
# Acute Coronary Syndromes Diagnosis and Treatment

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William Heberden (1710-1801)

# Canadian Cardiovascular Society Classification of Angina

- Class I
  - Angina occurs only with strenuous, rapid, or prolonged exertion. Ordinary physical activity does not cause angina.
- Class II
  - Slight limitation of ordinary activity. Angina occurs with climbing stairs rapidly, walking uphill, walking after meals, in cold, in wind, or under emotional stress.
- Class III
  - Marked limitations of ordinary physical activity. Angina occurs on walking one to two level blocks or climbing one flight of stairs at usual pace.
- Class IV
  - Inability to carry on physical activity without discomfort. Anginal

# Unstable Angina Pectoris

- Rest angina
  - Angina occurring at rest and usually prolonged >20 min occurring within 1 wk of presentation
- New-onset angina
  - Angina of at least CCSC III severity with onset within 2 mo of presentation
- Increasing angina

# Goals

- Reduce myocardial necrosis,
- Protect left ventricles (LV) function
- Prevent heart failure
- Limit major adverse cardiac events (MACE) and requirement of invasive procedure

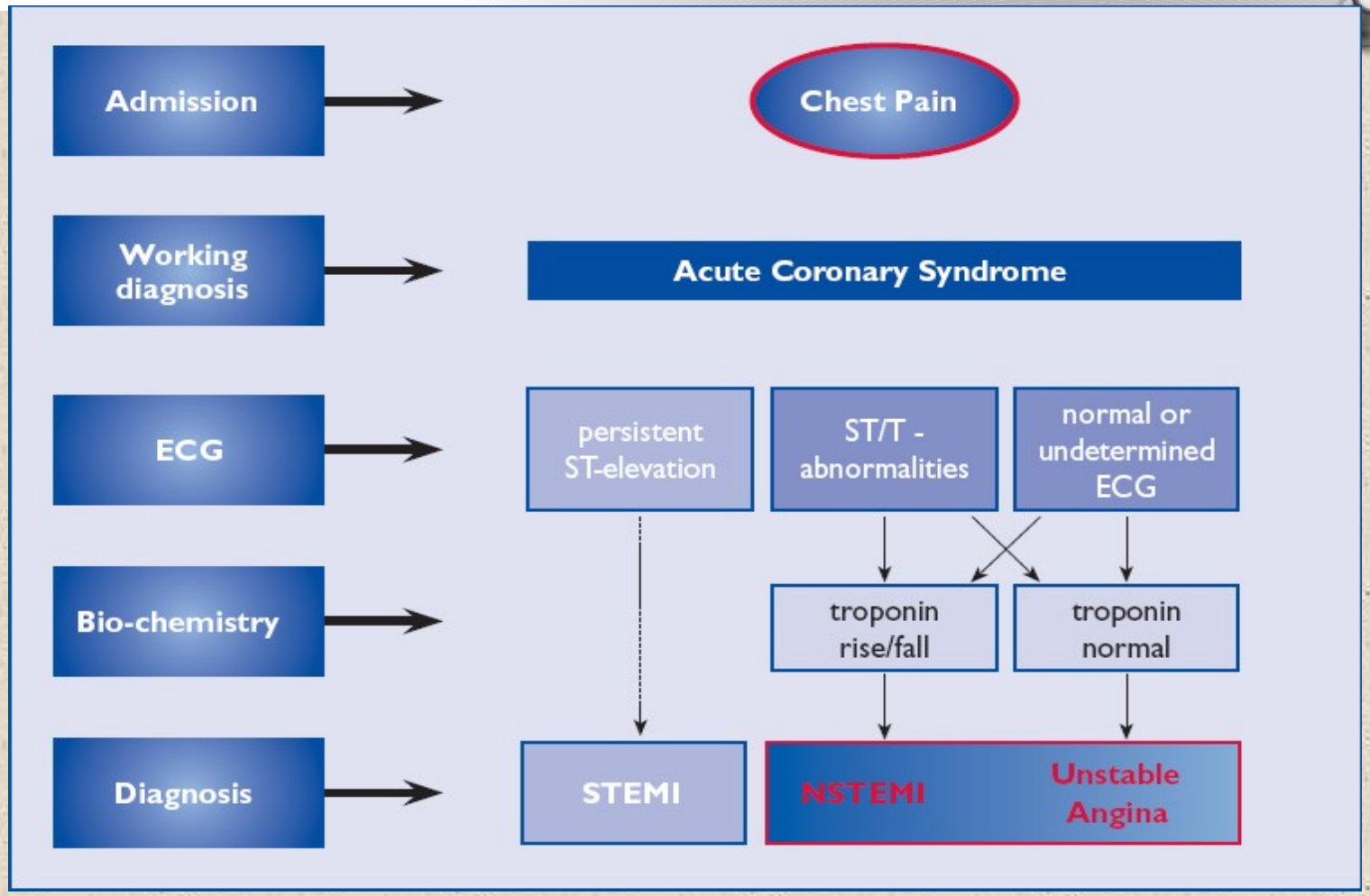
# Goals

- **Treat**
  - VF,
  - pulseless VT,
  - symptomatic bradycardia,
  - unstable tachycardia,
  - pulmonary edema,
  - cardiogenic shock

