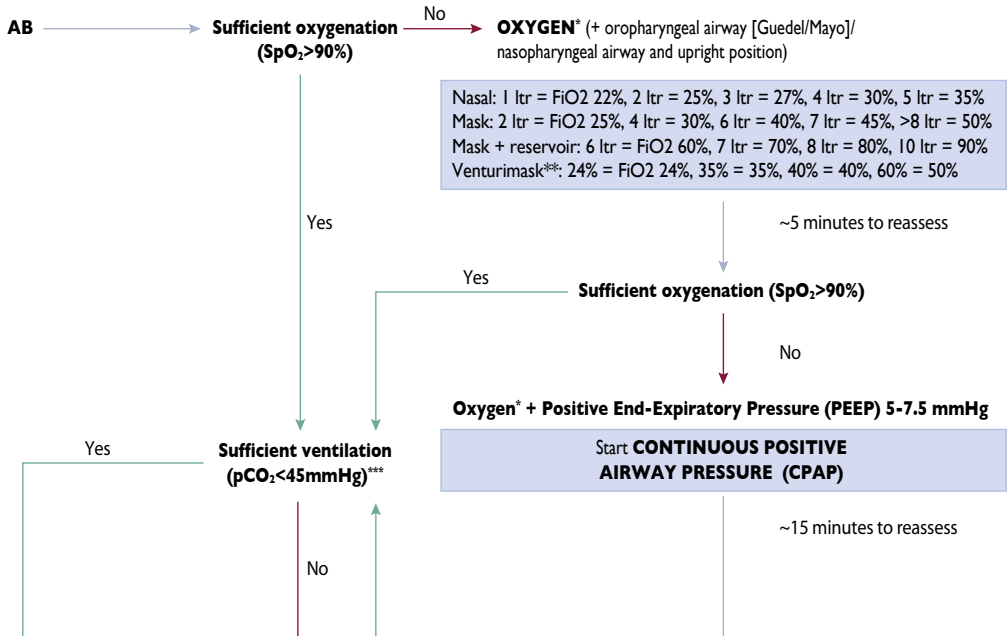


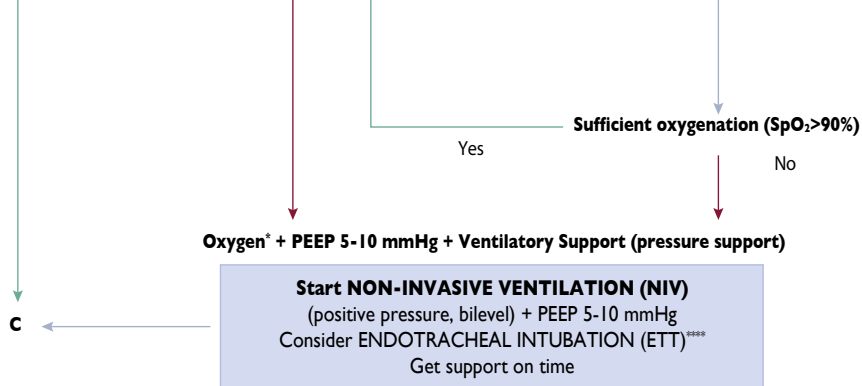




# ACUTE HEART FAILURE: Initial diagnosis and treatment

## Airway (A) & Breathing (B)





\* Goal SpO<sub>2</sub> 94-98%.

\*\* Use the predefined liters of oxygen. When using higher flows the FiO<sub>2</sub> will drop.

\*\*\* For a patient with COPD, a pCO<sub>2</sub> of 45-50 mmHg may be optimal. Aim for a normal pH.

\*\*\*\* Consider if the above fails or when patient is fatigued.

## ACUTE HEART FAILURE: Initial diagnosis (CDE)

**C - CIRCULATION\*** HR (bradycardia [ $<60/\text{min}$ ], normal [ $60\text{-}100/\text{min}$ ], tachycardia [ $>100/\text{min}$ ]), rhythm (regular, irregular), SBP (very low [ $<90\text{ mmHg}$ ], low, normal [ $110\text{-}140\text{ mmHg}$ ], high [ $>140\text{ mmHg}$ ]), and elevated jugular pressure should be checked

### INSTRUMENTATION & INVESTIGATIONS:

Consider intravenous (central) & arterial line (BP monitoring)

#### Laboratory measures

- Cardiac markers (troponin, (BNP/NT-proBNP, MR-proANP)
- Complete blood count, electrolytes, creatinine, urea, glucose, inflammation, TSH

#### Standard 12-lead ECG

- Venous blood gases, D-dimer (suspicion of acute pulmonary embolism)
- Rhythm, rate, conduction times?
- Signs of ischemia/myocardial infarction? Hypertrophy?

#### Echocardiography

- Ventricular function (systolic and diastolic)?
- Presence of valve dysfunction (severe stenosis/insufficiency)?
- Pericardial effusion/tamponade?

### ACTIONS:

Rule in/out diagnosis of acute heart failure as diagnosis for symptoms and signs

Establish cause of disease

Determine severity of disease

Start treatment as soon as possible, i.e. both heart failure and the factors identified as triggers

### D – DISABILITY DUE TO NEUROLOGICAL DETERIORATION

Normal consciousness/altered mental status? Measurement of mental state with AVPU (alert, visual, pain or unresponsive) Glasgow

Coma Scale: EMV score  $<8$  → Consider ETT

Anxiety, restlessness? → Consider morphine 2.0-5 mg i.v. bolus (diluted in normal saline), preceded by metoclopramide 10 mg i.v. PRN

### E – EXPOSURE & EXAMINATION

Temperature/fever : central and peripheral

Weight

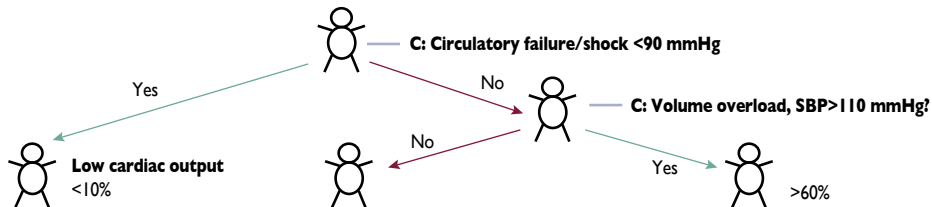
Skin/extremities: circulation (e.g. capillary refill), color

Urinary output ( $<0.5\text{ ml/kg/hr}$ ) → Insert indwelling catheter; the benefits should outweigh the risks of infection and long-term complications

## ACUTE HEART FAILURE: Initial treatment (C) IV therapy

3.1

p.47



### 1 Inotropic drugs

- Dobutamine 2.5 µg/kg/min
- Milrinone bolus 25 µg/kg in 10-20 min, continuous 0.375 µg/kg/min

### 2 Vasopressor i.v.

- Norepinephrine 0.2 µg/kg/min

### 3 Diuretics i.v.

- Furosemide 20-40 mg bolus, continuous 100 mg/6 h

### 4 Consider hypertonic saline + diuretic

### 5 Consider mechanical circulatory support

### 1 Diuretics i.v.

- Furosemide 20-40 mg bolus, continuous 100 mg/6 h\*

### 2 Inotropic drugs

- Dobutamine continuous 2.5 µg/kg/min
- Milrinone bolus 25 µg/kg in 10-20 min, continuous 0.375 µg/kg/min
- Levosimendan bolus 12 µg/kg in 10 min, continuous 0.1 µg/kg/min

### 3 Consider to start ACE-I/ARB, beta-blocker, MRA.

\*See Chapter 8: use of drugs in acute Cardiovascular Care.

(See table page 50-51)

### 1 Vasodilators

- Nitroglycerine spray 400 µg sublingual, repeat ~5-10 min
- Nitroglycerine i.v. continuously ~10 µg/min, increase ~5 µg/min
- Nitroprusside 0.3 µg/kg/min increase to 5 microg/kg/min

### 2 Diuretics i.v.

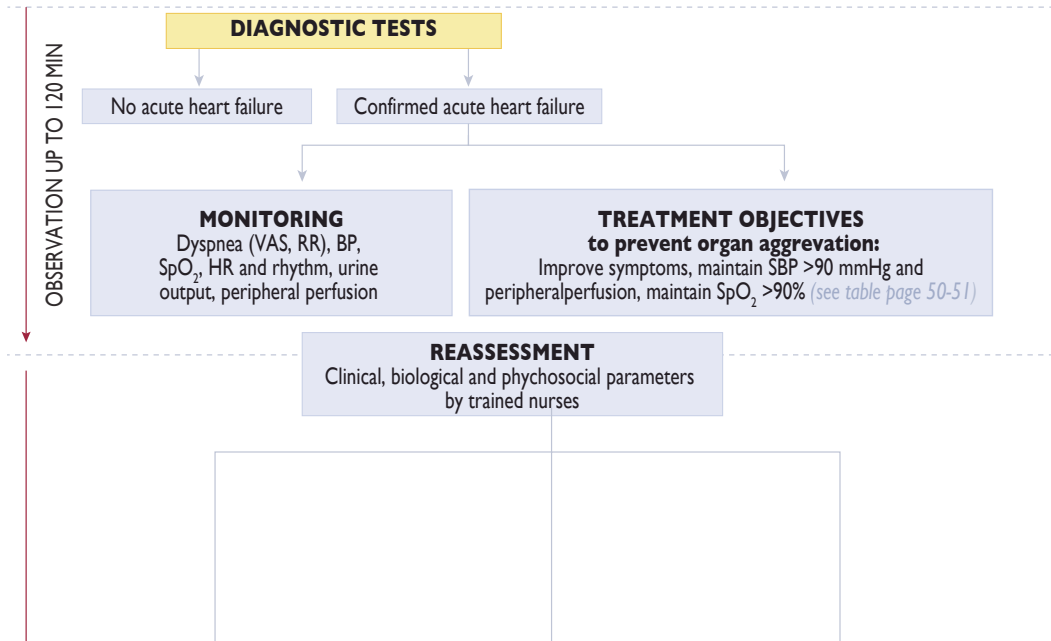
- Furosemide 20-40 mg bolus, continuous 100 mg/6 h

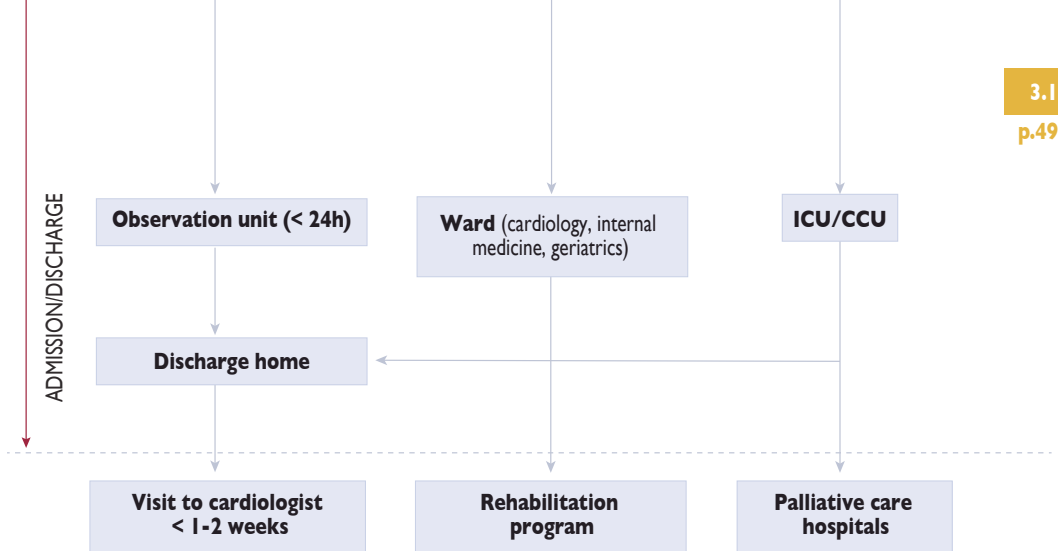
### 3 Consider to start ACE-I/ARB, beta-blocker, MRA.

\*See Chapter 8: use of drugs in acute Cardiovascular Care.

(See table page 50-51)

\* Use higher dose in patients on chronic diuretic treatment for HF (i.e. 2.5 times normal dose).





## ACUTE HEART FAILURE: Treatment (C) and preventive measures

3.1

### Management of oral therapy in AHF in the first 48 hours

p.50

	Normotension/ Hypertension	Hypotension		Low Heart rate		Potassium		Renal impairment	
		<100 >85 mmHg	<85 mmHg	<60 ≥50 bpm	<50 bpm	≤3.5 mg/dL	>5.5 mg/dL	Cr < 2.5, eGFR > 30	Cr > 2.5, eGFR < 30
ACE-I/ARB	Review/increase	Reduce/ stop	Stop	No change	No change	Review/ increase	Stop	Review	Stop
Beta-blocker	No change	Reduce/ stop	Stop	Reduce	Stop	No change	No change	No change	No change
MRA	No change	No change	Stop	No change	No change	Review/ increase	Stop	Reduce	Stop
Diuretics	Increase	Reduce	Stop	No change	No change	Review/ No change	Review/ increase	No change	Review

CCB, calcium channel blockers (mg/dL); Cr, creatinine blood level (mg/dL); eGFR, estimated glomerular filtration rate ml/min/1.73 m<sup>2</sup>; MRA, mineralocorticoid receptor antagonist; (\*) amiodarone. - Depicted from Mebazaa A et al. Eur J Heart Fail. (2015);17(6):544-58.



**Management of oral therapy in AHF in the first 48 hours**

	Normotension/ Hypertension	Hypotension		Low Heart rate		Potassium		Renal impairment	
		<100 >85 mmHg	<85 mmHg	<60 ≥50 bpm	<50 bpm	≤3.5 mg/dL	>5.5 mg/dL	Cr < 2.5, eGFR > 30	Cr > 2.5, eGFR < 30
Other vasodilators (Nitrates)	Increase	Reduce/ stop	Stop	No change	No change	No change	No change	No change	No change
Other heart rate slowing drugs (amiodarone, CCB, Ivabradine)	Review	Reduce/ stop	Stop	Reduce/ stop	Stop	Review/ stop (*)	No change	No change	No change

Thrombosis prophylaxis should be started in patients not anticoagulated (enoxaparin 1 mg/kg as first dose)

Maintain an adequate nutritional status with a nutritional support of 20-25 kcal/kg/day within the first 48 hours

CCB, calcium channel blockers (mg/dL); Cr, creatinine blood level (mg/dL); eGFR, estimated glomerular filtration rate ml/min/1.73 m<sup>2</sup>; MRA, mineralocorticoid receptor antagonist; (\*) amiodarone. - Depicted from Mebazaa A et al. Eur J Heart Fail. (2015);17(6):544-58.

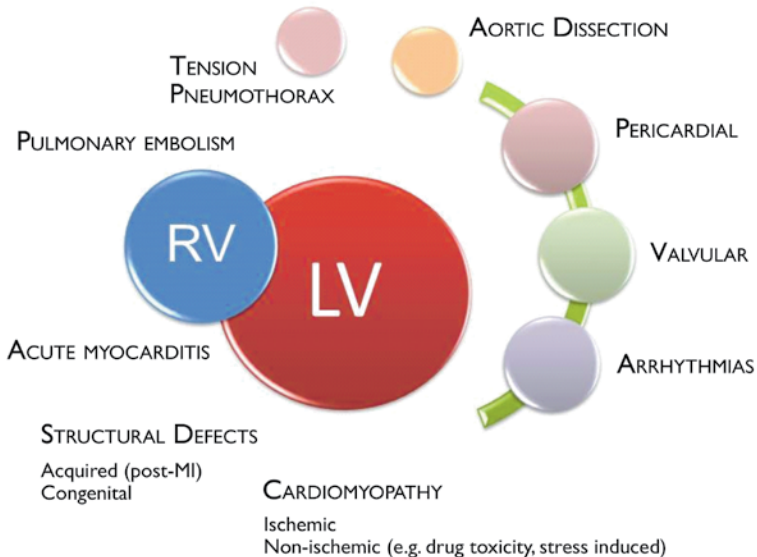
Clinical condition defined as the inability of the heart to deliver an adequate amount of blood to the tissues to meet resting metabolic demands as a result of impairment of its pumping function.

### Hemodynamic criteria to define cardiogenic shock

- Systolic blood pressure  $<80$  to  $90$  mmHg or mean arterial pressure  $30$  mmHg lower than baseline
- Severe reduction in cardiac index:
  - $<1.8$  L/min/m<sup>2</sup> without support or
  - $<2.0$  to  $2.2$  L/min/m<sup>2</sup> with support
- Adequate or elevated filling pressure:
  - Left ventricular end-diastolic pressure  $>18$  mmHg or
  - Right ventricular end-diastolic pressure  $>10$  to  $15$  mmHg

## CARDIOGENIC SHOCK: Causes

LV pump failure is the primary insult in most forms of CS, but other parts of the circulatory system contribute to shock with inadequate compensation or additional defects.



## CARDIOGENIC SHOCK: Initial triage and management

This protocol should be initiated as soon as cardiogenic shock/end organ hypoperfusion is recognised and should not be delayed pending intensive care admission.

