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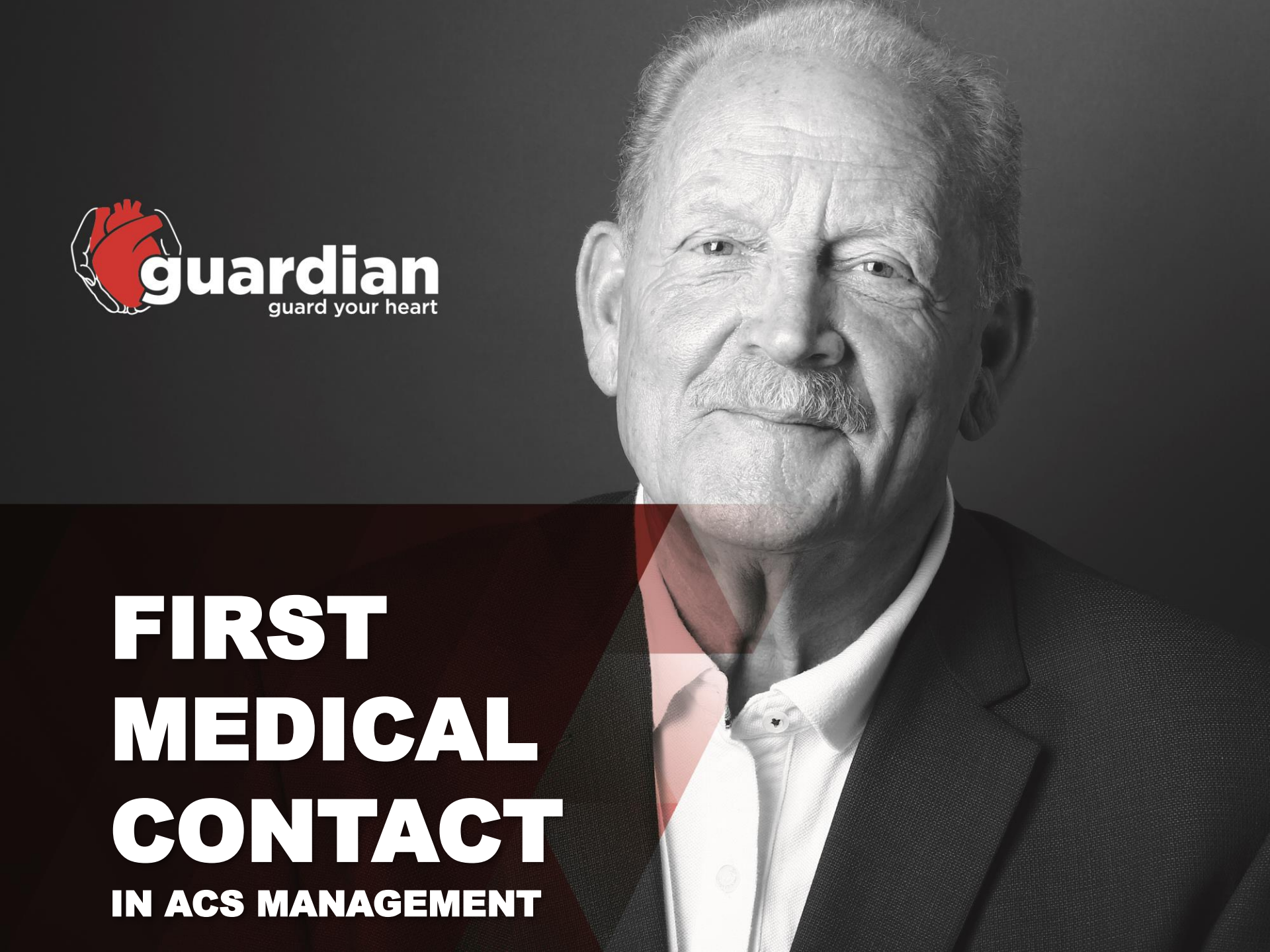

FIRST MEDICAL CONTACT

IN ACS MANAGEMENT

DEFINITIONS OF TERMS

- **First Medical contact:** The time point when the patient is either **INITIALLY ASSESSED** by a healthcare provider (HCP) - EMS, physician, nurse - trained and able to obtain and interpret the ECG

- FMC can be either in the **PRE-HOSPITAL SETTING** or arrival at **Emergency Department (ED)**

- **STEMI diagnosis:** The time at which the ECG of a patient with ischaemic symptoms is interpreted as presenting ST-segment elevation or equivalent

Aboyans V, Ricco J, Bartelink M, Björck M, Brodmann M, Cohnert T et al. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS).a European Heart Journal. 2017;39(9):763-816.
(ESC STEMI 2017 page 13 Table 4)

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DEFINITIONS OF TERMS RELATED TO REPERFUSION THERAPY

Term	Definition
Primary PCI strategy	Emergent coronary angiography and PCI of the IRA if indicated.
Rescue PCI	Emergent PCI performed as soon as possible in the case of failed fibrinolytic treatment.
Routine early PCI strategy after fibrinolysis	Coronary angiography, with PCI of the IRA if indicated, performed between 2 and 24 hours after successful fibrinolysis.
Pharmaco-invasive strategy	Fibrinolysis combined with rescue PCI (in case of failed fibrinolysis) or routine early PCI strategy (in case of successful fibrinolysis).

Aboyans V, Ricco J, Bartelink M, Björck M, Brodmann M, Cohnert T et al. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS). European Heart Journal. 2017;39(9):763-816. (ESC STEMI 2017 page 13 Table 4 FMC Defn.)

SUMMARY OF IMPORTANT TIME TARGETS

Intervals	Time Targets
Maximum time from FMC to ECG and diagnosis	≤ IO min
Maximum expected delay from STEMI diagnosis to primary PCI. Choose primary PCI strategy over fibrinolysis (if this target time cannot be met, consider fibrinolysis)	≤ 120 min
Maximum time from STEMI diagnosis to wire crossing in patients presenting at primary PCI hospitals	≤ 60 min
Maximum time from STEMI diagnosis to wire crossing in transferred patients	≤ 90 min

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(File: ESC STEMI 2017, pg 16 table 5)

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SUMMARY OF IMPORTANT TIME TARGETS (CONTINUED)

Intervals	Time Targets
Maximum time from STEMI diagnosis to bolus or infusion start of fibrinolysis in patients unable to meet primary PCI target times.	≤ IO min
Time delay from start of fibrinolysis to evaluation of its efficacy (success or failure).	60-90 min
Time delay from start of fibrinolysis to angiography (if fibrinolysis is successful).	2-24 hours

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(File: ESC STEMI 2017, pg 16 table 5)

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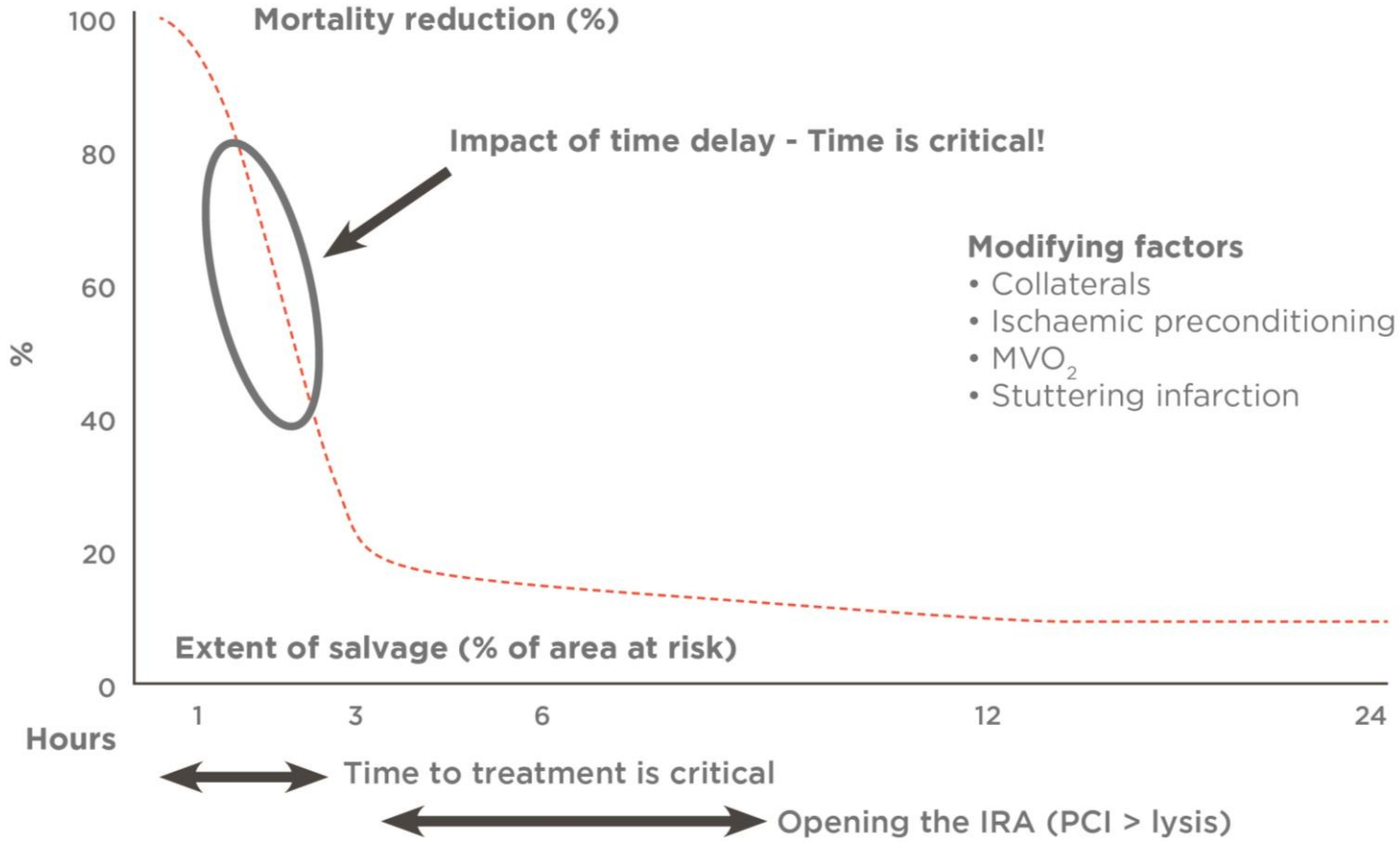
RELATIONSHIP BETWEEN MORTALITY REDUCTION AND EXTENT OF SALVAGE



Gersh B, Stone G, White H, Holmes D. Pharmacological Facilitation of Primary Percutaneous Coronary Intervention for Acute Myocardial Infarction. JAMA. 2005;293(8):979.

(File: Gersh 2005)

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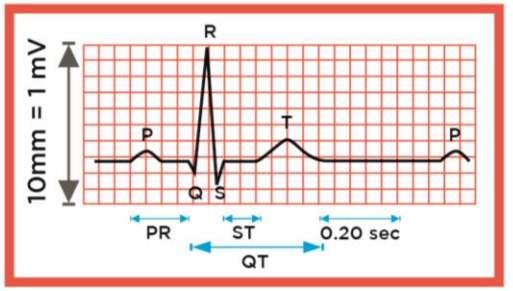
BASIC ACS PATHWAY

ACUTE CORONARY SYNDROME (ACS)



History & clinical examination (screening)

Pretest probability, risk factors

ECG

ST segment elevation

Yes

No

Non ST segment elevation acute coronary syndrome (NSTEAC)

Cardiac biomarkers

Elevated Troponin

± ECG changes

Yes

No

Acute myocardial infarction (AMI)

STEMI represents around 40% of all AMI

STEMI

ST elevation myocardial infarction

NSTEMI

Non ST elevation myocardial infarction

Unstable Angina

Adapted from: Pathophysiology of Acute Coronary Syndrome and Heart Failure | Heart Online [Internet]. Heartonline.org.au. 2019 [cited 1 January 2019]. Available from: http://www.heartonline.org.au/articles/pathophysiology/pathophysiology-of-acute-coronary-syndrome-and-heart-failure#classification-of-acute-coronary-syndrome
(File: Heartonline)

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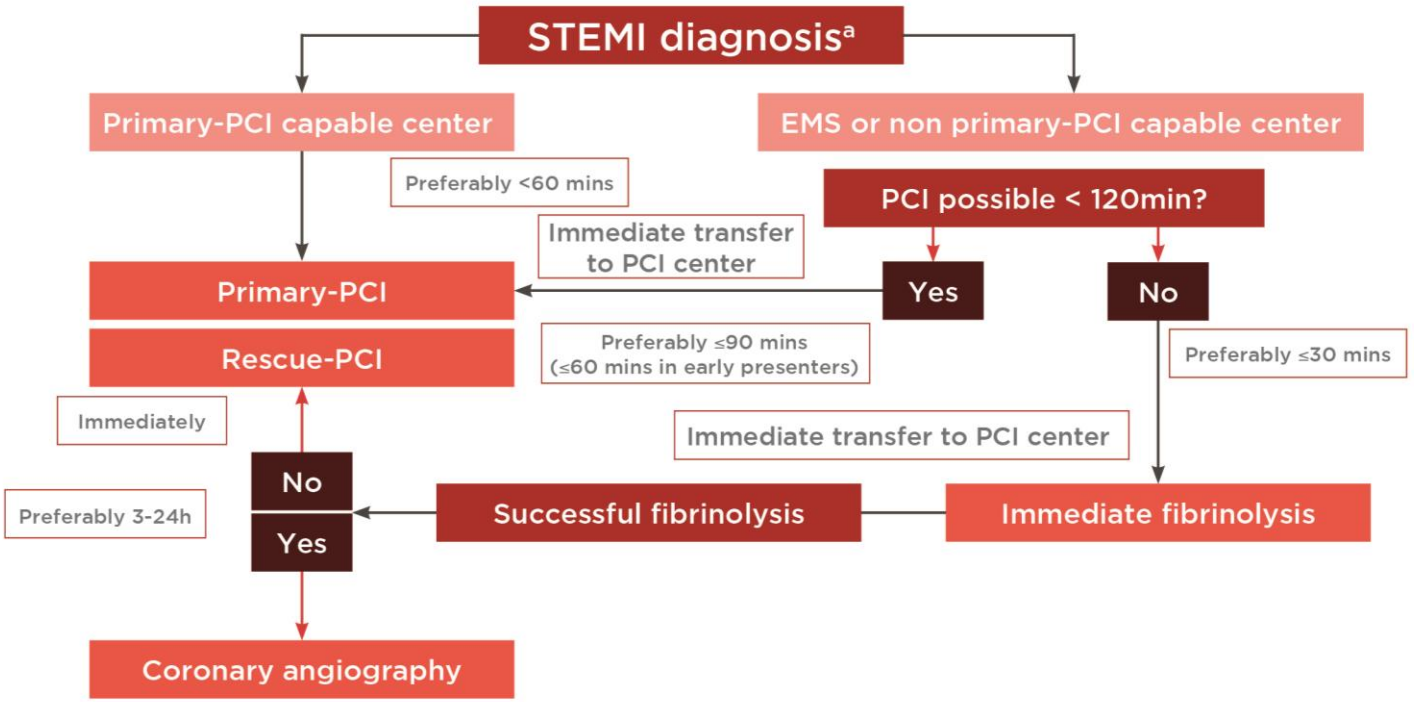
PREHOSPITAL AND IN-HOSPITAL MANAGEMENT AND REPERFUSION STRATEGIES WITHIN 24H OF FMC



a: The time point the diagnosis is confirmed with patient history and ECG ideally within 10 mins from the first medical contact (FMC). All delays are related to FMC (first medical contact); Cath = catheterization laboratory; EMS = emergency medical system; FMC = first medical contact; PCI = percutaneous coronary intervention; STEMI = ST - segment elevation myocardial infarction

1. Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress.
2. Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619. (File: ESC 2012 pg 12, fig. 2)

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THE ACTIVATION PROCESS FOR ERs

TIME **STARTS** WHEN THE PATIENT ARRIVES IN THE ER.
YOU HAVE **30 MINUTES** TO COMPLETE ALL 3 STEPS:

DIAGNOSIS

- History of cardiac chest pain
- ECG within 10 minutes of arrival
- Know the inclusion and exclusion criteria for pathway activation

ACTIVATION

- Pre specified telephone number to obtain the EMS controller or cath-lab team if ER is on the same site as the cath lab
- One call only to activate service
- Use the regionally agreed terminology to activate the service

PREPARATION

- Explain the diagnosis and plan to the patient
- Give medication
- Complete transfer document
- Handover to EMS crew / cath lab team

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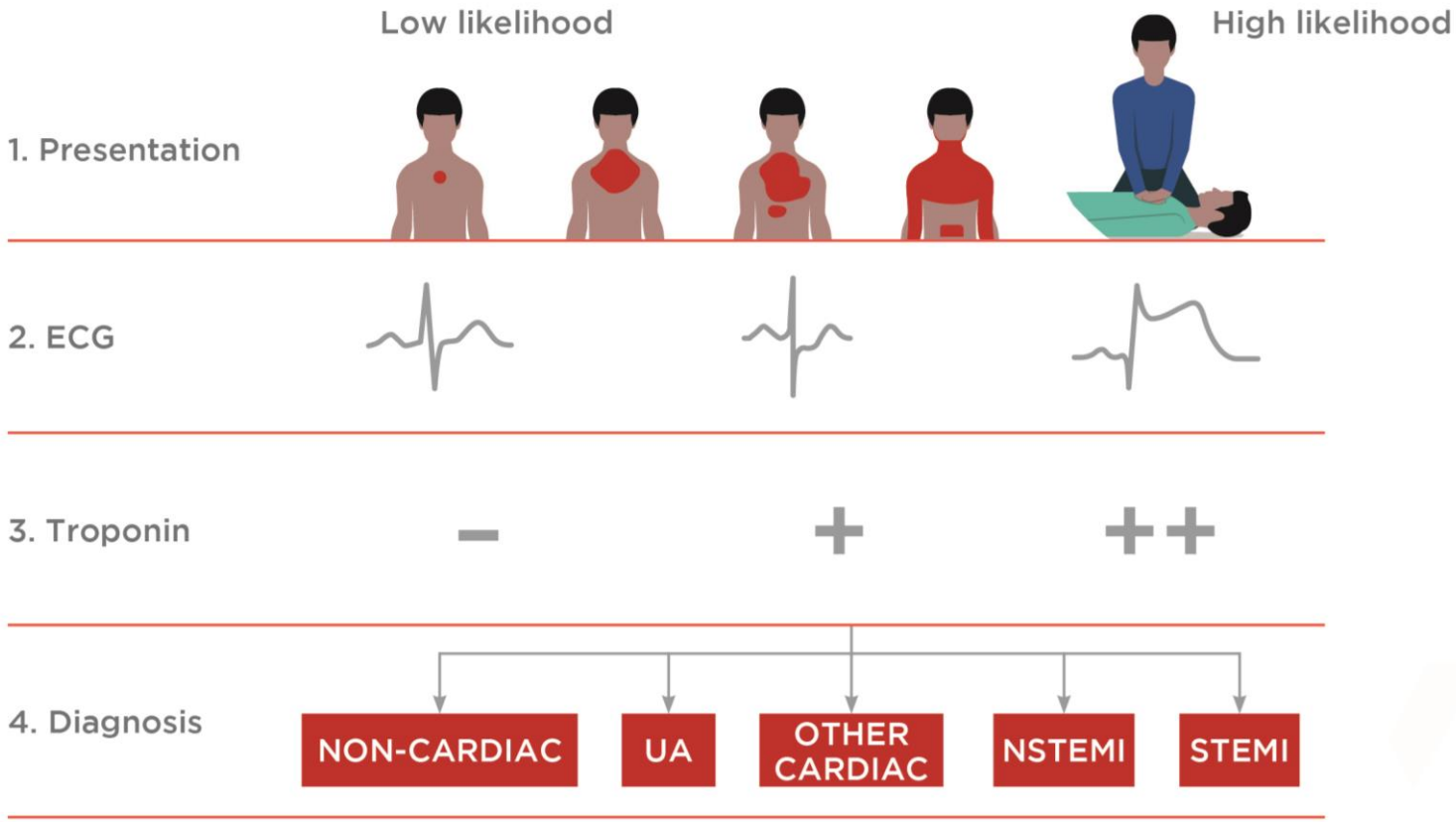
INITIAL ASSESSMENT OF PATIENTS WITH SUSPECTED ACUTE CORONARY SYNDROMES



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

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.

(File: ESC NSTEMI 2015, page 275, Table 4)

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HISTORY & CLINICAL EXAMINATION (SCREENING)

IMMEDIATE ASSESSMENT

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REFERENCE

INITIAL DIAGNOSIS

Recommendations	Class	Level
ECG monitoring		
12-lead ECG recording and interpretation is indicated as soon as possible at the point of FMC, with a maximum target delay of 10 min	I	B
ECG monitoring with defibrillator capacity is indicated as soon as possible in all patients with suspected STEMI	I	B
The use of additional posterior chest wall leads (V7-V9) in patients with high suspicion of posterior myocardial infarction (circumflex occlusion) should be considered	IIa	B
The use of additional right pre-cordial leads (V3R and V4R) in patients with inferior myocardial infarction should be considered to identify concomitant RV infarction	IIa	B
Blood sampling		
Routine blood sampling for serum markers is indicated as soon as possible in the acute phase but should not delay reperfusion treatment	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.

(File: ESC STEMI 2017, page126)

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SIX INITIAL ASSESSMENT AND MANAGEMENT DECISIONS PERTAINING TO PATIENTS PRESENTING WITH CHEST PAIN AND A POSSIBLE ACUTE CORONARY SYNDROME

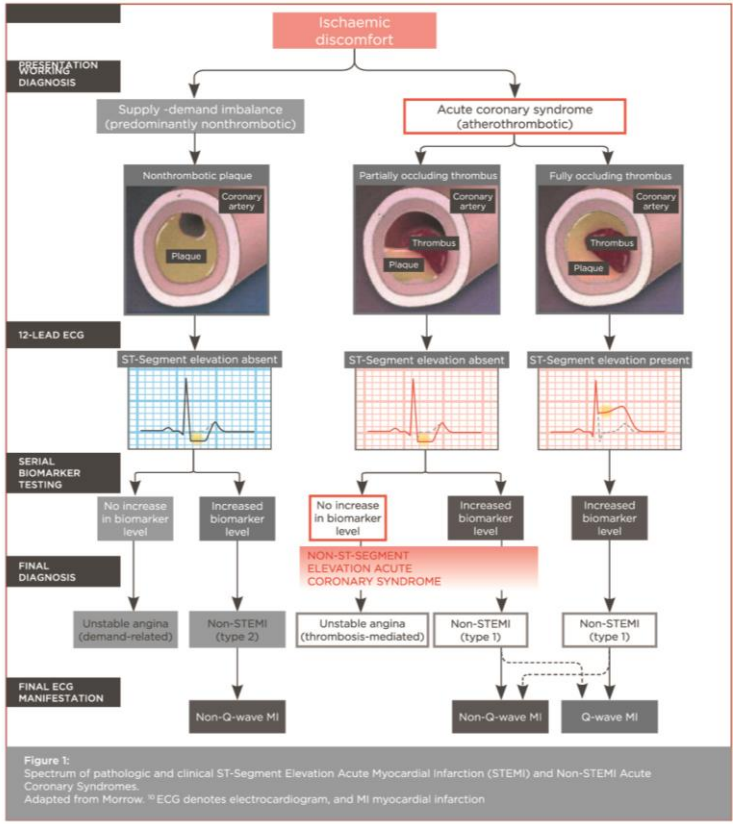

Figure 1:
Spectrum of pathologic and clinical ST-Segment Elevation Acute Myocardial Infarction (STEMI) and Non-STEMI Acute Coronary Syndromes.
Adapted from Morrow. [6] ECG denotes electrocardiogram, and MI myocardial infarction

1	**Assess risk of cardiovascular death or recurrent ischaemia (high, intermediate, or low risk) on the basis of clinical features, ECG, and troponin testing; an integrated risk score (e.g. TIMI or GRACE score) can be used.**
2	Triage to an acute coronary syndrome pathway (STEMI, non STEMI, possible or probable unstable angina, or non-ischemic disorder) on the basis of the history, examination, ECG, and cardiac troponin test result.
3	Initiate general care: limit activity; administer aspirin, nitroglycerin, and a statin; consider administration of oxygen, beta-blocker, or morphine.
4	Choose invasive or non-invasive (ischaemia-guided) initial strategy; the choice of early invasive management is based on risk and patient's preferences.
5	Select a second anti-platelet agent to add to aspirin (P2Y12 inhibitor or glycoprotein IIb/IIIa inhibitor), with selection based on thrombotic risk, timing of invasive strategy, likelihood of need for surgical revascularization, and risk of bleeding.
6	Choose an anticoagulant agent (unfractionated heparin, low molecular-weight heparin, fondaparinux, or bivalirudin) according to the initial management strategy (invasive or non-invasive) and risk of bleeding.

Anderson J, Morrow D. Acute Myocardial Infarction. New England Journal of Medicine. 2017;376(21):2053-2064.
(File: Anderson et al: pg 2055 Figure 1 pg2056 Table 1)

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DIAGNOSTIC CRITERIA FOR AMI

ANY ONE OF THE FOLLOWING CRITERIA MEETS THE DIAGNOSIS FOR AMI ACCORDING TO THE JOINT ESC/ACCF/AHA/WHF TASK FORCE:

A rise and/or fall of cardiac biomarkers (preferably troponin (cTn)) with at least one value above the 99th percentile upper reference limit (URL) together with at least one of the following:

+

- Symptoms of ischaemia
- New or presumed-new significant ST-segment-T wave (ST-T) changes or new left bundle branch block (LBBB)
- Development of pathological Q waves in the ECG
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality
- Identification of an intracoronary thrombus by angiography or autopsy

Cardiac death with prior new ischaemic ECG changes and symptoms suggestive of myocardial ischaemia, without definitive biomarker evidence

PCI-related MI

Stent thrombosis associated with MI

Coronary artery bypass grafting (CABG)-related MI

AMI: Acute Myocardial Infarction

Thygesen K, Alpert J, Jaffe A, Simoons M, Chaitman B, White H et al. Third Universal Definition of Myocardial Infarction. Journal of the American College of Cardiology. 2012;60(16):1581-1598.
(File: Defn MI. pg 2 Box 1)

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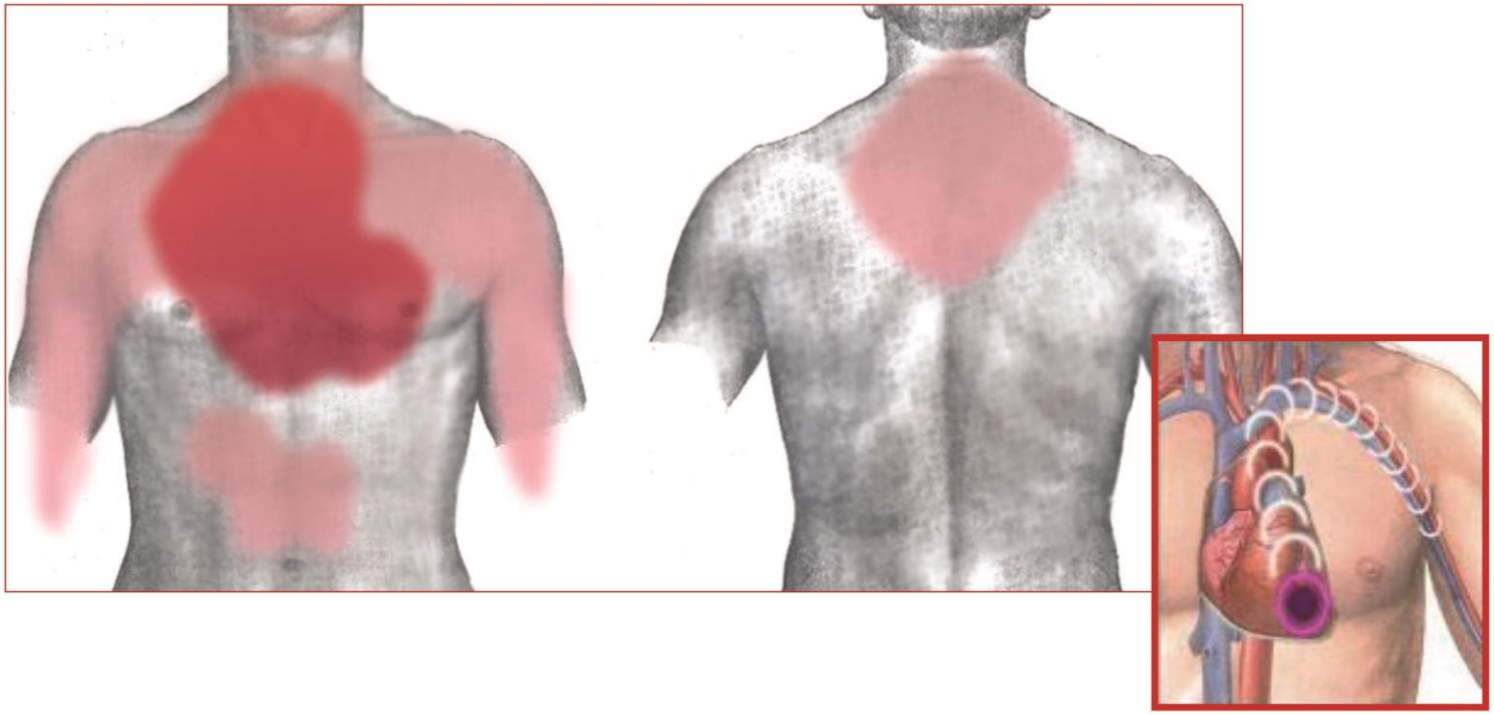
ISCHAEMIC SYMPTOMS

TYPICAL DISCOMFORT / PAIN ZONES
RED = MOST TYPICAL, LIGHT RED – SECONDARY



Heuser J. Pain in acute myocardial infarction [Internet]. 2006 [cited 9 January 2019]. Available from: https://en.wikipedia.org/wiki/Myocardial_infarction (File: MI 1)

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ISCHAEMIC SYMPTOMS - EXPLAINED

DISCOMFORT or **PAIN IN THE CENTER OF THE CHEST** that lasts >20 minutes (MI), or that goes away and comes back (Crescendo Angina/UAP).