immediately

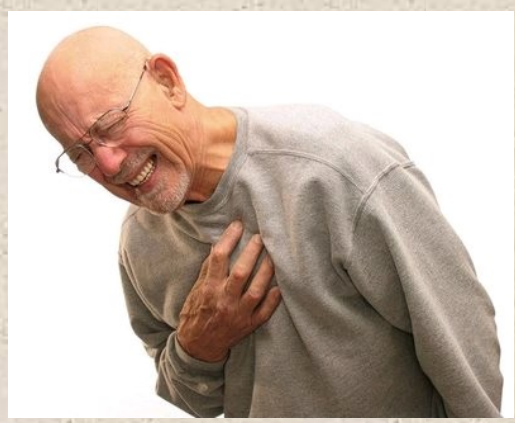
# Acute Coronary Syndrome

- Strongly suspicious for injury ST-elevation MI (STEMI)
  - ST elevation or new or presumably new LBBB;
- Strongly suspicious for ischemia ; High risk unstable angina/ non- ST-elevation MI (UA/NSTEMI)
  - ST depression or dynamic T wave inversion;






- ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation European Heart Journal (2011) 32, 2999–3054



# Chest pain

- Classic
  - Retrosternal left anterior chest or
  - Epigastric discomfort described as crushing, tightening, squeezing,
  - Pressure like sensation
  - Reduced likelihood of ACS
  - Stabbing,

# Chest pain

- Two fold higher risk of ischemia
  - Dyspnea, diaphoresis, nausea, and/or vomiting
- Atypical presentations of ACS
  - women,
  - non white minorities,
  - diabetics,
  - the elderly,
  - patients with psychiatric disease
  -

# Physical examination

- The physical examination is frequently normal.
- Signs of heart failure or hemodynamic instability.
- Exclude non-cardiac causes of chest pain and non-ischaemic cardiac disorders
- PE, aortic dissection, pericarditis, valvular heart disease

# ECG

- First-line diagnostic tool.
- It should be obtained within 10 min after first medical contact
- About half of patients with AMI have "**diagnostic**" changes on the initial ECG
- If the initial ECG is normal or inconclusive,

# ECG

- Comparison with a previous ECG, if available, is valuable,
- ECG recordings should be repeated at least at (3 h) 6–9 h and 24 h after first presentation, and immediately in the case of recurrence of chest pain or symptoms

# Cardiac biomarkers

- Troponins
  - More specific and sensitive than CK, CK-MB, and myoglobin. Elevation of cardiac troponins reflects myocardial cellular damage
  - There is no fundamental difference between troponin T and troponin I. Useful for diagnose

# Cardiac biomarkers

- Troponins
  - A single negative test on first contact with the patient is not sufficient for ruling out
  - NSTE-ACS, as in many patients an increase in troponins can be detected only in the subsequent hours. Therefore, repeated

# Non-acute coronary syndrome causes of troponin elevation

- Chronic or acute renal dysfunction
- Severe congestive heart failure – acute and chronic
- Hypertensive crisis
- Tachy- or bradyarrhythmias
- Pulmonary embolism, severe pulmonary hypertension
- Inflammatory diseases, e.g. myocarditis
- Acute neurological disease, including stroke, or subarachnoid haemorrhage
- Aortic dissection, aortic valve disease or hypertrophic cardiomyopathy

# Non-acute coronary syndrome causes of troponin elevation

- Cardiac contusion, ablation, pacing, cardioversion, or endomyocardial biopsy
- Hypothyroidism
- Apical ballooning syndrome (Tako-Tsubo cardiomyopathy)
- Infiltrative diseases, e.g. amyloidosis, haemochromatosis, sarcoidosis,sclerodermia
- Drug toxicity, e.g. adriamycin, 5-fluorouracil, herceptin, snake venoms
- Burns, if affecting >30% of body surface area
- Rhabdomyolysis
- Critically ill patients, especially with respiratory failure, or sepsis

# Cardiac biomarkers

- CK MB
  - Increase in 4-8 h
  - Peak 12-24 h
- Myoglobin
  - Increase in 6-8h of 80-100% MI patients

# Other cardiac biomarkers

- Natriuretic peptides are useful markers in the emergency room in evaluating chest pain or dyspnoea and were shown to be helpful in differentiating cardiac and non-cardiac causes of dyspnea
- hsCRP has no role for the diagnosis of ACS

# Other cardiac biomarkers

- Early diagnosis of ACS may be improved by measurements of fatty acid-binding protein or ischaemia-modified-albumin as well as markers of systemic stress (copeptin).
- However, the incremental value—particularly over highly sensitive troponin tests—has not been evaluated, thereby presently precluding any recommendation for routine use.