EMERGENCY DEPARTMENT	0 min	CARDIAC INTENSIVE CARE UNIT	<p><b>EARLY TRIAGE &amp; MONITORING</b></p> <p>Start high flow O<sub>2</sub> Establish i.v. access</p>	<ul style="list-style-type: none"> <li>• Age: 65–74, ≥75</li> <li>• Heart rate &gt;100 beats per minute</li> <li>• Systolic blood pressure &lt;100 mmHg</li> <li>• Proportional pulse pressure ≤25 mmHg (CI &lt;2.2l/min/m<sup>2</sup>)</li> <li>• Orthopnea (PCWP &gt;22 mmHg)</li> <li>• Tachypnea (&gt;20/min), &gt;30/min (!)</li> <li>• Killip class II-IV</li> <li>• Clinical symptoms of tissue hypoperfusion/hypoxia:               <ul style="list-style-type: none"> <li>- cool extremities,</li> <li>- decreased urine output (urine output &lt;40 ml/h)</li> <li>- decreased capillary refill or mottling</li> <li>- alteration in mental status</li> </ul> </li> </ul>
	5 min		<p><b>INITIAL RESUSCITATION</b></p> <ul style="list-style-type: none"> <li>• Arterial and a central venous catheterization with a catheter capable of measuring central venous oxygen saturation</li> <li>• Standard transthoracic echocardiogram to assess left (and right) ventricular function and for the detection of potential mechanical complications following MI</li> <li>• Early coronary angiography in specialized myocardial intervention center when signs and/or symptoms of ongoing myocardial ischemia (e.g. ST segment elevation myocardial infarction).</li> </ul>	<ul style="list-style-type: none"> <li>• CORRECT: hypoglycemia &amp; hypocalcemia,</li> <li>• TREAT: sustained arrhythmias: brady- or tachy-</li> <li>• Isotonic saline-fluid challenge of 20 to 30 ml per kilogram of body weight over a 30-minute period to achieve a central venous pressure of 8 to 12 mmHg or until perfusion improves (with a maximum of 500 ml)</li> <li>• CONSIDER NIV/mechanical ventilation for comfort (fatigue, distress) or as needed:               <ul style="list-style-type: none"> <li>- To correct acidosis</li> <li>- To correct hypoxemia</li> </ul> </li> <li>• INOTROPIC SUPPORT (dobutamine and/or vasopressor support)</li> </ul>
	15 min		<p><b>TREATMENT GOALS</b></p> <ul style="list-style-type: none"> <li>• a mean arterial pressure of 60 mmHg or above,</li> <li>• a mean pulmonary artery wedge pressure of 18 mmHg or below,</li> <li>• a central venous pressure of 8 to 12 mmHg,</li> <li>• a urinary output of 0,5 ml or more per hour per kilogram of body weight</li> <li>• an arterial pH of 7.3 to 7.5</li> <li>• a central venous saturation (ScvO<sub>2</sub>) ≥70% (provided SpO<sub>2</sub> ≥93% and Hb level ≥9 g/dl)</li> </ul>	
	60 min			

For more informations on individual drug doses and indications:

\*See Chapter 8: Use of drugs in Acute Cardiovascular Care.

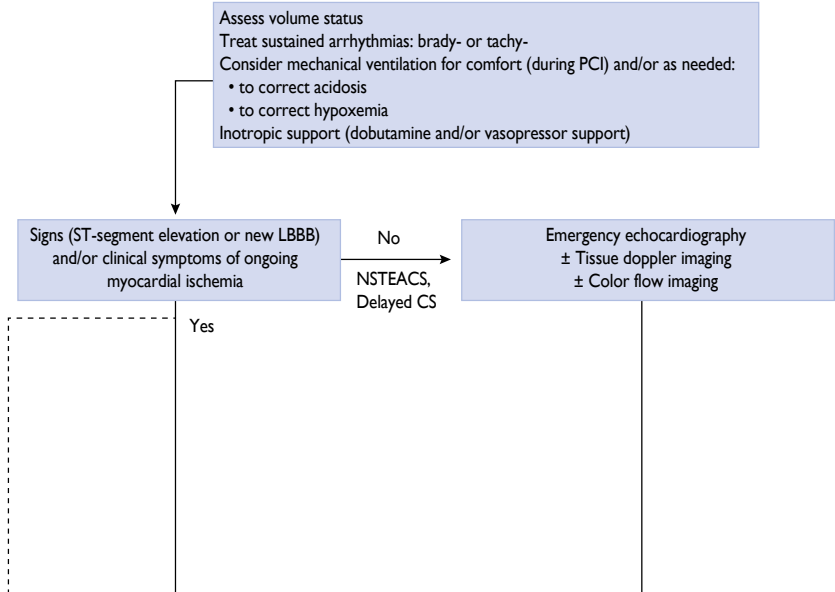
Ventilator mode	Pressure assist/control
Tidal Volume goal	Reduce tidal volume to 6-8 ml/kg lean body weight
Plateau Pressure goal	$\leq 30$ cm H <sub>2</sub> O
Anticipated PEEP levels	5-10 cm H <sub>2</sub> O
Ventilator rate and pH goal	12-20, adjusted to achieve a pH $\geq 7.30$ if possible
Inspiration: Expiration time	1:1 to 1:2
Oxygenation goal:	
• PaO <sub>2</sub>	50-80 mmHg
• SpO <sub>2</sub>	> 90%

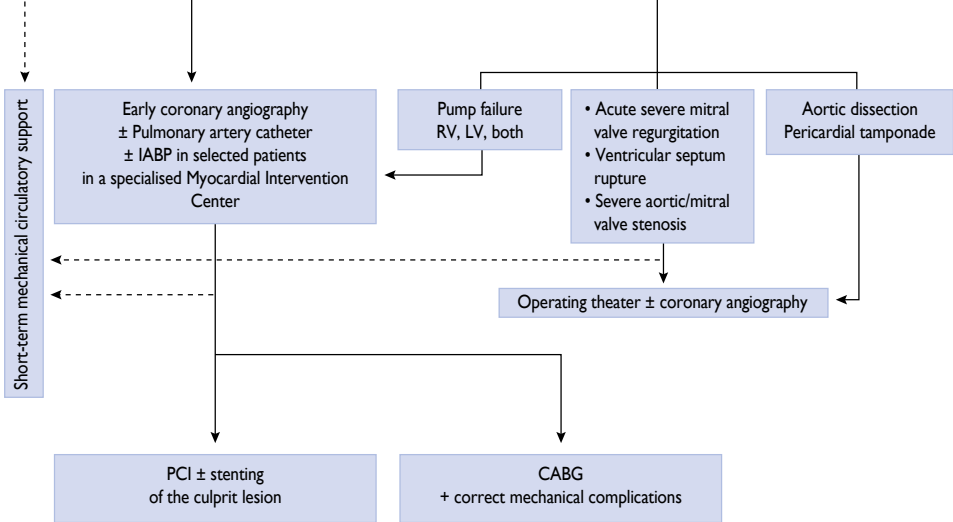
Predicted body weight calculation:

- Male:  $50 + 0.91$  (height in cm - 152.4)
- Female:  $45.5 + 0.91$  (height in cm - 152.4)

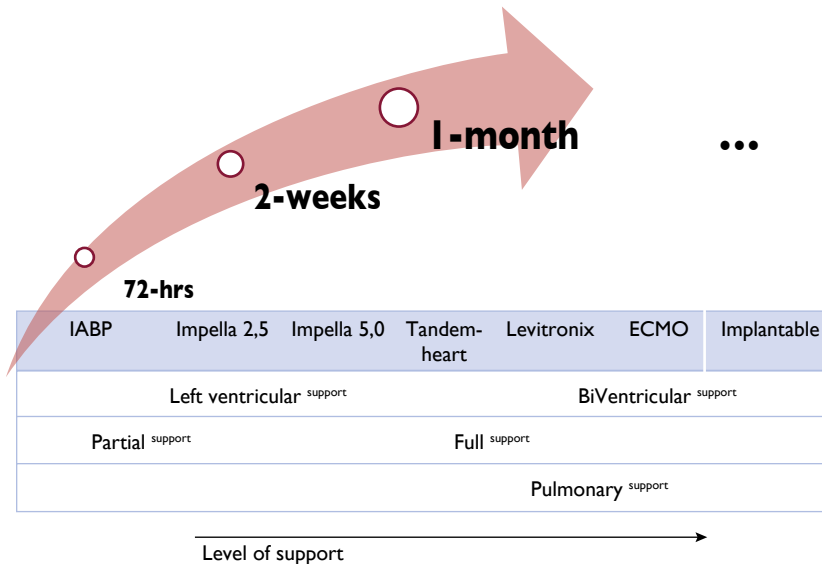
Some patients with CS will require increased PEEP to attain functional residual capacity and maintain oxygenation, and peak pressures above 30 cm H<sub>2</sub>O to attain effective tidal volumes of 6-8ml/kg with adequate CO<sub>2</sub> removal.

## CARDIOGENIC SHOCK: Management following STEMI





## CARDIOGENIC SHOCK: Mechanical circulatory support, basic characteristics





	Type	Support	Access
<b>Intra-aortic balloon pump</b>	Balloon counterpulsation	Pulsatile flow <0.5 L	Arterial: 7.5 French
<b>Impella Recover</b> LP 2.5 CP LP 5.0	Axial flow	Continuous flow <2.5 L <4,0 L <5.0 L	Arterial: 12 French Arterial: 14 French Arterial: 21 French
<b>Tandemheart</b>	Centrifugal flow	Continuous flow	<5.0 L Venous: 21 French Arterial: 15-17 French
<b>Cardiohelp</b>			<5.0 L Venous: 15-29 French Arterial: 15-29 French

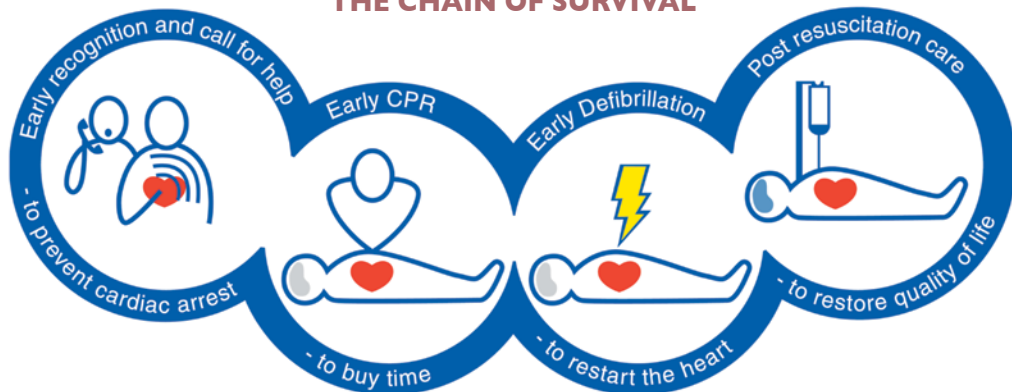
Different systems for mechanical circulatory support are available to the medical community. The available devices differ in terms of the insertion procedure, mechanical properties, and mode of action. A minimal flow rate of 70 ml/kg/min, representing a cardiac index of at least 2.5 L/m<sup>2</sup>, is generally required to provide adequate organ perfusion. This flow is the sum of the mechanical circulatory support output and the remaining function of the heart.

The SAVE-score may be a tool to predict survival for patients receiving ECMO for refractory cardiogenic shock ( ).

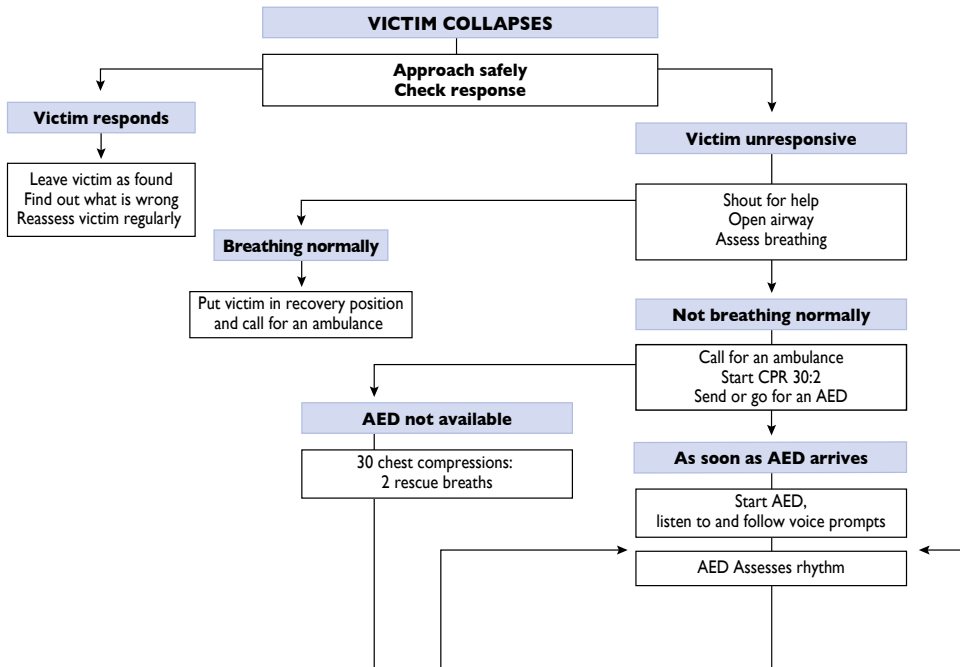


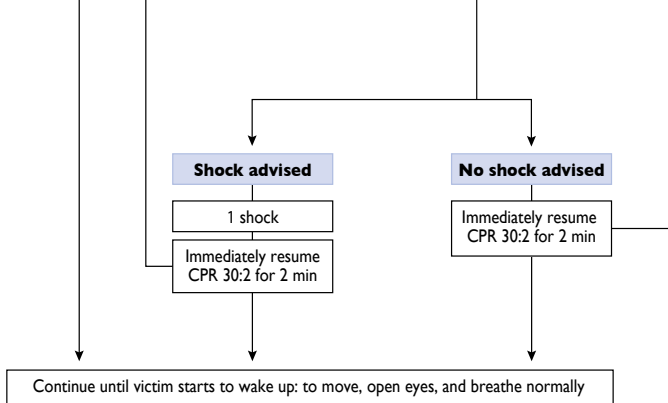
# CHAPTER 4: CARDIAC ARREST AND CARDIOPULMONARY RESUSCITATION

## THE CHAIN OF SURVIVAL

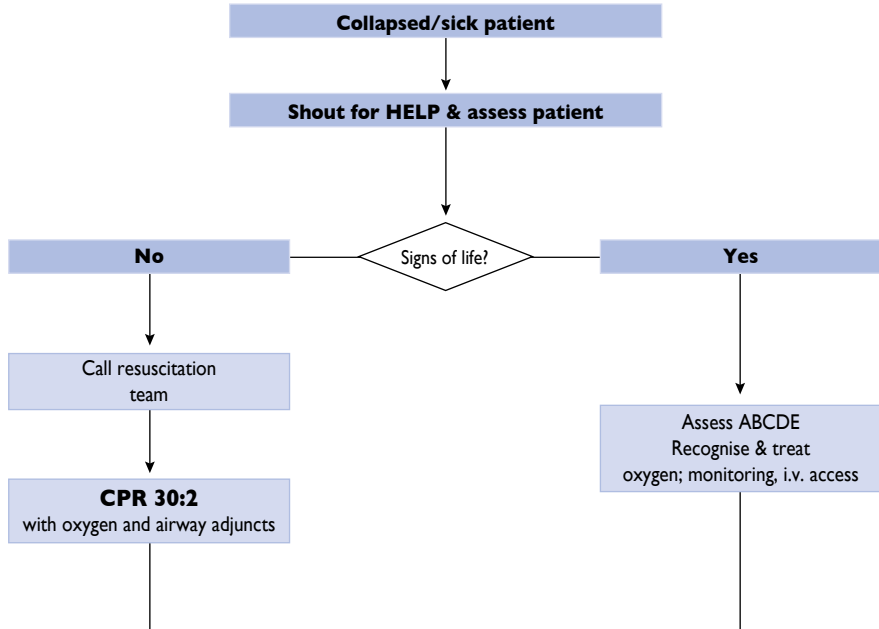


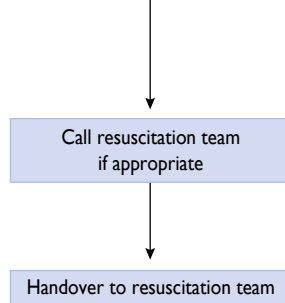
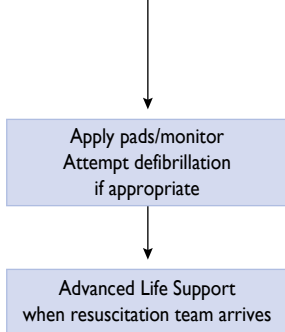
## OUT OF HOSPITAL CARDIAC ARREST: Assessment of a collapsed victim and initial treatment