Feels like an **UNCOMFORTABLE PRESSURE**, **SQUEEZING** or **BURNING**. It often spreads to the **NECK/JAW**, **ARMS, SHOULDERS** or the **ABDOMEN** and is not respiratory dependant. Chest pain may also include back pain.

Common accompanying symptoms are **NAUSEA**, **DIZZINESS**, **NAUSEA & VOMITING**, **COLD SWEAT**, **ANXIETY, FATIGUE** and possibly **DYSPNEA**.

Sub-lingual (oral) Nitroglycerine has minimal or **NO EFFECT**.

Symptoms in women are often different than in men. Women are more likely to experience nausea, dizziness, and anxiety.

Symptoms may be vague or atypical - have a high index of suspicion

Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress.
(File: Snyders pg 6)

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EVALUATION OF THE ADULT WITH CHEST PAIN IN THE EMERGENCY DEPARTMENT

Questions to Ask

- **Onset of pain** (e.g., abrupt or gradual)
- **Provocation/Palliation** (which activities provoke pain; which alleviate pain)
- **Quality of pain** (e.g., sharp, squeezing, pleuritic)
- **Radiation** (e.g., shoulder, jaw, back)
- **Site of pain** (e.g., substernal, chest wall, diffuse, localized)
- **Timing** (e.g., constant or episodic, duration of episodes, when pain began)

QUESTIONS TO ASK

ISCEMIC PAIN

- Typically gradual in onset, although the intensity of the discomfort may wax and wane and may worsen with exertion
- Highest relative risk of AMI: radiation to an upper extremity, particularly when there is radiation to both arms, and pain associated with diaphoresis or with nausea and vomiting
- Current pain is reminiscent of prior MI.

NON-CARDIAC PAIN

- Aortic dissection, pneumothorax, and pulmonary embolism: starts suddenly and is severe at onset.
- Pulmonary embolism: can begin suddenly, but may worsen over time.
- Non-traumatic pneumothorax: occurs suddenly most often at rest, without any precipitating event.
- Ruptured oesophagus and mediastinitis: history of forceful vomiting preceding symptoms, but not in all cases.
- Stable angina, discomfort occurs only when activity creates an oxygen demand that outstrips supply limitations imposed by a fixed atherosclerotic lesion. Occurs at relatively predictable points and changes slowly over time.
- Unstable angina represents an abrupt change from baseline functioning, which may manifest as discomfort that begins at lower levels of exercise or at rest.

Hollander J, Chase M. Evaluation of the adult with chest pain in the emergency department [Internet]. Uptodate.com. 2019 [cited 9 January 2019]. Available from: https://www.uptodate.com/contents/evaluation-of-the-adult-with-chest-pain-in-the-emergency-department?topicRef=184&source=s

(File: UTD 1)

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EVALUATION OF THE ADULT WITH CHEST PAIN IN THE EMERGENCY DEPARTMENT

ONSET –

Ischaemic pain is typically gradual in onset, although the intensity of the discomfort may wax and wane.

PROVOCATION AND PALLIATION -

provoked by an activity, such as exercise, which increases cardiac oxygen demand.

QUALITY –

often characterized more as a discomfort than pain.

Terms frequently:
squeezing, tightness, pressure, constriction, crushing, strangling, burning, heartburn, fullness in the chest, band-like sensation, knot in the center of the chest, lump in throat, ache, heavy weight on chest (elephant sitting on chest), like a bra too tight, and toothache (when there is radiation to the lower jaw).

In some cases, the patient cannot qualify the nature of the discomfort but places his or her clenched fist in the center of the chest, known as the “Levine sign.”

Does not change with respiration or position.
NOT LOCALIZED

It may or may not respond to nitroglycerin and, if there is improvement, this may only be temporary.

Hollander J, Chase M. Evaluation of the adult with chest pain in the emergency department [Internet]. Uptodate.com. 2019 [cited 9 January 2019]. Available from: https://www.uptodate.com/contents/evaluation-of-the-adult-with-chest-pain-in-the-emergency-department?topicRef=184&source=s
(File: UTD 1)

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EVALUATION OF THE ADULT WITH CHEST PAIN IN THE EMERGENCY DEPARTMENT

RADIATION –

often radiates to other parts of the body including the upper abdomen (epigastrium), shoulders, arms (upper and forearm), wrist, fingers, neck and throat, lower jaw and teeth (but not upper jaw), and not infrequently to the back (specifically the interscapular region). Pain radiating to the upper extremities is highly suggestive of ischaemic pain.

SITE –

Not felt in one specific spot, but rather it is a diffuse discomfort that may be difficult to localize. Often indicated as the entire chest, rather than localizing it to a specific area by pointing a single finger.

TIME COURSE –

Angina is usually brief (two to five minutes) and is relieved by rest or with nitroglycerin. In comparison, patients with an acute coronary syndrome (ACS) may have chest pain at rest, and the duration is variable but generally lasts longer than 30 minutes. Classic anginal pain lasting more than 20 minutes suggests ACS.

Hollander J, Chase M. Evaluation of the adult with chest pain in the emergency department [Internet]. Uptodate.com. 2019 [cited 9 January 2019]. Available from: https://www.uptodate.com/contents/evaluation-of-the-adult-with-chest-pain-in-the-emergency-department?topicRef=184&source=s
(File: UTD 1)

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1. Buttar H, Li T, Ravi N. Prevention of cardiovascular diseases: Role of exercise, dietary interventions, obesity and smoking cessation. Experimental and Clinical Cardiology. 2005;10(4):229-249.
2. Acute Coronary Syndrome [Internet]. www.heart.org. 2015 [cited 9 January 2019]. Available from: http://www.heart.org/en/health-topics/heart-attack/about-heart-attacks/acute-coronary-syndrome
Files: Buttar pg 230, ACS AHA)

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HEART SCORE FOR CHEST PAIN PATIENTS

HEART PATHWAY

HISTORY (ANAMNESIS)	Highly suspicious	2	
	Moderately suspicious	1	
	Slightly suspicious	0	
ECG	Significant ST-deviation	2	
	Non-specific repolarisation disturbance/LBBM/PM	1	
	Normal	0	
AGE	≥ 65 years	2	
	45 – 65 years	1	
	≤ 45 years	0	
RISK FACTORS	≥ 3 risk factors or history or atherosclerotic disease	2	
	1 or 2 risk factors	1	
	No risk factors known	0	
TROPONIN	≥ 3x normal limit	2	
	1 – 3x normal limit	1	
	≤ normal limit	0	
		TOTAL	

Objectively risk-stratifies patients into low, moderate, and high-risk categories, helping guide management, leading to better resource utilization, shorter hospital and ED stays for low risk patients, and earlier interventions for moderate- and high-risk patients.

HEART SCORE	RISK OF MACE	DECISION
LOW 0 - 3	**0.9 – 1.7%**	**DISCHARGE FOLLOW UP** in 72h (AHA/ACC)
INTERMEDIATE 4 - 7	**12 – 16%**	**ADMIT** for trending of troponin and provocative testing
HIGH +7	**7.5 – 65%**	**INVASIVE MEASURES** - Cardiologist referral

Backus B, Six J, Poldervaart J. HEART Score [Internet]. Heartscore.nl. 2017 [cited 9 January 2019]. Available from: http://www.heartscore.nl/score/ (Files: HEART Score;)

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HEART SCORE FOR CHEST PAIN PATIENTS

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		TOTAL	

RISK FACTORS FOR ATHEROSCLEROTIC DISEASE

- Hypercholesterolemia
- Hypertension
- Diabetes Mellitus
- Cigarette smoking
- Positive smoking
- Obesity (BMI-30)

HEART SCORE	RISK CATEGORY	PROPOSED POLICY
0-3	**LOW RISK**	**DISCHARGE FOLLOW UP** within 1 week (physician/cardiologist)
≥ 4	*** @ RISK**	**OBSERVATION** pre-transfer MANAGEMENT URGENT TRANSFER ± SPECIFIC TREATMENT

*Adapted - combined intermediate & high risk = @RISK. For use outside ED

Backus B, Six J, Poldervaart J. HEART Score [Internet]. Heartscore.nl. 2017 [cited 9 January 2019]. Available from: http://www.heartscore.nl/score/ (Files: HEART Score;)

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HEART SCORE FOR CHEST PAIN PATIENTS

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TROPONIN	≥ 3x normal limit	2	
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		TOTAL	

ECG:

- 8-11% of patients with chest pain and later diagnosed STEMI will demonstrate normal initial ECG
- Up to one third of STEMI pts will demonstrate findings on ECG by 30 min

RISK FACTORS[1,2]:

3 OR MORE = SCORE OF 2

- **HTN**
- **Hypercholesterolemia**
- **DM**
- **Obesity** (current, or smoking cessaton ≤ 3 mo)
- **Positive Family History** (parent or sibling with CVD before age 65)
- **Atherosclerotic disease**: prior MI, PCI/CABG, CVA/TIA, or peripheral arterial disease

CAUTION:

- Experiences taking a detailed chest pain history and reading EKGs NB!
- No risk factors increases likelihood of ACS in women
- Only DM and + family history increase likelihood in men
- Age: >65 overwhelms any risk factor for predicting ACS
- Age: <40 number of risk factors contributes to risk of ACS
- Consider undiagnosed comorbidities

1. Backus B, Six J, Poldervaart J. HEART Score [Internet]. Heartscore.nl. 2017 [cited 9 January 2019]. Available from: http://www.heartscore.nl/score/ (Files: HEART Score;)
2. Six A, Backus B, Kelder J. Chest pain in the emergency room: value of the HEART score. Netherlands Heart Journal. 2008;16(6):191-196.

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HEART SCORE FOR CHEST PAIN PATIENTS

HEART PATHWAY[1]

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TROPONIN	≥ 3x normal limit	2	
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	≤ normal limit	0	
		TOTAL	

The HEART Score outperforms the TIMI Score for UA/NSTEMI, safely identifying more low-risk patients.[2]

The **TIMI** and **GRACE** scores were not derived for use in the undifferentiated chest pain patient in the ED, but rather for high risk patients to evaluate for the need for invasive therapy.[2]

TABLE 1[2]

Table 1. Thrombolysis in Myocardial Infarction Score*

Age ≥65 years
≥3 Risk factors for ACS: hypertension, hyperlipidemia, smoking, diabetes, and family history
Aspirin use in last 7 days
Previous known coronary stenosis ≥50%
≥2 angina events in 24 h, or persisting discomfort
ST segment deviation of ≥0.05 mV on initial ECG
Elevated cardiac biomarkers

ACS = acute coronary syndrome; ECG = electrocardiography.
* Patients earn 1 point for yes and 0 points for no. Low risk scores range from 0 to 2; intermediate scores range from 3 to 4, and high risk scores range from 5 to 7.

TABLE 2[2]

Table 2. Global Registry of Acute Coronary Events Score*

Age (Years)	Points	HR (Beats/min)	Points	SBP (mm Hg)	Points	Cr (mg/dL)	Points	Killip Classification	Points
<39	0	<70	0	<80	0	0.0–0.39	1	I	0
40–49	18	70–89	5	80–99	37	0.40–0.79	4	II	15
50–59	36	90–109	10	100–119	30	0.80–1.19	7	III	29
60–69	55	110–149	17	120–139	23	1.20–1.59	10	IV	44
70–79	73	150–199	26	140–159	17	1.60–1.99	13	Cardiac arrest	30
80–89	91	≥200	34	160–199	7	2.0–3.99	21	Elevated cardiac markers	13
≥90	100	—	—	≥200	0	≥4	28	ST segment deviation	17

Cr = creatine; HR = heart rate; SBP = systolic blood pressure.
* Low risk scores range from 1 to 88, intermediate risk scores range from 89 to 118, and high risk scores are ≥119.

1. Backus B, Six J, Poldervaart J. HEART Score [Internet]. Heartscore.nl. 2017 [cited 9 January 2019]. Available from: http://www.heartscore.nl/score/ (Files: HEART Score;)
2. Lee H, Rodriguez C. HEART Score for Major Cardiac Events - MDCalc [Internet]. Mdcalc.com. 2019 [cited 4 February 2019]. Available from: https://www.mdcalc.com/heart-score-major-cardiac-events (File: MDCalc 1)

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HEART SCORE FOR CHEST PAIN PATIENTS

HEART PATHWAY[1]

Using the HEART Pathway can decrease MACEs to <1% using the HEART Score with 0-h and 3-h **Troponin testing**.

Dynamic **ECG changes** are accommodated

Shared decision making, incorporating active patient participation in evaluation and management decisions results in greater knowledge of risk, increased engagement, and decreased admission rate[1]

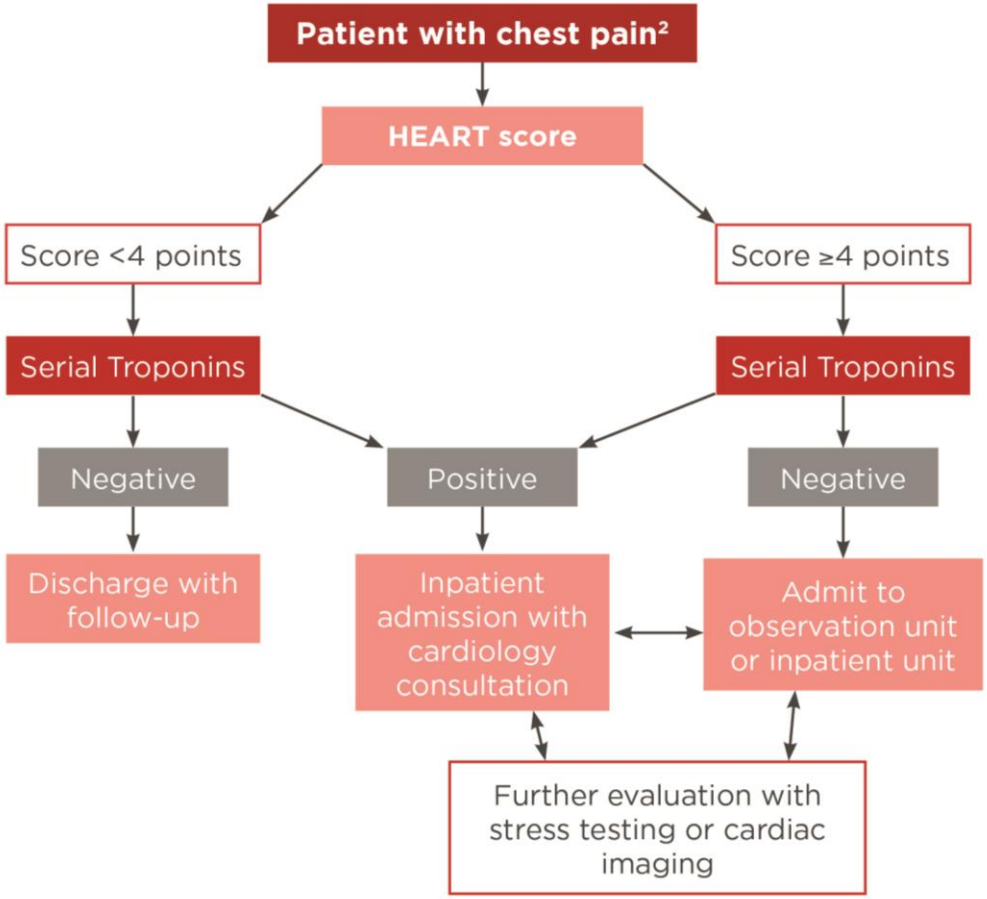

Fig 1. Heart Pathway [26].

1. Long B, Oliver J, Streitz M, Koyfman A. An end-user's guide to the HEART score and pathway. The American Journal of Emergency Medicine. 2017;35(9):1350-1355.
(Full text reference pending)
2. Mahler S, Riley R, Hiestand B, Russell G, Hoekstra J, Lefebvre C et al. The HEART Pathway Randomized Trial. Circulation: Cardiovascular Quality and Outcomes. 2015;8(2):195-203.
(FIle: HEART Pathway pg 14 fig 1)

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DIAGNOSIS AND RISK STRATIFICATION IN PATIENTS WITH SUSPECTED NSTE-ACS

Recommendations	Class	Level
Diagnosis and risk stratification		
It is recommended to base diagnosis and initial short-term ischaemic and bleeding risk stratification on a combination of clinical history, symptoms, vital signs, other physical findings, ECG and laboratory results.	I	A
It is recommended to obtain a 12-lead ECG within 10 min after first medical contact and to have it immediately interpreted by an experienced physician. It is recommended to obtain an additional 12-lead ECG in case of recurrent symptoms or diagnostic uncertainty.	I	B
Additional ECG leads (V3R, V4R, V7-V9) are recommended if ongoing ischaemia is suspected when standard leads are inconclusive	I	C
It is recommended to use established risk scores for prognosis estimation.	I	B

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 14+15)

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MONITORING IN PATIENTS WITH SUSPECTED NSTE-ACS

Recommendations	Class	Level
Continuous rhythm monitoring is recommended until the diagnosis of NSTEMI is established or ruled out.	I	C
It is recommended to admit NSTEMI patients to a monitored unit.	I	C
Rhythm monitoring up to 24h or PCI (whichever comes first) should be considered in NSTEMI patients at low risk for cardiac arrhythmias.	IIa	C
In the absence of signs or symptoms of ongoing ischaemia, rhythm monitoring in unstable angina may be considered in selected patients (e.g. suspicion of coronary spasm or associated symptoms suggestive of arrhythmic events).	IIb	C

ACS = acute coronary syndromes; NSTEMI = non-ST-elevation myocardial infarction; PCI = percutaneous coronary intervention.

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 14+15)

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RISK CRITERIA MANDATING INVASIVE STRATEGY IN NSTE-ACS

VERY-HIGH-RISK CRITERIA
Immediate invasive intervention <120 min

- Haemodynamic instability or cardiogenic shock
- Recurrent or ongoing chest pain refractory to medical treatment
- Life-threatening arrhythmias or cardiac arrest
- Mechanical complication of myocardial infarction
- Acute heart failure
- Recurrent dynamic ST-T wave changes, particularly with intermittent ST-elevation

HIGH-RISK CRITERIA
Early invasive intervention <24 hr

- Rise or fall in cardiac troponin compatible with myocardial infraction
- Dynamic ST- or T-wave changes (symptomatic or silent)
- GRACE score > 140

INTERMEDIATE-RISK CRITERIA (Ischaemia-Guided Intervention)
Delayed invasive intervention 25-27 hr

- Diabetes mellitus
- Renal insufficiency (eGFR <60 ml/min/1.73m2)
- LVEF <40% or congestive heart failure
- Early post-infarction angina
- Prior percutaneous coronary intervention
- Prior coronary artery bypass surgery
- GRACE risk score > 109 and <140

LOW-RISK CRITERIA
Depends on spontaneous or provoked ischaemia

Any characteristics not mentioned above

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 28 table 13)

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DIFFERENTIAL DIAGNOSES OF ACS

Cardiac	Pulmonary	Vascular
Myopericarditis Cardiomyopathies	**Pulmonary embolism**	**Aortic dissection**
Tachyarrhythmias	**(Tension) - Pneumothorax**	Symptomatic aortic aneurysm
Acute heart failure	Bronchitis, pneumonia	Stroke
Hypertensive emergencies	Pleuritis	
Aortic valve stenosis		
Tako-Tsubo cardiomyopathy		
Coronary spasm		
Gasto-intenstinal	**Orthopaedic**	**Other**
Oesophagitis, reflux or spasm	Musculoskeletal disorders	Anxiety disorders
Peptic ulcer, gastritis	Chest trauma	Herpes zoster
Pancreatitis	Muscle injury/inflammation	Anaemia
Cholecystitis	Costochondritis	
	Cervical spine pathologies	

Most frequent in bold

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(File: ESC NSTEMI 2015, page 275, Table 4)

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Electrocardiogram
*ECG

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RECORDING THE ECG

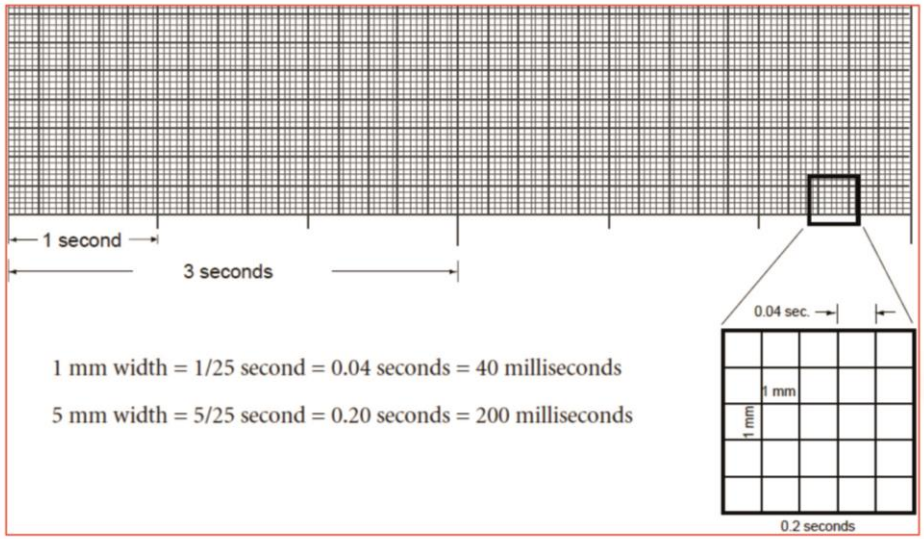
ECG PAPER AND STANDARDIZATION

An ECG is a **GRAPHICAL DISPLAY OF ELECTRICAL ENERGY** generated by the heart over time.

ECG graph paper records **CARDIAC ELECTRICAL ACTIVITY** at a rate of 25mm/second.

The paper is divided into small 1mm squares with thicker lines every 5mm.

The width of an ECG tracing is a **MEASUREMENT OF TIME.**



The Six Second ECG: A Practical Guidebook to Basic ECG Interpretation. 1st ed. North Vancouver: SkillStat Learning Inc.; 2004.

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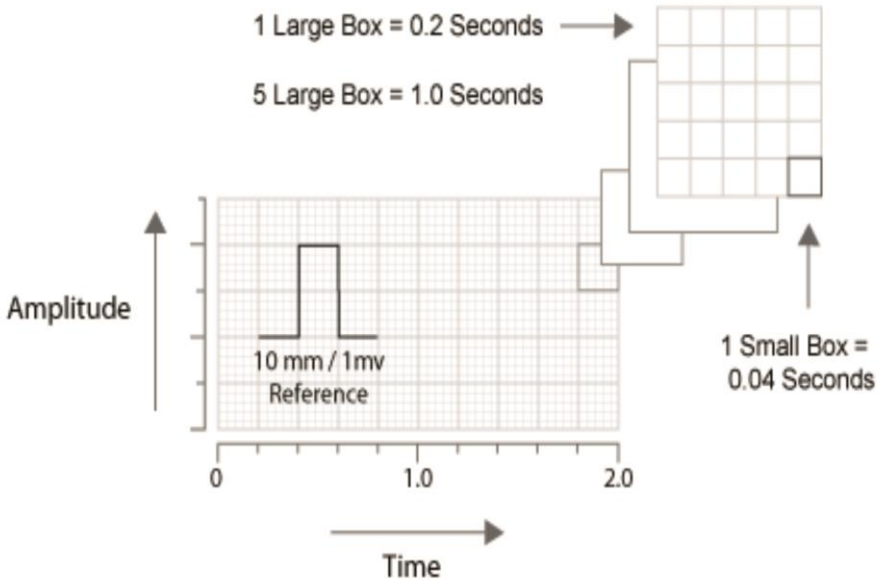
RECORDING THE ECG

The height (amplitude) of an ECG tracing **MEASURES ELECTRICAL VOLTAGE.**

A waveform with a height of **10 MM EQUALS 1 MILLIVOLT.**

The **COMPARATIVE HEIGHT OR DEPTH OF WAVEFORMS** can yield significant information about the heart i.e. ischemia monitoring.



The Six second ECG. North Vancouver, B.C.: Skillstat Learning Inc.; 2005. (File: ECG primer pg 74 fig. 4.8)

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RECORDING THE ECG

PRECAUTIONS:

- Make sure that the electrodes have not dried out.
- Shave chest chair, if necessary, to ensure good skin contact with the electrode.
- Clean the area with alcohol if necessary, but allow the alcohol to dry before placing the electrodes.
- Check the ECG cables and lead wires for fraying or broken wires which might give an inaccurate ECG trace.
- Check all leads to make sure that they are connected.

Preparing the patient for successful ECG monitoring [Internet]. Welchallyn.com. 2003 [cited 9 January 2019]. Available from: https://www.welchallyn.com/content/dam/welchallyn/documents/upload-docs/Research/Reference/Preparing-the-Patient-for-Successful-ECGMonitoring_Reference.pdf (File: WelchAllyn page 2)

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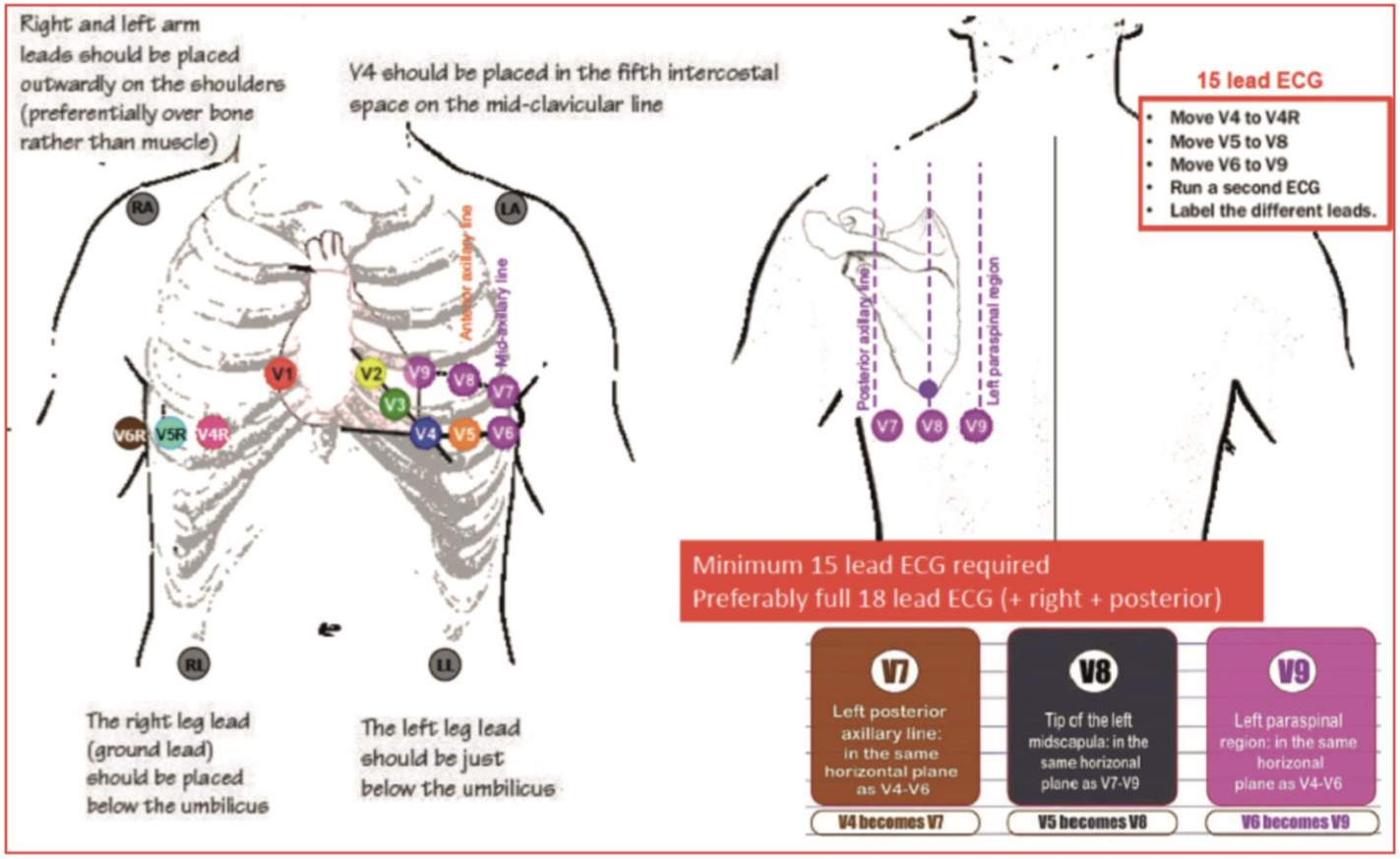
ECG PAPER AND STANDARDIZATION



REFERENCE TO BE PROVIDED

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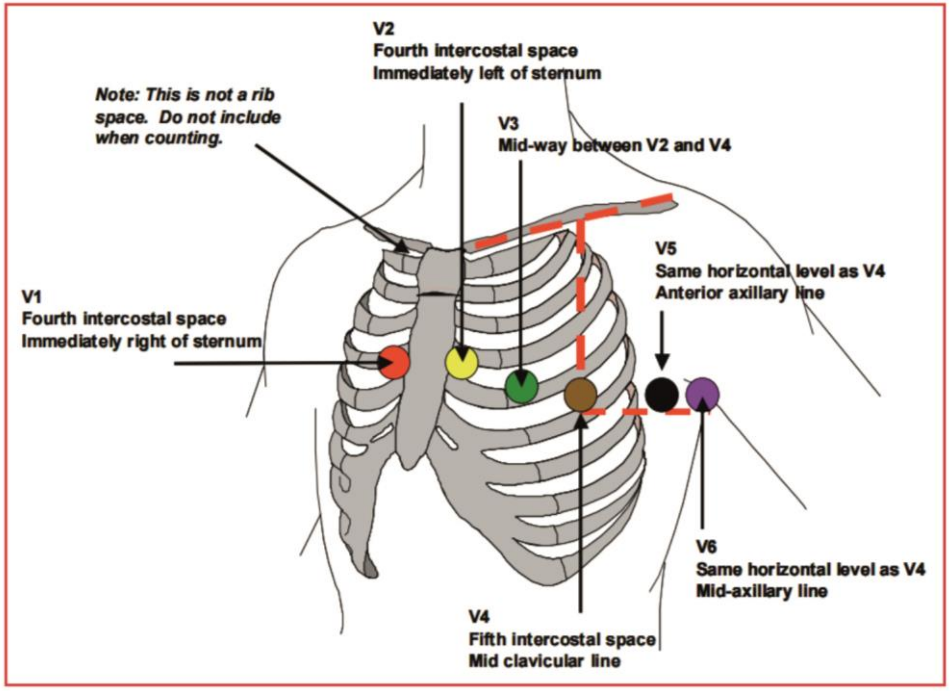
ECG PAPER AND STANDARDIZATION

The Angle of Louis/sternal notch identifies the second rib and provides a landmark for noting the fourth intercostal space (ICS).