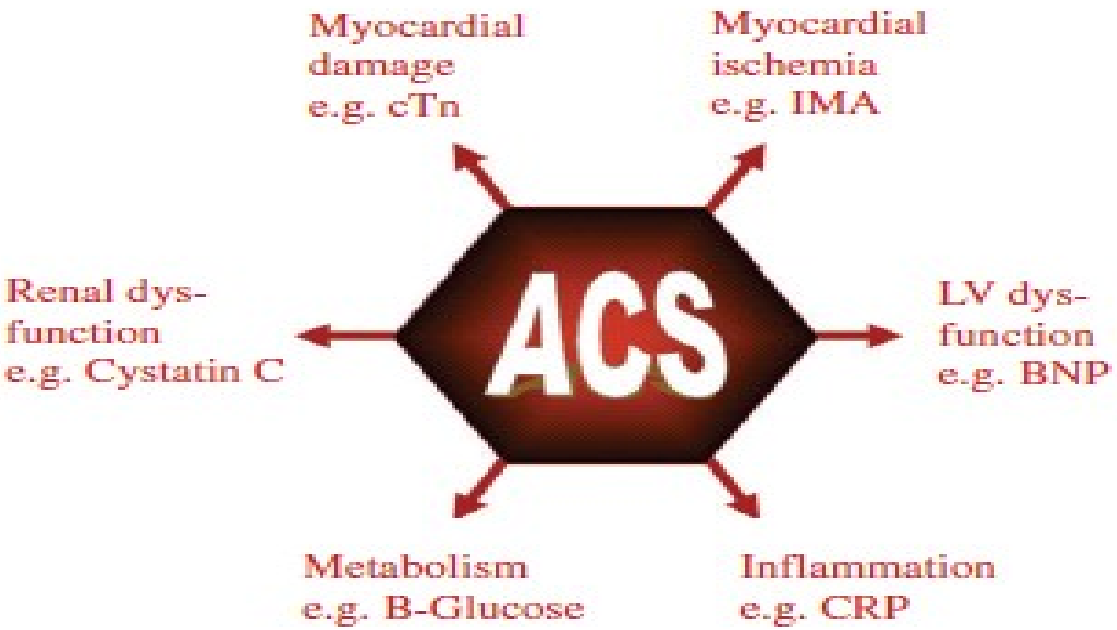
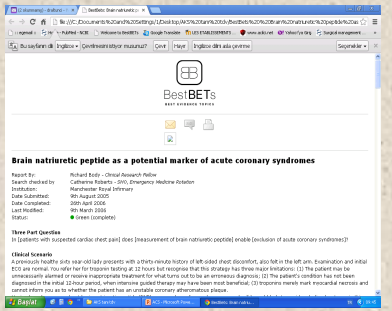



**Figure 1** Different pathophysiological mechanisms and associated biomarkers.
BNP, B-type natriuretic peptide; CRP, C-reactive protein; cTn, cardiac troponin I or T; IMA, ischemia modified albumin; LV, left ventricular.

# Point of care testing

- Rapid response testing accelerates decision making and supports the standard of care for acute coronary syndromes
- POC cardiac biomarker testing
- will help reduce or eliminate significant delays in emergency room diagnosis and




- Brain natriuretic peptide as a potential marker of acute coronary syndromes (2006)
- BNP has shown promise as an early cardiac marker and may aid prognostic stratification,
- NPV and PPV may be unacceptably low to enable use as a sole cardiac marker.
- Incorporation into multimarker strategy is


- Heart fatty acid binding protein for rapid diagnosis of acute myocardial infarction in the Emergency Department (2009)
- H-FABP is a promising biomarker for early exclusion of AMI in the ED but cannot be used alone to rule out the diagnosis.
- [illegible] analysis is likely to [illegible]

# New biomarkers

- CRP, serum amyloid A (SAA), IL-6, soluble intercellular adhesion molecule (ICAM), soluble vascular cell adhesion