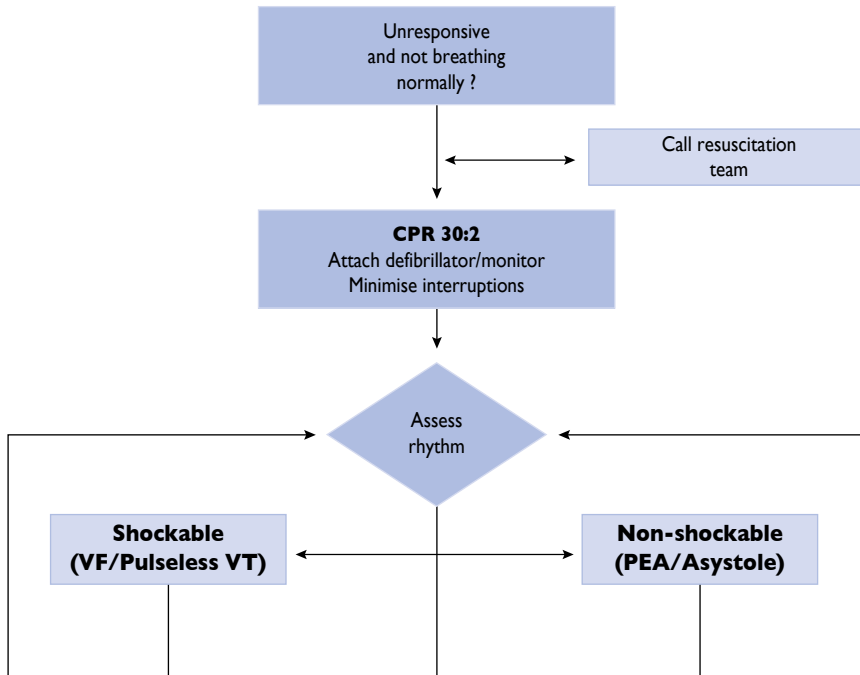


## IN-HOSPITAL CARDIAC ARREST: Assessment of a collapsed victim and initial treatment

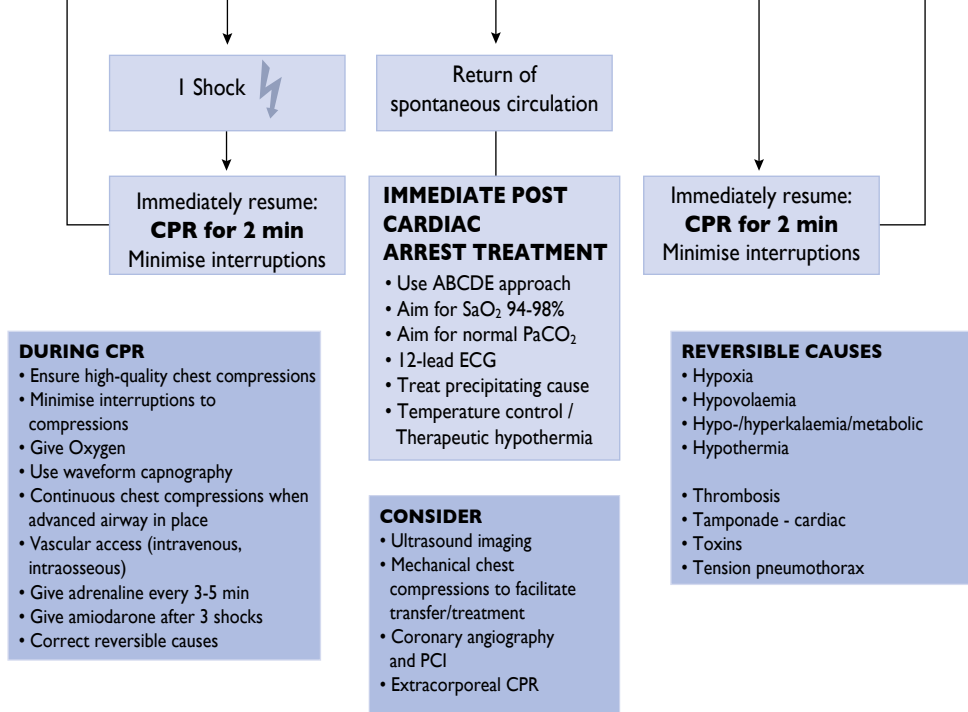




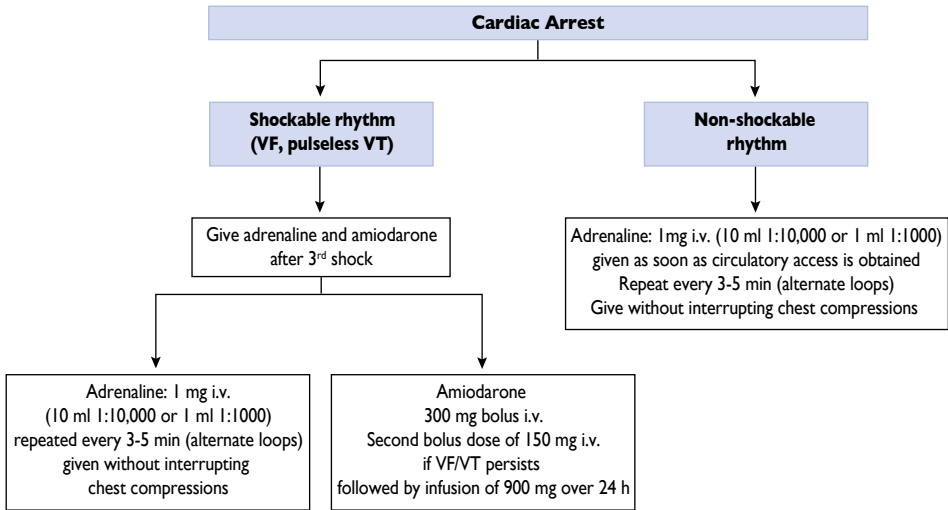
## IN-HOSPITAL CARDIAC ARREST: Advanced life support







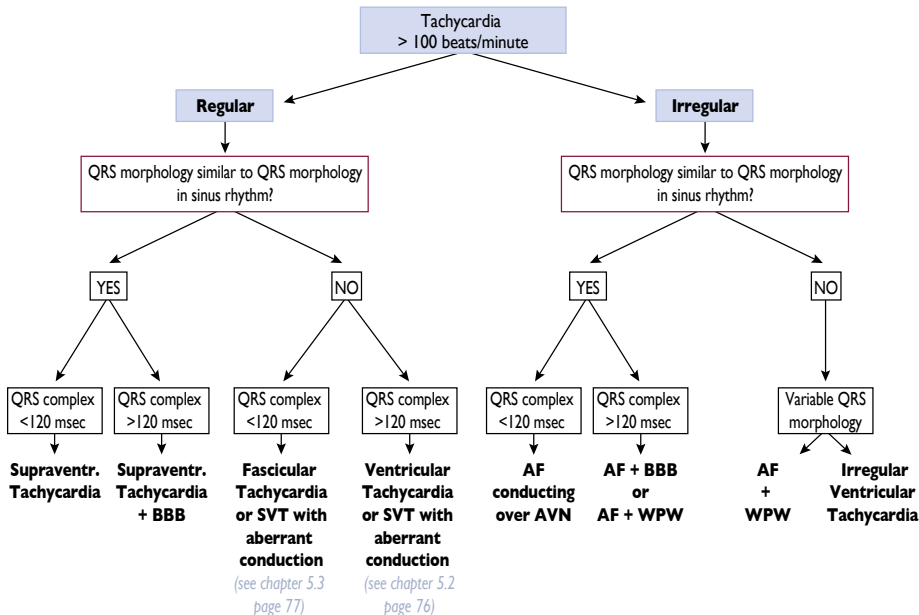
## IN-HOSPITAL CARDIAC ARREST: Drug therapy during advanced life support



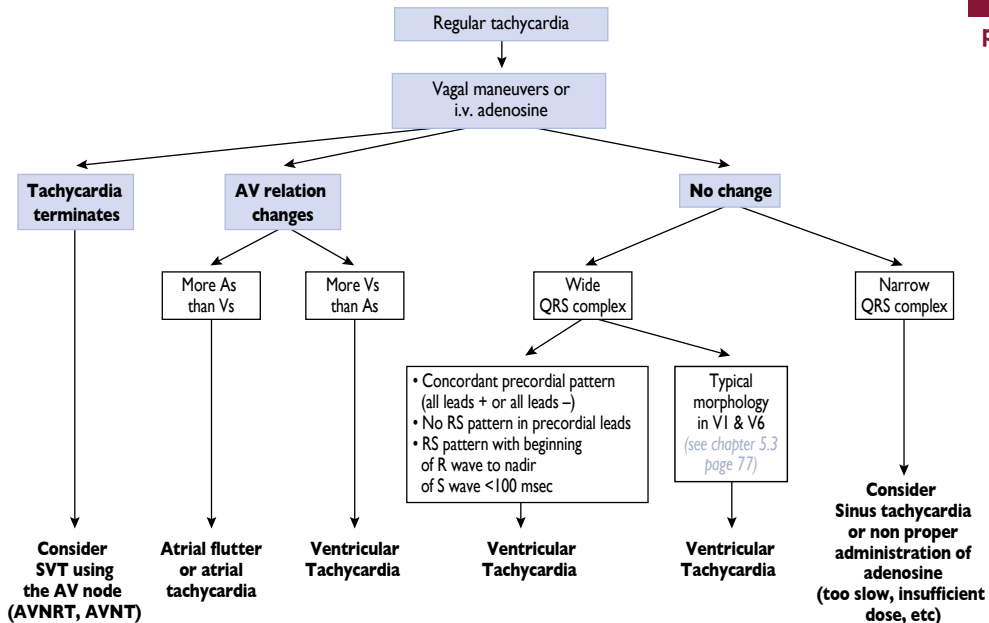
# CHAPTER 5: RHYTHM DISTURBANCES

<b>5.1 SUPRAVENTRICULAR TACHYCARDIAS AND ATRIAL FIBRILLATION</b> .....	p.70
J. Brugada	
<b>5.2 VENTRICULAR TACHYCARDIAS</b> .....	p.74
M. Santini, C. Lavalle, S. Lanzara	
<b>5.3 BRADYARRHYTHMIAS</b> .....	p.77
B. Gorenek	

## TACHYARRHYTHMIAS: Diagnostic criteria



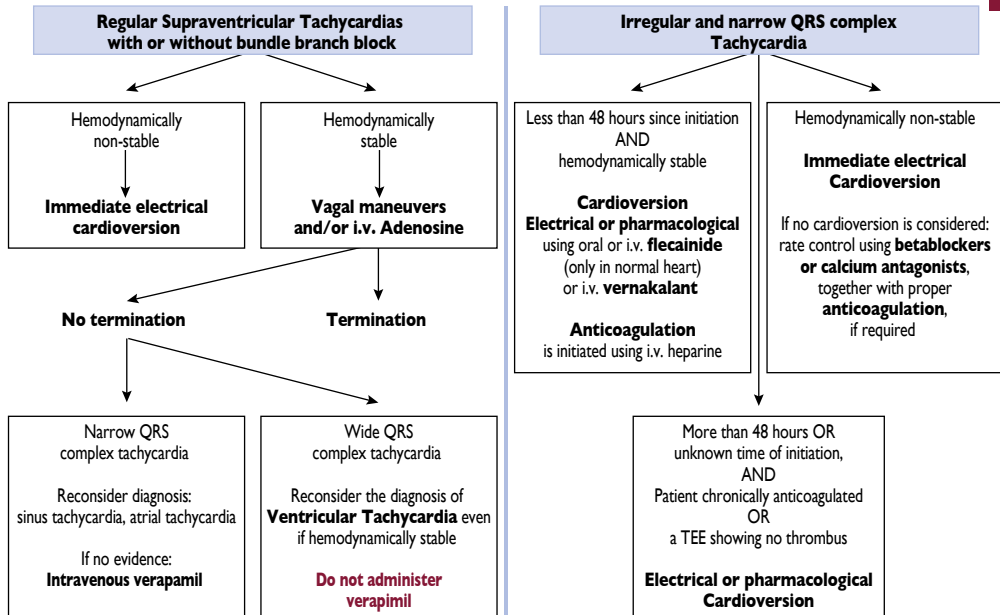
## TACHYARRHYTHMIAS: Diagnostic maneuvers



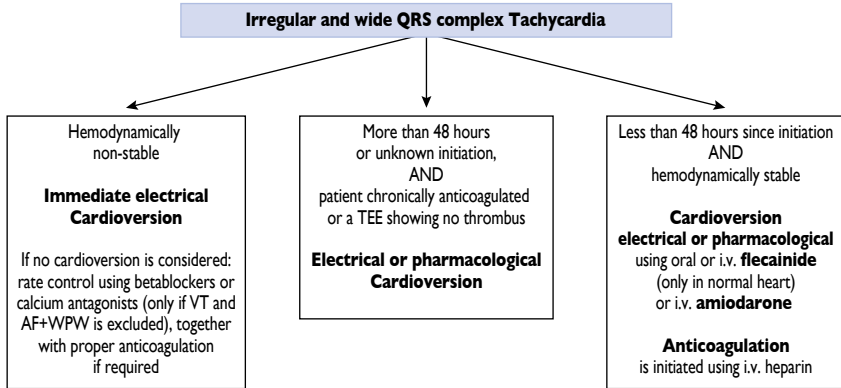
## TACHYARRHYTHMIAS: Therapeutic algorithms (I)

5.1

p.72



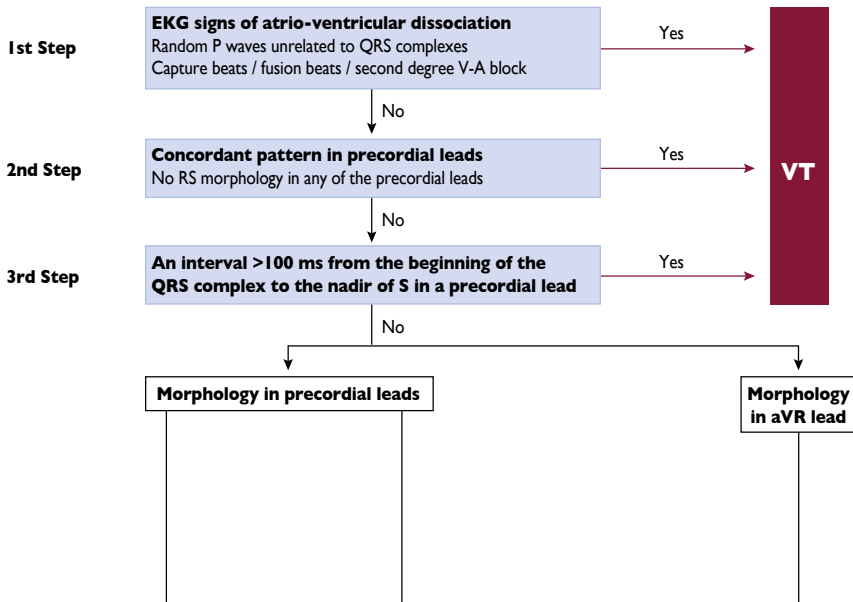
## TACHYARRHYTHMIAS: Therapeutic algorithms (2)



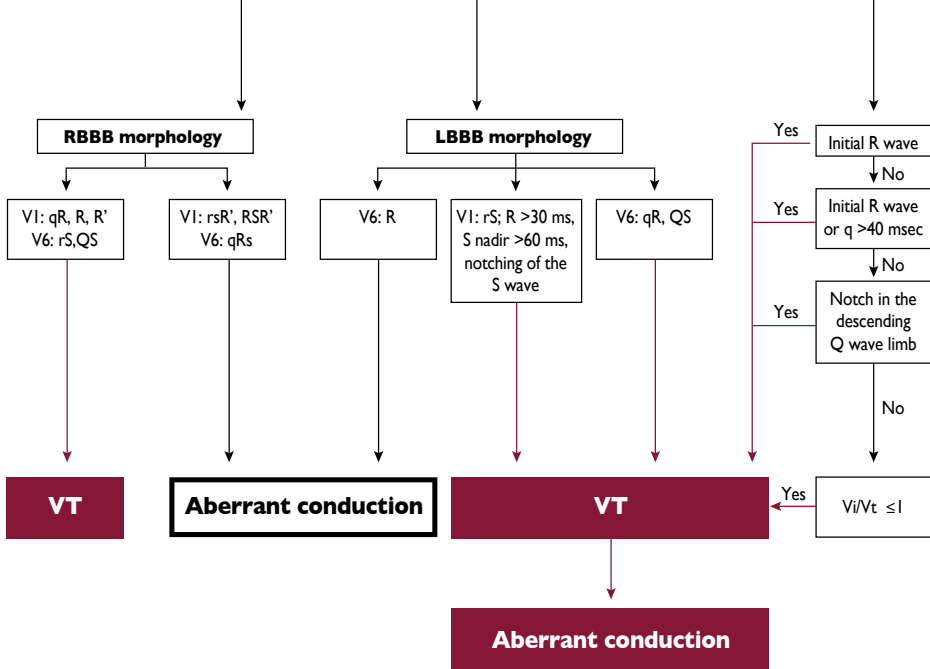
## VENTRICULAR TACHYCARDIAS: Differential diagnosis of wide QRS tachycardias

5.2

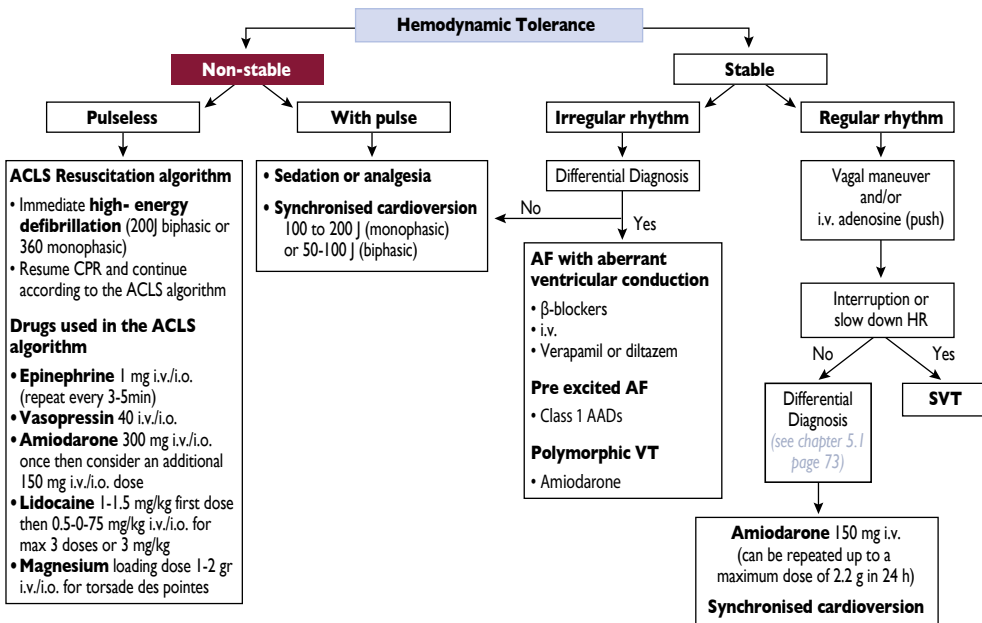
p.74







## Management of wide QRS TACHYCARDIAS



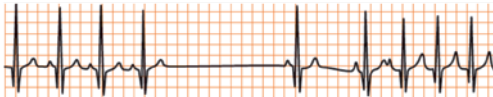
## BRADYARRHYTHMIAS: Definitions and diagnosis

5.3

p.77



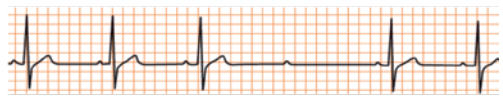
### Sinus node dysfunction



- **Sinus bradycardia.** It is a rhythm that originates from the sinus node and has a rate of under 60 beats per minute
- **Sinoatrial exit block.** The depolarisations that occur in the sinus node cannot leave the node towards the atria
- **Sinus arrest.** Sinus pause or arrest is defined as the transient absence of sinus P waves on the ECG



### Atrioventricular (AV) blocks



- **First degree AV block.** Atrioventricular impulse transmission is delayed, resulting in a PR interval longer than 200 msec
- **Second degree AV block.** Mobitz type I (Wenckebach block): Progressive PR interval prolongation, which precedes a nonconducted P wave
- **Second degree AV block.** Mobitz type II: PR interval remains unchanged prior to a P wave that suddenly fails to conduct to the ventricles
- **Third degree (complete) AV block.** No atrial impulses reach the ventricle

- Rule out and treat any underlying causes of bradyarrhythmia
- Treat symptomatic patients only

For more information on individual drug doses and indications, See chapter 8: Use of drugs in Acute Cardiovascular Care.