V1: 4th ICS right para-sternal
V2: 4th ICS left para-sternal
V3: Midway between V2 and V4
V4: 5th ICS at midclavicular line
V5: Same horizontal level as V4 at anterior axillary line
V6: Same horizontal level as V4, V5 at mid-axillary line

Take note: In female patients, place V4, V5 and V6 electrodes beneath the left breast.[1]



Aehlert B. ECGs made easy. 6th ed. St. Louis, Missouri: Elsevier. (File: ECGs made easy page 45 table 2.4)

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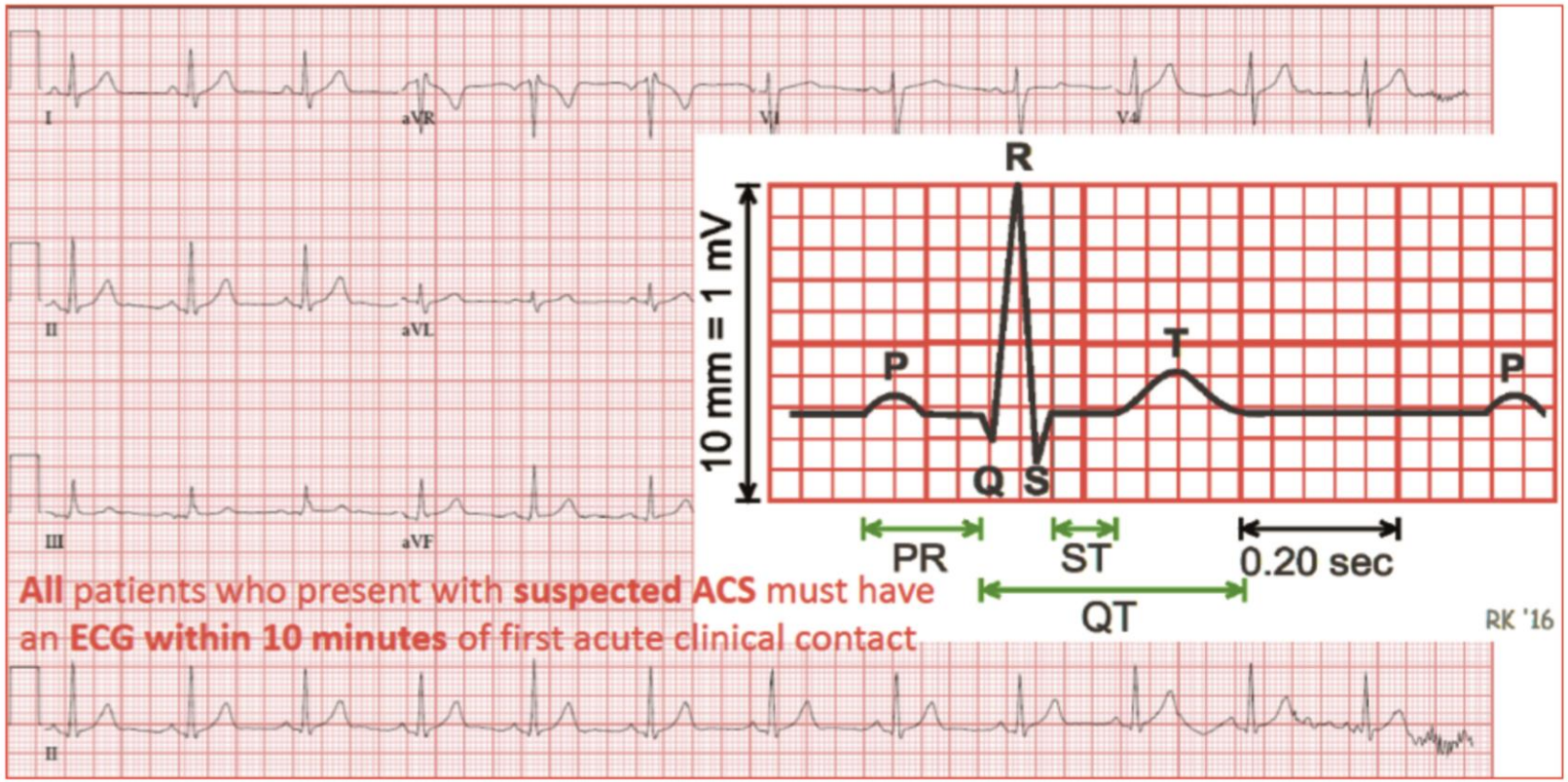
ELECTROCARDIOGRAM (ECG)



1. Kumar A, Cannon C. Acute Coronary Syndromes: Diagnosis and Management, Part I. Mayo Clinic Proceedings. 2009;84(10):917-938. (File: Kumar pg 921)
2. Klabunde R. ECG components [Internet]. 2016 [cited 9 January 2019]. Available from: https://www.cvphysiology.com/Arrhythmias/A009.htm

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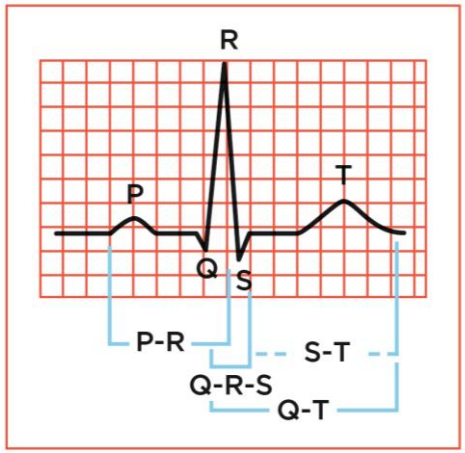
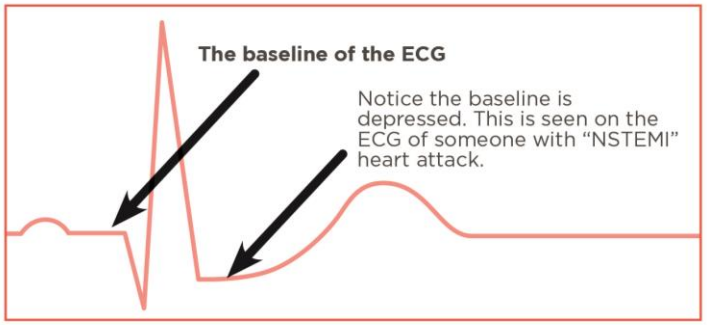
SEEING THE DIFFERENCE ON THE ECG

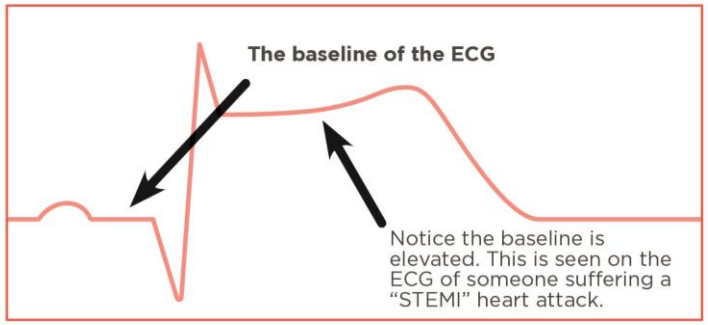


NORMAL ECG

Only a 12 lead ECG may be used to make a diagnosis



N STEMI



STEMI

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STEMI - ECG INTERPRETATION

POSTERIOR MI[1]

ST-segment depression in leads Vl-V3 with a positive T-wave suggests myocardial infarction, and confirmed by ST-segment elevation of >0.5 mm in leads V7-V9

ROUTINE BLOOD SAMPLING for serum markers is indicated as soon as possible in the acute phase but should not delay reperfusion treatment[1]

If initial ECG is not diagnosed but suspicion is high for STEMI, **OBTAIN SERIAL ECG** at 5-10 minute intervals[2]

1. Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177. (File: ESC STEMI 2017, page127)
2. Aboufakher R. ECG in STEMI Importance and Challenges. Presentation presented at; 2017; Altru Health System Grand Forks, ND. (File: STEMI Presentation slide 46)

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STEMI - ECG INTERPRETATION

J-point elevation in men ≥40 years old

- ≥2mm in leads V2 and V3
- ≥1mm in all other leads

J-point elevation in woman

- ≥1.5 mm in leads V2 and V3
- ≥1 mm in all other leads

J-point elevation in men <40 years old

- ≥2.5 mm in leads V2 and V3
- ≥1 mm in all other leads

Inferior MI

Record right pre-cordial leads (V3R and V4R), seeking ST-elevation to identify concomitant right ventricular (RV) infraction

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.

(File: ESC STEMI 2017, page126)

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WHAT TO LOOK FOR ON THE ECG WHEN STEMI IS SUSPECTED

1. ST SEGMENT ELEVATION
2. ST SEGMENT DEPRESSION
3. Q WAVES

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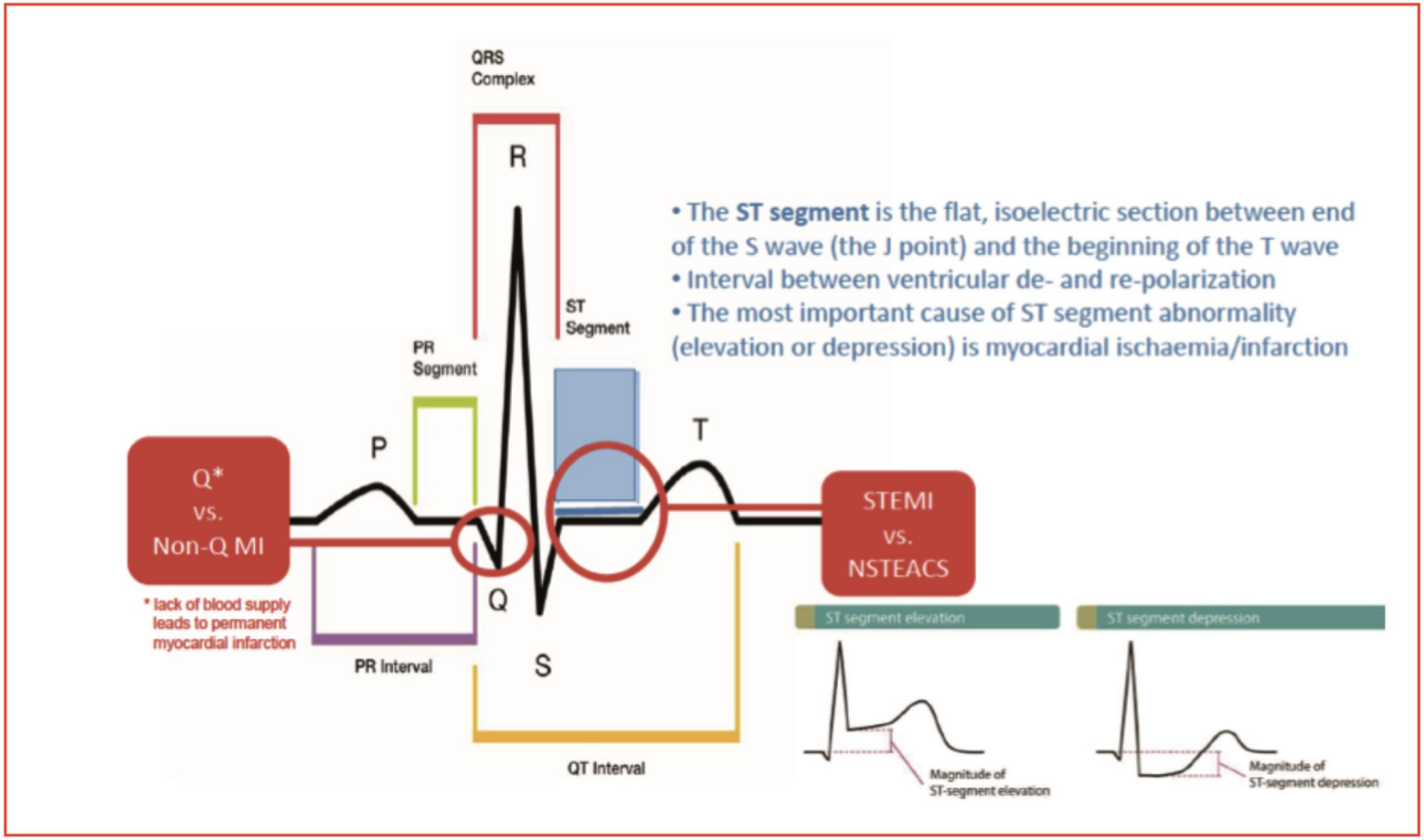
REFERENCE

AMI: ECG DIAGNOSIS



Adapted from: Burns D. The ST Segment • LITFL Medical Blog • ECG Library Basics [Internet]. Life in the Fast Lane. 2018 [cited 12 January 2019]. Available from: https://litfl.com/st-segment-ecg-library/

(File: ECG components)

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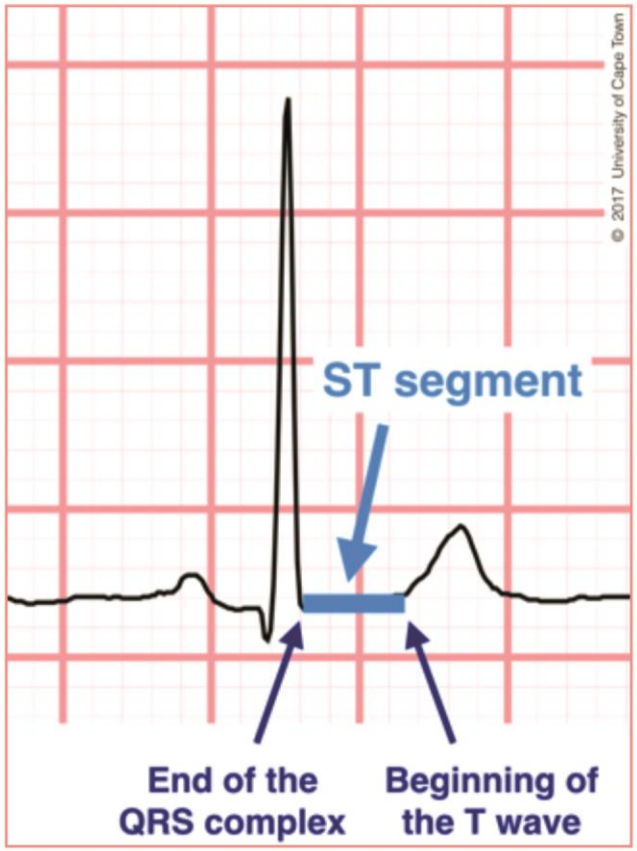
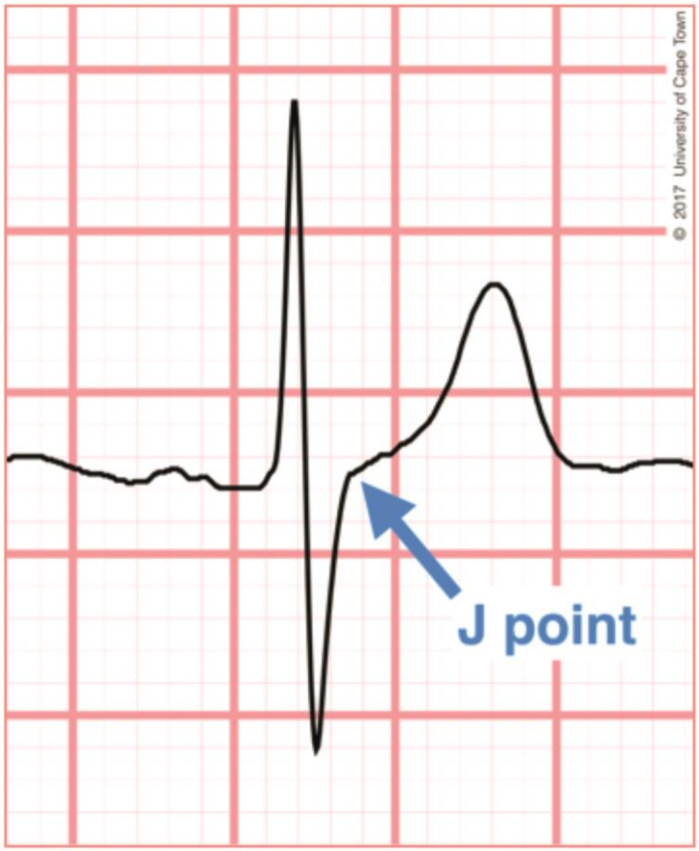
HOW TO ANALYSE THE ST SEGMENT





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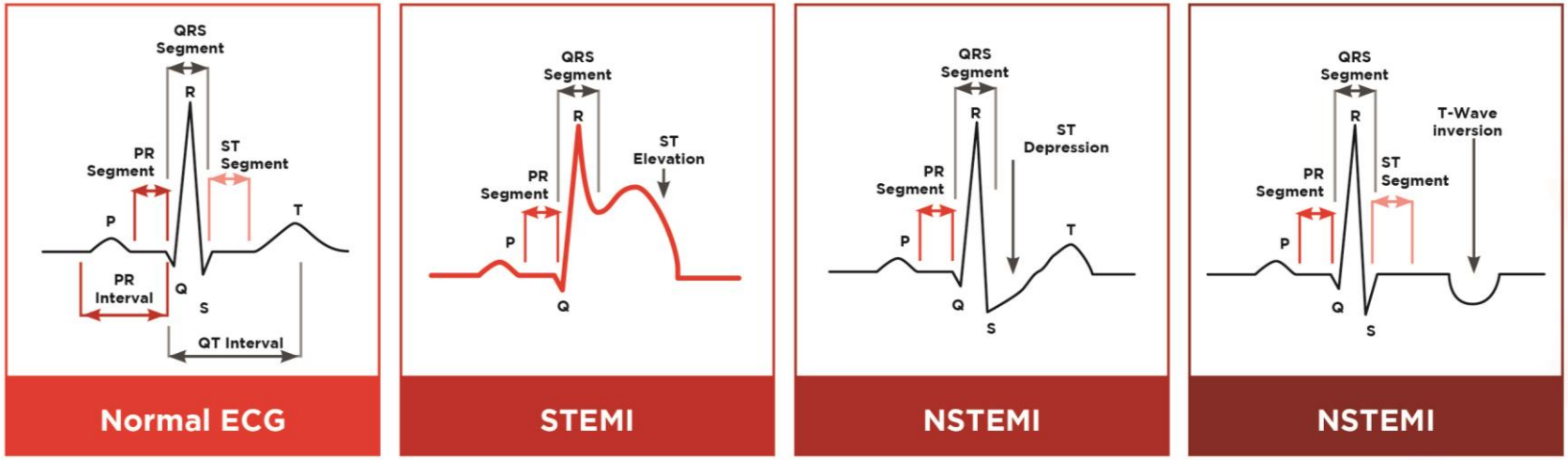
DIAGNOSIS OF STEMI: ECG CHANGES

- ST-segment elevation with pathological Q-wave formation
- Sometimes T-wave inversion may be found but it is a non-specific feature
- ST-segment elevation indicates full thickness cardiac muscle injury, pathological Q-wave indicates muscle necrosis and T-wave inversion indicates muscle ischaemia



Diagnosis of STEMI [Internet]. metalyse (tenecteplase). 2019 [cited 12 January 2019]. Available from: http://www.metalyse.com/stemi/diagnosis
(File: Metalyse)

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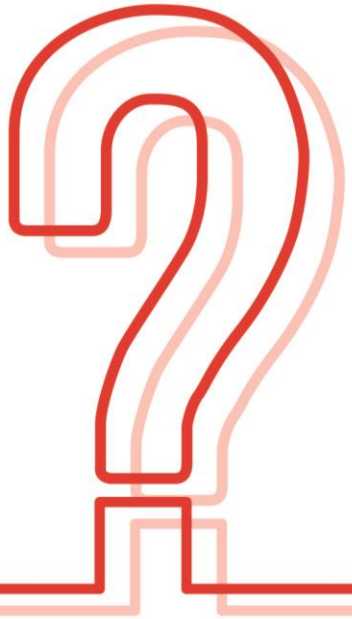
THE STEPWISE APPROACH TO STEMI

QUESTION 1

Is there ST segment elevation?

QUESTION 2

If not, is there ST segment depression that represents ST segment elevation elsewhere (reciprocal changes)?



ECG Changes in Acute Coronary Syndrome [Internet]. EMS World. 2014 [cited 12 January 2019]. Available from: https://www.emsworld.com/article/12003483/ecg-changes-in-acute-coronary-syndrome

(File: Stepwise approach to STEMI)

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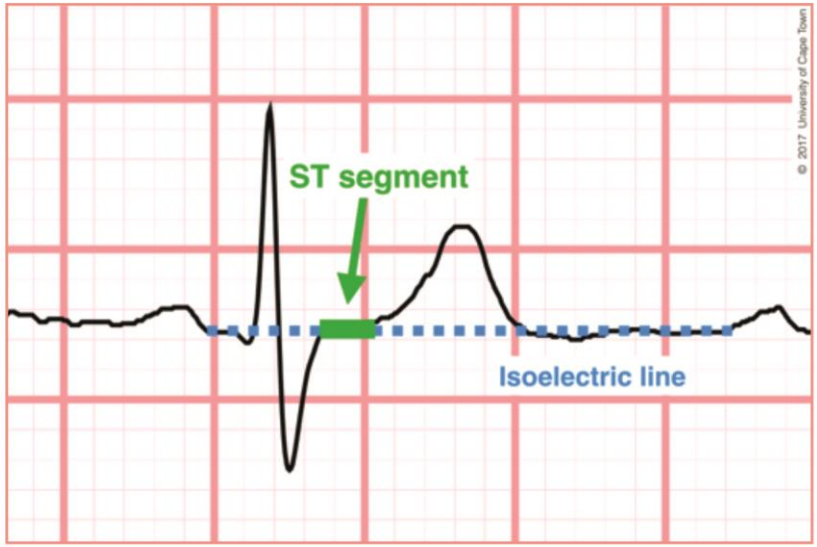
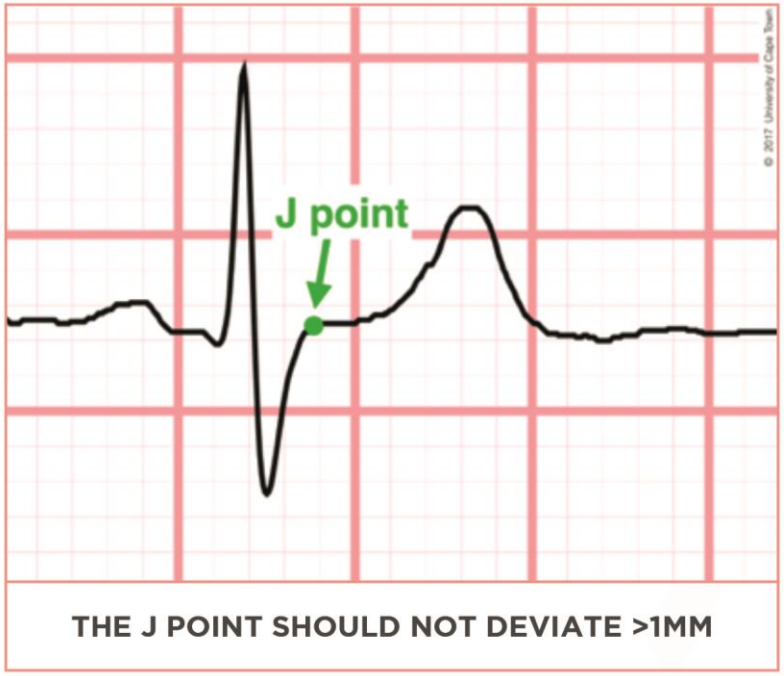
HOW TO ANALYSE THE ST SEGMENT





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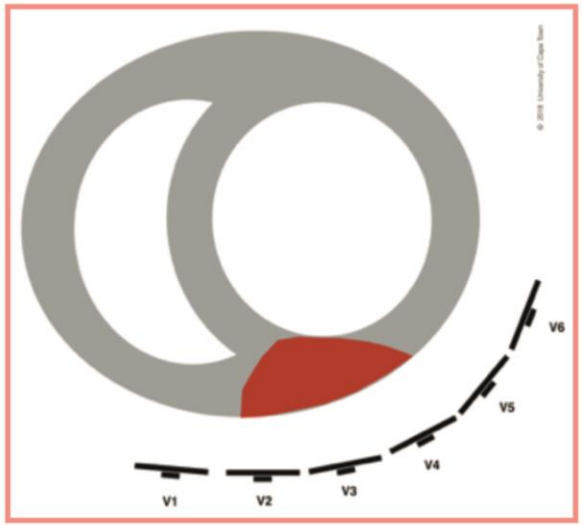
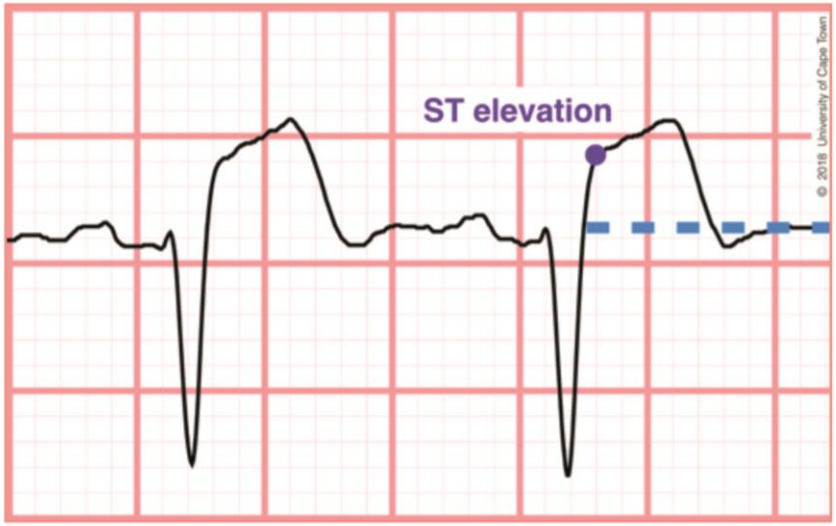
THE STEPWISE APPROACH TO STEMI

The first question is:
Is there ST-segment elevation?[1]

↓

This should prompt an urgent reperfusion strategy





Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.