# Echocardiography

- LV systolic function is an important prognostic variable
- Transient segmental hypokinesia or akinesia may be detected during ischemia.
- Differential diagnoses such as aortic dissection, pulmonary embolism, aortic stenosis, hypertrophic cardiomyopathy, or pericardial effusion may be identified

# Echocardiography

- It is important that noncardiologists (e.g. ED physicians) have undergone training in cardiac ultrasound.
- Rapid, safe, painless and effective imaging tool that can be utilized in the ED in the initial assessment of certain patients presenting with acute chest pain.
- Most useful in the acute management of the

# High Likelihood

Any of the following

- History
  - Chest or left arm pain or discomfort as chief symptom
  - Reproducing prior documented angina; known history of CAD including MI
- Examination
  - Transient MR murmur,
  - Hypotension, diaphoresis,
  - Pulmonary edema, or rales
- ECG
  - New or presumably new transient ST-segment deviation (≥1 mm)
  -
- Cardiac markers

# Intermediate Likelihood

Absence of high-likelihood features and presence of any of the following

- History
  - Chest or left arm pain or discomfort as chief symptom;
  - age >70 years; male sex;
  - Diabetes Mellitus
- Examination
  - Extracardiac vascular disease,
- ECG
  - Fixed Q waves ST depression 0.5 to 1 mm or
  - T-wave inversion >1 mm
- Cardiac markers
  - Normal

# Low Likelihood

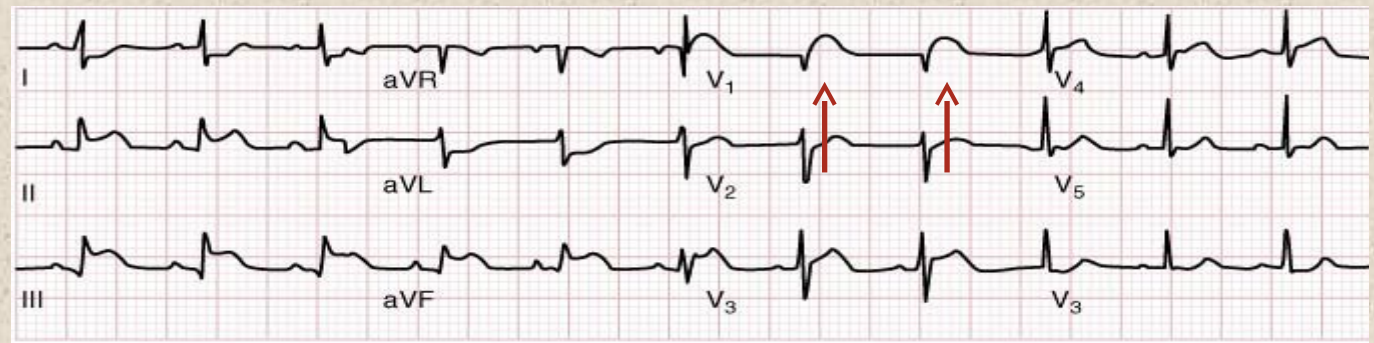
Absence of high- or intermediate-likelihood features but may have the following

- History
  - Probable ischemic symptoms in absence of any intermediate-likelihood characteristics;
  - Recent cocaine use
- Examination
  - Chest discomfort reproduced by palpation,
- ECG
  - T-wave flattening or inversion <1 mm in leads with dominant R waves
  - Normal ECG
-

# ED treatment

- **M**orphine (3-5 mg IV)
  - STEMI Class I
  - NSTEMI Class IIa
- **O**xygen (if <%94)
- **N**itroglycerin
  - up to 3 doses (tablets or spray) at intervals of 3 to 5 minutes
- **A**spirin (160 – 325 mg)

# Nitrates?




A

Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition*: http://www.accessmedicine.com


- Nitrates in all forms are contraindicated
  - Patients with initial systoloic BP<90 mm Hg or ≥ 30 mm Hg below baseline
  - Patients with right ventricular infarction
  -