### Temporary transvenous pacing

#### Be Careful!

- Complications are common!
- Shall not be used routinely
- Use only as a last resource when chronotropic drugs are insufficient
- Every effort should be made to implant a permanent pacemaker as soon as possible, if the indications are established.

#### Indications limited to:

- High-degree AV block without escape rhythm
- Life threatening bradyarrhythmias, such as those that occur during interventional procedures, in acute settings such as acute myocardial infarction, drug toxicity.

## **BRADYARRHYTHMIAS: Treatment (2)**

### **Pacemaker therapies in sinus node dysfunction**

#### **Permanent pacemaker is indicated in the following settings:**

- Documented symptomatic bradycardia, including frequent sinus pauses that produce symptoms
- Symptomatic chronotropic incompetence
- Symptomatic sinus bradycardia that results from required drug therapy for medical conditions

#### **Permanent pacemaker is not recommended in the following settings:**

- Asymptomatic patients
- Patients for whom the symptoms suggestive of bradycardia have been clearly documented to occur in the absence of bradycardia
- Symptomatic bradycardia due to nonessential drug therapy

## **BRADYARRHYTHMIAS: Treatment (3)**

### **Pacemaker therapies in atrioventricular blocks**

**Permanent pacemaker therapy is indicated in the following settings regardless of associated symptoms:**

- Third-degree AV block
- Advanced second-degree AV block
- Symptomatic Mobitz I or Mobitz II second-degree AV block
- Mobitz II second-degree AV block with a wide QRS or chronic bifascicular block
- Exercise-induced second- or third-degree AV block
- Neuromuscular diseases with third- or second-degree AV block
- Third- or second-degree (Mobitz I or II) AV block after catheter ablation or valve surgery when block is not expected to resolve

**Permanent pacemaker is not recommended in the following settings:**

- Asymptomatic patients
- Patients for whom the symptoms suggestive of bradycardia have been clearly documented to occur in the absence of bradycardia
- Symptomatic bradycardia due to nonessential drug therapy

# CHAPTER 6: ACUTE VASCULAR SYNDROMES

## 6.1 ACUTE AORTIC SYNDROMES ..... p.82

A. Evangelista

## 6.2 ACUTE PULMONARY EMBOLISM ..... p.92

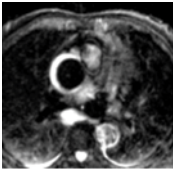
A. Torbicki

## ACUTE AORTIC SYNDROMES: Concept and classification (I)

### Types of presentation

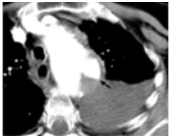
6.1

p.82



#### Intramural hematoma (IMH)

Aortic wall hematoma with no entry tear and no two-lumen flow



#### Aortic aneurysm rupture

(contained or not contained)

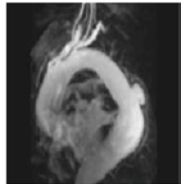
#### Classic aortic dissection

Separation of the aorta media with presence of extraluminal blood within the layers of the aortic wall. The intimal flap divides the aorta into two lumina, the true and the false



#### Penetrating aortic ulcer (PAU)

Atherosclerotic lesion penetrates the internal elastic lamina of the aorta wall





## ACUTE AORTIC SYNDROMES: Concept and classification (2)

### Anatomic classification and time course

#### DeBakey's Classification

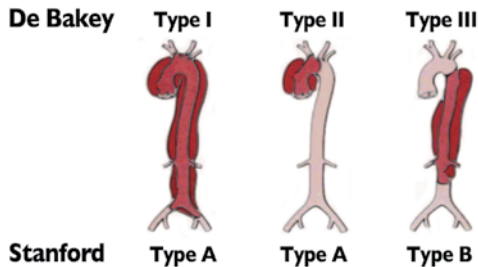
- Type I and type II dissections both originate in the ascending aorta  
In type I, the dissection extends distally to the descending aorta  
In type II, it is confined to the ascending aorta
- Type III dissections originate in the descending aorta

#### Stanford Classification

- Type A includes all dissections involving the ascending aorta regardless of entry site location
- Type B dissections include all those distal to the brachiocephalic trunk, sparing the ascending aorta

#### Time course

- Acute: < 14 days
- Subacute: 15-90 days
- Chronic: > 90 days



Adapted with permission from Nienaber CA, Eagle KA, Circulation 2003;108(6):772-778. All rights reserved.

## ACUTE AORTIC SYNDROME: Clinical suspicion and differential diagnosis

### SYMPTOMS AND SIGNS SUGGESTIVE OF AAS

- Abrupt and severe chest/back pain with maximum intensity at onset
- Pulse/pressure deficit
  - Peripheral or visceral ischemia
  - Neurological deficit
- Widened mediastinum on chest X -ray
- Risk factors for dissection
- Other
  - Acute aortic regurgitation
  - Pericardial effusion
  - Hemomediastinum/hemothorax

### DIFFERENTIAL DIAGNOSIS

- Acute coronary syndrome (with/without ST-segment elevation)
- Aortic regurgitation without dissection
- Aortic aneurysms without dissection
- Musculoskeletal pain
- Pericarditis
- Pleuritis
- Mediastinal tumours
- Pulmonary embolism
- Cholecystitis
- Atherosclerosis or cholesterol embolism

## General approach to the patient with suspected ACUTE AORTIC SYNDROME

Consider acute aortic dissection in all patients presenting with:

- Chest, back or abdominal pain
- Syncope
- Symptoms consistent with perfusion deficit (central nervous system, visceral myocardial or limb ischemia)



Pre-test risk assessment for acute aortic dissection

### High-risk conditions

- Marfan's syndrome
- Connective tissue disease
- Family history of aortic disease
- Aortic valve disease
- Thoracic aortic aneurysm

### High-risk pain features

**Chest, back or abdominal pain described as:**

Abrupt at onset, severe in intensity, and ripping/sharp or stabbing quality

### High-risk exam features

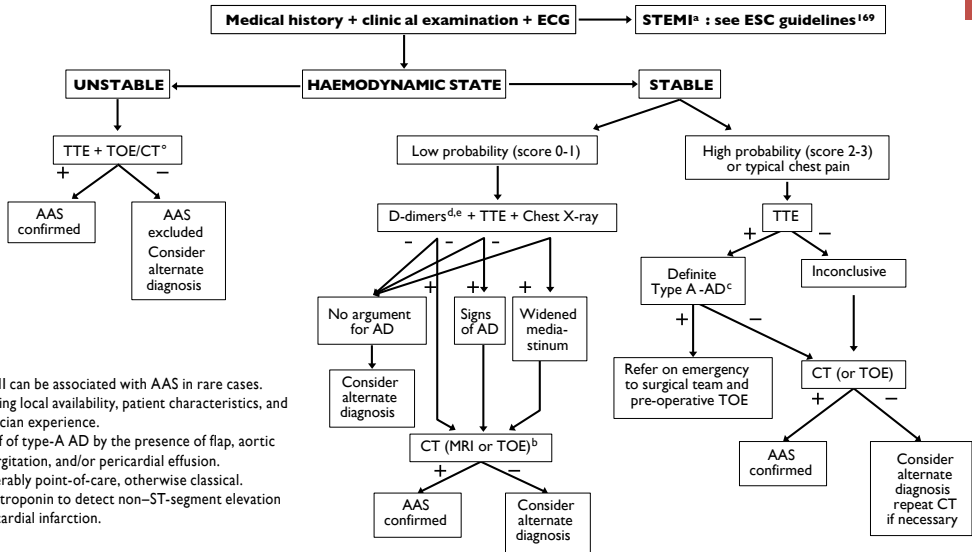
- **Perfusion deficit:**
  - Pulse deficit
  - SBP differential
  - Focal neurological deficit
- **Aortic regurgitation murmur**
- **Hypotension or shock**

## Laboratory tests required for patients with ACUTE AORTIC dissection

Laboratory tests	To detect signs of:
Red blood cell count	Blood loss, bleeding, anaemia
White blood cell count	Infection, inflammation (SIRS*)
C-reactive protein	Inflammatory response
ProCalcitonin	Differential diagnosis between SIRS* and sepsis
Creatine kinase	Reperfusion injury, rhabdomyolysis
TroponinIorT	Myocardial ischaemia, myocardial infarction
D-dimer	Aortic dissection, pulmonary embolism, thrombosis
Creatinine	Renal failure (existing or developing)
Aspartate transaminase/ alanine aminotransferase	Liver ischaemia, liver disease
Lactate	Bowel ischaemia, metabolic disorder
Glucose	Diabetes mellitus
Blood gases	Metabolic disorder, oxygenation

\*SIRS = systemic inflammatory response syndrome.

## ACUTE CHEST PAIN



<sup>a</sup> STEMI can be associated with AAS in rare cases.  
<sup>b</sup> Pending local availability, patient characteristics, and physician experience.  
<sup>c</sup> Proof of type-A AD by the presence of flap, aortic regurgitation, and/or pericardial effusion.  
<sup>d</sup> Preferably point-of-care, otherwise classical.  
<sup>e</sup> Also troponin to detect non-ST-segment elevation myocardial infarction.

Flowchart for decision-making based on pre-test sensitivity of acute aortic syndrome.  
 Reference: Eur Heart J 2014;eurheartj.ehu281

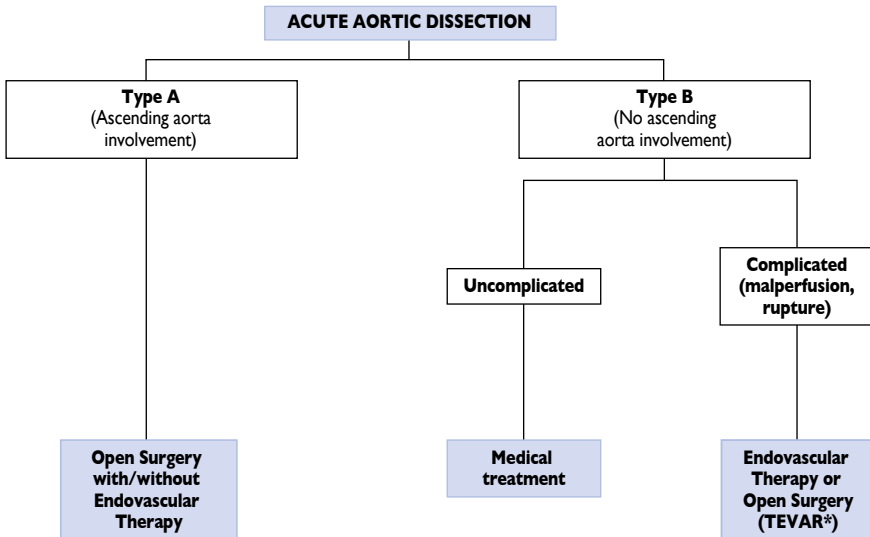
## Details required from imaging in ACUTE AORTIC dissection

<b>Aortic dissection</b>	<ul style="list-style-type: none"><li>• Visualization of intimal flap</li><li>• Extent of the disease according to the aortic anatomic segmentation</li><li>• Identification of the false and true lumens (if present)</li><li>• Localization of entry and re-entry tears (if present)</li><li>• Identification of antegrade and/or retrograde aortic dissection</li><li>• Identification grading, and mechanism of aortic valve regurgitation</li><li>• Involvement of side branches</li><li>• Detection of malperfusion (low flow or no flow)</li><li>• Detection of organ ischaemia (brain, myocardium, bowels, kidneys, etc.)</li><li>• Detection of pericardial effusion and its severity</li><li>• Detection and extent of pleural effusion</li><li>• Detection of peri-aortic bleeding</li><li>• Signs of mediastinal bleeding</li></ul>
<b>Intramural haematoma</b>	<ul style="list-style-type: none"><li>• Localization and extent of aortic wall thickening</li><li>• Co-existence of atheromatous disease (calcium shift)</li><li>• Presence of small intimal tears</li></ul>
<b>Penetrating aortic ulcer</b>	<ul style="list-style-type: none"><li>• Localization of the lesion (length and depth)</li><li>• Co-existence of intramural haematoma</li><li>• Involvement of the peri-aortic tissue and bleeding</li><li>• Thickness of the residual wall</li></ul>
<b>In all cases</b>	<ul style="list-style-type: none"><li>• Co-existence of other aortic lesions: aneurysms, plaques, signs of inflammatory disease, etc.</li></ul>

## ACUTE AORTIC SYNDROMES MANAGEMENT: General approach

6.1

p.89



\*TEVAR Thoracic Endovascular Aortic Repair.

- 1 • Detailed **medical history** and complete **physical examination** (when possible)
- 2 • **Standard 12-lead ECG**: Rule-out ACS, documentation of myocardial ischemia
- 3 • **Intravenous line, blood sample** (CK, Tn, myoglobin, white blood count, D-dimer, hematocrit, LDH)
- 4 • **Monitoring**: HR and BP
- 5 • **Pain relief** (morphine sulphate) (*see chapter 3*)
- 6 • **Noninvasive imaging** (*see previous page*)
- 7 • **Transfer to ICU**

For more information on individual drug doses and indications, See **chapter 8: Use of drugs in Acute Cardiovascular Care.**



### TYPE A ACUTE AORTIC DISSECTION

#### URGENT SURGERY (<24h)

Graft replacement of ascending aorta +/- arch with/without aortic valve or aortic root replacement/repair (depending on aortic regurgitation and aortic root involvement)

#### Emergency Surgery

- Haemodynamic instability (hypotension/shock)
- Tamponade
- Severe acute aortic regurgitation
- Impending rupture
- Flap in aortic root
- Malperfusion syndrome

#### Elective/individualised Surgery

- Non-complicated intramural hematoma
- Comorbidities
- Age >80 years

### TYPE B ACUTE AORTIC DISSECTION

#### Definitive diagnosis

by clinical presentation and imaging

Yes

No

#### COMPLICATED

defined as:

- Impending rupture
- Malperfusion
- Refractory HTN
- SBP <90 mmHg)
- Shock

**MEDICAL MANAGEMENT and TEVAR**

**MEDICAL MANAGEMENT and OPEN SURGERY REPAIR**  
if TEVAR contraindicated

#### UNCOMPLICATED

defined as:

No features of complicated dissection

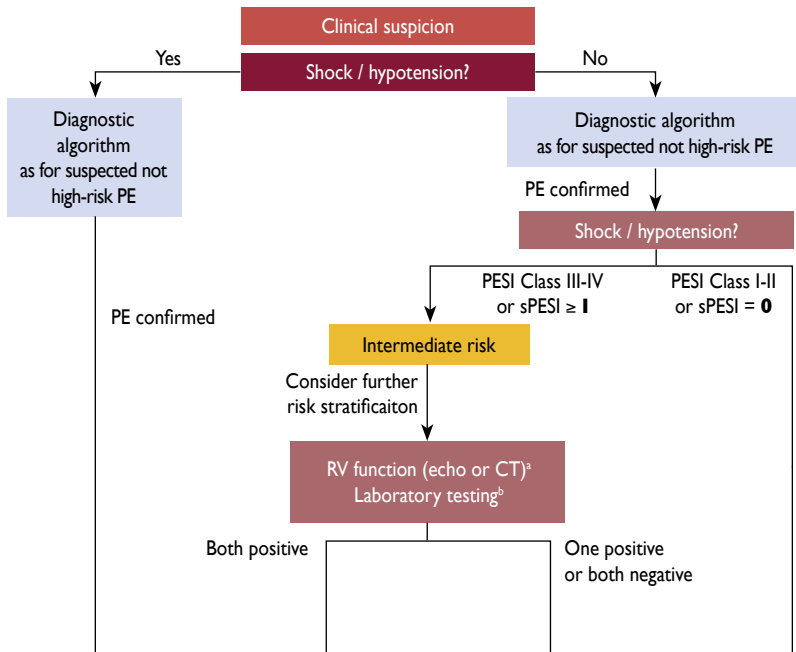
**MEDICAL MANAGEMENT and imaging surveillance protocol**

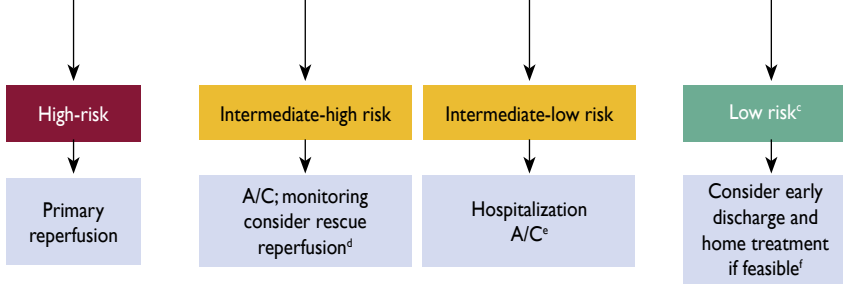
- On admission
- At 7 days
- At discharge
- Every 6 months thereafter

## Risk-adjusted management strategies in ACUTE PULMONARY EMBOLISM

6.2

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<sup>a</sup> If echocardiography has already been performed during diagnostic work-up for PE and detected RV dysfunction, or if the CT already performed for diagnostic work-up has shown RV enlargement (RV/LV (left ventricular) ratio  $\geq 0.9$ , a cardiac troponin test should be performed except for cases in which primary reperfusion is not a therapeutic option (e.g. due to severe comorbidity or limited life expectancy of the patient).