(File: ESC STEMI 2017, page126)

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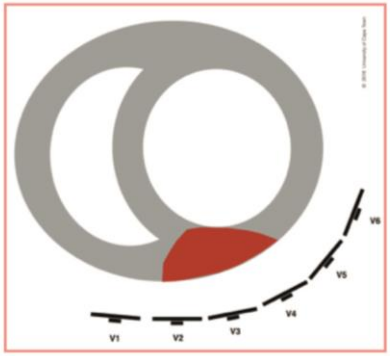
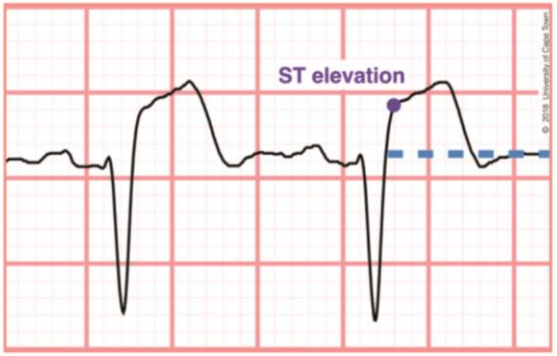
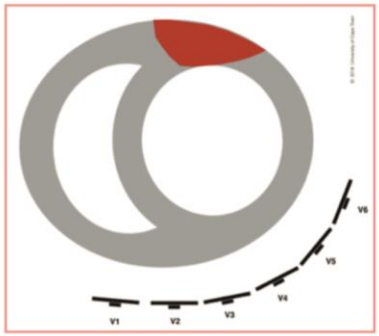
WHAT TO LOOK FOR ON THE ECG WHEN STEMI IS SUSPECTED

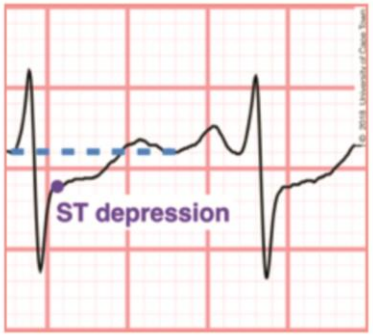
1 **ST segment elevation** represents transmural ischaemia ("dying muscle" can still be reversed by urgent reperfusion)

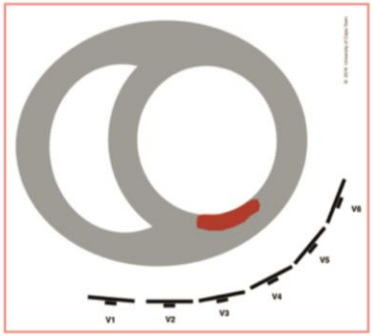




2 **ST segment depression** can represent reciprocal changes (mirror image of ST elevation elsewhere), or subendocardial ischaemia (in the absence of ST elevation)







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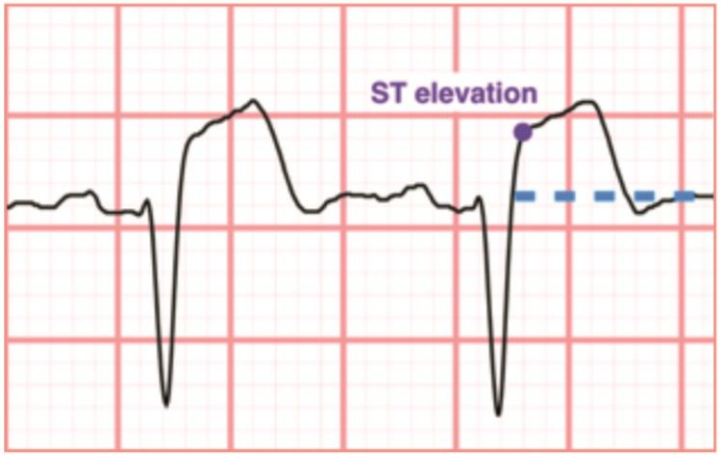
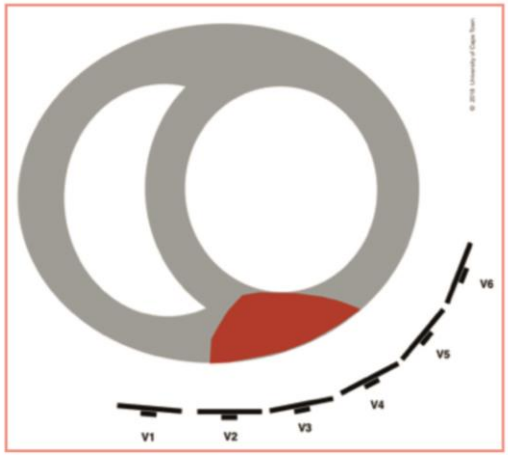
ACUTE MYOCARDIAL INFARCTION

STEMI

- **Complete coronary occlusion with infarction**
- **Transmural infarction**
- **Recognized by ST segment elevation**
- **Will produce cardiac enzyme leak**
  (but very important to note that an ECG with ST segment elevation is enough to make the diagnosis, there is no time to wait for the troponin result)





Nickson C. Acute Coronary Syndromes [Internet]. Life in the Fast Lane • LITFL • Medical Blog. 2019 [cited 5 February 2019]. Available from: https://lifeinthefastlane.com/ccc/acute-coronary-syndromes/
(File: LITFL ACS)

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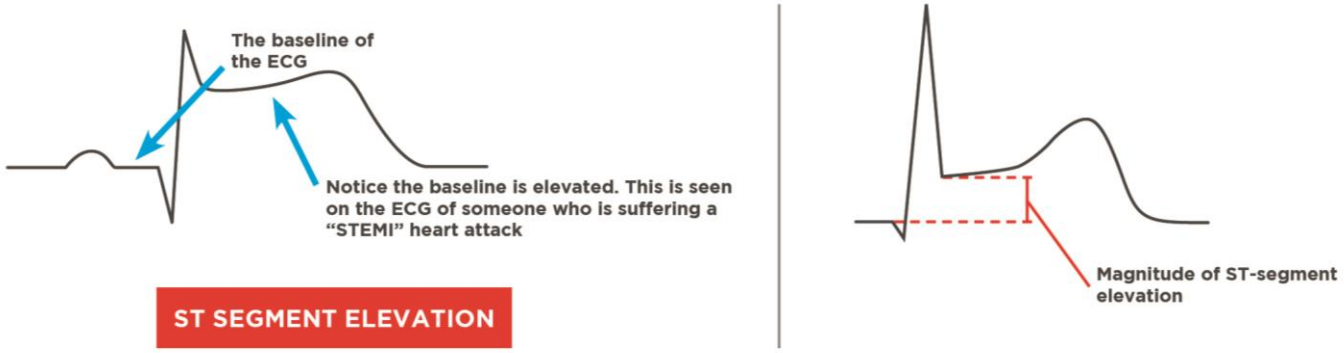
STEMI: ECG DIAGNOSIS

- ACS consistent clinical presentation and symptoms (≥20 min duration) with
- new or persistent (>20 min) STE in ≥2 contiguous leads of:
- >1mm STE in any leads other than leads V2-V3

  For leads V2-V3 the following applies:
- ≥2.5 mm (i.e ≥2.5 small squares) STE in men <40 years
- ≥2 mm (i.e ≥2 small squares) STE in men ≥40 years
- ≥1.5 mm STE in women
- Atypical ECG presentation



Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.

(File: ESC STEMI 2017, page126)

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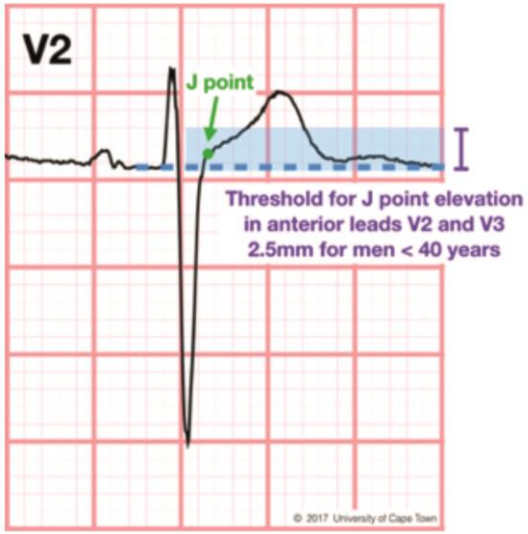
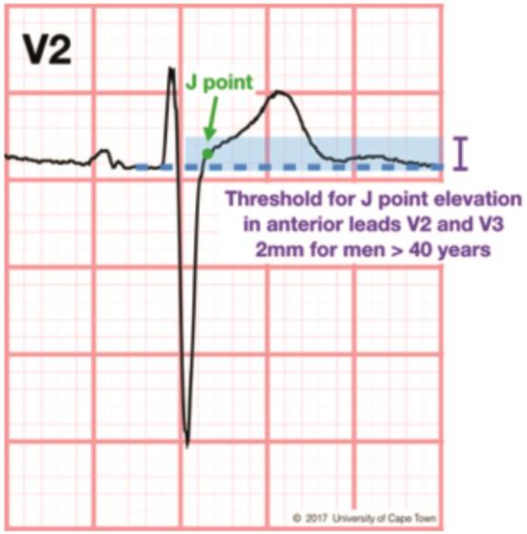
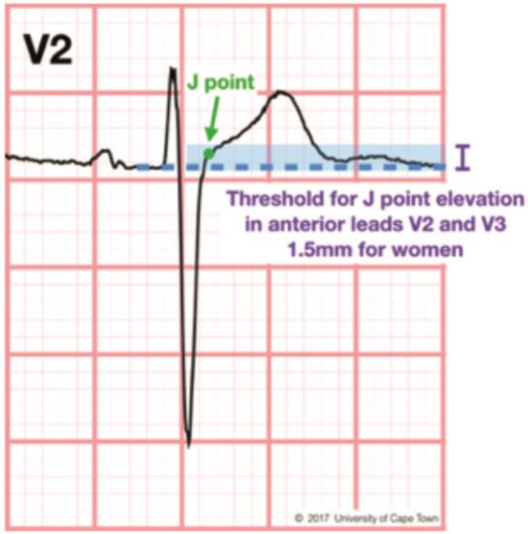
IT IS NORMAL TO HAVE SOME J POINT ELEVATION IN V2 AND V3







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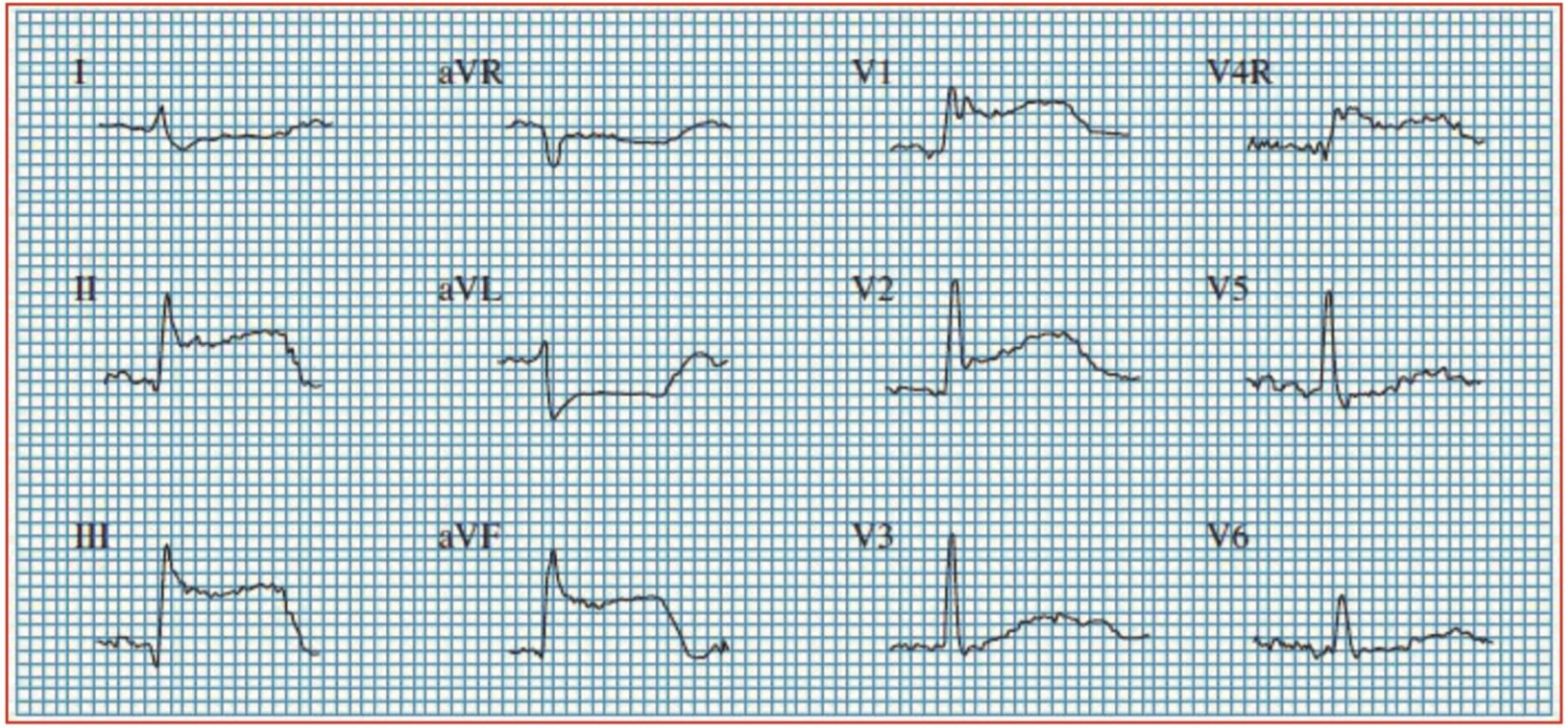
DIAGNOSING A STEMI

The diagnosis is strengthened if there is reciprocal ST depression



REFERENCE TO BE PROVIDED

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HOW TO LOCALISE A STEMI

V1 – V4	Anterior myocardial infarction
I, aVL, V5 – V6	Lateral myocardial infarction
I, aVL, V1 – V6	Antero-lateral myocardial infarction
V1 – V3	Antero-septal myocardial infarction
II, III, aVF	Inferior myocardial infarction
I, aVL, V5 – V6, II, III, aVF	Infero-lateral myocardial infarction

Aboufakher R. ECG in STEMI Importance and Challenges. Presentation presented at; 2017; Altru Health System Grand Forks, ND. (File: STEMI Presentation slide)

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STEMI TYPES DEFINED BY ECG CHANGES

STEMI type	Area affected	Occluded vessel	ECG Findings		Prognosis
			ST segment elevation	Reciprocal ST- segment depression	
Anterior	Anterior wall of LV	LAD branch of LCA	Leads V1 – V6	Inferior leads II, III and aVF	Poor
Antero-septal	Area between LV and RV	LAD septal branches	Leads V1 – V4	Inferior leads II, III and aVF	
Lateral	Lateral wall of LV	1st diagonal branch of LAD and obtuse marginal branch of LCX	Leads I, aVL, V5 and V6	Inferior leads II, III and aVF	
High lateral	Superior portion of the lateral wall of LV	1st diagonal branch of LAD	Leads I and aVL	Inferior leads II, III and aVF	
Antero-lateral	Anterior and lateral wall of LV	Proximal LAD or LAD + LCX	Leads I, aVL, V4 – V6	Inferior leads II, III and aVF	
Inferior	Inferior wall of LV	RCA	Leads II, III and aV	Leads I and aVL	Good[a]
Posterior	Posterior part of LV	Posterior descending artery	Leads V7 – V9 (posterior leads)[b]		
RV infarction[c]			Right sided chest leads (V3 R– V6 R)		

LV, left ventricle; RV, right ventricle; LAD, left anterior descending artery; LCX, left circumflex artery; LCA, left coronary artery; RCA, right coronary artery. a ~40% of these patients have a concomitant RV infarction and a poor prognosis; b Not directly visualised by the standard 12- lead ECG – must be confirmed by 15-lead ECG; C RV infarction is uncommon.

Johnson H. ST-elevation myocardial infarction (STEMI). Presentation; 2018.
(File: STEMI slide 28)

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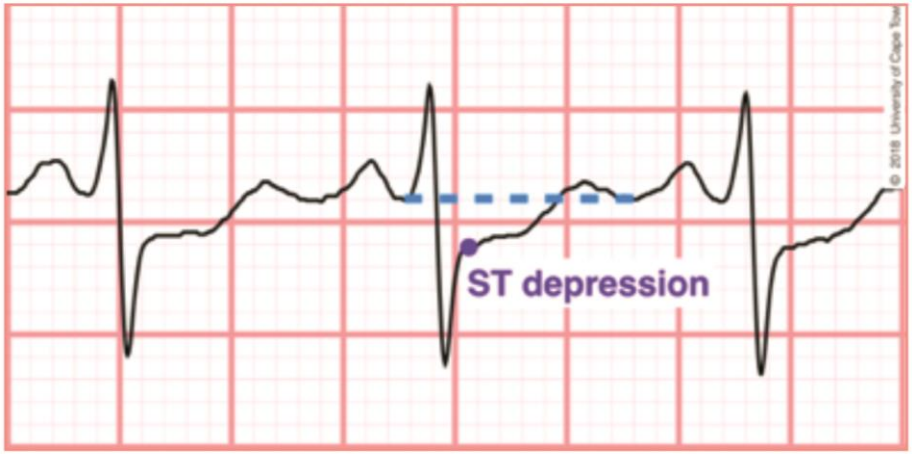
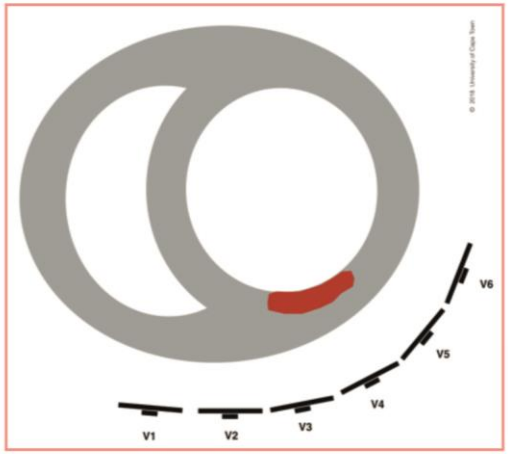
ACUTE MYOCARDIAL INFARCTION

Non-STEMI[1,2]

- Partial coronary occlusion
- Subendocardial ischaemia
- Can present with ST segment depression / T wave changes
- Diagnosis confirmed by cardiac enzyme leak





1. Rawshani A. NSTEMI (Non ST Elevation Myocardial Infarction) & Unstable Angina: Diagnosis, Criteria, ECG, Management – ECG learning [Internet]. ECG learning. 2016 [cited 5 February 2019]. Available from: https://ecgwaves.com/nstemi-non-st-elevation-myocardialinfarction-unstable-angina-criteria-ecg-diagnosis-management/
(File: Rawshani)
2. Amsterdam E, Wenger N. The 2014 American College of Cardiology ACC/American Heart Association Guideline for the Management of Patients With Non-ST-Elevation Acute Coronary Syndromes. Clinical Cardiology. 2015;38(2):121-123.
(File: AHA/ACC NSTEMI page 349)

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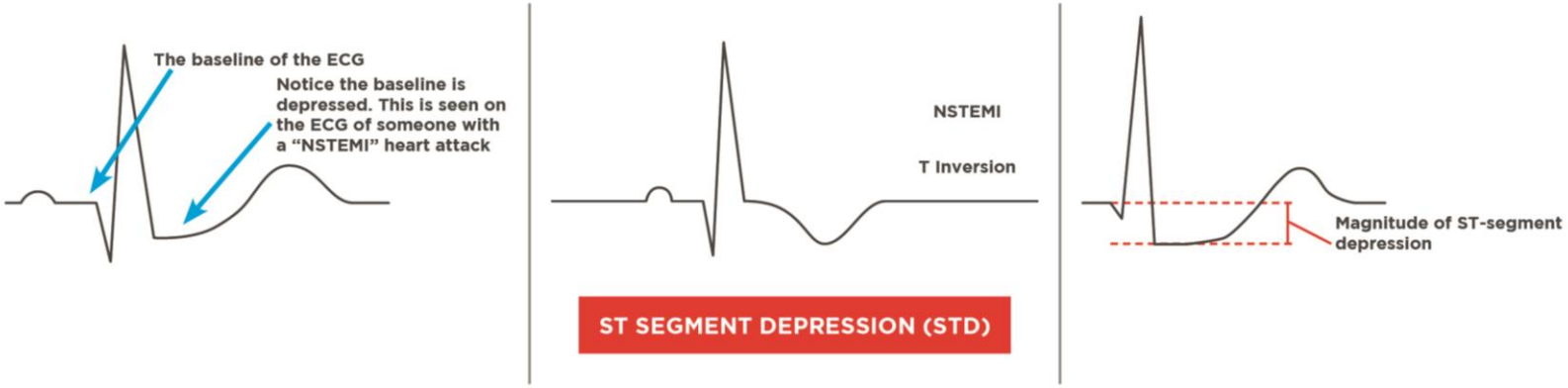
NSTEMI: ECG DIAGNOSIS

ACS consistent clinical presentation and symptoms[1,2,3]

with

- ±ECG findings:
  - Normal ECG
  - transient or persistent (>20 min) STD> 0.5 mm
  - STE >0.5 mm <1 mm
  - T-wave inversion
  - Flat T-waves or pseudo-normalisation of T-waves (hyper-acute STEMI)



1. Amsterdam E, Wenger N. The 2014 American College of Cardiology ACC/American Heart Association Guideline for the Management of Patients With Non-ST-Elevation Acute Coronary Syndromes. Clinical Cardiology. 2015;38(2):121-123. (File: AHA/ACC NSTEMI page 353)
2. Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315. (ESC NSTEMI 2015 pg 275)
3. Rawshani A. T-waves in ischemia: hyperacute, inverted (negative), Wellen's sign & de Winter's sign – ECG learning [Internet]. ECG learning. 2017 [cited 5 February 2019]. Available from: https://ecgwaves.com/t-wave-negative-inversions-hyperacute-wellens-signde-winters/ (File: Rawshani 2)

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ATYPICAL ELECTROCARDIOGRAPHIC PRESENTATIONS

Bundle branch block

Criteria that can be used to improve the diagnostic accuracy of STEMI in LBBB:

- Concordant ST-segment elevation ≥1 mm in leads with a positive QRS complex
- Concordant ST-segment depression ≥1 mm in V_1-V_3
- Discorda nt ST-segment elevation ≥5 mm in leads with a negative QRS complex

The presence of RBBB may confound the diagnosis of STEMI.

Ventricular paced rhythm

During RV pacing, the ECG also shows LBBB and the above rules also apply for the diagnosis of myocardial infarction during pacing; however, they are less specific.

Isolated posterior myocardial infarction

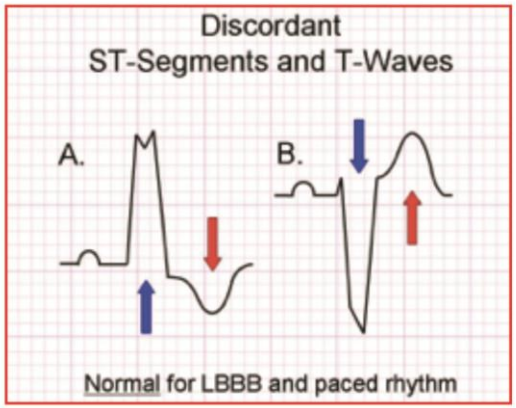
Isolated ST depression ≥0.5 mm in leads V_1-V_3 and ST-segment elevation (≥0.5 mm) inposterior chest wall leads V_7-V_9

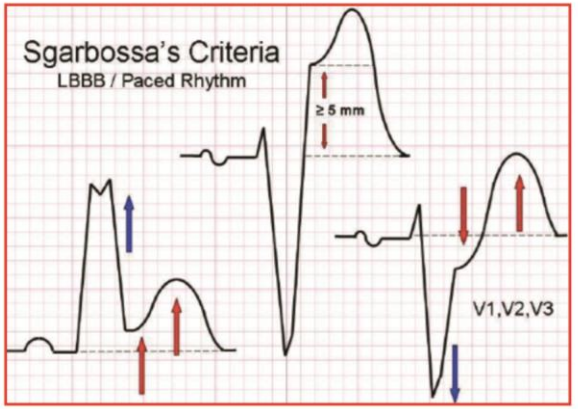
Ischaemia due to left main coronary artery occlusion or multivessel disease

ST depression ≥1 mm in eight or more surface leads, coupled with ST-segment elevation in aVR and/or V_1, suggests left main-, or left main equivalent- coronary obstruction, or severe three vessel ischaemia.

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(File: ESC STEMI 2017 page 127)

ATYPICAL: ECG PRESENTATIONS





- LBBB - new or presumed
- Ventricular paced rhythm

A total score of ≥3 has a specificity of 90% for diagnosing myocardial infarction

Modified Sgarbossa Criteria:

≥1 lead with >1 mm of concordant ST elevation	5pt
≥1 lead of V1-V3 with ≥1 mm of concordant ST depression	3pt
≥1 lead anywhere with ≥1 mm STE and proportionally excessive discordant STE, (defined by ≥25% the depth of the preceding S-wave)	2pt

Patients *without* diagnostic STE but persistent ischaemic symptoms

Cadogan D. Sgarbossa Criteria • LITFL • ECG Library Diagnosis [Internet]. Life in the Fast Lane. 2018 [cited 12 January 2019]. Available from: https://litfl.com/sgarbossa-criteria-ecg-library/
(File: Sgarbossa criteria)

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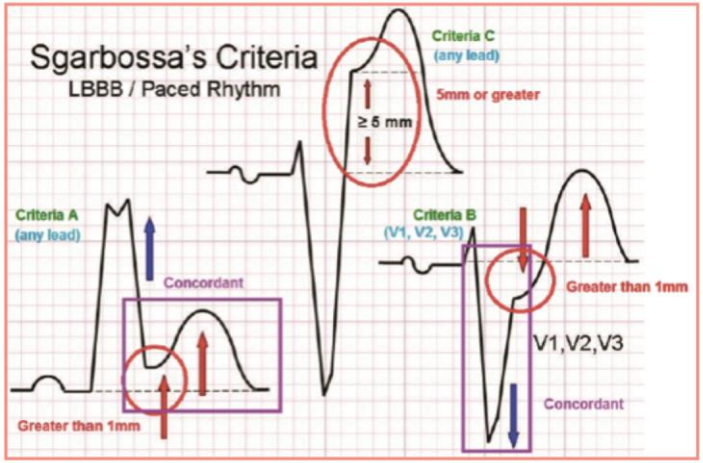
ATYPICAL ELECTROCARDIOGRAPHIC PRESENTATIONS

Bundle branch block

Criteria that can be used to improve the diagnostic accuracy of STEMI in LBBB:

- Concordant ST-segment elevation ≥1 mm in leads with a positive QRS complex
- Concordant ST-segment depression ≥1 mm in V_1-V_3
- Discorda nt ST-segment elevation ≥5 mm in leads with a negative QRS complex

The presence of RBBB may confound the diagnosis of STEMI.



Ventricular paced rhythm

During RV pacing, the ECG also shows LBBB and the above rules also apply for the diagnosis of myocardial infarction during pacing; however, they are less specific.