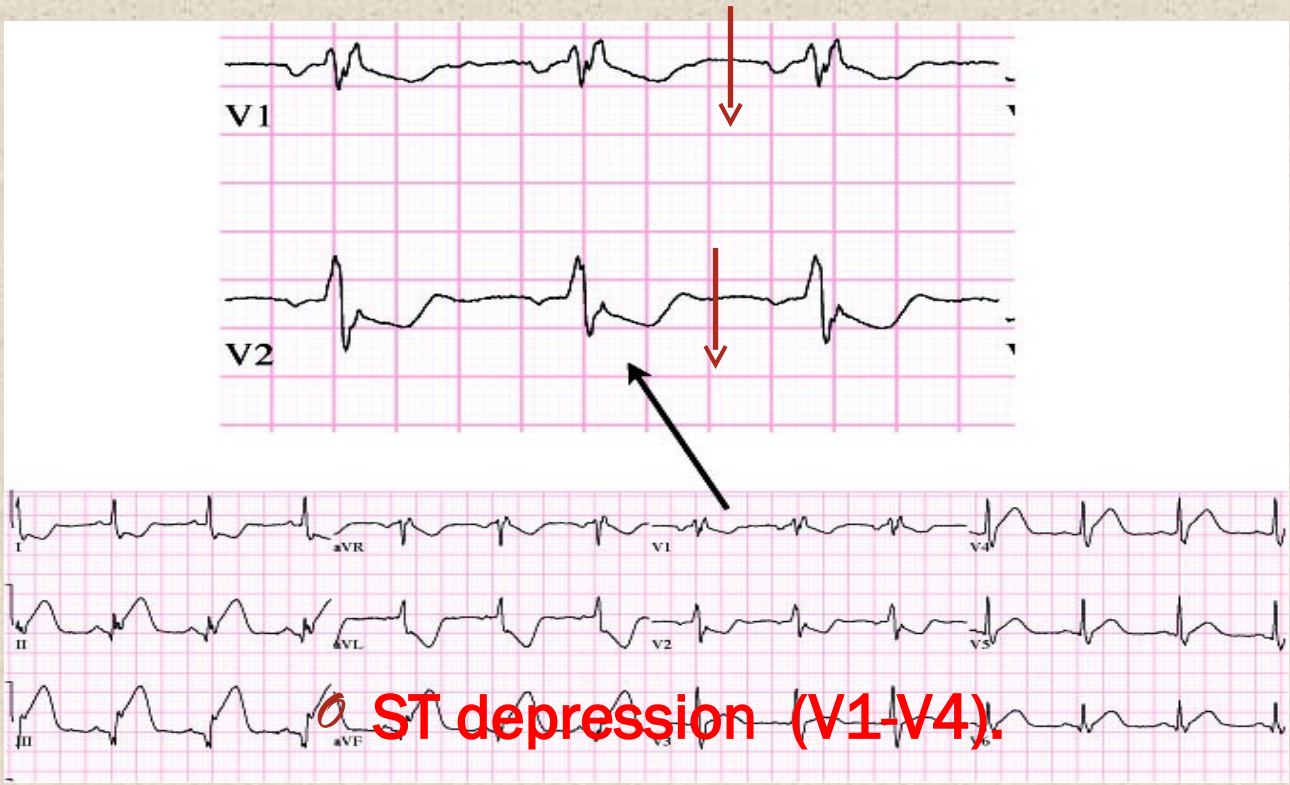
# STEMI

- New ST elevation at the J point
  - in at least 2 contiguous leads of ≥2 mm (0.2 mV) in men or
  - ≥1.5 mm (0.15 mV) in women in leads V2–V3 and/or
  - of ≥1 mm (0.1 mV) in other contiguous chest leads or the limb leads

# STEMI

- New or presumably new LBBB has been considered a STEMI equivalent.
- ST depression in ≥2 precordial leads (V1–V4) may indicate transmural posterior injury

# Posterior MI




- ST depression (V1-V4).
- V1 or V2 R > S
- (V7-V9) ST elevation

# STEMI treatment

- Reperfusion therapy should be administered to all eligible patients with STEMI with symptom onset within the prior 12 hours(LOE A)
- Primary PCI is the recommended method of reperfusion when it can be performed in a timely fashion by experienced operators(LOE A)

# STEMI treatment

- PCI-capable hospital for primary PCI is the recommended triage strategy for patients with STEMI, with an ideal FMC-to-device time system goal of 90 minutes or less (LOE B)
- Patients with STEMI who initially arrive at or are transported to a non–PCI-capable hospital, with an FMC-to-device time system goal of 120 minutes or less(LOE B)

# STEMI treatment

- When fibrinolytic therapy is indicated or chosen as the primary reperfusion strategy, it should be administered within 30 minutes of hospital arrival(LOE B)
- Primary PCI is reasonable in patients with STEMI if there is clinical and/or ECG evidence of ongoing ischemia between 12 and 24 hours after symptom onset(LOE B)

**Table 2. Primary PCI in STEMI**

| | COR | LOE | References |
|---|---|---|---|
| Ischemic symptoms <12 h | I | A | (82,208,209) |
| Ischemic symptoms <12 h and contraindications to fibrinolytic therapy irrespective of time delay from FMC | I | B | (210,211) |
| Cardiogenic shock or acute severe HF irrespective of time delay from MI onset | I | B | (212–215) |
| Evidence of ongoing ischemia 12 to 24 h after symptom onset | IIa | B | (94,95) |
| PCI of a noninfarct artery at the time of primary PCI in patients without hemodynamic compromise | III: Harm | B | (216–218) |

COR indicates Class of Recommendation; FMC, first medical contact; HF, heart failure; LOE, Level of Evidence; MI, myocardial infarction; PCI, percutaneous coronary intervention; and STEMI, ST-elevation myocardial infarction.