<sup>b</sup> Markers of myocardial injury (e.g. elevated cardiac troponin I or T concentrations in plasma), or of heart failure as a result of (right) ventricular dysfunction (elevated natriuretic peptide concentrations in plasma). If a laboratory test for a cardiac biomarker has already been performed during initial diagnostic work-up (e.g. in the chest pain unit) and was positive, then an echocardiogram should be considered to assess RV function, or RV size should be (re)assessed on CT.

<sup>c</sup> Patients in the PESI Class I-II, or with sPESI of 0, and elevated cardiac biomarkers or signs of RV dysfunction on imaging tests, are also to be classified into the intermediate-low risk category. This might apply to situations in which imaging or biomarker results become available before calculation of the clinical severity index. These patients are probably no candidates for home treatment.

<sup>d</sup> Thrombolysis, if (and as soon as) clinical signs of haemodynamic decompensation appear; surgical pulmonary embolectomy or percutaneous catheter-directed treatment may be considered as alternative options to systemic thrombolysis, particularly if the bleeding risk is high.

<sup>e</sup> Monitoring should be considered for patients with confirmed PE and a positive troponin test, even if there is no evidence of RV dysfunction on echocardiography or CT.

<sup>f</sup> The simplified version of the PESI has not been validated in prospective home treatment trials; inclusion criteria other than the PESI were used in two single-armed (non-randomized) management studies.

## ACUTE PULMONARY EMBOLISM: Diagnosis

6.2

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### CARDIOVASCULAR

#### Symptoms/Signs

including but not limited to:

- Chest pain (angina)
- Syncope
- Tachycardia
- ECG changes
- NT-proBNP ↑
- Troponin ↑

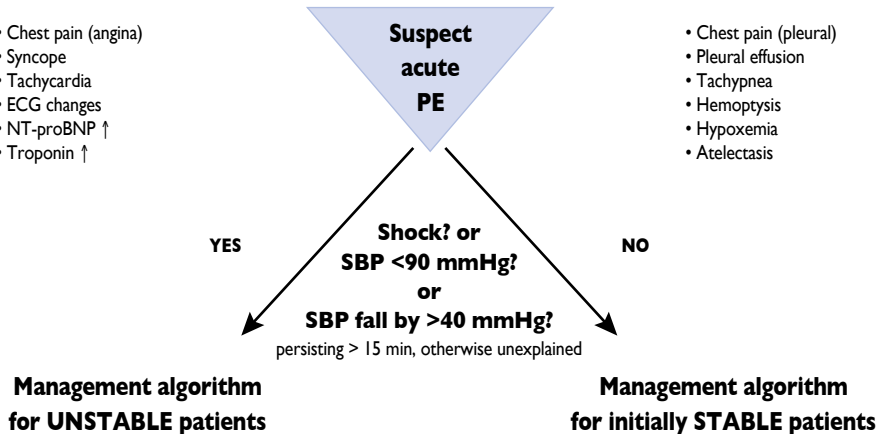
### RESPIRATORY

#### Symptoms/Signs

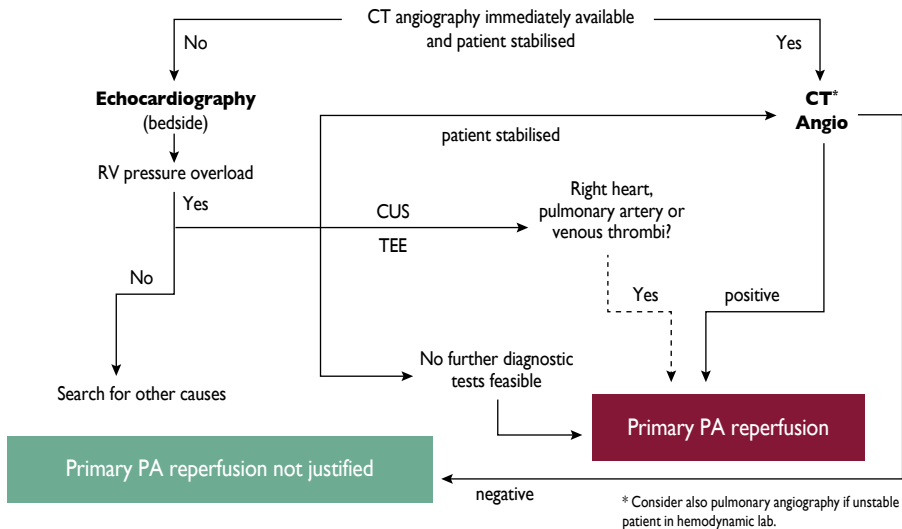
including but not limited to:

- Chest pain (pleural)
- Pleural effusion
- Tachypnea
- Hemoptysis
- Hypoxemia
- Atelectasis

## Dyspnea



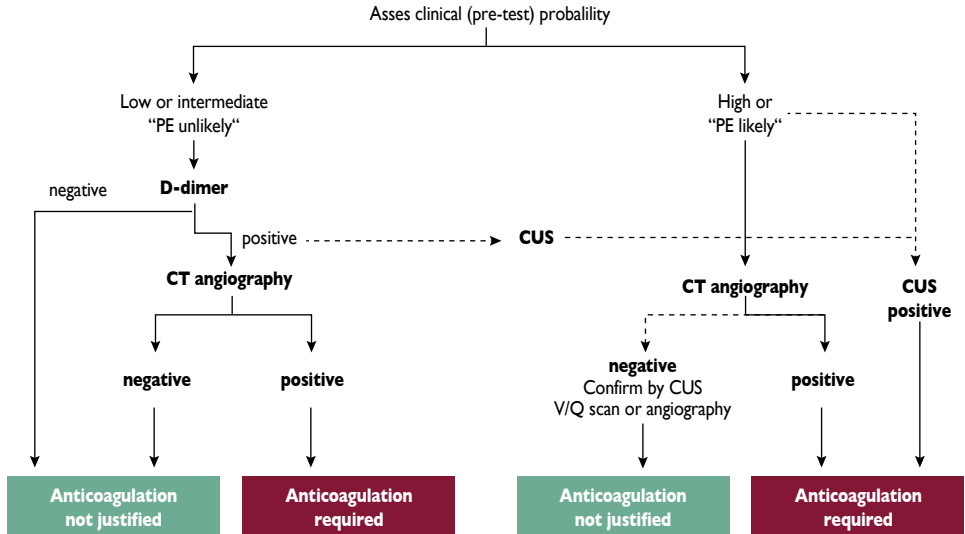
## Management algorithm for unstable patients with suspected ACUTE PULMONARY EMBOLISM



**ACUTE PE: Management strategy for initially unstable patients with confirmed high risk pulmonary embolism**

<b>Shock or hypotension</b>	<b>YES</b>		
<b>Contraindications for thrombolysis</b>	No	Relative	Absolute
<b>Primary PA reperfusion strategy</b>	<b>Thrombolysis</b>	<b>Low-dose/ transcatheter thrombolysis/ clot fragmentation</b>	<b>Surgical or Percutaneous catheter embolectomy (availability/experience)</b>
<b>Supportive treatment</b>	<b>i.v. UFH, STABILISE SYSTEMIC BLOOD PRESSURE, CORRECT HYPOXEMIA</b>		

## Management algorithm for initially stable patients with suspected ACUTE PULMONARY EMBOLISM



## Suggested management strategy for initially stable patients with (non-high risk) confirmed

<b>Markers for myocardial injury</b>	Positive	Positive	Negative
<b>Markers for RV overload</b>	Positive	Positive	Negative
<b>Clinical risk assessment score (PESI)</b>	Positive (class III-V)	Positive (class III-V)	Negative (class I-II)
<b>Suggested initial anticoagulation</b>	<b>UFH i.v /LMWH s.c.</b>	<b>LMWH/Fonda/ apixaban/ rivaroxaban</b>	<b>apixaban/rivaroxaban</b>

<b>STRATEGY</b>	<b>Monitoring (ICU)* rescue thrombolysis</b>	<b>Hospitalisation** (telemonitoring)</b>	<b>Early discharge***</b>
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\* When all markers are positive.

\*\* When at least one marker is positive.

\*\*\* When all markers are negative.

### Pharmacological treatment:

For more information on individual drug doses and indications, See chapter 8: Use of drugs in Acute Cardiovascular Care.



**PULMONARY EMBOLISM: Pharmacological treatment**  
**Key drugs for initial treatment of patients with confirmed PE**

For more information on individual drug doses and indications, See chapter 8: Use of drugs in Acute Cardiovascular Care.

<b>Unstable</b>	Alteplase (rtPA) (intravenous)	100 mg/2 h or 0.6 mg/kg/15 min (max 50 mg)
	Urokinase (intravenous)	3 million IU over 2 h
	Streptokinase (intravenous)	1.5 million IU over 2 h
	Unfractionated heparin (intravenous)	80 IU/kg bolus + 18 IU/kg/h
<b>Stable</b>	Enoxaparine (subcutaneous)	1.0 mg/kg BID or 1.5 mg/kg QD
	Tinzaparin (subcutaneous)	175 U/kg QD
	Fondaparinux (subcutaneous)	7.5 mg (50-100 Kg of body weight) 5 mg for patients <50 kg, 10 mg for patients >100 kg
	Rivaroxaban (oral)	15 mg BID (for 3 weeks, then 20 mg QD)
	Apixaban (oral)	10mg bid (for 7 days, than 5mg bid)



# CHAPTER 7: ACUTE MYOCARDIAL / PERICARDIAL SYNDROMES

## **7.1 ACUTE MYOCARDITIS** ..... p.102

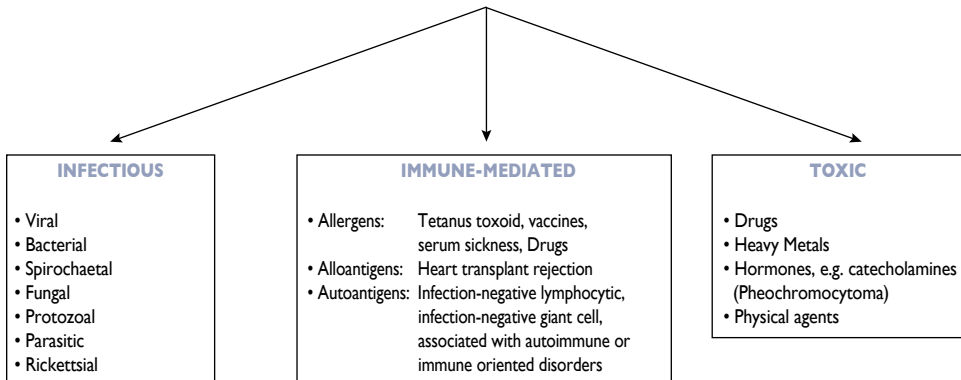
A. Keren, A. Caforio

## **7.2 ACUTE PERICARDITIS AND CARDIAC TAMPONADE** ..... p.107

C. Vrints, S. Price

**MYOCARDITIS (WHO /ISFC):** Inflammatory disease of the myocardium diagnosed by established histological, immunological and immunohistochemical criteria.

### CAUSES OF MYOCARDITIS



## ACUTE MYOCARDITIS: Diagnostic criteria (I)

### Diagnostic criteria for clinically suspected myocarditis

Clinical presentations with or without ancillary findings	Diagnostic criteria
<ul style="list-style-type: none"> <li>• Acute chest pain (pericarditic or pseudo-ischemic)</li> <li>• New-onset (days up to 3 months) or worsening dyspnea or fatigue, with or without left/right heart failure signs</li> <li>• Palpitation, unexplained arrhythmia symptoms, syncope, aborted sudden cardiac death</li> <li>• Unexplained cardiogenic shock and/or pulmonary oedema</li> </ul>	<p><b>I. ECG/Holter/stress test features:</b> Newly abnormal ECG and/or Holter and/or stress testing, any of the following:</p> <ul style="list-style-type: none"> <li>• I to III degree atrioventricular block, or bundle branch block, ST/T wave changes (ST elevation or non ST elevation, T wave inversion),</li> <li>• Sinus arrest, ventricular tachycardia or fibrillation and asystole, atrial fibrillation, frequent premature beats, supraventricular tachycardia</li> <li>• Reduced R wave height, intraventricular conduction delay (widened QRS complex), abnormal Q waves, low voltage</li> </ul> <p><b>II. Myocardiocytolysis markers:</b> Elevated TnT/TnI</p> <p><b>III. Functional/structural abnormalities on echocardiography</b></p> <ul style="list-style-type: none"> <li>• New, otherwise unexplained LV and/or RV structure and function abnormality (including incidental finding in apparently asymptomatic subjects): regional wall motion or global systolic or diastolic function abnormality, with or without ventricular dilatation, with or without increased wall thickness, with or without pericardial effusion, with or without endocavitary thrombi</li> </ul> <p><b>IV. Tissue characterisation by CMR:</b> Edema and/or LGE of classical myocarditic pattern</p>
<p style="text-align: center;"><b>Ancillary findings which support the clinical suspicion of myocarditis</b></p> <ul style="list-style-type: none"> <li>• Fever <math>\geq 38.0^{\circ}\text{C}</math> within the preceding 30 days</li> <li>• A respiratory or gastrointestinal infection</li> <li>• Previous clinically suspected or biopsy proven myocarditis</li> <li>• Peri-partum period</li> <li>• Personal and/or family history of allergic asthma</li> <li>• Other types of allergy</li> <li>• Extra-cardiac autoimmune disease</li> <li>• Toxic agents</li> <li>• Family history of dilated cardiomyopathy, myocarditis</li> </ul>	

## ACUTE MYOCARDITIS: Diagnostic criteria (2)

### Acute myocarditis should be clinically suspected in the presence of:

One or more of the clinical presentations shown in the Diagnostic Criteria\*  
with or without Ancillary Features\*

AND

One or more Diagnostic Criteria from different categories (I to IV)\*

OR

when the patient is asymptomatic, two or more diagnostic criteria from different categories (I to IV)\*

#### **in the absence of:**

- 1) angiographically detectable coronary artery disease
- 2) known pre-existing cardiovascular disease or extra-cardiac causes that could explain the syndrome (e.g. valve disease, congenital heart disease, hyperthyroidism, etc.)

#### **Suspicion is higher with higher number of fulfilled criteria\***

Endomyocardial biopsy is necessary to: 1) confirm the diagnosis of clinically suspected myocarditis,  
3) identify the type and aetiology of inflammation, and 2) provide the basis for safe immunosuppression  
(in virus negative cases).

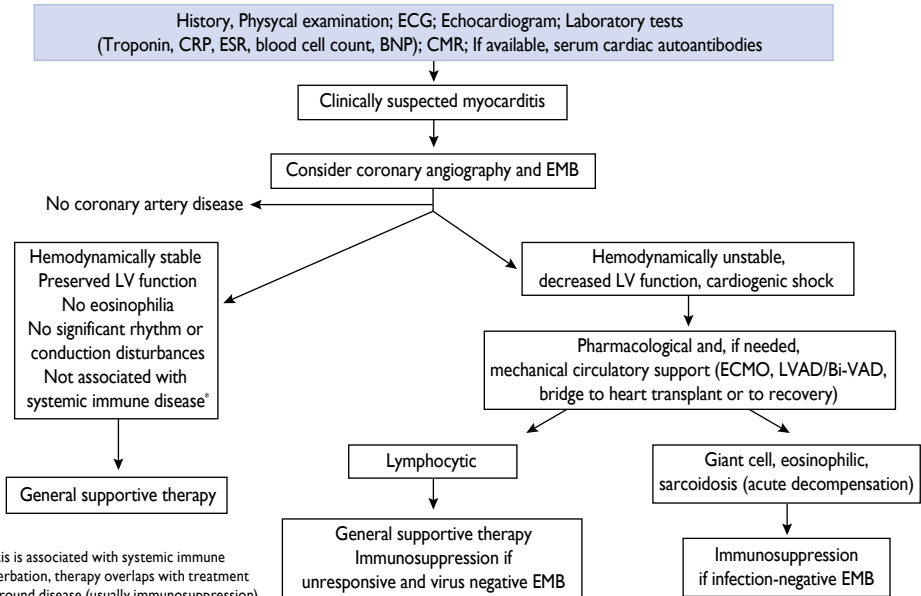
\*See chapter 7.1 page 101.