Cadogan D. Sgarbossa Criteria • LITFL • ECG Library Diagnosis [Internet]. Life in the Fast Lane. 2018 [cited 12 January 2019]. Available from: https://litfl.com/sgarbossa-criteria-ecg-library/

(File: Sgarbossa criteria)

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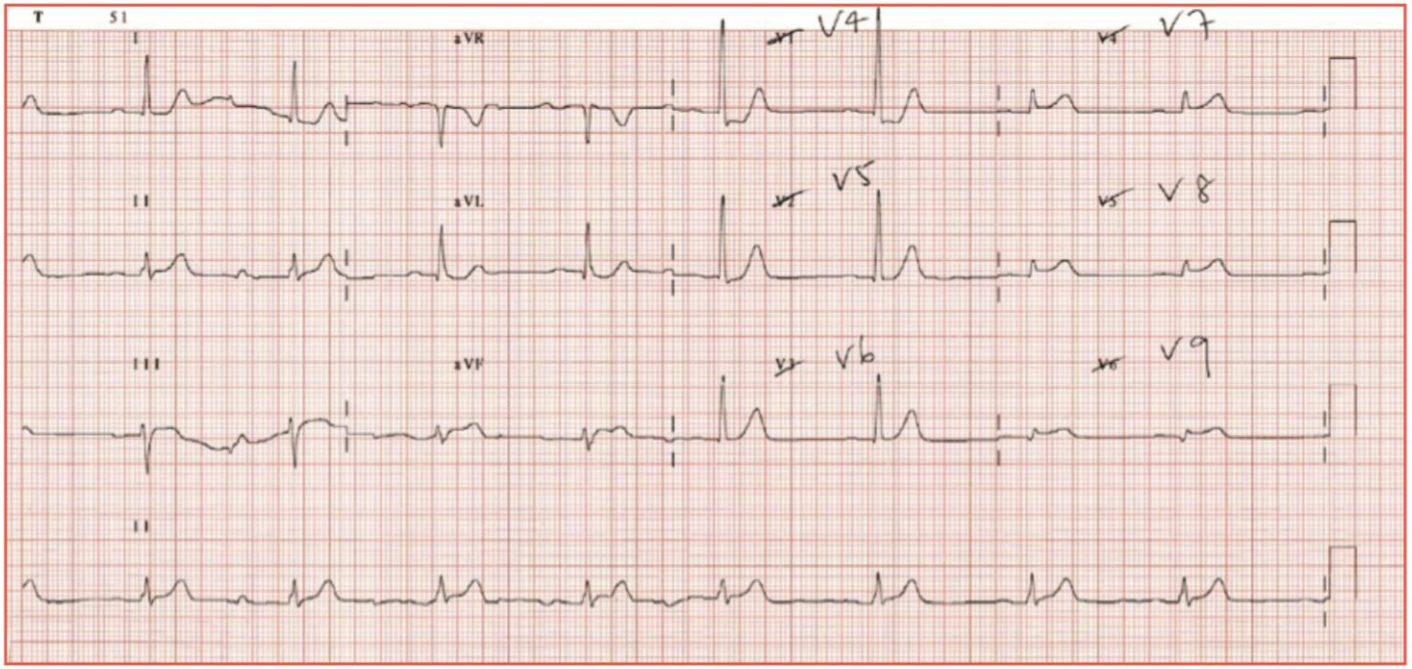
ATYPICAL: ECG PRESENTATIONS

Isolated posterior AMI: Tall R in V1; STD ≥0.5 mm V1-3 with STE ≥0.5 mm V7-9



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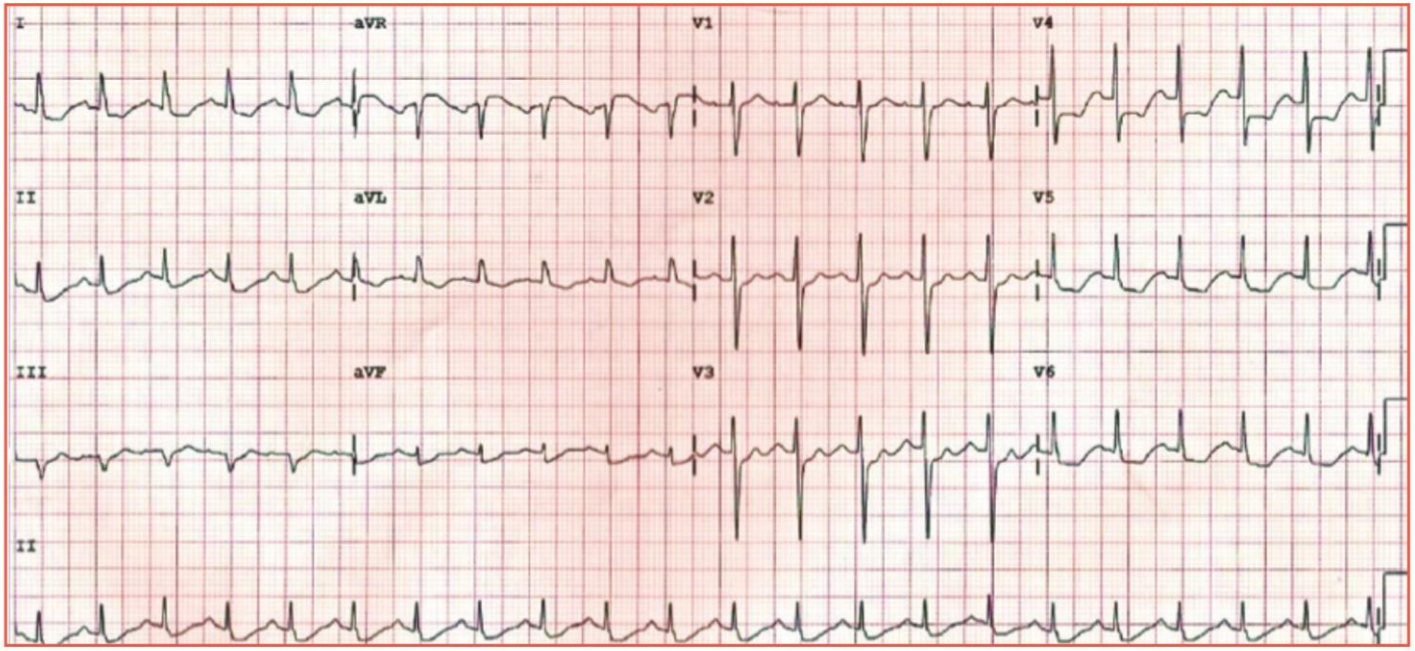
ATYPICAL: ECG PRESENTATIONS

LMCA/multivessel occlusion: STE aVR and/or V1 with STD ≥8 surface leads



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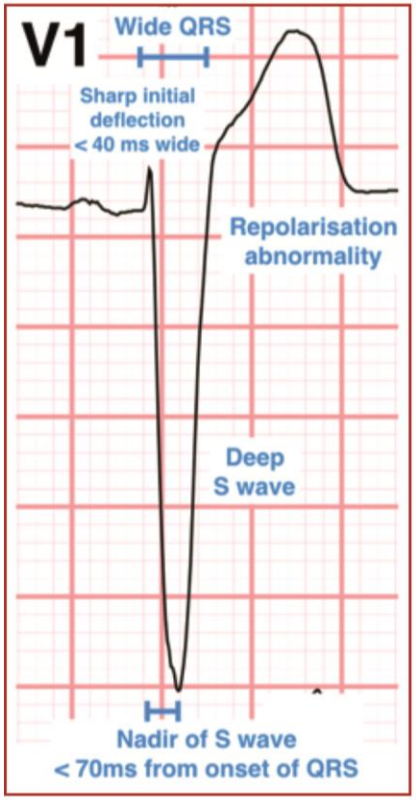
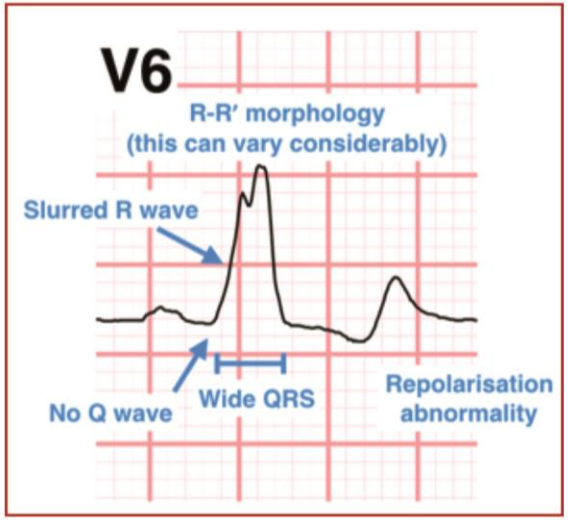
WHAT IF THE PATIENT HAS LBBB?





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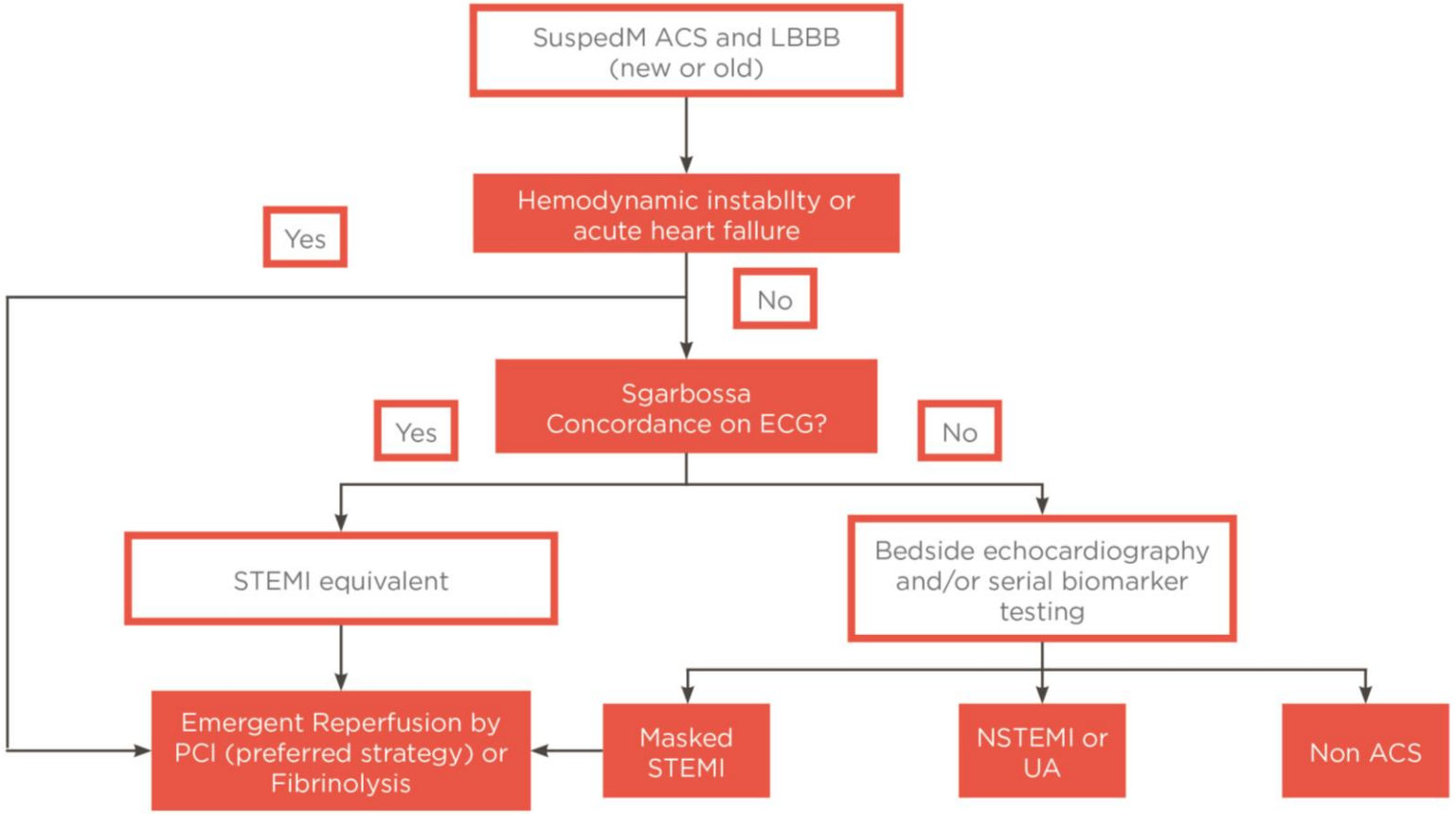
WHAT IF THE PATIENT HAS LBBB?



Neeland I, Kontos M, de Lemos J. Evolving Considerations in the Management of Patients With Left Bundle Branch Block and Suspected Myocardial Infarction. Journal of the American College of Cardiology. 2012;60(2):96-105.

(File: Neeland pg 16)

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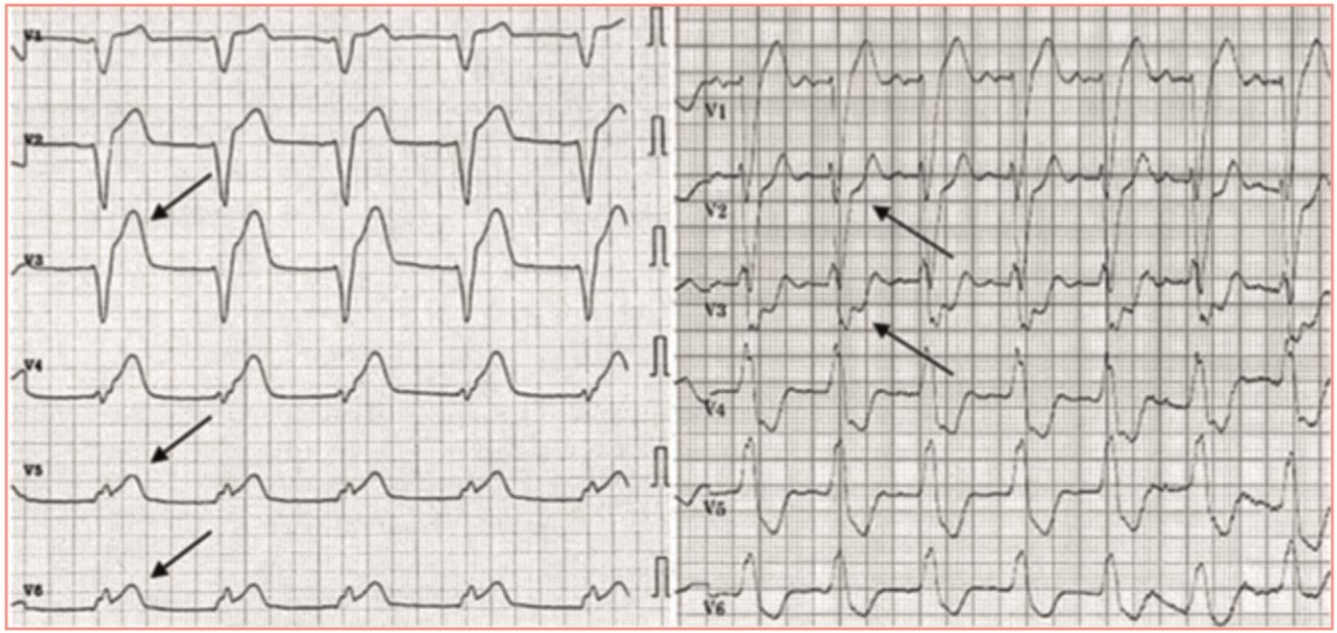
LBBB IN ACS – SGARBOSSA AND MORE...



Diagnosis of Acute Myocardial Infarction in a Patient With LBBB[1]

- ST-segment elevation at least 1mm concordant with QRS complex (arrows, leads V_5 and V_6)
- ST-segment elevation at least 5mm discordant with the QRS complex (arrow, lead V_3)
- ST-segment depression at least 1mm in leads V_2 and V_3(arrows)

Cadogan D. Sgarbossa Criteria • LITFL • ECG Library Diagnosis [Internet]. Life in the Fast Lane. 2018 [cited 12 January 2019]. Available from: https://litfl.com/sgarbossa-criteria-ecg-library/
(File: Sgarbossa Criteria)

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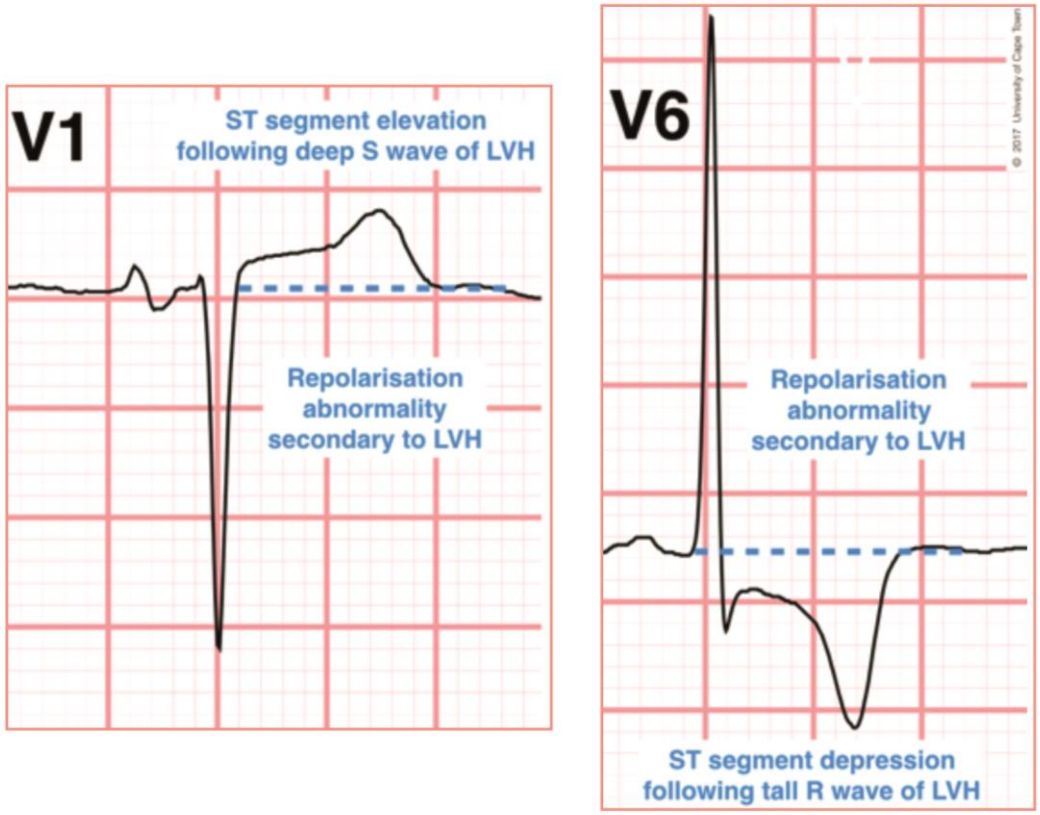
WHAT IF THE PATIENT HAS LVH?



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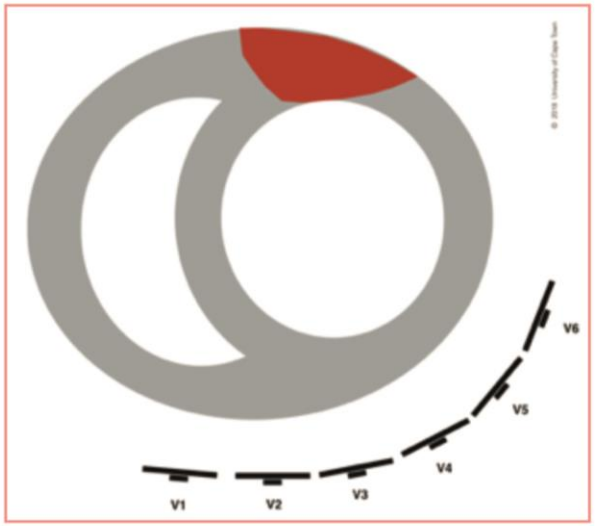
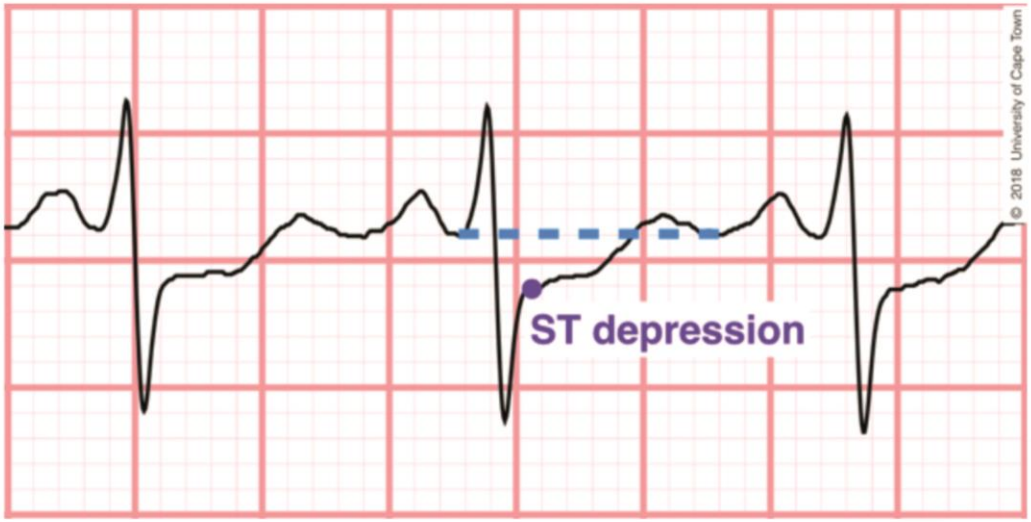
IF THERE IS NO ST SEGMENT ELEVATION, THE NEXT QUESTION IS:

Is there ST segment depression that represents ST elevation from another area (i.e. in posterior infarct)?





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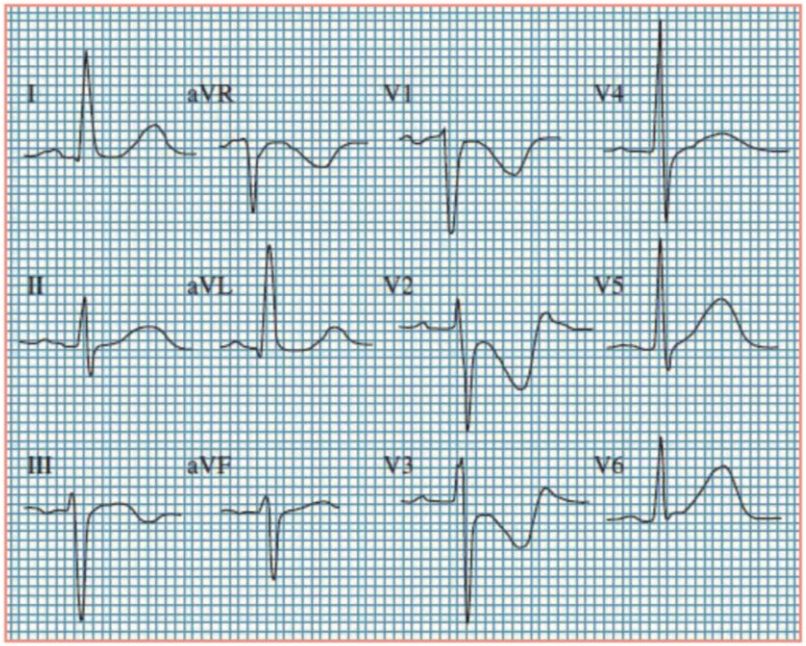
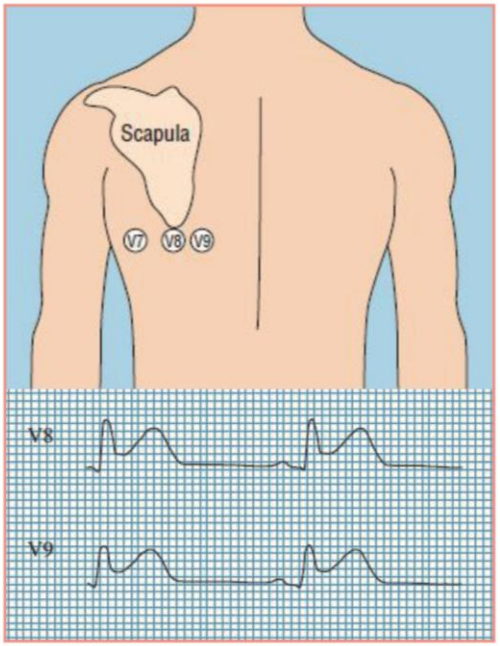
ST DEPRESSION IN ANTERIOR LEADS COULD REPRESENT POSTERIOR MI





Obtain V7, V8 and V9 if posterior infarct is suspected

REFERENCE TO BE PROVIDED
please see SSA poster
previously done

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LOOK OUT FOR COMPLICATIONS

BRADYCARDIA

No P waves: Sinus arrest
More P than QRS: 2nd / 3rd degree AV block

TACHYCARDIA

Regular wide complex tachycardia: VT

Rawshani A. Third-degree AV block (3rd degree AV block, AV block 3, AV block III) – ECG learning [Internet]. ECG learning. 2016 [cited 12 January 2019]. Available from: https://ecgwaves.com/ecg-third-degree-av-block-iii-3-criteria-management/
(File: Rawshani 3)

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THE CLASSIFICATION OF ISCHEMIC SYNDROMES

INFARCTION

STEMI

Aetiology
Complete occlusion (typically thrombosis or embolism) of a coronary artery.

ECG
- ST segment elevation >1 mm (0.1 mV) in 2 or more anatomically contiguous precordial leads or 2 or more adjacent limb leads
- OR- New or presumed new LBBB

STEMI mimics:
- left ventricular hypertrophy,
- left bundle-branch block,
- paced rhythm,
- benign early repolarization,
- pericarditis, and
- hyperkalemia

Biomarkers:
Useful for confirmatory and prognostic purposes, but are not required for the diagnosis of STEMI and should not delay treatment.

ISCHEMIA

High-risk unstable angina (UA) or NSTEMI

Aetiology
- Transient or near-complete occlusion
- Acute factor that deprives myocardium of oxygen
    - focal coronary artery spasm,
    - severe progressive atherosclerosis,
    - restenosis following PCI,
    - recreational drug use (e.g., cocaine or other stimulants),
    - arterial inflammation, and
    - extrinsic causes leading to myocardial supply-demand mismatch (i.e., type 2 MI precipitated by acute blood loss in a patient with underlying CAD)]

ECG
- Ischaemic ST-segment depression of 0.5 mm (0.5 mV) or greater
- OR- Dynamic T wave inversion with pain or discomfort
- OR- Transient ST elevation of 0.5 mm or greater for less than 20 minutes.

Biomarkers:
Serum levels of cardiac biomarkers are elevated.

? NORMAL

Intermediate or low risk UA

Aetiology
Present in patients with ischaemic symptoms suggestive of an ACS and no elevation in troponins, with or without electrocardiogram changes indicative of ischaemia.

ECG
- Normal or non-diagnostic changes in ST segment or T wave that are inconclusive and require further risk stratification
- Includes people with normal ECGs and those who have ST-segment deviation in either direction that is less than 0.5 mm or T wave inversion of 2 mm or 0.2 mV or less

Biomarkers:
Serum levels of cardiac biomarkers are not elevated.

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CARDIAC BIOMARKERS

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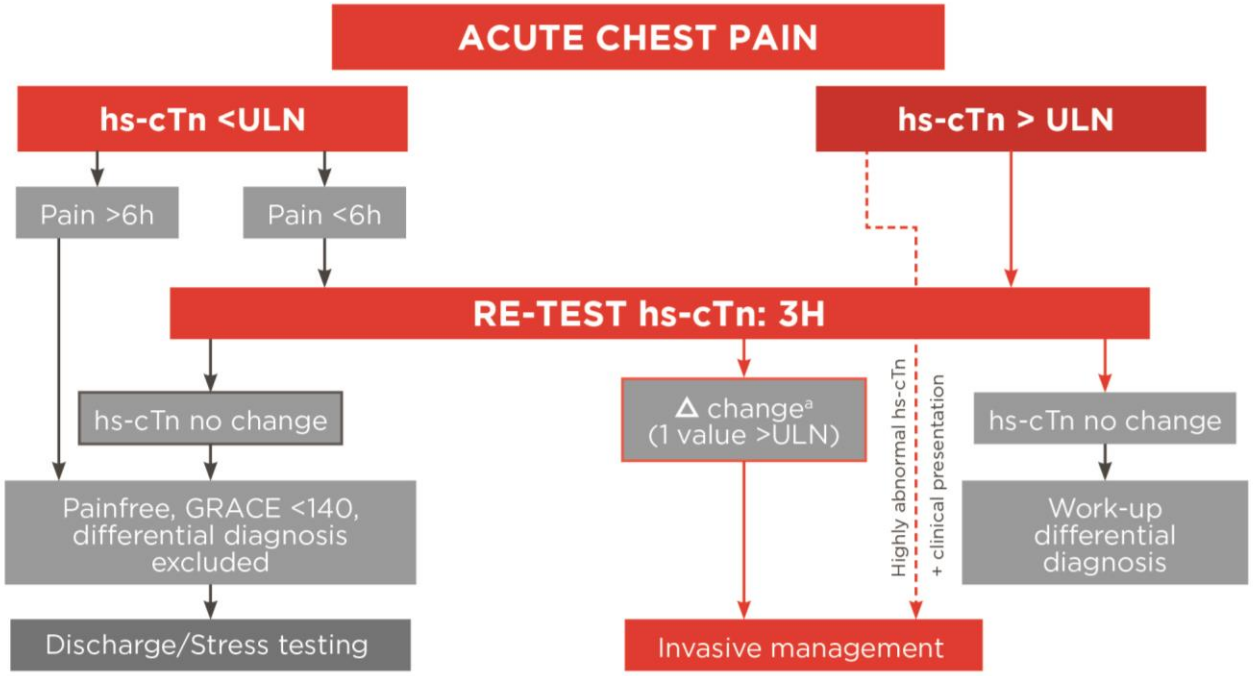
REFERENCE

0H/3H DIAGNOSTIC ALGORITHM USING HIGHSENSITIVITY CARDIAC TROPONIN (HS-CTN) ASSAYS



GRACE = Global Industry of Acute Coronary Events score; hs-cTn = high sensitivity cardiac troponin; ULN = upper limit of normal, 99th percentile of healthy control. [a]Δ change, dependant on assay, Highly abnormal hs Tn defines values beyond 5-fold the upper limit of normal

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.