# Beta blockers

- Oral beta blockers should be initiated in the first 24 hours in patients with STEMI who do not have any of the following:
  - signs of HF, evidence of a low output state,
  - increased risk for cardiogenic shock,
  - or other contraindications to use of oral beta blockers (PR interval more than 0.24 seconds, second- or third-degree heart block,

# Antiplatelet Therapy to Support Primary PCI for STEMI

- Aspirin 162 to 325 mg before primary PCI (LOE B).
- A loading dose of a P2Y12 receptor inhibitor as early as possible or at time of primary PCI
  - Clopidogrel 600 mg (LOE B)
  - Prasugrel 60 mg (LOE B)
  - [illegible] mg (LOE B)

# Fibrinolytic Agents

- Tenecteplase (TNK-tPA)
  - Strong fibrin specifity
  - Single IV weight-based bolus
  - 30 mg for weight <60 kg;
  - 35 mg for 60–69 kg;
  - 40 mg for 70–79 kg;
  - 45 mg for 80–89 kg;

# Fibrinolytic Agents

- Reteplase (rPA)
  - 10 U+10-U IV boluses given 30 min apart
- Alteplase (tPA)
  - 90-min weight-based infusion
  - Bolus 15 mg,
  - infusion 0.75 mg/kg for 30 min (max 50 mg),
  - 0.5 mg/kg (max 35 mg) over the next 60 min;

# Fibrinolytic Agents

- Streptokinase
  - No fibrin specifity
  - 1.5 million units IV given over 30–60 min
  - no longer marketed in the United States but is available in other countries.
  - Streptokinase is absolutely contraindicated within 6 mo of previous exposure because of the potential for serious allergic reaction

# Absolute contraindications for fibrinolytics

- Any prior ICH
- Known structural cerebral vascular lesion (e.g., arteriovenous malformation)
- Known malignant intracranial neoplasm (primary or metastatic)
- Ischemic stroke within 3 mo
- EXCEPT acute ischemic stroke within 4.5 h
- Suspected aortic dissection
- Active bleeding or bleeding diathesis (excluding menses)
- Significant closed-head or facial trauma within 3 mo
-

# Relative contraindications for fibrinolytics

- History of chronic, severe, poorly controlled hypertension
- Significant hypertension on presentation (SBP >180 mmHg or DBP >110 mmHg)
- History of prior ischemic stroke >3 mo
- Known intracranial pathology not covered in absolute contraindications
- Traumatic or prolonged (>10 min) CPR
- Major surgery (<3 wk)
- Recent (within 2 to 4 wk) internal bleeding
- Noncompressible vascular punctures
-

# NSTEMI

- ST-segment depression or transient elevation and/or T-wave changes.
- ST-segment depression ≥0.05 mV in two or more contiguous leads, in the appropriate clinical context, is suggestive of NSTE-ACS and linked to prognosis.