Reference: Caforio ALP et al. Eur Heart J. (2013) Jul 3 (16).

## ACUTE MYOCARDITIS: Diagnostic and management protocol

7.1

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\*If myocarditis is associated with systemic immune disease exacerbation, therapy overlaps with treatment of the background disease (usually immunosuppression).

## Management of patients with life-threatening ACUTE MYOCARDITIS

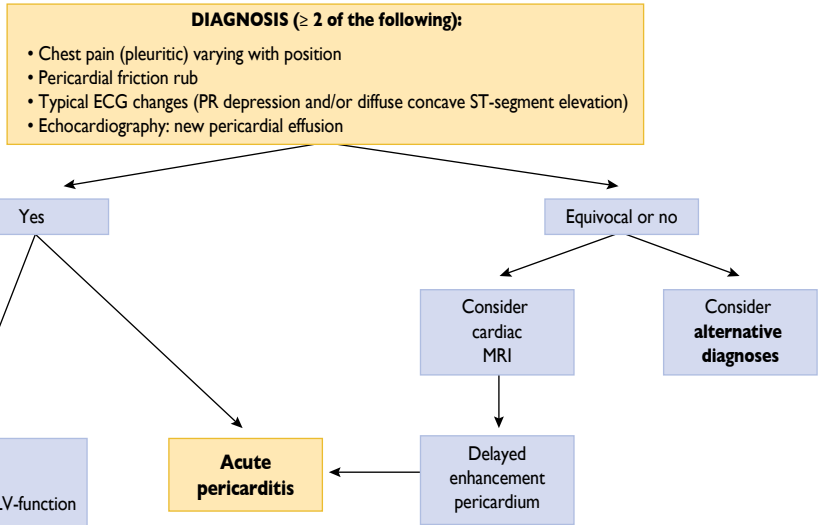
- Patients with a life-threatening presentation should be sent to specialised units with capability for hemodynamic monitoring, cardiac catheterisation and expertise in endomyocardial biopsy.
- In patients with hemodynamic instability a **mechanical cardio-pulmonary assist device** may be needed as a bridge to recovery or to heart transplantation.
- **Heart transplant** should be deferred in the acute phase, because recovery may occur, but can be considered for hemodynamically unstable myocarditis patients, including those with giant cell myocarditis, if optimal pharmacological support and mechanical assistance cannot stabilise the patient
- **ICD implantation** for complex arrhythmias should be deferred until resolution of the acute episode, with possible use of a lifevest during the recovery period.



## ACUTE PERICARDITIS: Diagnosis

7.2

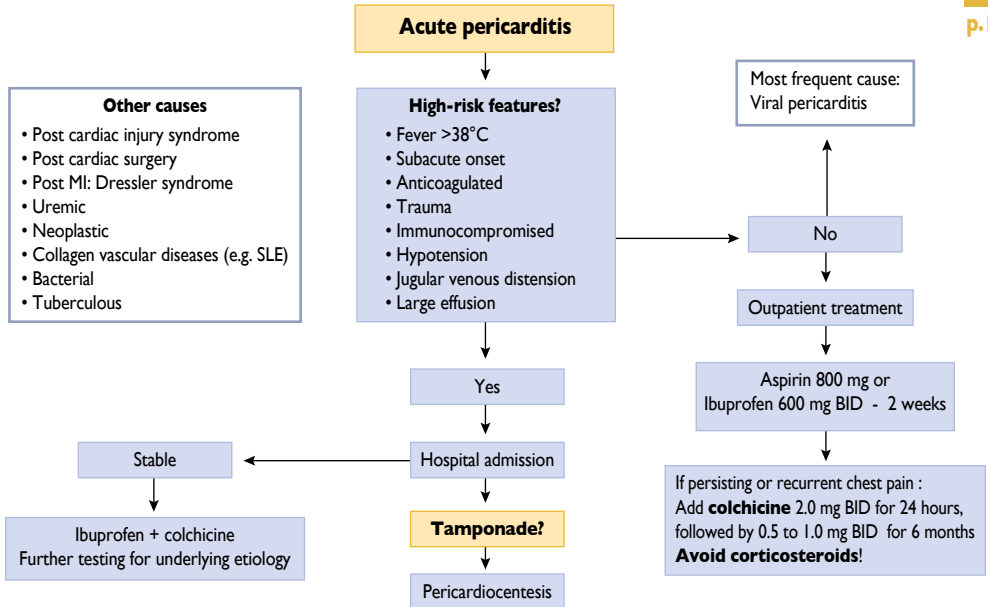
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## ACUTE PERICARDITIS: Management

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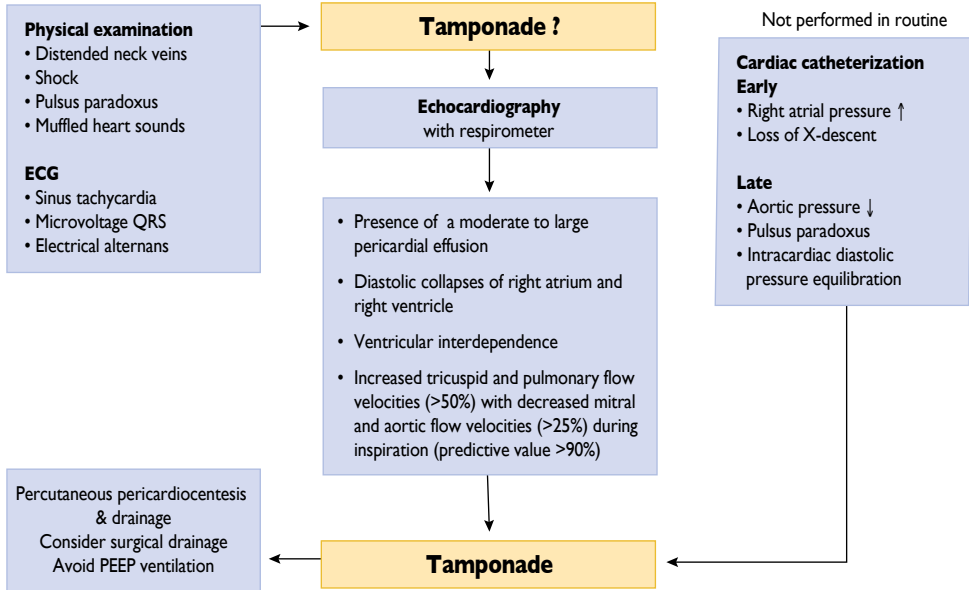
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## CARDIAC TAMPONADE: Diagnosis and management

7.2

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# CHAPTER 8: DRUGS USED IN ACUTE CARDIOVASCULAR CARE

Ana de Lorenzo

## Oral antiplatelets

Drug	Indications	Dose	Dose adjustments	Comments
<b>Aspirin</b>	Primary (not universally approved) and secondary cardiovascular disease prevention	LD (if ACS): 150-300 mg oral MD: 75-100 mg oral QD	-	Major contraindications: GI bleeding-active peptic ulcer
<b>Ticagrelor</b>	ACS (all patients at moderate-to-high risk of ischaemic events, e.g. elevated cardiac troponins)	LD: 180 mg oral MD: 90 mg oral BID	-	Major contraindications: previous intracerebral hemorrhage
	Secondary prevention 1-3 years post-MI	MD: 60 mg oral BID	-	Major contraindications: previous intracerebral hemorrhage
<b>Prasugrel</b>	ACS with planned PCI	LD: 60 mg oral MD: 10 mg oral QD	MD: 5 mg QD weight < 60 kg	Contraindication: previous stroke/TIA Prasugrel is generally not recommended in elderly, and if positive benefit/risk 5 mg is recommended
<b>Clopidogrel</b>	ACS + PCI or medical management (patients who cannot receive ticagrelor or prasugrel) and in ACS patients at high bleeding risk (e.g. patients who require oral anticoagulation)	LD: 300-600 mg oral MD: 75 mg oral QD	-	-

DISCLAIMER: The guidance suggested in this document does not override the individual responsibility of the healthcare professional to make appropriate decisions according to each patient's circumstances and profile, as well as local regulations and licenses.

## Oral antiplatelets (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
Clopidogrel	STEMI + fibrinolysis < 75 years	LD: 300 mg oral MD: 75 mg oral QD	-	Prasugrel and ticagrelor have not been studied as adjuncts to fibrinolysis and oral anticoagulants
	STEMI + fibrinolysis ≥ 75 years	LD: 75mg oral. MD: 75 mg oral QD	-	
	Secondary prevention >12 months post coronary stenting	MD: 75 mg oral QD	-	
Vorapaxar	Co-administered with aspirin and, where appropriate, clopidogrel, in patients with a history of MI or peripheral artery disease	2.08 mg oral QD	-	Initiated at least 2 weeks after a MI and preferably within the first 12 months Major contraindications: active pathologic bleeding or increased risk of bleeding, history of stroke / TIA or intracranial bleeding, severe hepatic dysfunction

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## Intravenous Antiplatelets

Drug	Indications	Dose	Dose adjustments	Comments
<b>Abciximab</b>	Adjunct to PCI for bailout situations or thrombotic complications	LD: 0.25 mg/Kg i.v. MD: 0.125 µg/Kg/min i.v. (max: 10 µg/min) for 12h	-	Contraindications: Active internal bleeding - History of CVA within 2 years - Bleeding diathesis - Preexisting thrombocytopenia - Recent (within 2 months) intracranial or intraspinal surgery or trauma - Recent (within 2 months) major surgery - Intracranial neoplasm, arteriovenous malformation, or aneurysm - Severe uncontrolled hypertension - Presumed or documented history of vasculitis - Severe hepatic failure or severe renal failure requiring haemodialysis - Hypertensive retinopathy
<b>Eptifibatid</b>	ACS treated medically or with PCI	LD: 180 µg/Kg i.v. (at a 10 min interval) If STEMI and PCI: add a second 180 mcg/kg i.v. bolus at 10 min MD: 2 µg/Kg/min i.v. infusion	Reduce infusion dose to 1 µg/kg/min if CrCl 30-50ml/min	Contraindications: Bleeding diathesis or bleeding within the previous 30 days - Severe uncontrolled hypertension - Major surgery within the preceding 6 weeks - Stroke within 30 days or any history of hemorrhagic stroke - Coadministration of another parenteral GP IIb/IIIa inhibitor - Dependency on renal dialysis - Known hypersensitivity to any component of the product

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## Intravenous Antiplatelets (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Tirofiban</b>	ACS treated medically or with PCI	LD: 25 µg/Kg i.v. over 5 min MD: 0.15 µg/Kg/min i.v. Infusion to 18 hour	CrCl < 30ml/min: decrease 50% bolus and infusion dose	Contraindications: Severe hypersensitivity reaction to tirofiban A history of thrombocytopenia following prior exposure Active internal bleeding or a history of bleeding diathesis, major surgical procedure or severe physical trauma within the previous month
<b>Cangrelor</b>	All patients undergoing PCI (elective + ACS) immediate onset + rapid offset (platelet recovery in 60 min)	IV Bolus of 30 µg/Kg + IV infusion of 4 µg/kg/min For at least 2 hours from start of PCI	-	Major contraindications: significant active bleeding or stroke Transition to oral P2Y12 inhibitors variable according to type of agent

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## Oral Anticoagulants

Drug	Indications	Dose	Dose adjustments	Comments
<b>Warfarin</b> <b>Acenocoumarol</b>	Treatment and prophylaxis of thrombosis	INR goal of 2-3 (INR: 2.5-3.5 for mechanical mitral valve prostheses or double valve replacement)	Assessing individual risks for thromboembolism and bleeding	-
<b>Dabigatran</b>	Prevention of stroke and systemic embolism in NVAF	150 mg oral BID	110 mg BID (if age $\geq$ 80, increased bleeding risk or concomitant use of verapamil)	Contraindicated if CrCl < 30ml/min or severe hepatic impairment Active pathological bleeding Idarucizumab: specific antidote (not yet available)
	Treatment of DVT and PE in patients who have been treated with a parenteral anticoagulant for 5-10 days and prevention of recurrent DVT and PE in patients who have been previously treated	150 mg oral BID		

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## Oral Anticoagulants (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Rivaroxaban</b>	Prevention of stroke and systemic embolism in NVAF	20 mg oral QD	CrCl < 50ml/min: 15 mg QD	Contraindicated if CrCl < 15ml/min or hepatic disease associated with coagulopathy and clinically relevant bleeding risk
	Treatment of DVT and PE and prevention of recurrent DVT and PE	15 mg oral BID for the first 3 weeks followed by 20 mg QD	Reduce the maintenance dose to 15 mg QD if bleeding risk outweighs the risk for recurrent DVT and PE (not formally approved)	
	Prevention of atherothrombotic events after an ACS	2.5 mg oral BID	-	
<b>Apixaban</b>	Prevention of stroke and systemic embolism in NVAF	5 mg oral BID	2.5 mg oral BID 1) when at least 2 of the following characteristics: age ≥ 80, Cr > 1.5 mg/dl or weight < 60Kg 2) when CrCl 15-29 mL/min	Contraindicated if CrCl < 15ml/min or severe hepatic impairment
	Treatment of DVT and PE	10 mg oral BID for the first 7 days followed by 5 mg oral BID	-	
	Prevention of recurrent DVT and PE	2.5 mg oral BID	-	

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## Intravenous/Subcutaneous Anticoagulants

Drug	Indications	Dose	Dose adjustments	Comments
UFH	NSTE-ACS	LD: 4000 IU i.v. MD: 1000 IU/h i.v.	Target aPTT: 50-70s or 1.5 to 2.0 times that of control to be monitored at 3, 6, 12 and 24h	Monitoring for heparin-induced thrombocytopenia (HIT) Dose-independent reaction
	STEMI	Primary PCI: 70-100 IU/Kg i.v. when no GP-IIb/IIIa inhibitor is planned. 50-60 IU/Kg i.v. bolus with GP-IIb/IIIa inhibitors - Fibrinolysis/No reperfusion: 60 IU/kg i.v. bolus (max: 4000 IU) followed by an i.v. infusion of 12 IU/kg (max: 1000 IU/h) for 24-48h	Target aPTT: 50-70s or 1.5 to 2.0 times that of control to be monitored at 3, 6, 12 and 24h	
	Treatment of DVT and PE	80 IU/Kg i.v. bolus followed by 18 IU/Kg/h	According to aPTT, thromboembolic and bleeding risk	
Fondaparinux	NSTE-ACS	2.5 mg QD s.c.	-	Severe hepatic impairment: caution advised Contraindicated if CrCl < 20ml/min Contraindicated for DVT/PE treatment if CrCl < 30ml/min
	STEMI	Fibrinolysis/No reperfusion: 2.5 mg i.v. bolus followed by 2.5 mg QD s.c. up to 8 days or hospital discharge	-	
	Treatment of DVT and PE	5 mg QD s.c. (< 50 kg); 7.5 mg QD s.c. (50-100 kg); 10 mg QD s.c. (> 100 kg)	If > 100Kg and CrCl 30-50ml/min: 10 mg followed by 7.5 mg/24h s.c.	
	Prevention of VTE	2.5 mg QD s.c.	CrCl 20-50ml/min: 1.5 mg QD s.c.	