(ESC NSTEMI 2015 page 10 Figure 2)

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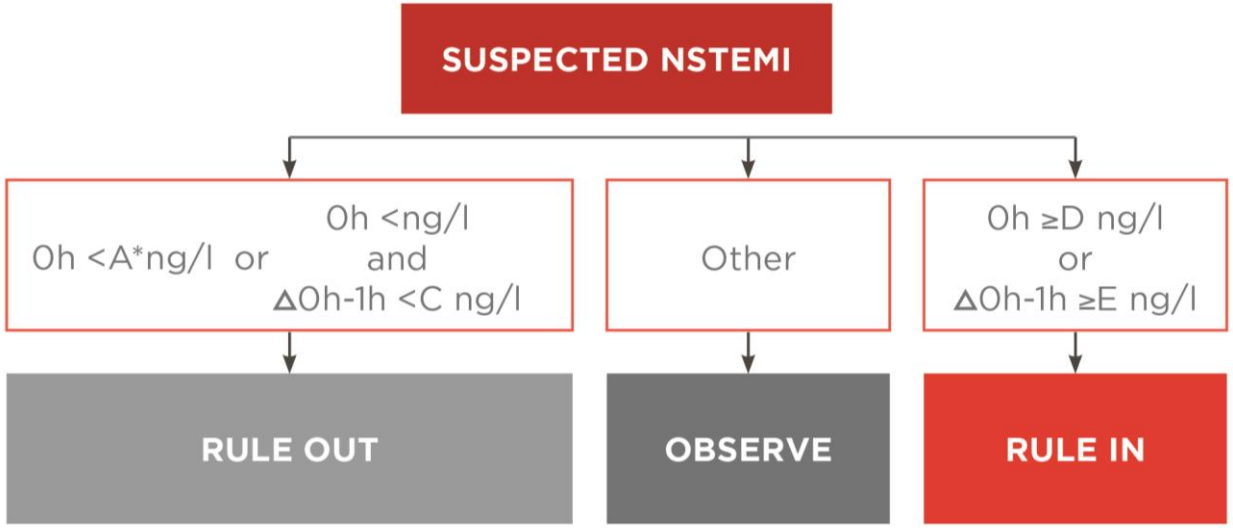
0H/1H DIAGNOSTIC ALGORITHM USING HIGHSENSITIVITY CARDIAC TROPONIN



	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

*Only applicable if chest pain onset >3h
+At the time of the publication of the guideline not yet commercially available

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.

(ESC NSTEMI 2015 page 10 Figure 2)

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CAUSES OF CARDIAC TROPONIN ELEVATION (OTHER THAN ACUTE CORONARY SYNDROMES)

STEMI type	Area affected	Occluded vessel	Prognosis
Ischaemic mechanism	**Other mechanisms**	**Other mechanisms**	**Stable atherosclerotic coronary artery disease**
Acute heart failure	Cardiac contusion	Endocarditis	Other coronary disease e.g. SLE, scleroderma, Kawasaki's disease, transplant vasculopathy
Pulmonary embolism	Procedural trauma:	Stroke	Atrial fi brillation
Tachy-arrhythmias	Cardiac surgery	Tako-tsubo cardiomyopathy	Chronic heart failure
Brady-arrhythmias	Uncomplicated PCI	Rhabdomyolysis	Chronic renal failure
Accelerated hypertension	ASD closure	COPD exacerbation	Hypertension/ LV hypertrophy
Hypotension/shock	Endomyocardial biopsy	Acute renal failure	Pulmonary arterial hypertension
Sepsis	Pacing	Burns > 30%	Aortic valve disease
ADRS	ICD shocks	Snake venoms	Hypertrophic cardiomyopathy
Aortic dissection	RF/cryo ablation	Chemotherapy: Adriamycin, 5-fluoro-uracil, herceptin	Infiltration: amyloidosis, haemochromatosis, sarcoidosis
Carbon monoxide poisoning	External cardiac massage	Sympathomimetic drugs	Peri-partum cardiomyopathy
	External cardioversion/ defibrillation	Strenouous exertion	Hypothyroidism
		After non-cardiac surgery	Diabetes

LV, left ventricle; RV, right ventricle; LAD, left anterior descending artery; LCX, left circumflex artery; LCA, left coronary artery; RCA, right coronary artery. a ~40% of these patients have a concomitant RV infarction and a poor prognosis; b Not directly visualised by the standard 12- lead ECG – must be confirmed by 15-lead ECG; C RV infarction is uncommon.

Jardine R, Dalby A, Klug E, Vermaak W, White H, Badenhorst J et al. Consensus statement on the use of high sensitivity cardiac troponins. SA Heart. 2012;9(3):210-215
(SA Heart Consensus Guidelines, table 2 pg 212)

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TREATMENT STRATEGIES

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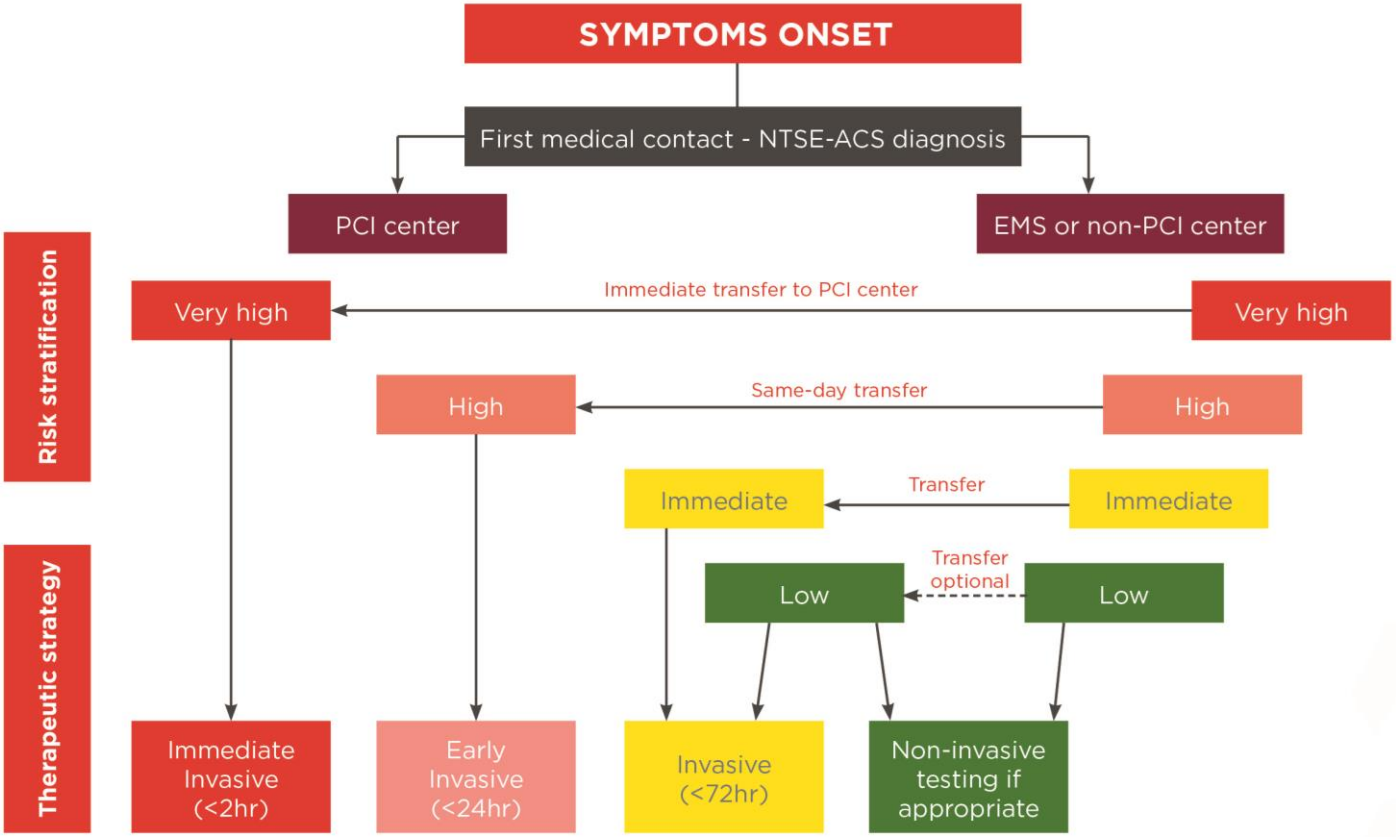
REFERENCE

SELECTION OF NTSE-ACS TREATMENT STRATEGY AND TIMING ACCORDING TO INITIAL RISK STRATIFICATION



EMS = emergency medical services; PCI = percutaneous coronary intervention

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.

(ESC NSTEMI 2015 pg 30 figure 6)

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LONG-TERM MANAGEMENT POST NSTE-ACS (1)

Recommendations	Class	Level
It is recommended to advise all patients on life style changes (including smoking cessation, regular physical activity and a healthy diet).	I	A
It is recommended to start high-intensity statin therapy as early as possible, unless contraindicated, and maintain it long-term.	I	A
An ACE Inhibitor Is recommended In patients with LVEF ≤40%, or heart failure, hypertension or diabetes, unless contraindicated. An ARB provides an alternative, particularly if ACE inhibitors are not tolerated.	I	A
Beta-blocker therapy Is recommended In patients with LVEF ≤40%, unless contraindicated.	I	A

Fig 1. Heart Pathway [26].

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 39 5.9.3)

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LONG-TERM MANAGEMENT POST NSTE-ACS (2)

Recommendations	Class	Level
Mineralocorticoid receptor antagonists, preferably eplerenone, are recommended In patients with LVEF is 35% and either heart failure or diabetes after NSTE-ACS but no significant renal dysfunction or hyperkalaemia.	I	A
A diastolic blood pressure goal of <90 mm-Hg is recommended (<85mm-Hg in diabetic patients).	I	A
Participation in a well-structured cardiac rehabilitation program to modify lifestyle habits and increase adherence to treatment should be considered.	IIa	A
In patients with LDL-cholesterol ≥70 mg/dL (≥1.8 mmol/L) despite a maximally tolerated statin dose, further reduction in LDL-cholesterol with a non-statin agent* should be considered.	IIa	B
A systolic blood pressure goal of <140 mm-Hg should be considered.	IIa	B

*At the time of finalizing these guidelines this recommendation applied only to ezetimibe.

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 39 5.9.3)

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MONITORING IN PATIENTS WITH SUSPECTED NSTE-ACS

Recommendations	Class	Level
Continuous rhythm monitoring is recommended until the diagnosis of NS1EMI is established or ruled out.	I	C
It is recommended to admit NSTEMI patients to a monitored unit.	I	C
Rhythm monitoring up to 24h or PCI (whichever comes first) should be considered in NSTEMI patients at low risk for cardiac arrhythmias.	IIa	C
Rhythm monitoring for >24h should be considered in NSTEMI patients at intermediate to high-risk for cardiac arrhythmias.	IIa	C
In the absence of signs or symptoms of ongoing ischaemia, rhythm monitoring in unstable angina may be considered in selected patients (e.g. suspicion of coronary spasm or associated symptoms suggestive of arrhythmic events).	IIb	C

ACS = acute coronary syndromes; NSTEMI = non-ST-elevation myocardial infarction; PCI = percutaneous coronary intervention.

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 28 table 13)

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MANAGEMENT - ACUTE MI

Apple F. Acute Myocardial Infarction and Coronary Reperfusion: Serum Cardiac Markers for the 1990s. American Journal of Clinical Pathology. 1992;97(2):217-226.

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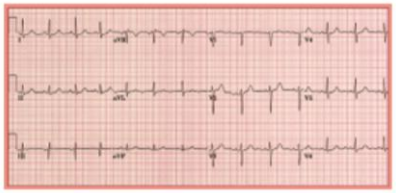
MANAGEMENT - LOW RISK CHEST PAIN/ACS

HISTORY (ANAMNESIS)	Highly suspicious	2	
	Moderately suspicious	1	
	Slightly suspicious	0	
ECG	Significant ST-deviation	2	
	Non-specific repolarisation disturbance/LBBM/PM	1	
	Normal	0	
AGE	≥ 65 years	2	
	45 – 65 years	1	
	≤ 45 years	0	
RISK FACTORS	≥ 3 risk factors or history or atherosclerotic disease	2	
	1 or 2 risk factors	1	
	No risk factors known	0	
TROPONIN	≥ 3x normal limit	2	
	1 – 3x normal limit	1	
	≤ normal limit	0	
		TOTAL	

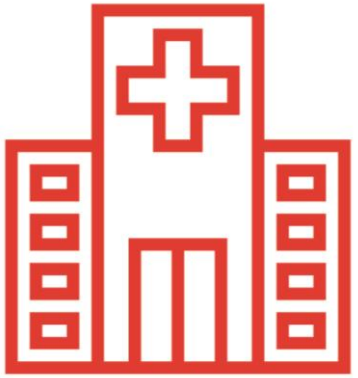
HEART SCORE	RISK CATEGORY
0 - 3	LOW RISK

+



Normal or non-diagnostic ECG
(STdeviation <0.5mm; t-wave ≤2mm)

=



PROPOSED POLICY

DISCHARGE FOLLOW UP
within 1 week
(physician/cardiologist)

Brady W, de Souza K. The HEART score: A guide to its application in the emergency department. Turkish Journal of Emergency Medicine. 2018;18(2):47-51. (HEART score Pg 2 Fig. 1)

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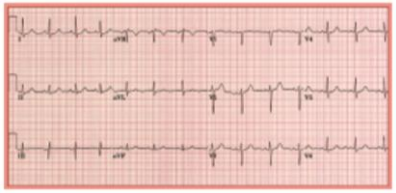
MANAGEMENT - @RISK ACS (EXCLUDING DIAGNOSED AMI)

HISTORY (ANAMNESIS)	Highly suspicious	2	
	Moderately suspicious	1	
	Slightly suspicious	0	
ECG	Significant ST-deviation	2	
	Non-specific repolarisation disturbance/LBBM/PM	1	
	Normal	0	
AGE	≥ 65 years	2	
	45 – 65 years	1	
	≤ 45 years	0	
RISK FACTORS	≥ 3 risk factors or history or atherosclerotic disease	2	
	1 or 2 risk factors	1	
	No risk factors known	0	
TROPONIN	≥ 3x normal limit	2	
	1 – 3x normal limit	1	
	≤ normal limit	0	
		TOTAL	

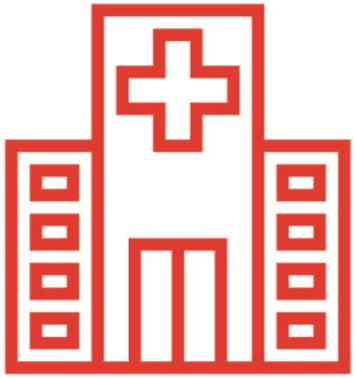
HEART SCORE	RISK CATEGORY
>4	LOW RISK

+



Normal or non-diagnostic ECG
(STdeviation <0.5mm; t-wave ≤2mm)

=



PROPOSED POLICY

OBSERVATION pre-transfer
MANAGEMENT
URGENT TRANSFER
± SPECIFIC TREATMENT

Brady W, de Souza K. The HEART score: A guide to its application in the emergency department. Turkish Journal of Emergency Medicine. 2018;18(2):47-51. (HEART score Pg 2 Fig. 1)

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IMMEDIATE GENERAL TREATMENT

* Support ABCs (resuscitate if/as need)
* If SaO_2 < 94% start LFNC 02 @ 2L/min –titrate

- **ASPIRIN 300mg** chewed STAT[1]
- **NITROGLYCERIN[1]**
  (1st check ECG, see contraindications)
  - Nitrolingual Spray®:
    1 spray ±repeat @5min (max 3)
  - Sublingual:
    1 tablet ±repeat @5min (max 3 in 15min)
- **CLOPIDOGREL 300MG[1]**
  po STAT
- ± Morphine l-2mg IVI increments if need be (discomfort not relieved by nitroglycerin)[1]

CONTRAINDICATIONS ASPIRIN[1]

Known hypersensitivity to aspirin - give patient Clopidogrel 300mg po STAT

Relative Contraindications

- Active peptic ulcer disease
- Bleeding disorder
- Allergy

CONTRAINDICATIONS NITROGLYCERIN[2]

- Hypotension SBP <90mmHg
- Severe bradycardia <50 bpm
- Severe tachycardia >100 bpm
- RV infarction (associated with inferior MI)
- Use of phosphodiesterase inhibitors:
  e.g. Sildenafil (Viagra¨)/Vardenafil (Levitra¨) within 24hrs; Tadalafil (Cialis¨) within 48hrs.

1. Amsterdam E, Wenger N, Brindis R, Casey D, Ganiats T, Holmes D et al. 2014 AHA/ACC Guideline for the Management of Patients With Non–ST-Elevation Acute Coronary Syndromes. Circulation. 2014;130(25). (AHA/ACC NSTEMI page 18/19)
2. Busti A, Kellogg D. Contraindications to the Use of Nitroglycerin in Acute Coronary Syndrome [Internet]. Ebmconsult.com. 2015 [cited 20 January 2019]. Available from: https://www.ebmconsult.com/articles/contraindications-nitroglycerin-in-acutecoronary-syndrome (Nitroglycerin CI)

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IMMEDIATE GENERAL TREATMENT

- **TITRATE OXYGEN** (starting with 4L/min) to maintain oxygen saturation ($Sa0_2$) between 90%-94%[1]
- **TITRATED IV OPIOIDS** to relieve pain[1]
- A **MILD TRANQUILLIZER** (usually a benzodiazepine) for **VERY ANXIOUS PATIENTS**[1]
- **NITROGLYCERIN** if not contraindicated (see next slide for contraindications)[2]

1. Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177. (ESC STEMI pg 9 4.2)
2. Amsterdam E, Wenger N, Brindis R, Casey D, Ganiats T, Holmes D et al. 2014 AHA/ACC Guideline for the Management of Patients With Non–ST-Elevation Acute Coronary Syndromes. Circulation. 2014;130(25). (AHA/ACC NSTEMI page 18/19)

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NITRATES CONTRAINDICATIONS

- **HYPOTENTION**
- Severe **BRADYCARDIA**
- Severe **TACHYCARDIA**
- **RV INFARCTION**
- The use of 5’ **PHOSPHODIESTERASE INHIBITOR** within the 24 to 48 hours

Busti A, Kellogg D. Contraindications to the Use of Nitroglycerin in Acute Coronary Syndrome [Internet]. Ebmconsult.com. 2015 [cited 20 January 2019]. Available from: https://www.ebmconsult.com/articles/contraindications-nitroglycerin-in-acute-coronarysyndrome

(Nitroglycerin CI)

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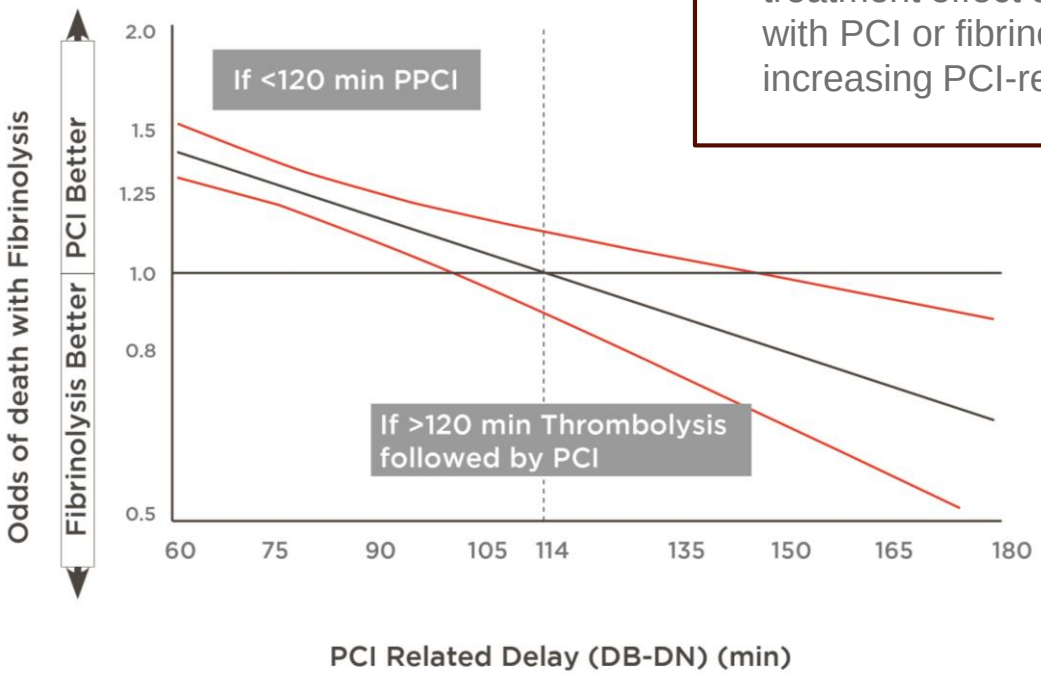
REPERFUSION CHOICE DEPENDS ON TIME TO TREATMENT

Multivariable analysis estimating the treatment effect of reperfusion therapy with PCI or fibrinolysis based on increasing PCI-related delay.



N= 192 509 pts from 645 National Registry of Myocardial Infarction Hospitals

Pinto D, Kirtane A, Nallamothu B, Murphy S, Cohen D, Laham R et al. Hospital Delays in Reperfusion for ST-Elevation Myocardial Infarction. Circulation. 2006;114(19):2019-2025. (Pinto et al page 6)

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REPERFUSION IS CRITICAL

- Need to open the **BLOCKED VESSEL** as soon as possible either via PCI or Thrombolysis
- **PPCI RECOMMENDED OVER FIBRINOLYSIS** if performed by an experienced team within 120 minutes of first medical contact
- **LONGER PCI-DELAY** are associated with higher mortality rates and reduced PPCI survival advantage[2]
- Often **NOT A 24 HOUR SERVICE!**

Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders)

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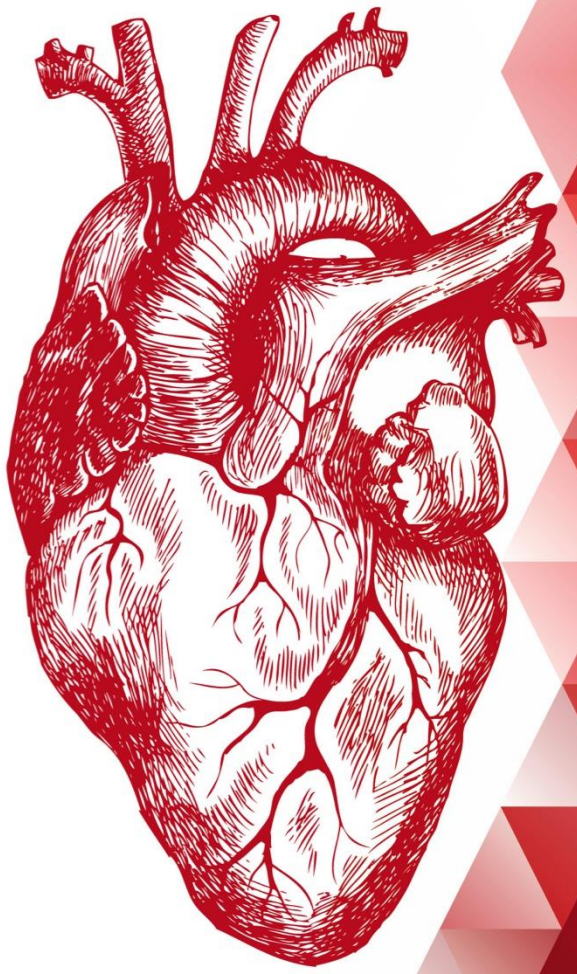
TREATMENT CHOICE CONCLUSIONS

- During first 2-3 hours after symptom onset, **TIME TO TREATMENT IS CRITICAL**
- After 3 hours, **PPCI IS PREFERRED** if it can be done within 2 hours of first medical contact.
- If not, then a **PHARMACOINVASIVE STRATEGY WITH THROMBOLYSIS** followed by immediate transfer for PCI within next 3-24 hours may improve myocardial salvage and survival.
- **IMMEDIATE OR 'RESCUE' PCI** for failed thrombolysis



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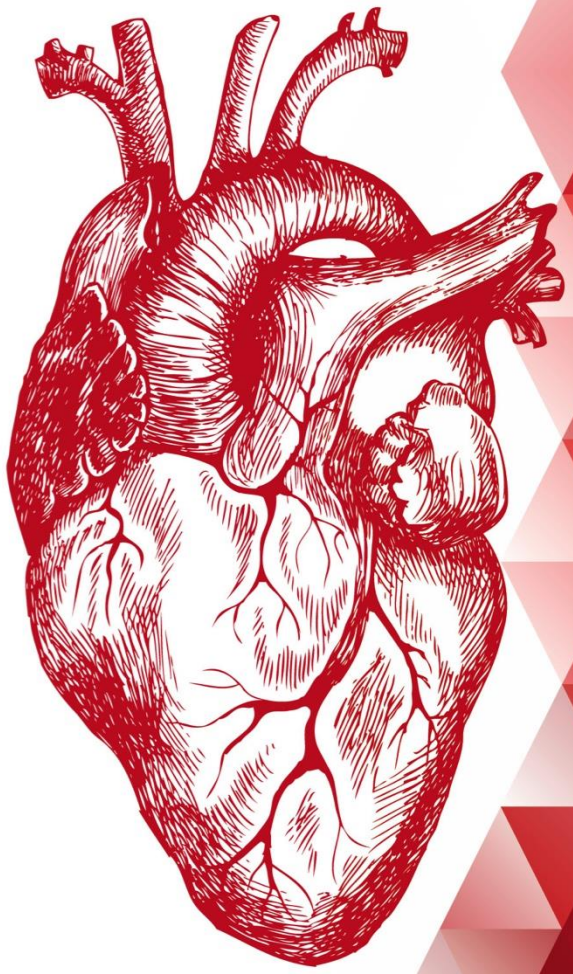
Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders)

REPERFUSION THERAPY

GENERAL RECOMMENDATIONS

- Indicated in all patients with symptoms of **ISCHAEMIA OF <12 HOURS DURATION** and persistent ST-segment elevation
- Primary PCI (pPCI) is **RECOMMENDED OVER FIBRINOLYSIS** within indicated time frames
- If pPCI cannot be performed timely after STEMI diagnosis, **FIBRINOLYTIC THERAPY IS RECOMMENDED WITHIN 12 HOURS OF SYMPTOM ONSET** in patients without contra-indications



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Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders)

REPERFUSION THERAPY

Recommendations	Class	Level
Reperfusion therapy is indicated in all patients with symptoms of ischaemia of ≤12 hours duration and persistent ST-segment elevation.	I	A
A primary PCI strategy is recommended over fibrinolysis within indicated time frames.	I	A
If primary PCI cannot be performed timely after STEMI diagnosis, fibrinolytic therapy is recommended within 12 hours of symptom onset in patients without contra-indications.	I	A

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REPERFUSION THERAPY

Recommendations	Class	Level
Reperfusion therapy is indicated in all patients with symptoms of <12h duration and persistent Stsegment elevation or (presumed) new LBBB.	I	A
Reperfusion therapy (preferably primary PCI) is indicated if there is evidence of ongoing ischaemia, even if symptoms may have started >12h beforehand or if pain and ECG changes have been stuttering.	I	C
Reperfusion therapy with primary PCI may be considered in stable patients presenting 12-24h after symptom onset.	IIb	B
Routine PCI of a totally occluded artery >24h after symptom onset in stable patients without signs of ischaemia (regardless of whether fibrinolysis was given or not) is not recommended.	III	A

ECG= electrocardiogram; i.v. = intravenous; LBBB = left bundle, branch block; PCI = percutaneous coronary intervention

Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress.
(Snyders slide 22)

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REPERFUSION THERAPY

Recommendations	Class	Level
In the absence of ST-segment elevation, a primary PCI strategy is indicated in patients with suspected ongoing ischaemic symptoms suggestive of myocardial infarction and at least one of the following criteria present: • haemodynamic instability or cardiogenic shock, • recurrent or ongoing chest pain refractory to medical treatment, • life-threatening arrhythmias or cardiac arrest, • mechanical complications of myocardial infarction, • acute heart failure, • recurrent dynamic ST-segment or T-wave changes, particularly with intermittent ST-segment elevation	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI pg 15)

REPERFUSION THERAPY

Recommendations	Class	Level
Early angiography (within 24 hours) is recommended if symptoms are completely relieved and ST-segment elevation completely normalized spontaneously or after nitroglycerin administration (provided there are no recurrence of symptoms or ST-segment elevation).	I	C
In patients with time from symptom onset >12 hours, a primary PCI strategy is indicated in the presence of ongoing symptoms suggestive of ischaemia, haemodynamic instability, or life-threatening arrhythmias.	I	C
A routine primary PCI strategy should be considered in patients presenting late (12-48 hours) after symptom onset.	IIa	B
In asymptomatic patients, routine PCI of an occluded IRA >48 hours after onset of STEMI is not indicated.	III	A

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI pg 16)

TIME TO TREAT =

DEGREE OF MYOCARDIAL SALVAGE!