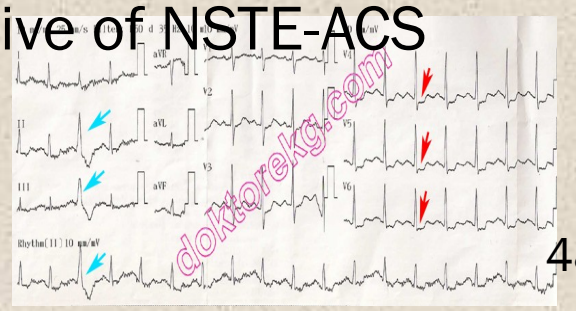
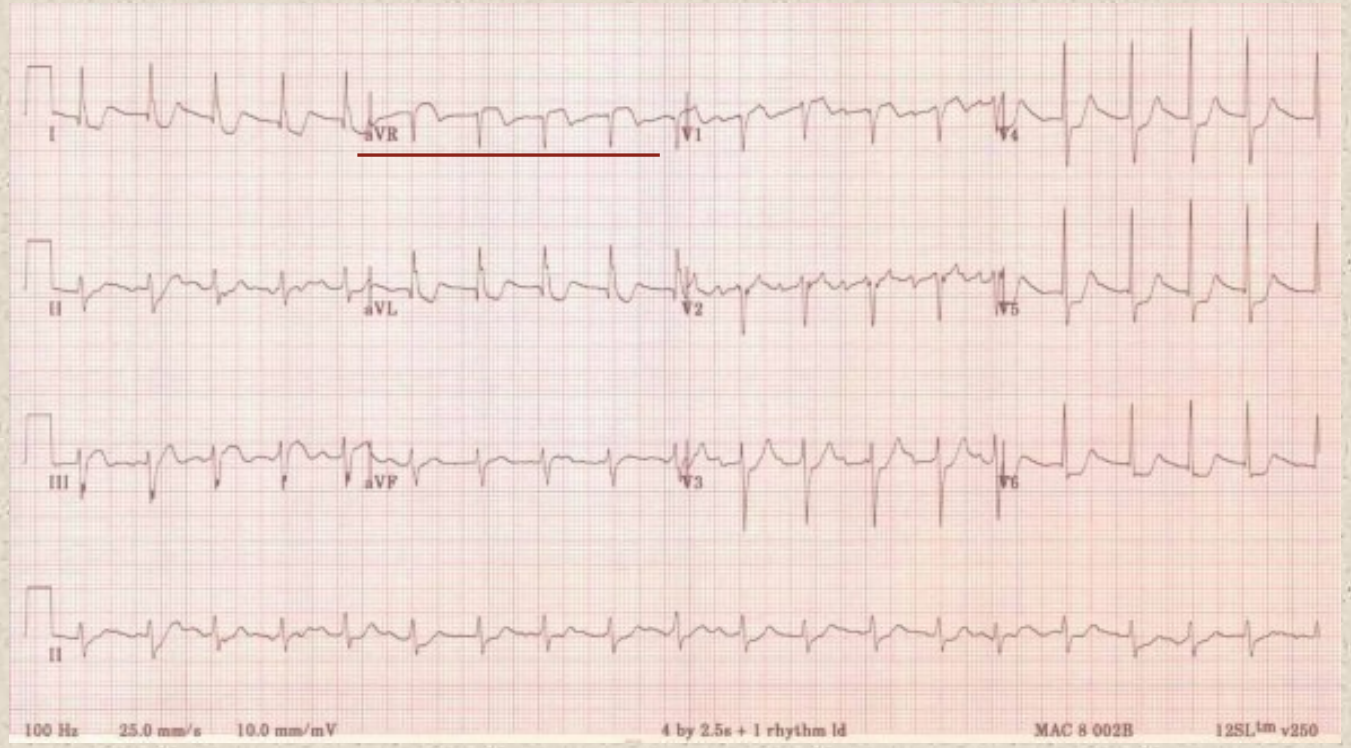


**Table 4** Cardiac and non-cardiac conditions that can mimic non-ST-elevation acute coronary syndromes

| Cardiac | Pulmonary | Haematological | Vascular | Gastro-intestinal | Orthopaedic/ infectious |
|---|---|---|---|---|---|
| Myocarditis | Pulmonary embolism | Sickle cell crisis | Aortic dissection | Oesophageal spasm | Cervical discopathy |
| Pericarditis | Pulmonary infarction | Anaemia | Aortic aneurysm | Oesophagitis | Rib fracture |
| Cardiomyopathy | Pneumonia<br>Pleuritis | | Cerebrovascular disease | Peptic ulcer | Muscle injury/ inflammation |
| Valvular disease | Pneumothorax | | | Pancreatitis | Costochondritis |
| Tako-Tsubo cardiomyopathy | | | | Cholecystitis | Herpes zoster |
| Cardiac trauma | | | | | |

# aVR is the forgotten ECG lead






left main or

# NSTEMI treatment

- IV nitrates are more effective than sublingual nitrates with regard to symptom relief and regression of ST depression.
- The dose should be titrated upwards until symptoms (angina and/or dyspnea) are relieved unless side effects (notably headache or hypotension) occur

# NSTEMI treatment

- Aspirin reduces the incidence of recurrent MI or death in patients with what was then called unstable angina
- A P2Y12 inhibitor should be added to aspirin as soon as possible and maintained over 12 months, unless there are contraindications such as excessive risk of bleeding

# Treatment summary in ED

- STEMI (PCI)
  - Aspirin 150-325 mg PO
  - Clopidogrel 600 mg PO
- STEMI (fibrinolitic)
  - Aspirin 150-325 mg PO
  - Clopidogrel 600 mg PO

# Treatment summary in ED

- UAP/NSTEMI
  - Aspirin 162–325 mg PO
  - Clopidogrel of 300–600 mg PO (age<75)
  - Enoxaparin 1 mg/kg every 12 h SC
  - Nitroglycerin  Start at 10 micrograms/min IV
  - Metoprolol 50 milligrams PO every 12 h