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## Intravenous/Subcutaneous Anticoagulants (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
Bivalirudin	PCI for NSTEMI-ACS	0.75 mg/kg i.v. bolus followed immediately by 1.75 mg/kg/h infusion which may be continued for up to 4h post PCI as clinically warranted and further continued at a reduced infusion dose of 0.25 mg/kg/h for 4-12h as clinically necessary	Patients undergoing PCI with CrCl 30-50ml/min should receive a lower infusion rate of 1.4 mg/kg/h. No change for the bolus dose.	Contraindicated if CrCl < 30ml/min
	PCI for STEMI	0.75 mg/kg i.v. bolus followed immediately by 1.75 mg/kg/h infusion which should be continued for up to 4h after the procedure After cessation of the 1.75 mg/kg/h infusion, a reduced infusion dose of 0.25 mg/kg/h may be continued for 4-12h		
	PCI for elective cases	0.75 mg/kg i.v. bolus followed immediately by 1.75 mg/kg/h infusion which may be continued for up to 4h post PCI as clinically warranted		

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Drug	Indications	Dose	Dose adjustments	Comments
<b>Enoxaparin</b>	NSTE-ACS	30 mg i.v. + 1 mg/kg s.c. BID	If > 75 years: no LD and MD 0.75 mg/Kg BID s.c. CrCl < 30ml/min: no LD and MD 1 mg/Kg QD s.c. If > 75 years and CrCl < 30ml/min: no LD and 0.75 mg/Kg QD s.c.	Monitoring for HIT - Anti Xa monitoring during treatment with LMWH might be helpful in pregnancy, extreme body weights and renal impairment.
	STEMI	Primary PCI: 0.5 mg/Kg i.v. bolus Fibrinolysis/No reperfusion: a) Age < 75y: 30 mg i.v. bolus followed by 1 mg/Kg BID s.c. until hospital discharge for a max of 8 days - The first two doses should not exceed 100 mg b) Age > 75y: no bolus; 0.75 mg/Kg BID s.c. - The first two doses should not exceed 75 mg	In patients with CrCl < 30 ml/min: regardless of age, the s.c. doses are given once daily	
	Treatment of DVT and PE	1 mg/Kg s.c. BID or 1.5 mg/Kg s.c. QD	CrCl < 30ml/min: 1 mg/Kg/24h s.c.	
	Prevention of VTE	40 mg s.c. QD	CrCl < 30ml/min: 20 mg s.c. QD	

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## Intravenous/Subcutaneous Anticoagulants (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Tinzaparin</b>	Prevention of VTE	3500 IU s.c. QD (moderate risk) 4500 IU s.c. QD (high risk)	-	Monitoring for HIT - Anti Xa monitoring during treatment with LMWH might be helpful in pregnancy, extreme body weights and renal impairment - Dalteparin: In cancer patients, dose of 200 IU/kg (max: 18000 IU)/24h for 1 month, followed by 150 IU/kg/24h for 5 months - After this period, vitamin K antag or a LMWH should be continued indefinitely or until the cancer is considered cured
	Treatment of DVT and PE	175 IU/Kg s.c. QD	-	
<b>Dalteparin</b>	Prevention of VTE	2500 IU s.c. QD (moderate risk) 5000 IU s.c. QD (high risk)	-	Monitoring for HIT - Anti Xa monitoring during treatment with LMWH might be helpful in pregnancy, extreme body weights and renal impairment - Dalteparin: In cancer patients, dose of 200 IU/kg (max: 18000 IU)/24h for 1 month, followed by 150 IU/kg/24h for 5 months - After this period, vitamin K antag or a LMWH should be continued indefinitely or until the cancer is considered cured
	Treatment of DVT and PE	200 IU/Kg QD or 100 IU/Kg BID s.c.	Anti Xa monitoring if renal impairment	
<b>Argatroban</b>	Anticoagulant in patients with HIT	Initial i.v. infusion dose: 2 µg/kg/min (not to exceed 10 µg/kg/min) Patients undergoing PCI: 350 µg/kg i.v. followed by 25 µg/kg/min i.v.	Renal and hepatic impairment: caution advised	Monitored using aPTT goal: 1.5 to 3.0 times the initial baseline value PCI:ACT goal: 300-450s

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Drug	Indications	Dose	Dose adjustments	Comments
<b>Streptokinase (SK)</b>	STEMI	1.5 million units over 30-60min i.v.	-	<p><b>Absolute contraindications to fibrinolytics:</b></p> <ul style="list-style-type: none"> <li>Previous intracranial haemorrhage or stroke of unknown origin at any time</li> <li>Ischaemic stroke in the preceding 6 months</li> <li>Central nervous system damage or neoplasms or atrioventricular malformation</li> <li>Recent major trauma/surgery/head injury (within the preceding 3 weeks)</li> <li>Gastrointestinal bleeding within the past month</li> <li>Known bleeding disorder (excluding menses)</li> <li>Aortic dissection</li> <li>Non-compressible punctures in the past 24h (e.g. liver biopsy, lumbar puncture)</li> </ul>
	Treatment of PE	250000 IU as a LD over 30min, followed by 100000 IU/h over 12-24h	-	
<b>Alteplase (tPA)</b>	STEMI	15 mg i.v. bolus: 0.75 mg/kg over 30 min (up to 50 mg) then 0.5 mg/kg over 60 min i.v. (up to 35 mg)	-	
	Treatment of PE	Total dose of 100 mg: 10 mg i.v. bolus followed by 90 mg i.v. for 2h	If weight < 65 Kg; max dose < 1.5 mg/kg	

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Drug	Indications	Dose	Dose adjustments	Comments
<b>Retepase (rt-PA)</b>	STEMI	10 units + 10 units i.v. bolus given 30 min apart	Renal and hepatic impairment: caution advised	<p><b>Absolute contraindications to fibrinolytics:</b></p> <p>Previous intracranial haemorrhage or stroke of unknown origin at any time Ischaemic stroke in the preceding 6 months Central nervous system damage or neoplasms or atrioventricular malformation Recent major trauma/surgery/head injury (within the preceding 3 weeks) Gastrointestinal bleeding within the past month Known bleeding disorder (excluding menses) Aortic dissection Non-compressible punctures in the past 24h (e.g. liver biopsy, lumbar puncture)</p>
<b>Tenecteplase (TNK-tPA)</b>	STEMI	Over 10 seconds; Single i.v. bolus: 30 mg if < 60 kg 35 mg if 60 to < 70 kg 40 mg if 70 to < 80 kg 45 mg if 80 to < 90 kg 50 mg if ≥ 90 kg	-	

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Drug	Indications	Dose	Dose adjustments	Comments
<b>Beta-blockers:</b> Preferred over calcium channel blockers - Contraindicated if coronary spasm, severe bradycardia, AV block, severe bronchospasm				
<b>Atenolol</b>	NSTE-ACS	LD: 25-100 mg oral MD: 25-100 mg QD	Elderly: start at a lower dose CrCl: 15-35ml/min: max dose 50 mg/day; CrCl < 15ml/min: max dose 25 mg/day	Only if normal LVEF
	STEMI	25-100 mg QD, titrate as tolerated up to 100 mg QD only if no LVSD or CHF		
<b>Carvedilol</b>	NSTE-ACS	LD: 3.125-25 mg oral MD: 3.125-25 mg BID	Caution in elderly and hepatic impairment	Preferred if LVSD/HF
	STEMI	3.125-6.25 mg BID, titrated as tolerated up to 50 mg BID		
<b>Bisoprolol</b>	NSTE-ACS	LD: 1.25-10 mg oral MD: 1.25-10 mg QD	Caution in renal or hepatic impairment	Preferred if LVSD/HF
	STEMI	1.25-5 mg QD, titrate as tolerated up to 10 mg QD		

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## Antiischemic drugs (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Beta-blockers:</b> Preferred over calcium channel blockers - Contraindicated if coronary spasm, severe bradycardia, AV block, severe bronchospasm				
<b>Metoprolol</b>	NSTE-ACS	LD: 25-100 mg oral MD: 25-100 mg BID	Caution in hepatic impairment	Preferred if LVSD/HF
	STEMI	5-25 mg BID, titrate as tolerated up to 200 mg QD		
<b>Calcium antagonists:</b> Consider if beta-blockers are contraindicated. First option in vasospastic angina				
<b>Verapamil</b>	ACS	LD: 80-120 mg oral MD: 80-240 mg TID-QD	Caution in elderly, renal or hepatic impairment	Contraindicated if bradycardia, HF, LVSD
<b>Diltiazem</b>	ACS	LD: 60-120 mg oral MD: 60-300 mg TID-QD	Caution in elderly and hepatic impairment	Contraindicated if bradycardia, HF, LVSD

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## Antiischemic drugs (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Calcium antagonists:</b> Consider if beta-blockers are contraindicated. First option in vasospastic angina				
Amlodipine	ACS	LD: 5-10 mg oral, MD: 5-10 mg QD	Caution in hepatic impairment	Contraindicated if hypotension
<b>Nitrates</b>				
Nitroglycerin	i.v.	ACS If intolerant or unresponsive to nitroglycerin s.l. 5 µg/min - Increase by 5 mcg/min q3-5min up to 20 µg/min - If 20 mcg/min is inadequate, increase by 10 to 20 µg/min every 3 to 5min - Max dose: 400 µg/min	-	Contraindicated if severe hypotension and co-administration with phosphodiesterase inhibitors The most common adverse effects are headache and dizziness  Use glass bottles for nitroglycerin i.v. administration
	spray	Angina 1-2 puff s.l. every 5min as needed, up to 3 puff in 15min	-	
	sublingual tablet	Angina 0.3 to 0.6 mg s.l. or in the buccal pouch every 5min as needed, up to 3 doses in 15min	-	

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Drug	Indications	Dose	Dose adjustments	Comments
Isosorbide mononitrate	Angina	5-10 mg BID with the two doses given 7h apart (8am and 3pm) to decrease tolerance development - then titrate to 10 mg BID in first 2-3 days <b>Extended release tablet:</b> Initial: 30-60 mg given in the morning as a single dose Titrate upward as needed, giving at least 3 days between increases Max daily single dose: 240mg	-	Contraindicated if severe hypotension and co-administration with phosphodiesterase inhibitors The most common adverse effects are headache and dizziness
Isosorbide dinitrate	Angina	Initial dose: 5 to 20 mg orally 2 or 3 times/day MD: 10 to 40 mg orally 2 or 3 times a day Extended release: 40 to 160 mg/day orally	-	
Nitroglycerin transdermal patch	Angina	0.2 to 0.4 mg/h patch applied topically once a day for 12 to 14h per day; titrate as needed and tolerated up to 0.8 mg/h	-	

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## Antiischemic drugs (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Other antiischemic drugs</b>				
<b>Ivabradine</b>	Stable angina	5-7.5 mg oral BID	Caution in elderly and CrCl < 15ml/min	Contraindicated if severe hepatic impairment
<b>Ranolazine</b>	Stable angina	Initial dose: 375 mg oral BID After 2-4 weeks, the dose should be titrated to 500 mg BID and, according to the patient's response, further titrated to a recommended max dose of 750 mg BID	Use with caution in renal and hepatic impairment, CHF, elderly, low weight	Contraindicated if CrCl < 30ml/min, concomitant administration of potent CYP3A4 inhibitors, moderate or severe hepatic impairment
<b>Trimetazidine</b>	Stable angina	Modified-release: 35 mg oral BID	Caution in elderly and 30 < CrCl < 60ml/min	Contraindicated in parkinson disease, parkinsonian symptoms, tremors, restlessleg syndrome, movement disorders, severe renal impairment

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## Hypolipidemic drugs

Drug	Indications	Dose				Dose adjustments	Comments
<b>Statins: Secondary prevention of cardiovascular disease:</b> start with high doses and down titrate if side effects Target LDL-C levels < 70 mg/dl initiated early after admission							
<b>Atorvastatin</b>	<b>LDL-C reduction</b>				-	Contraindicated in patients with active liver disease or with unexplained elevation of liver function enzyme levels	
<b>Rosuvastatin</b>	<30%	30-40%	40-50%	>50%	CrCl < 30ml/min: start 5 mg QD, max: 10 mg QD		
	Simva 10 mg	Simva 20-40 mg	Simva 40 mg	Ator 80 mg			
<b>Pitavastatin</b>	Lova 20 mg	Ator 10 mg	Ator 20-40 mg	Simva/ezet 40/10 mg	CrCl 30-59ml/min: start 1 mg QD, max 2 mg/day; CrCl 10-29ml/min: not defined		
<b>Simvastatin</b>	Prava 20-40 mg	Prava 40 mg	Rosu 10-20 mg	Rosu 40 mg	Severe renal impairment: start 5 mg QPM		
<b>Fluvastatin</b>	Fluva 40 mg	Fluva 80 mg	Pita 4 mg		Caution in severe renal impairment		
<b>Pravastatin</b>	Pita 1 mg	Rosu 5 mg	Simva/ezet 20/10 mg		Significant renal impairment: start 10 mg QD		
<b>Lovastatin</b>		Pita 2 mg			CrCl < 30ml/min: caution if dose > 20 mg QD		

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## Hypolipidemic drugs (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Others</b>				
<b>Ezetimibe</b>	Hyperlipidemia	10 mg oral QD	Avoid use if moderate-severe hepatic impairment	-
<b>Fenofibrate</b>	Hyperlipidemia	48-160 mg oral QD May adjust dose q4-8 weeks	CrCl 50-90ml/min: start 48-54 mg QD	Contraindicated if CrCl < 50ml/min or hepatic impairment
<b>Gemfibrozil</b>	Hyperlipidemia	900-1200 mg/day oral		Contraindicated if severe renal impairment or hepatic dysfunction Statins may increase muscle toxicity: avoid concomitant use
<b>Evolocumab</b>	PCSK9 inhibitor (not yet available). Most common side effects: nasopharyngitis, upper respiratory tract infection, headache and back pain			

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## Heart failure & hypertension

Drug	Indications	Dose	Dose adjustments	Comments
<b>ACEI</b>				
<b>Captopril</b>	HF	Start: 6.25 mg oral TID Target dose: 50 mg TID	CrCl > 50 ml/min: 75-100% of the normal dose CrCl 10-50ml/min: 25-50% CrCl < 10ml/min: 12.5%	Check renal function, electrolytes, drug interactions  Major contraindications: History of angioedema, known bilateral renal artery stenosis, pregnancy (risk)
	HTN	Start: 12.5 mg oral BID Target dose: 25-50 mg TID Max 450 mg/day		
<b>Enalapril</b>	HF, HTN	Start: 2.5 mg oral BID Target dose: 10-20 mg BID	CrCl 30-80ml/min: start 5 mg/day CrCl 10-30ml/min: start 2.5 mg/day	
<b>Lisinopril</b>	HF	Start: 2.5-5.0 mg oral QD Target dose: 20-35 mg QD	CrCl 31-80ml/min: start 5-10 mg/day CrCl 10-30ml/min: start 2.5-5 mg/day CrCl < 10ml/min: start 2.5 mg/day	
	HTN	10-20 mg oral QD Max: 80 mg QD		

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Perindopril</b>	HF	Start: 2.5 mg oral QD Max: 5mg QD	CrCl > 60ml/min: start 5 mg/day CrCl 31-60ml/min: start 2.5 mg/day CrCl 15-30ml/min: start 2.5 mg alternate days CrCl < 15ml/min: start 2.5 mg/day on the day of dialysis	Check renal function, electrolytes, drug interactions  Major contraindications: History of angioedema, known bilateral renal artery stenosis, pregnancy (risk)
	HTN	Start: 2.5-5 mg QD Target dose: 10 mg QD		
<b>Ramipril</b>	HF, HTN	Start: 2.5 mg oral QD Target dose: 5 mg BID	CrCl < 40ml/min: start 1.25 mg QD, max 5 mg/day Caution in elderly and hepatic impairment	
<b>Trandolapril</b>	HF	Start: 0.5 mg oral QD Target dose: 4 mg QD	CrCl < 30ml/min or severe hepatic impairment: start 0.5 mg	
	HTN	2-4 mg oral QD	CrCl < 30ml/min or severe hepatic impairment: start 0.5 mg	

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>ARB</b>				
<b>Candesartan</b>	HF, HTN	Start: 4-8 mg oral QD Target dose: 32 mg QD	If renal or hepatic impairment: start 4 mg/day	If ACEI is not tolerated. Check renal function, electrolytes, drug interactions  Major contraindications: History of angioedema, known bilateral renal artery stenosis, pregnancy (risk)
	<b>Losartan</b>	HF	Start: 50 mg oral QD Target dose: 150 mg QD	
HTN		50-100 mg oral QD	CrCl < 20ml/min: 25 mg QD Caution if hepatic impairment	
<b>Valsartan</b>	HF	Start: 40 mg oral BID Target dose: 160 mg BID	If mild-moderate hepatic impairment: max dose 80 mg/day	
	HTN	80-160 mg QD	If mild-moderate hepatic impairment: max dose 80 mg/day	

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments	
<b>Beta-blockers:</b> Check 12-lead ECG					
<b>Cardioselective</b>	<b>Atenolol</b>	HTN	Start: 25 mg oral QD Usual dose: 50-100 mg QD	CrCl 10-50ml/min: decrease dose 50% CrCl < 10ml/min: decrease dose 75%	Major contraindications: asthma, 2nd or 3rd degree AV block
	<b>Bisoprolol</b>	HF	Start: 1.25 mg oral QD Target dose: 10 mg QD		
		HTN	Start: 2.5-5 mg oral QD Usual dose: 5-10 mg QD Max dose: 20 mg QD		
	<b>Metoprolol</b>	HF	Start: 12.5-25 mg oral QD Target dose: 200 mg QD	Hepatic impairment: start with low doses and titrate gradually	
		HTN	100-400 mg QD Max dose: 400 mg QD		

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments	
<b>Beta-blockers:</b> Check 12- lead ECG					
<b>Cardioselective</b>	<b>Nebivolol</b>	HF	Start: 1.25 mg oral QD Target dose: 10 mg QD	Renal impairment or elderly: start dose 2.5 mg QD, titrate to 5 mg QD Hepatic impairment: contraindicated	Major contraindications: asthma, 2nd or 3rd degree AV block
		HTN	Start: 2.5 mg oral QD Usual dose: 5 mg QD		
<b>Non-cardioselective</b>	<b>Carvedilol</b>	HF	Start: 3.125 mg oral BID Target dose: 25-50 mg BID	Caution in elderly Contraindicated if hepatic impairment	
		HTN	Start: 12.5 mg oral QD Usual dose: 25 mg QD and max dose: 25 mg BID or 50 mg QD		

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Other vasodilators</b>				
<b>Amlodipine</b>	HTN	Start: 5 mg oral QD, increase after 1-2 weeks Max: 10 mg/day	Elderly or secondary agent: start 2.5 mg QD Hepatic impairment: start 2.5 mg QD	Contraindicated if cardiogenic shock, 2nd or 3rd degree AV block, severe hypotension
<b>Nifedipine</b>	HTN	Extended-release form: Start 20 mg oral BID or TID Max: 60 mg BID	Renal and hepatic impairment: caution advised	
<b>Clevidipine</b>	HTN	Initiate the IV infusion at 4 ml/h (2 mg/h); the dose may be doubled every 90 seconds Uptitration until desired BP range is achieved Half life of 1-2min	The desired therapeutic response for most patients occurs at doses of 8-12 ml/h (4-6 mg/h) The max recommended dose is 64 ml/h (32 mg/h)	Hypersensitivity to soy, peanut, or egg products Critical Aortic stenosis, mitral stenosis, HOCM