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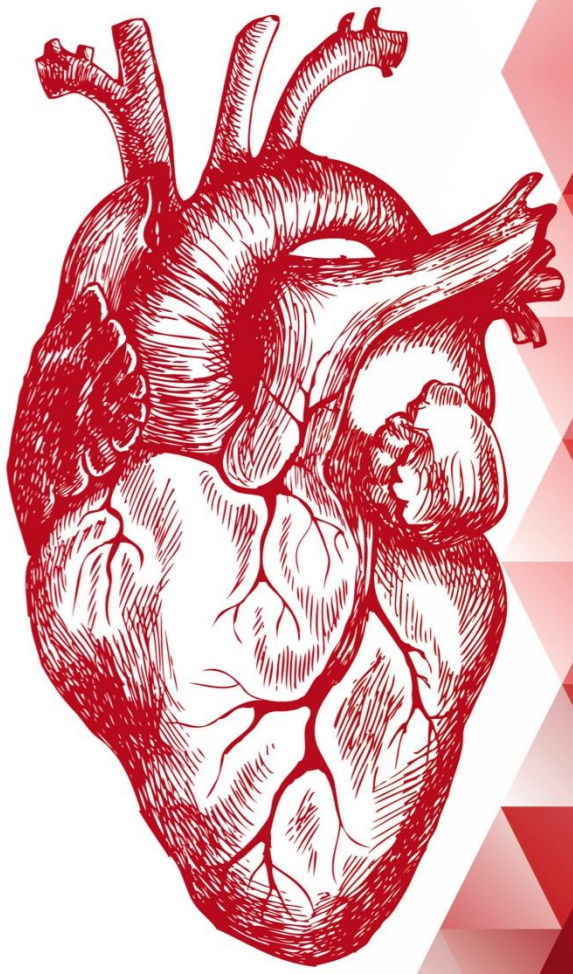
Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders slide 23)

THE INTEGRATED STRATEGY

PHARMACO-INVASIVE STRATEGY

- **FIBRINOLYSIS** within 3 hours of the onset of chest pain
- All patients to undergo **ANGIOGRAPHY ± PCI** within 3-24 hours following fibrinolysis
- Merging the **MEDICAL & MECHANICAL** strategies



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Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders slide 57, 58)

REPERFUSION STRATEGY: PPCI

ABSENSE OF ST-SEGMENT ELEVATION:

pPCI is indicated in patients with **SUSPECTED ONGOING ISCHAEMIC SYMPTOMS** suggestive of MI and at least one of the following criteria present:

- **HAEMODYNAMIC INSTABILITY** or cardiogenic shock
- Recurrent or ongoing **CHEST PAIN** refractory to medical treatment
- Life-threatening **ARRHYTHMIAS** or cardiac arrest
- **MECHANICAL COMPLICATIONS** of MI
- Acute **HEART FAILURE**
- Recurrent dynamic **ST-SEGMENT** or **T-WAVE CHANGES**, particularly with intermittent ST-segment elevation

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 34)

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REPERFUSION STRATEGY: PPCI

LATE ARRIVALS

- **EARLY ANGIOGRAPHY** (within 24 hours) if symptoms are completely relieved and ST-segment elevation completely **NORMALIZED SPONTANEOUSLY** of after nitroglycerin administration (provided there are no recurrence of symptoms or ST-segment elevation).

- Time from onset >12 hours: pPCI in the presence of **ONGOING ISCHAEMIC SYMPTOMS** suggestive of ischaemia, haemodynamic instability or life-threatening arrhythmias

- **ROUTINE PPCI STRATEGY** in late presenters (12-48 hours after symptom onset).

Roffi M, Patrono C, Collet J, Mueller C, Valgimigli M, Andreotti F et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Heart Journal. 2015;37(3):267-315.
(ESC NSTEMI 2015 pg 34)

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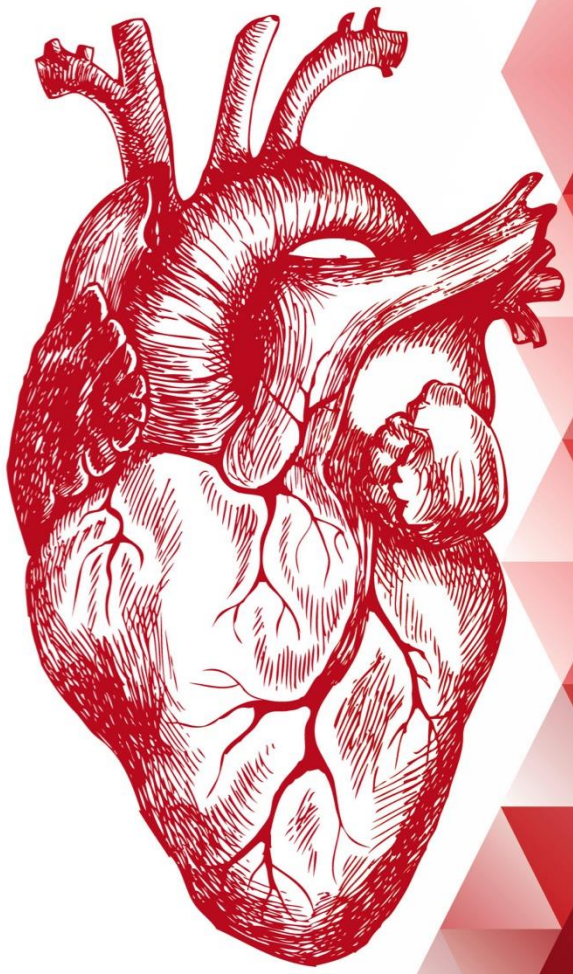
REPERFUSION STRATEGY: FIBRINOLYTIC THERAPY

GENERAL RECOMMENDATIONS:

- Inititate as soon as possible after **STEMI DIAGNOSIS,** preferably in the **PREHOSPITAL SETTING.**
- A **FIBRIN-SPECIFIC AGENT** (i.e. tenecteplase, alteplase, or reteplase) is recommended
- A half-dose of tenecteplase should be considered in patients **>75 YEARS OF AGE**



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Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177. (ESC STEMI 2017 pg 21)

REPERFUSION STRATEGY: PHARMACOINVASIVE

- Defined as: **FIBRINOLYSIS COMBINED WITH RESCUE PCI** (in case of failed fibrinolysis) or routine early PCI strategy (in case of successful fibrinolysis).

- P-PCI and the pharmaco-invasive method **ARE NOT COMPETING STRATEGIES**, but early lytic administration is a means of obtaining the best possible outcome for patients without **TIMEOUS ACCESS TO A CATH LAB**.

- Feasible in a much broader population base and may offer outcomes comparable to P-PCI in **RESOURCE-CONSTRAINED AND REMOTE REGIONS.**

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 20)

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PHARMACO-INVASIVE APPROACH

American College of Cardiology Foundation / American Heart Association (ACCF/AHA) joint committee & the European Society of Cardiology (ESC) state:

Primary percutaneous coronary intervention (PPCI) is recommended in STEMI patients within 120 min of first medical contact (FMC)[1]

If PPCI is not achievable within the recommended timeframe, fibrinolysis (pre- or in-hospital) is recommended with immediate transfer to a PCI-capable facility for early coronary angiography and PCI if indicated[2]

The combination of fibrinolysis (pharmacological) and PCI (mechanical) treatments is known as the pharmaco-invasive strategy[2]

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1. Amsterdam E, Wenger N, Brindis R, Casey D, Ganiats T, Holmes D et al. 2014 AHA/ACC Guideline for the Management of Patients With Non–ST-Elevation Acute Coronary Syndromes. Circulation. 2014;130(25) (AHA/ACC NSTEMI pg 27)
2. Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177. (ESC SCTEMI 2017 pg 22_

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THE NEED FOR A PHARMACO-INVASIVE STRATEGY

PPCI within 120 min of FMC is the gold standard in the management of STEMI. However, access to timely PPCI is not available to much of the world's population, due to:

- Socio-economic status
- Country-specific healthcare resources, practices and policies
- Non-patient-related factors such as transport conditions and location/availability of PCI-capable facilities

Armstrong P, Van de Werf F. Rationale for pharmaco-invasive strategy [Internet]. metalyse (tenecteplase). 2019 [cited 20 January 2019]. Available from: http://www.metalyse.com/pharmaco-invasive-strategy/rationale

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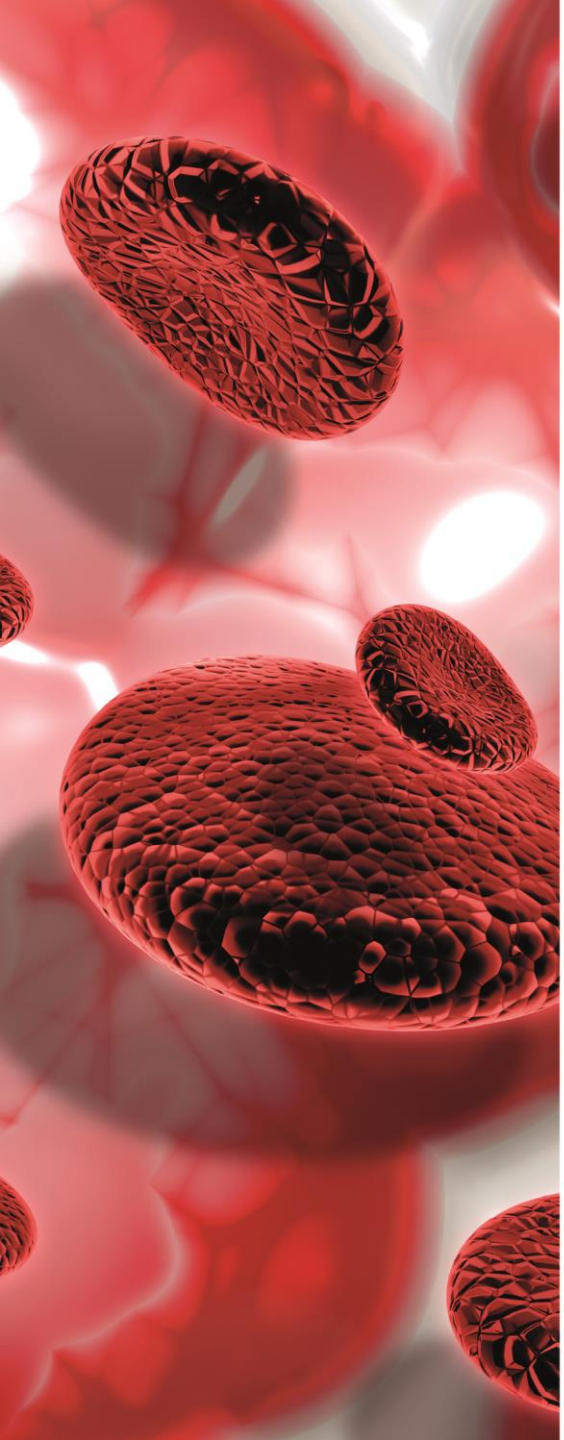
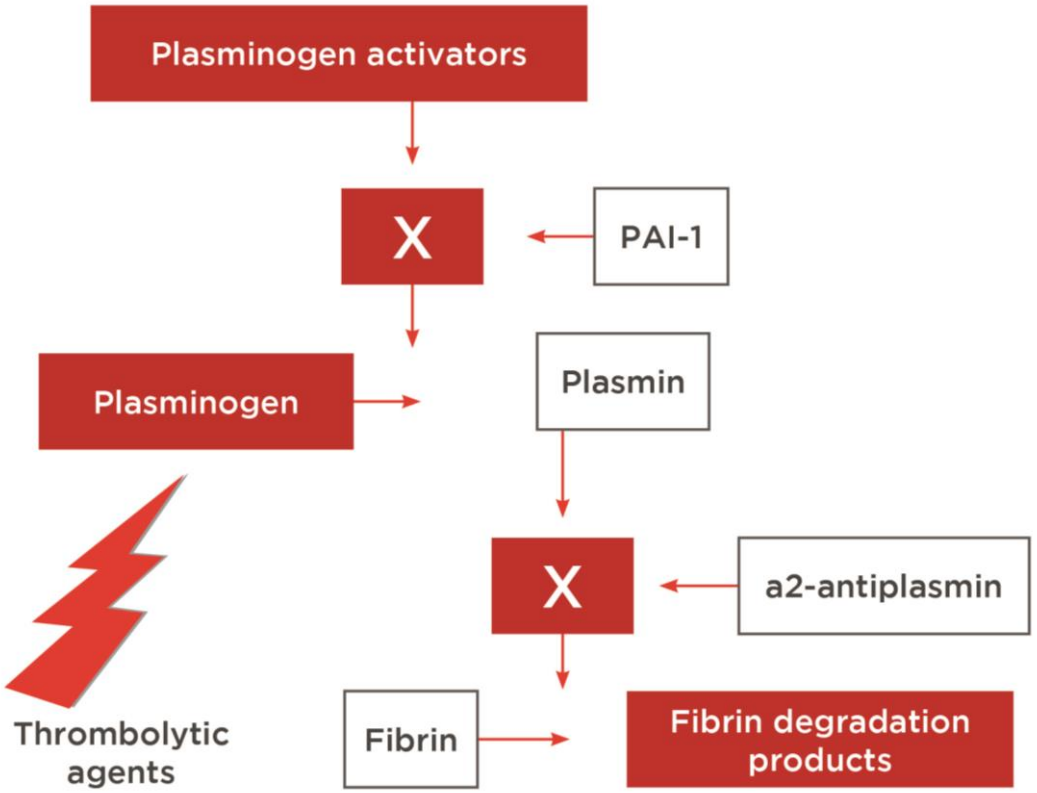


THROMBOLYTIC AGENTS



REFERENCE

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FIBRINOLYTIC THERAPY

Recommendations	Class	Level
When fibrinolysis is the reperfusion strategy, it is recommended to initiate this treatment as soon as possible after STEMI di agnosis, preferably in the prehospital setting.	I	A
A fibrin-specific agent (i.e. tenecteplase, alteplase, reteplase) is recommended.	I	B
A half-dose of tenecteplase should be considered in patients ≥75 years of age.	IIa	B
Anti platelet co-therapy with fibrinolysis		
Oral or i.v. aspirin is indicated.	I	B
Clopidogrel is indicated in addition to aspirin.	I	A
DAPT (in the form of aspirin plus a P2Y12 inhibitor) is indicated for up to 1 year in patients undergoing fibrinolysis and subsequent PCI.	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

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FIBRINOLYTIC THERAPY

Recommendations	Class	Level
Anticoagulation co-therapy with fibrinolysis		
Anticoagulation is recommended in patients treated with lytics until revascularization (if performed) or for the duration of hospital stay up to 8 days. The anticoagulant can be:	I	A
Enoxaparin i.v. followed by s.c. (preferred over UFH)	I	A
UFH given as a weight-adjusted i.v. bofus followed by infusion.	I	B
In patients treated with streptokinase: fondaparinux i.v. bolus followed by an s.c. dose 24 hours later.	IIa	B
Transfer after fibrinolysis		
Transfer to a PCI-capable centre following fibrinolysis is indicated in all patients immediately after fibrinolysis	I	A

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

FIBRINOLYTIC THERAPY

Recommendations	Class	Level
Interventions following fibrinolysis		
Emergency angiography and PCI if indicated is recommended in patients with heart failure/shock.	I	A
Rescue PCI is indicated immediately when fibrinolysis has failed (<50% ST-segment resolution at 60-90 min) or at any time in the presence of haemodynamic or electrical instability, or worsening ischaemia.	I	A
Angiography and PCI of the IRA, if indicated, is recommended between 2 and 24 hours after successful fibrinolysis.	I	A
Emergency angiography and PCI if needed is indicated in the case of recurrent ischaemia or evidence of reocdusion after initial successful fibrinolysis.	I	B

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

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DOSES OF FIBRINOLYTIC AGENTS

Drug	Initial Treatment	Specific contra-indications
Doses of fibrinolytic therapy		
Streptokinase	1.5 million units over 30-60 min i.v.	Previous treatment with streptokinase or anistreplase
Alteplase (tPA)	15mg i.v. bolus 0.75mg/kg i.v. over 30 min (up to 50mg) then 0.5mg/kg i.v. over 60 min (up to 35mg)	
Reteplase (rPA)	10 units + 10 units i.v. bolus given 30 min apart	
Tenecteplase (TNK-tPA)	Single i.v. bolus 30mg (6000 IU) if <60kg 35mg (7000 IU) if 60 to <70kg 40mg (8000 IU) if 70 to <80kg 45mg (9000 IU) if 80 to <90kg 50mg (10000 IU) if >90kg It is recommended to reduce to half-dose in patients >75 years of age	

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

CONTRA-INDICATIONS TO FIBRINOLYTIC THERAPY

ABSOLUTE:

- Previous intracranial haemorrhage or stroke of **UNKNOWN ORIGIN AT ANYTIME**
- Ischaemic stroke in the **PRECEDING 6 MONTHS**
- Central nervous system damage or neoplasms or **ARTERIOVENOUS MALFORMATION**
- Recent **MAJOR TRAUMA/SURGERY/HEAD INJURY** (within the preceding month)
- **GASTROINTESTINAL BLEEDING** within the past month
- Known **BLEEDING DISORDER** (excluding menses)
- **AORTIC DISSECTION**
- **NON-COMPRESSIBLE PUNCTURES** in the past 24 hours (e.g. liver biopsy, lumbar puncture)

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

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CONTRA-INDICATIONS TO FIBRINOLYTIC THERAPY

RELATIVE:

- **TRANSIENT ISCHAEMIC ATTACK** in the preceding 6 months
- Oral **ANTICOAGULANT THERAPY**
- **PREGNANCY** or within 1 week postpartum
- **REFRACTORY HYPERTENSION** (SBP >180 mm Hg and/or DBP >110 mm-Hg)
- Advanced **LIVER DISEASE**
- Infective **ENDOCARDITIS**
- Active **PEPTIC ULCER**

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

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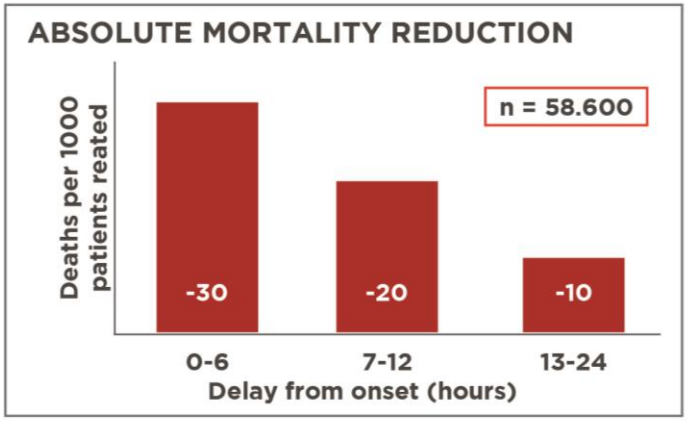
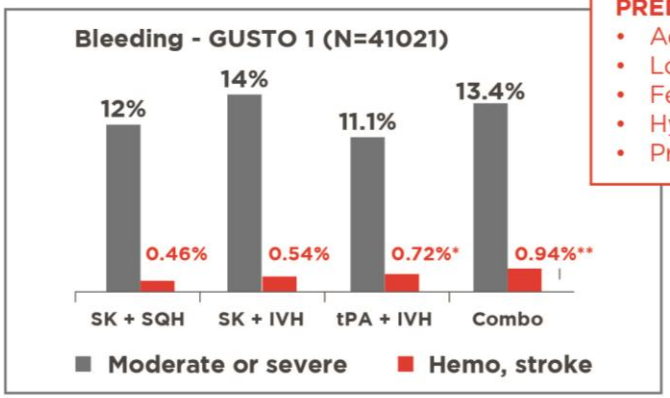
BUT WHAT ABOUT THE RISKS ASSOCIATED WITH THROMBOLYSIS?





PREDICTORS
- Advanced age
- Low weight
- Female
- Hypertension
- Prior stroke

THROMBOLYSIS IS HIGHLY EFFECTIVE BUT THERE IS 1% CHANCE OF INTRACRANIAL BLEEDING

*p = 0.003 vs SK ** p<0.001 vs SK

Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders slide 33)

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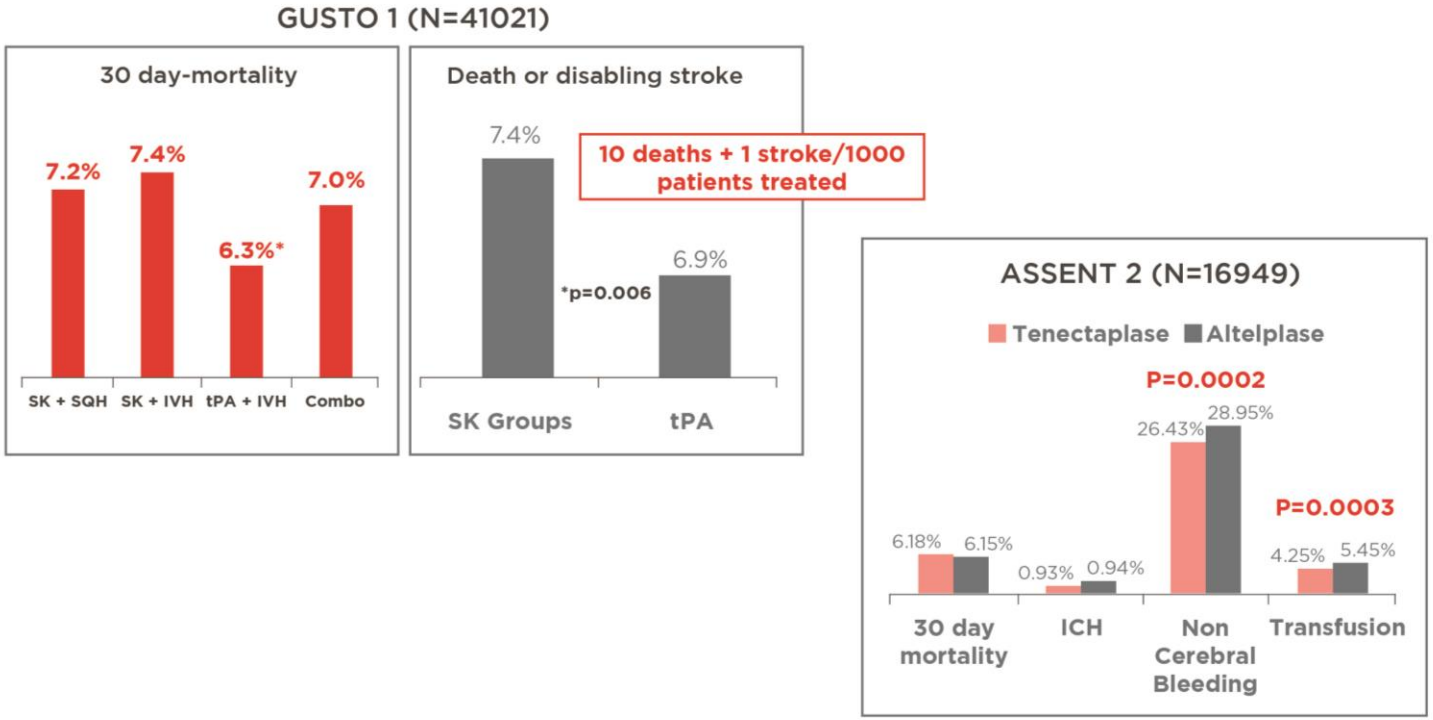
TENECTEPLASE HAS A LOWER RATE OF NON CEREBRAL BLEEDING AND EASY ADMINISTRATION



*p = 0.001 vs SK

Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress. (Snyders slide 34)

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SO DO I WAIT TO CHECK ON THE SUCCESS OF THROMBOLYSIS?

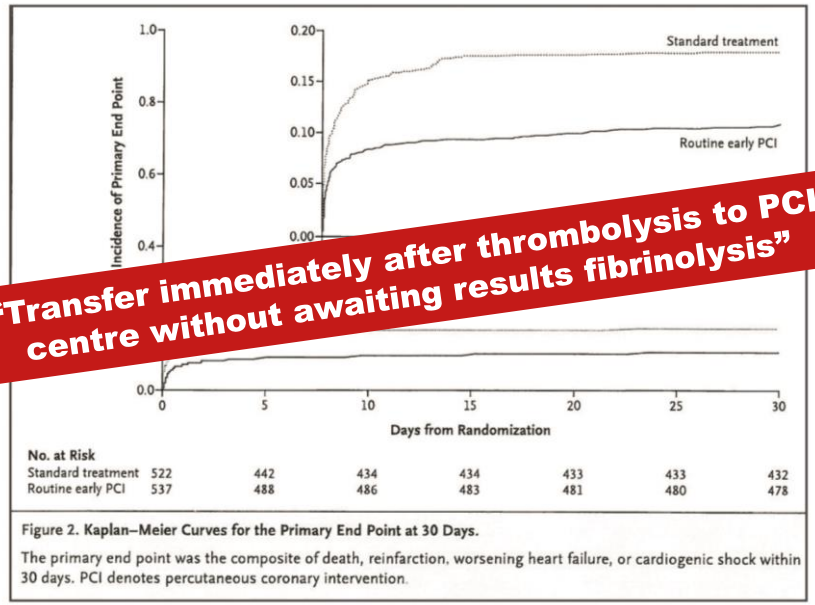

Figure 2. Kaplan–Meier Curves for the Primary End Point at 30 Days.

The primary end point was the composite of death, reinfarction, worsening heart failure, or cardiogenic shock within 30 days. PCI denotes percutaneous coronary intervention.

"Transfer immediately after thrombolysis to PCI centre without awaiting results fibrinolysis"

Routine transfer and PCI within 6 hours after lysis

OR

Transfer after 24 hours and elective cath within 2 weeks or urgent transfer for failed lysis (rescue PCI)

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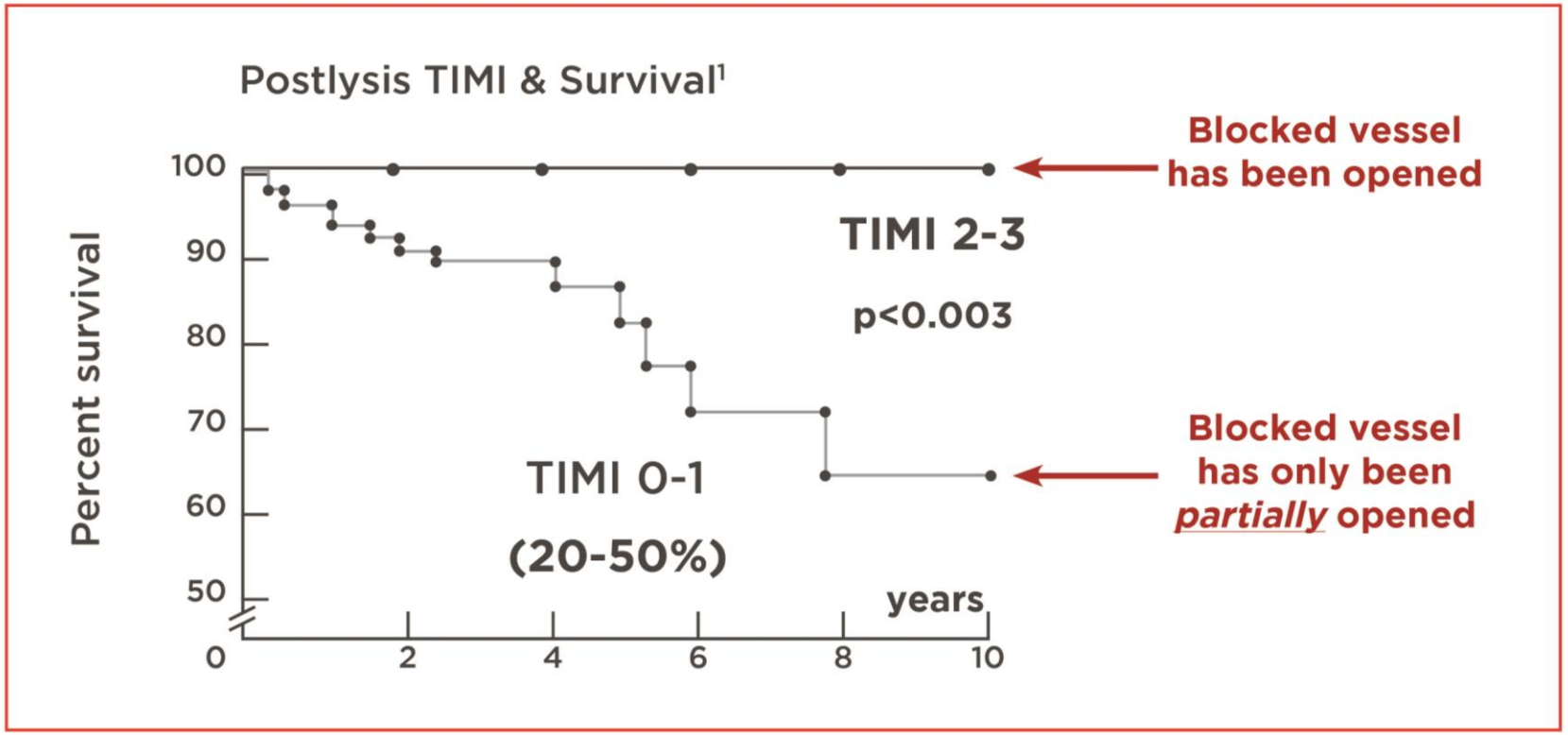
HOW DOES SUCCESS OF THROMBOLYSIS AFFECT SURVIVAL RATES?



Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress.
(Snyders slide 35)

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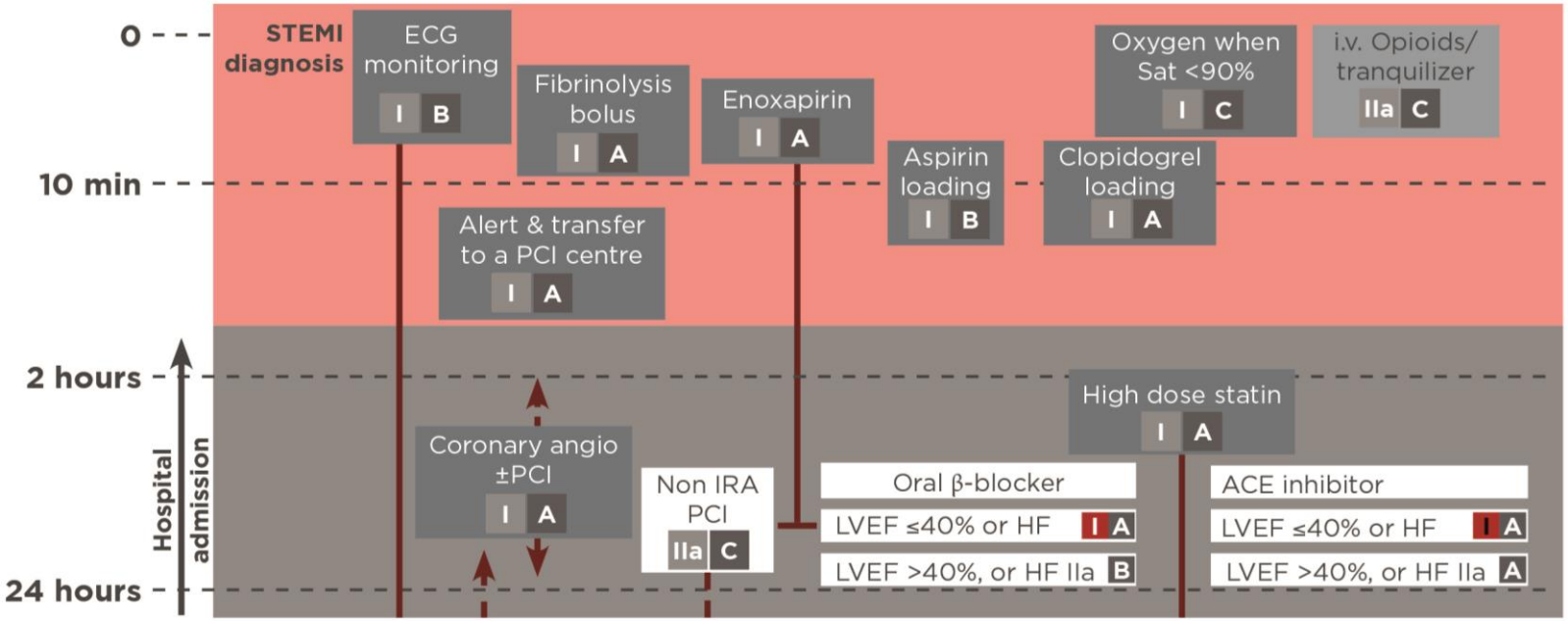
“DO NOT FORGET” INTERVENTIONS IN STEMI PATIENTS UNDERGOING A SUCCESSFUL FIBRINOLYSIS STRATEGY

Strategy clock



Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

(ESC STEMI 2017 pg 14 Fig 3)

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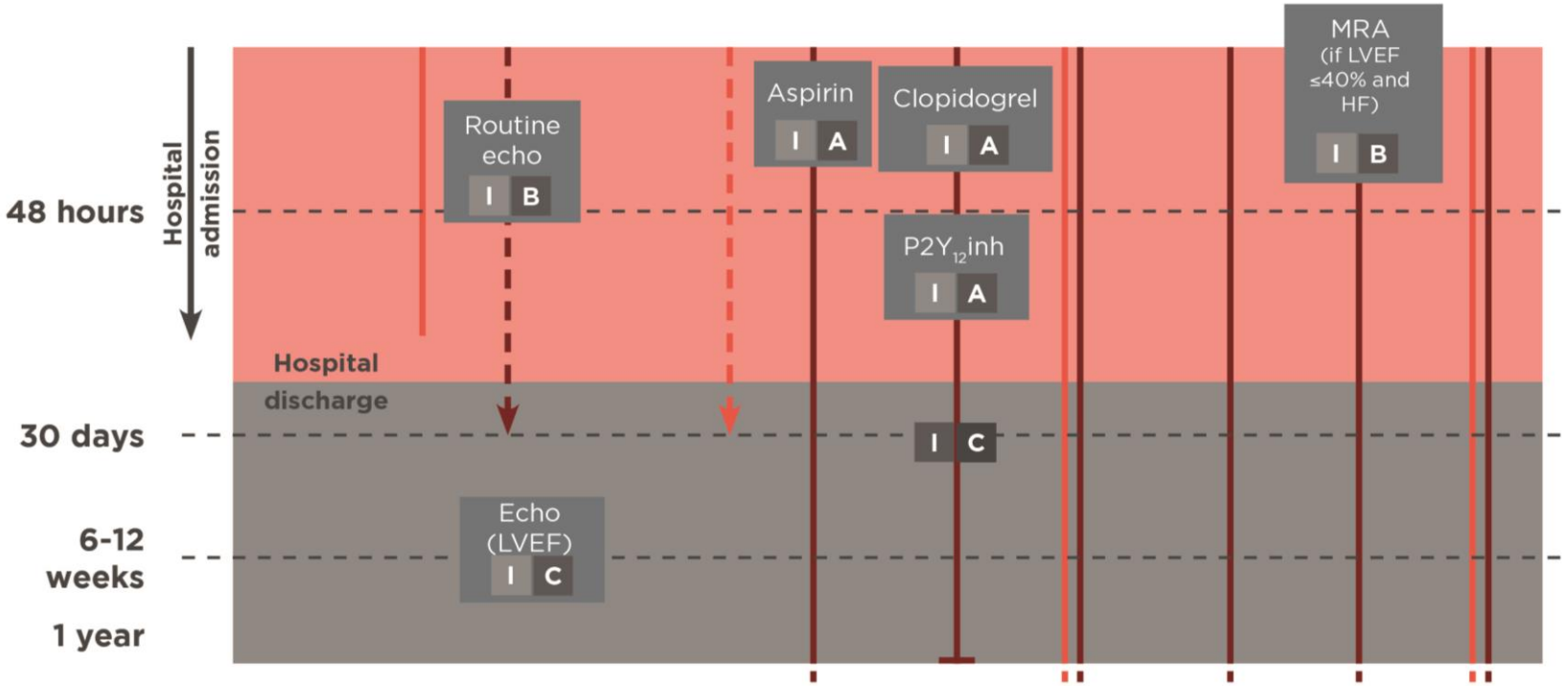
“DO NOT FORGET” INTERVENTIONS IN STEMI PATIENTS UNDERGOING A SUCCESSFUL FIBRINOLYSIS STRATEGY



Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177

(ESC STEMI 2017 pg 36 Fig 5)

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APPROACH TO PHARMACOTHERAPY IN EARLY HOSPITAL CARE OF PATIENTS WITH AN ACUTE CORONARY SYNDROME WITHOUT ST-SEGMENT ELEVATION

Therapeutic Target	Intervention
Myocardial supply–demand mismatch	• **OXYGEN:** Administer supplemental oxygen only if oxygen saturation <90% • **ANALGESICS:** Intravenous morphine (1 to 5mg; may repeat in 5 to 30 min if necessary) may be reasonable for persistent ischaemic pain. • **NITRATES:** Administer sublingual nitroglycerin (0.3 to 0.4mg; may repeat in 5 min, two times, as needed) for ischaemic pain and intravenous nitroglycerin for persistent ischaemia, heart failure, or hypertension. • **BETA-BLOCKERS:** An oral beta-blocker should be started in the first 24hr if there is no heart failure, low-output state, risk for shock, or other contraindication.† • **CALCIUM-CHANNEL BLOCKERS:** A calcium-channel blocker (nondihydropyridine) should be used for persistent ischaemia when betablockers are not successful, are contraindicated, or have unacceptable side effects.‡

- Adapted from Amsterdam et al. The approach to general treatment measures is similar for STEMI, although calcium-channel blockers are only weakly recommended for patients for whom beta-blockers are associated with unacceptable adverse events. The recommendation is class I for all listed interventions except analgesics and some uses of angiotensin-converting–enzyme (ACE) inhibitors, which are both class IIb; ACE inhibitors are class I in all patients with a left ventricular ejection fraction (LVEF) of <0.4 and in those with hypertension, diabetes mellitus, or stable chronic kidney disease and class IIb in all other patients with cardiac or other vascular disease
- † Beta-blockers also reduce the incidence of tachyarrhythmias. Patients with initial contraindications to beta-blockers should be reassessed for eligibility.
- ‡ Contraindications to calcium-channel blockers include left ventricular dysfunction, an increased risk of cardiogenic shock, a PR interval of more than 0.24 seconds, and second- or third-degree atrioventricular block in a patient without a cardiac pacemaker.

Anderson J, Morrow D. Acute Myocardial Infarction. New England Journal of Medicine. 2017;376(21):2053-2064.

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APPROACH TO PHARMACOTHERAPY IN EARLY HOSPITAL CARE OF PATIENTS WITH AN ACUTE CORONARY SYNDROME WITHOUT ST-SEGMENT ELEVATION

Therapeutic Target	Intervention
Coronary thrombus	• ANTI-PLATELET therapy: Administer oral aspirin (initial dose, 162 to 325 mg; then 81 to 325 mg daily indefinitely) and a P2Y12 inhibitor • ANTICOAGULANT therapy: Administer an intravenous anticoagulant agent to all patients, regardless of treatment strategy
Unstable atheroma or disease progression	• STATIN therapy: Initiate or continue high-intensity oral statin therapy (40 to 80 mg atorvastatin or 20 to 40 mg rosuvastatin on admission and then daily) for cholesterol management. • ACE inhibitor: ACE inhibitors should be started in all patients with LVEF of <0.4 and those with hypertension, diabetes mellitus, or stable chronic kidney disease; ACE inhibitors may also be reasonable in all other patients with cardiac or other vascular disease.

AHA/ACC and ESC guideline recommendations at discharge for all ACS patients demarcated in blue

Aspirin and a P2Y12 inhibitor

Beta-blocker / ACE inhibitor / Angiotensin II receptor blocker / mineralocorticoid receptor antagonists / other

High-intensity Statin therapy

Advise on lifestyle changes (including smoking cessation, regular physical activity and a healthy diet) and Cardiac rehabilitation

Anderson J, Morrow D. Acute Myocardial Infarction. New England Journal of Medicine. 2017;376(21):2053-2064.

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DOSES OF ANTI-THROMBIN CO-THERAPIES

Doses of antithrombin co-therapies	
With primary PCI	
Unfractionated heparin	70-100 U/kg i.v. bolus when no GP llb/IIa inhibitor is planned 50-60 U/kg i.v. bolus with GP AAb/IIa inhibitors
Enoxaparin	0.5 mg/kg i. v. bolus
Bivalirudin	0.75 mg/kg i.v. bolus followed by i.v. infusion of 1.75 mg/kg/h for up to 4h after the procedure as clinically warranted. 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 as clinically necessary
With fibrinolytic therapy	
Unfractionated heparin	60 U/kg i.v. bolus with a maximum of 4000 U followed by an i.v. infusion of 12 U/kg with a maximum of 1000 U/h for 24-48h. Target aPTT: 50-70 s or 2.0 times that of control to be monitored at 3, 6, 12 and 24h
Enoxaparin	In patients <75 years of age: 30 mg i.v. bolus followed 15 min later by 1mg/kg s.c. every 12h until hospital discharge for a maximum of 8 days. The first two doses should not exceed 100mg In patients >75 years of age: no i.v. bolus; start with first s.c. dose of 0.75mg/kg with a maximum of 75mg for the first two s.c. doses In patients with creatine clearance of <30mL/min, regardless of agee, the s.c. doses are given once every 24h
Fondaparinux	2.5mg i.v. bolus followed by a s.c. dose of 2.5mg once daily uo to 8 days or hospital discharge
Without reperfusion therapy	
Unfractionated heparin	Same dose as with fibrinolytic therapy
Enoxaparin	Same dose as with fibrinolytic therapy
Fondaparinux	Same dose as with fibrinolytic therapy

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 20 Table 6; pg 22 Table 7)

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DOSES OF FIBRINOLYTIC AGENTS AND ANTITHROMBOTIC CO-THERAPIES

Drug	Initial Treatment	Specific contra-indications
Doses of antiplatelet co-therapies		
Aspirin	Starting dose of 15-300 mg orally (or 75-250 mg intravenously if oral ingestion is not possible), followed by a maintenance dose of 75-100 mg/day	
Clopidogrel	Loading dose of 300 mg orally, followed by a main tenance dose of 75 mg/day. In patients ≥75 years of age: bloading dose of 75mg, followed by a maintenance dose of 75 mg/day.	
Reteplase (rPA)	**In patients <75 years of age:** 30 mg i.v. bolus followed 15 min later by 1 mg/kg s.c. every 12 hours until revascularization or hospital discharge for a maximum of 8 days. The first two s.c. doses should not exceed 100 mg per injection. **In patients ≥75 years of age:** no i.v. bolus; start with first s.c. dose of 0.75 mg/kg with a maximum of 75 mg per injection for the first two s.c. doses. In patients with eGFR <30 mL/min/1.73 m2, regardless of age, the s.c. doses are given once every 24 hours.	

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 20 Table 6; pg 22 Table 7)

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DOSES OF FIBRINOLYTIC AGENTS AND ANTITHROMBOTIC CO-THERAPIES

Drug	Initial Treatment	Specific contra-indications
UFH	60 IU/kg i.v. bolus with a maximum of 4000 IU followed by an i.v. infusion of 12 IU/kg with a maximum of 1000 IU/hour for 24-48 hours. Target aPTT: 50-70 s or 1.5 to 2.0 times that of control to be monitored at 3, 6, 12 and 24 hours.	
Fondaparinux (only with streptokinase)	2.5 mg i.v. bolus followed by a s.c. dose of 2.5 mg once daily up to 8 days or hospital discharge.	

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 20 Table 6; pg 22 Table 7)

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DOSES OF FIBRINOLYTIC AGENTS AND ANTITHROMBOTIC CO-THERAPIES

Agent	Normal renal function and stage 1-3 CKD (eGFR >30mL/min/1.73m^2)	Stage 4 CKD (eGFR 15 to <30mL/min/1.73m^2)	Stage 5 CKD (eGFR <15mL/min/ 1.73m^2)
UFH	*Before coronary angiography:* Bolus 60-70 IU/kg i.v. (maximum 5000 IU) and infusion (12-15 IU/kg/hour, maximum 1000 IU/hour), target aPTT 1.5-2.5 x control *During PCI:* 70-100 IU/kg i.v. (50-70 IU/kg if concomitant with GP IIb/ IIIa inhibitors).	No dose adjustment	No dose adjustment
Fondaparinux	2.5 mg s.c. once a day	Not recommended if eGFR <20 ml/min/1.73 m2 or dialysis	Not recommended

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 26 Table 9)

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DOSES OF ANTI-PLATELET CO-THERAPIES

Doses of antiplatelet co-therapies	
With primary PCI	
Aspirin	Loading dose of 150-300 mg orally or ofS0-150 mg i.v. if oral ingestion is not possible, followed by a maintenance dose of 75-100 mg/day
Clopidogrel	Loading dose of 600 mg orally; followed by a maintenance dose, of 75 mg/day
Prasugrel	Loading dose of 60 mg orally, followed by a maintenance dose of 10 mg/day. In patients with body weight <60 kg, a maintenance dose of 5 mg is recommended. In patients >75 years, prasugrel is generally not recommended, but a dose of 5 mg should be used if treatment is deemed necessary
Ticagrelor	Loading dose of 180 mg, orally, followed by a maintenance dose of 90 mg. b.i.d.
Abciximab	Bolus of 0.25 mg/kg i.v. and 0.125 µg/kg/min infusion (maximum 10 µg/min) for 12h
Eptifibatlde	Double bolus of 180 µg/kg i.v. (given at a 10 min interval) followed by an infusion of 2.0 µg/kg/min for 18h
Tirofiban	25 µg/kg over 3 min i.v. followed by a maintenance infusion of 0.15 µg//kg/min for 18h
With fibrinolytic therapy	
Aspirin	Starting dose 150-500 mg orally or i.v. dose of 250 mg if oral ingestion is not possible
Clopidogrel	Loading dose of 300 mg orally if aged ≤75 years, followed by a maintenance dose of 75 mg/day
Without reperfusion therapy	
Aspirin	Starting dose 150-500 mg orally
Clopidogrel	75 mg/day orally

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 20 Table 6)

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DOSES OF ANTI-PLATELET CO-THERAPIES

Doses of antiplatelet and parenteral anticoagulant therapies inpatients not receiving reperfusion therapy	
Antiplatelet therapies	
Aspirin	Loading dose of 150-300 mg orally followed by a maintenance dose of 75-100 mg/day
Clopidogrel	Loading dose of 300 mg, orally, followed by a maintenance dose of 75 mg/day orally
Parental anticoagulant therapies	
UFH	Same dose as with fibrinolytic therapy
Enoxaparin	Same dose as with fibrinolytic therapy
Fondaparinux	Same dose as with fibrinolytic therapy

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 26 Table 9)

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OXYGEN

RELIEF OF HYPOXAEMIA AND SYMPTOMS

Recommendations	Class	Level
Hypoxia		
Oxygen is indicated in patients with hypoxaemia (SaO_2 <90% or PaO_2 <60 mmHg)	I	C
Routine oxygen is not recommended in patients with SaO_2 >90%	III	I
Symptoms		
Titrated i.v. opioids should be considered to relieve pain	IIa	C
A mild tranquillizer (usually a benzodiazepine) should be considered in very anxious patients	IIa	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 9)

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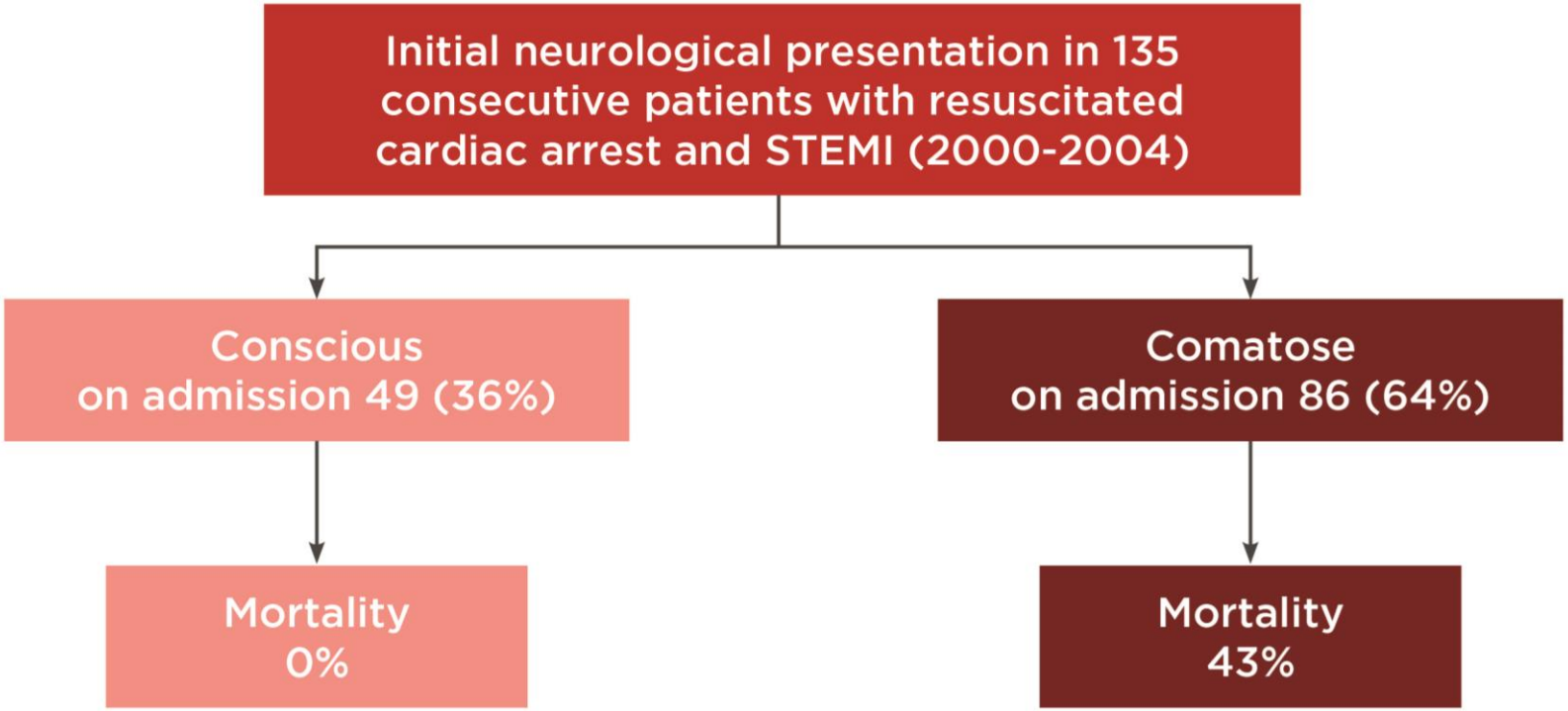
NEUROLOGIC STATUS

TWO DIFFERENT STEMI SUBGROUPS UNDERGOING PPCI AFTER PREHOSPITAL RESUSCITATION



Snyders A. Muscle for life - every minute counts. Presentation presented at; 2017; SA Heart Congress.
(Snyders slide 51)

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HYPERGLYCAEMIA

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MANAGEMENT OF HYPERGLYCAEMIA

Recommendations	Class	Level
It is recommended to measure glycaemic status at initial evaluation in all patients, and perform frequent monitoring in patients with known diabetes or hyperglycaemia defined as glucose levels ≥11.1mmol/L or ≥200 mg/dL)	I	C
In patients on metformin and/or SGLT2 inhibitors, renal function should be carefully monitored for at least 3 days after coronary angiography/PCI	I	C
Glucose-lowering therapy should be considered in ACS patients with glucose levels >10 mmol/L (>180 mg/dL), while episodes of hypoglycemia (defined as glucose levels ≤3.9 mmol/L or ≤70 mg/dl) should be avoided	IIa	C
Less stringent glucose control should be considered in the acute phase in patients with more advanced cardiovascular disease, older age, longer diabetes duration, and more co-morbidities.	IIa	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 28)

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LOGISTICAL ISSUES DURING HOSPITAL STAY

Recommendations	Class	Level
It is indicated that all hospitals participating in the care of STEMI patients have a CCU/ICCU equipped to provide all aspects of care for STEMI patients, including treatment of ischaemia, sever heart failure, arrhythmias, and common co-morbidities	I	C
Transfer back to a referring non-PCI hospital		
Same-day transfer should be considered appropriate in selected patients after successful primary PCI, i.e. those without ongoing myocardial ischaemia, arrhythmia, or haemodynamic instability, not requiring vasoactive or mechanical support, and not needing further early revascularization	IIa	C
Monitoring		
It is indicated that all STEMI patients have ECG monitoring for a minimum of 24 hours	I	C
Length of stay in the CCU		
It is indicated that patients with successful reperfusion therapy and uncomplicated clinical course are kept in the CCU/I CCU for a minimum of 24 hours whenever possible, after which they may be moved to a step-down monitored bed for an additional 24-48 hours.	I	C
Hospital discharge		
Early discharge (within 48-72 hours) should be considered appropriate in selected low risk patients if early rehabilitation and adequate follow-up are arranged.	IIa	A

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 25)

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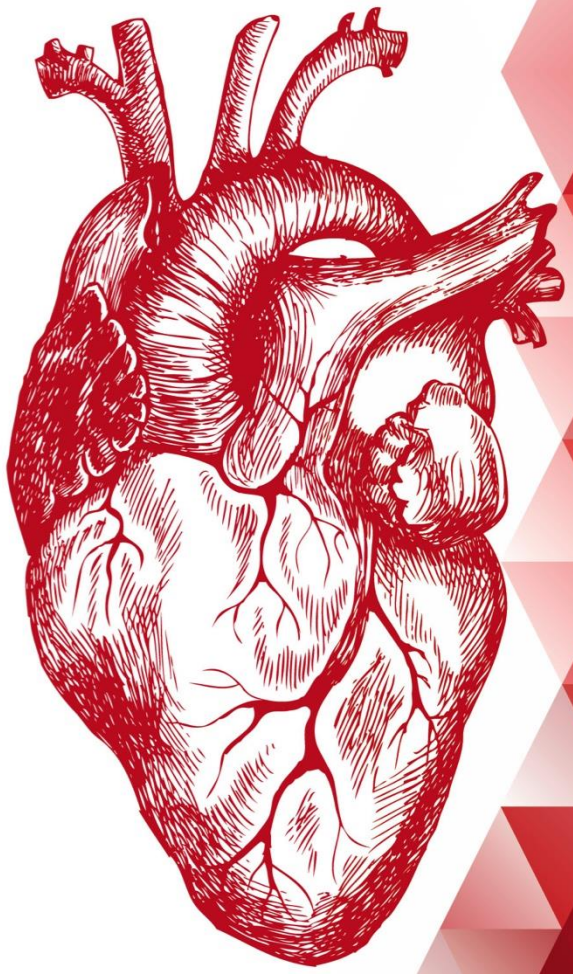
EMERGENCY MEDICAL SERVICES

THE ROLE OF EMS IN STEMI MANAGEMENT



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THE FASTEST WAY TO ACCESS THE SERVICE IS VIA EMS

- **PRE-HOSPITAL DIAGNOSIS** and transfer direct to a PPCI capable centre is the optimal way to access the service
- However, up to **50% WILL SELF PRESENT TO ER**
- **COMPLEX PATIENTS** and those with **DIFFICULT OR CONFOUNDER ECGS** will also be more likely to present to ER
- There will always need to be a **MECHANISM FOR MANAGING THESE PATIENTS**

REFERENCE

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AIM OF PRE-HOSPITAL / EMS CARE

- **DIAGNOSE STEMI IN FIELD** or ED using 12-lead ECG

- Activate pre-specified **CLINICAL PROTOCOL**

- **TRANSFER DIRECT TO PPCI CAPABLE CATHLAB** (if possible within 20 mins of onset)

REFERENCE

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IS PRE-HOSPITAL DIAGNOSIS POSSIBLE?

- Median accuracy **95%** (88-98) for **PARAMEDIC DIAGNOSIS** (after specific training)
- **FIELD TRANSMISSION TO A DUTY PHYSICIAN** also possible and does not cause significant delays
- **EMS WITH ON BOARD PHYSICIAN** who makes the diagnosis is also possible

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LOGISTICS OF PRE-HOSPITAL CARE

Recommendations	Class	Level
It is recommended that the pre-hospital management of STEMI patients is based on regional networks designed to deliver reperfusion therapy expeditiously and effectively, with efforts made to make primary PCI available to as many patients as possible	I	B
It is recommended that primary PCI-capable centres deliver a 24/7 service and are able to perform primary PCI without delay.	I	B
It is recommended that patients transferred to a PCI-capable centre for primary PCI bypass the emergency department and CCU/ICCU and are transferred directly to the catheterization laboratory	I	B
It is recommended that ambulance teams are trained and equipped to identify STEMI (with use of ECG recorders and telemetry as necessary) and administer initial therapy, including fibrinolysis when applicable.	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 13)

LOGISTICS OF PRE-HOSPITAL CARE

Recommendations	Class	Level
It is recommended that all hospitals and EMS participating in the care of patients with STEMI record and audit delay times and work to achieve and maintain quality targets	I	C
It is recommended that EMS transfer STEMI patients to a PCI-capable centre, by-passing non-PCI centres.	I	C
It is recommended that EMS, emergency medical departments, and CCU/ICCU have a written updated STEMI management protocol, preferably shared within geographic networks	I	C
It is recommended that patients presenting to a non-PCI-capable hospital and awaiting transportation for primary or rescue PCI are attended to in an appropriately monitored area (e.g.. The emergency department, CCU/ICCU, immediate care unit)	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.
(ESC STEMI 2017 pg 13)

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