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Other vasodilators</b>				
<b>Verapamil</b>	HTN	<b>Immediate-release form:</b> Dose: 80-120 mg oral TID; Start: 80 mg TID; Max: 480 mg/day	Start 40 mg oral TID in elderly or small stature patients	Contraindicated if bradycardia, HF, LVSD
<b>Loop diuretics</b>				
<b>Furosemide</b>	HF	20-40 mg i.v. bolus, continuous 100 mg/6h (adjust based on kidney function and clinical findings; monitor creatinine)	Anuria: contraindicated Cirrhosis/ascites: caution advised	-
	HTN	10-40 mg oral BID		
<b>Torsemide</b>	HF	10-20 mg oral or i.v. QD	Hepatic impairment: initial dose should be reduced by 50% and dosage adjustments made cautiously	-
	HTN	5 mg oral or i.v. QD Max 10 mg QD		

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Thiazides</b>				
<b>Chlorthalidone</b>	HF	50-100 mg oral QD MD: 25-50 mg QD	Elderly: max dose 25 mg/day CrCl < 25ml/min: avoid use	-
	HTN	Start 12.5-25 mg oral QD; Max: 50 mg/day	Elderly: max dose 25 mg/day CrCl < 25ml/min: avoid use	-
<b>Hydrochlorothiazide</b>	HF	25-200 mg oral/day	CrCl < 25 ml/min: avoid use Hepatic impairment: caution advised	-
	HTN	Start 12.5-25 mg oral QD MD: may increase to 50 mg oral as a single or 2 divided doses	CrCl < 25 ml/min: avoid use Hepatic impairment: caution advised	-

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Thiazides</b>				
<b>Indapamide</b>	HTN	Start 1.25 mg PO QAM x4weeks, then increase dose if no response Max: 5 mg/day	CrCl < 25 ml/min: avoid use Hepatic impairment: caution advised	-
<b>Aldosterone-antagonists</b>				
<b>Spironolactone</b>	HF	Start 25 mg oral QD Target dose: 25-50 mg QD	CrCl < 10ml/min, anuria or acute renal impairment: contraindicated Severe hepatic impairment and elderly: caution advised	Check renal function, electrolytes, drug interactions Produces gynecomastia
	HTN	50-100 mg/day oral		

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## Heart failure & hypertension (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Aldosterone-antagonists</b>				
<b>Eplerenone</b>	HF	Start 25 mg oral QD Target dose: 50 mg QD	Elderly: caution advised CrCl < 50ml/min: contraindicated	Check renal function, electrolytes, drug interactions Major contraindications: strong CYP3A4 inhibitors
	HTN	50 mg oral QD-BID Max: 100 mg/day		
<b>Others</b>				
<b>Ivabradine</b>	HF	5-7.5 mg oral BID	Caution in elderly and CrCl < 15ml/min	Contraindicated if severe hepatic impairment

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Drug	Indications	Dose	Dose adjustments	Comments
<b>Levosimendan</b>	HF/cardiogenic shock	LD: 6 to 12 µg/kg i.v. over 10 min (given only if immediate effect is needed) followed by 0.05 to 0.2 µg/kg/min as a continuous infusion for 24h	Avoid use if CrCl < 30ml/min or severe hepatic impairment	Calcium sensitizer and ATP-dependent potassium channel opener
<b>Milrinone</b>	HF/cardiogenic shock	50 µg/kg i.v. in 10-20 min, continuous 0.375-0.75 µg/kg/min	Renal: Same bolus. Adjust infusion: CrCl 50ml/min: start 0.43 µg/kg/min CrCl 40ml/min: start 0.38 µg/kg/min CrCl 30ml/min: start 0.33 µg/kg/min CrCl 20ml/min: start 0.28 µg/kg/min CrCl 10ml/min: start 0.23 µg/kg/min CrCl 5ml/min: start 0.20 µg/kg/min	Phosphodiesterase inhibitor  Caution if atrial flutter  Hypotensive drug
<b>Isoprenaline/ Isoproterenol</b>	Cardiogenic shock	0.5-5 µg/min (0.25-2.5 ml of a 1:250,000 dilution) i.v. infusion	-	β1, β2 agonist. Contraindicated in patients with tachyarrhythmia, tachycardia or heart block caused by digitalis intoxication, ventricular arrhythmias which require inotropic therapy, angina pectoris, recent ACS, hyperthyroidism
	Bradyarrhythmias	Bolus: 20-40 µg i.v. Infusion: 0.5 µg/min of 2 mg/100 ml normal saline		

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## Inotropics & vasopressors (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Dobutamine</b>	Cardiogenic shock	2-20 µg/kg/min i.v.	-	β <sub>1</sub> , α <sub>1</sub> /β <sub>2</sub> agonist. Increases contractility with little effect on heart rate and blood pressure. Reduces pulmonary and systemic VR, PCP
<b>Dopamine</b>	Cardiogenic shock	Dopaminergic effect: 2-5 µg/Kg/min i.v. β effect : 5-15 µg/Kg/min i.v. α effect : 15-40 µg/Kg/min i.v.	-	β, α, dopaminergic agonist Increases BP, PAP, heart rate, cardiac output and pulmonary and systemic VR More arrhythmogenic than dobutamine and noradrenaline
<b>Noradrenaline</b>	Cardiogenic shock	0.05-0.2 µg/kg/min i.v. titrate to effect	-	α <sub>1</sub> , β <sub>1</sub> agonist Increases BP and PAP Little arrhythmogenic

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## Antiarrhythmics

Drug	Indications	Dose	Dose adjustments	Comments
<b>Group I</b>				
<b>Procainamide i.v.</b>	AF (termination); stable VT (with a pulse)	15-18 mg/kg i.v. over 60 min, followed by infusion of 1-4 mg/min	Reduce LD to 12 mg/kg in severe renal impairment Reduce MD by one-third in moderate renal impairment and by two-thirds in severe renal impairment Caution in elderly and asthma	Hypotension (negative inotropic agent) Lupus-like syndrome Contraindicated if myasthenia gravis, AV block, severe renal impairment
<b>Lidocaine i.v.</b>	Pulseless VT/VF	1-1.5 mg/kg i.v./i.o. bolus (can give additional 0.5-0.75 mg/kg i.v./i.o. push every 5-10 min if persistent VT/VF, max cumulative dose = 3 mg/kg), followed by infusion of 1-4 mg/min	1-2 mg/min infusion if liver disease or HF	Contraindicated if advanced AV block, bradycardia, hypersensitivity to local anesthetics
	Stable VT (with a pulse)	1-1.5 mg/kg i.v. bolus (can give additional 0.5-0.75 mg/kg i.v. push every 5-10min if persistent VT, max cumulative dose = 3 mg/kg), followed by infusion of 1-4 mg/min	1-2 mg/min infusion if liver disease or HF	Caution in HF, renal impairment and elderly May cause seizures, psychosis. Stop if QRS widens > 50%

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## Antiarrhythmics (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Group I</b>				
<b>Flecainide i.v.</b>	SVT, ventricular arrhythmias	2 mg/kg (max 150 mg) i.v. over 30min This may be followed by an infusion at a rate of 1.5 mg/kg/h for 1 h, reduced to 0.1-0.25 mg/kg/h for up to 24h, max cumulative dose = 600 mg	Severe renal impairment: caution advised	Contraindicated if cardiogenic shock, recent MI, 2nd or 3rd degree AV block
<b>Propafenone i.v.</b>	PSVT, ventricular arrhythmias	LD: 0.5-2 mg/kg i.v. direct over a minimum of 3-5min MD: 0.5-2.5 mg/kg i.v. direct q8h (max 560 mg/day) or continuous infusion up to 23 mg/h	May need to reduce dose in renal or hepatic failure	Contraindicated if unstable HF, cardiogenic shock, AV block, bradycardia, myasthenia gravis severe hypotension, bronchospastic disorders, Brugada syndrome

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## Antiarrhythmics (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Group II</b>				
<b>Atenolol</b> i.v.	Arrhythmias	2.5 mg i.v. over 2.5 min every 5 min (max 10 mg)	Caution in elderly and/or severe renal impairment	Contraindicated if cardiogenic shock, bradycardia and greater than first-degree block, unstable HF
<b>Metoprolol</b> i.v.	Arrhythmias	2.5-5mg i.v. over 5 min, may repeat every 5 min (max 15mg)	Caution if severe hepatic impairment	Contraindicated if cardiogenic shock, bradycardia and greater than first-degree block, unstable HF
<b>Propranolol</b> i.v.	Arrhythmias	Initially given as slow i.v. boluses of 1 mg, repeated at 2 min intervals (max: 10 mg in conscious patients and 5 mg if under anesthesia)	-	Contraindicated if cardiogenic shock, bradycardia and greater than first-degree block, asthma, unstable HF

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Drug	Indications	Dose	Dose adjustments	Comments
<b>Group III</b>				
<b>Amiodarone i.v.</b>	AF (termination)	5 mg/Kg i.v. over 30 min, followed by infusion of 1 mg/min for 6h, then 0.5 mg/min	-	Reduce infusion rate if bradycardia, AV block, hypotension
	Stable VT (with a pulse)	150 mg i.v. over 10 min followed by infusion of 1 mg/min for 6h, then 0.5 mg/min	-	Bolus should be avoided if hypotension or severe LV dysfunction  Highly vesicant agent
	Pulseless VT/VF	300 mg bolus i.v. (can give additional 150 mg i.v. bolus if VF/VT persists) followed by infusion of 900 mg over 24h	-	
<b>Dronedarone</b>	Paroxysmal or persistent AF prevention	400 mg oral BID	-	Contraindicated if severe renal or liver dysfunction, LVSD, symptomatic HF, permanent AF, bradycardia... (multiple contraindications)

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## Antiarrhythmics (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Group IV</b>				
<b>Diltiazem</b> i.v.	PSVT;AF (rate control)	0.25 mg/kg i.v. over 2 min (may repeat with 0.35 mg/kg i.v. over 2 min), followed by infusion of 5-15 mg/h	Hepatic impairment: caution advised	-
<b>Verapamil</b> i.v.	PSVT;AF (rate control)	2.5-5 mg i.v. over 2 min (may repeat up to max cumulative dose of 20 mg); can follow with infusion of 2.5-10 mg/h	-	Contraindicated if AF+WPW, tachycardias QRS (except RVOT-VT), fascicular VT, bronchospasm, age>70 Antidote: - LVD: Calcium gluconate, dobutamine - Bradycardia/AV block: Atropine, Isoproterenol
<b>Adenosine</b> i.v.	Rapid conversion to a normal sinus rhythm of PSVT including those associated with accessory by-pass tracts (WPW syndrome)	Rapid i.v. boluses separated by 2 min: 6 mg → 6 mg → 12 mg	-	Contraindicated if sick sinus syndrome, second or third degree Atrio-Ventricular (AV) block (except in patients with a functioning artificial pacemaker), chronic obstructive lung disease with evidence of bronchospasm (e.g. asthma bronchiale), long QT syndrome, severe hypotension; decompensated states of heart failure - Adenosine can cause AF

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## Antiarrhythmics (Cont.)

Drug	Indications	Dose	Dose adjustments	Comments
<b>Others</b>				
<b>Magnesium sulfate</b>	VT-Torsades de Pointes	Bolus: 1-2 g i.v./i.o. over 5 min Perfusion: 5-20 mg/min i.v.	Caution if severe renal failure	Contraindicated if myasthenia gravis
<b>Vernakalant</b>	Acute atrial fibrillation	3 mg/kg i.v. over 10 min. If AF persists, a second 10-min-infusion of 2 mg/kg, 15 min later may be administered	-	Contraindicated if ACS within the last 30 days, severe aortic stenosis, SBP < 100mmHg, HF class NYHA III/IV, severe bradycardia, sinus node dysfunction or 2nd or 3rd degree heart block

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## Abbreviations

APTT = Activated partial thromboplastin time

AB = Airway and breathing

ABG = Arterial blood gas

AADs = Antiarrhythmic drugs

AAS = Acute aortic syndrome

ACEI = Angiotensin converting enzyme inhibitor

ACLS = Advanced cardiovascular life support

ACS = Acute coronary syndrome

ACT = Activated clotting time

AD = Aortic Dissection

AED = Automated external defibrillator

AF = Atrial fibrillation

Ao = Aortic

aPRR = Activated partial thromboplastin time

ARB = Angiotensin receptor blockers

AS = Aortic stenosis

AV = Atrioventricular

AVN = Atrioventricular node

AVNRT = Atrioventricular nodal re-entrant tachycardia

AVNT = Atrioventricular nodal tachycardia

BID = Twice a day

BBB = Bundle branch block

BLS = Basic life support

BNP = Brain natriuretic peptide

BP = Blood pressure

CABG = Coronary artery bypass grafting

CAD = Coronary artery disease

Cath Lab = Catheterisation laboratory

CCU = Coronary care unit

CHF = Congestive heart failure

CMR = Cardiovascular magnetic resonance

COPD = Chronic obstructive pulmonary disease

CPAP = Continuous positive airway pressure

CPR = Cardiopulmonary resuscitation

CrCl = Creatinine clearance

CS = Cardiogenic shock

CSM = Carotid sinus massage

CSNRT = Corrected sinus node recovery time

CSS = Carotid sinus syndrome

CT = Computed tomography

CT-angio = Computed tomography angiography

CUS = Compression venous ultrasound

CV = Cardiovascular

CXR = Chest X-ray

DD = Diastolic dysfunction

DM = Diabetes mellitus

## Abbreviations

DVT = Deep vein thrombosis  
ECG = Electrocardiogram  
ED = Emergency department  
EG = Electrograms  
EMB = Endomyocardial biopsy  
EMS = Emergency medical services  
EPS = Electrophysiological study  
ERC = European Resuscitation Council  
ESR = Erythrocyte sedimentation rate  
ETT = Exercise treadmill testing  
FMC = First medical contact  
GER = Gastroesophageal reflux  
GFR = Glomerular flow rate  
GI = Gastrointestinal  
GP = Glycoprotein  
HF = Heart failure  
HTN = Hypertension  
HR = Heart rate  
hsTn = High-sensitive troponin  
IABP = Intra-aortic balloon pump  
ICC = Intensive cardiac care  
ICCU = Intensive cardiac care unit  
ICD = Implantable cardioverter defibrillator

IHD = Ischemic heart disease  
IMH = Intramural hematoma  
ISFC = International Society and Federation of Cardiology  
i.o. = Intraosseous  
IV = Invasive ventilation  
i.v. = Intravenous  
KD = Kidney disease  
LBBB = Left bundle branch block  
LD = Loading dose  
LGE = Late gadolinium enhancement  
LMWH = Low-molecular weight heparin  
LOC = Loss of consciousness  
LV = Left ventricular  
LVD = Left ventricular dysfunction  
LVEF = Left ventricular ejection fraction  
LVH = Left ventricular hypertrophy  
LVSD = Left ventricular systolic dysfunction  
MCS = Mechanical circulatory support  
MD = Maintenance dose  
MDCT = Computed tomography with >4 elements  
MI = Myocardial infarction  
MRI = Magnetic resonance imaging

## Abbreviations

Mvo = Microvascular obstruction  
NIV = Non-invasive ventilation  
NOAC = New oral anticoagulants  
NSAID = Non-steroidal anti-inflammatory drugs  
NSTEMI = Non-ST-elevation ACS  
NTG = Nitroglycerin  
NT-proBNP = N-terminal pro brain natriuretic peptide  
NVAf = Non-valvular atrial fibrillation  
NYHA = New York Heart Association  
OH = Orthostatic hypotension  
PAP = Pulmonary arterial pressure  
PAU = Penetrating aortic ulcer  
PCI = Percutaneous coronary intervention  
PCM = Physical counter-measures  
PCP = Pulmonary capillary pressure  
PE = Pulmonary embolism  
PEA = Pulmonary endarterectomy  
PEEP = Positive end expiratory pressure  
PR = Pulmonary regurgitation  
ProCT = Procalcitonin  
PRN = Pro re nata  
PSVT = Paroxysmal supraventricular tachycardia

QD = Once a day  
QPM = Every evening  
rtPA = Recombinant tissue plasminogen activator  
RV = Right ventricular  
RVOT-VT = Right ventricular outflow tract ventricular tachycardia  
SBP = Systemic blood pressure  
s.c = Subcutaneous  
SLE = Systemic lupus erythematosus  
SMU = Syncope management units  
STE-ACS = ST-segment elevation acute coronary syndrome  
STEMI = ST-segment elevation myocardial infarction  
SVT = Supraventricular tachycardia  
SpO<sub>2</sub> = Oxygen saturation  
TEE = Transesophageal echocardiography  
TEVAR = Thoracic endovascular aortic aneurysm repair  
TIA = Transient ischemic attack  
TID = Three times a day  
TLOC = Transient loss of consciousness  
Tn = Troponin  
TOE = Transoesophageal echocardiography  
TSH = Thyroid-stimulating hormone

## Abbreviations

TTE = Transthoracic echocardiography

UFH = Unfractionated heparin

ULN = Upper limit of normal

VF = Ventricular fibrillation

VR = Vascular resistance

VT = Ventricular tachycardia

VTE = Venous thromboembolism

VVS = Vasovagal syncope

WHO = World Health Organization

WPW = Wolff-Parkinson-White

## Notes

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## Acknowledgements

We are indebted to all the authors for their commitment and for the strong effort to synthesise their wide scientific knowledge and clinical experience into simple algorithms and schemes using the aim to help clinicians in everyday clinical practice in the easiest possible manner as the main driver of their work.

The support of this initiative by the ACCA board members was essential to launch this initiative as was the hard work of the ESC staff to make this project move forward.

The financial support of the sponsors, AstraZeneca and Novartis Pharma AG, made the development of the Toolkit easier. We appreciate the generous unrestricted educational grants and the independence to develop the Toolkit with no influence whatsoever in the selection of faculty, topics, clinical or scientific content.

# Acute Cardiovascular Care Association Clinical Decision-Making TOOLKIT



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