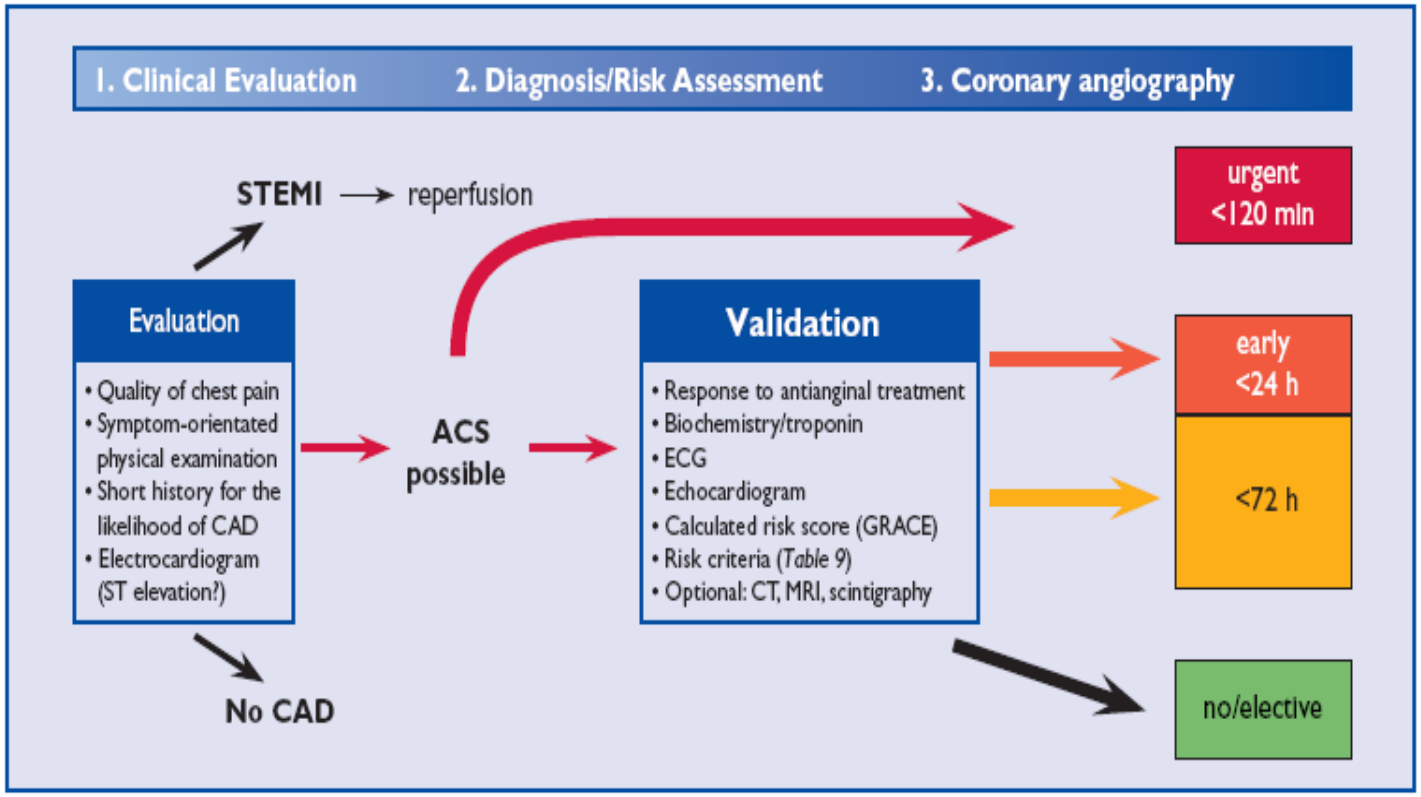



**Figure 6** Decision-making algorithm in ACS. ACS = acute coronary syndrome; CAD = coronary artery disease; CT = computed tomography; ECG, electrocardiogram; GRACE = Global Registry of Acute Coronary Events; MRI = magnetic resonance imaging; STEMI = ST-elevation myocardial infarction.


grace global registry of acute
Welcome to GRACE
GRACE ACS Risk Model
GRACE ACS Risk Model
www.outcomes-umassmed.org/grace/acs_risk/acs_risk_content.html
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Welcome to BestBETs
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www.acilci.net
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Surgical management ...
GRACE
Global Registry of Acute Coronary Events
ACS Risk Model
At Admission (in-hospital/to 6 months)
At Discharge (to 6 months)
Age
Years
HR
bpm
SBP
mmHg
Creat.
mg/dL
CHF
Killip Class
SI Units
Cardiac arrest at admission
ST-segment deviation
Elevated cardiac enzymes/markers
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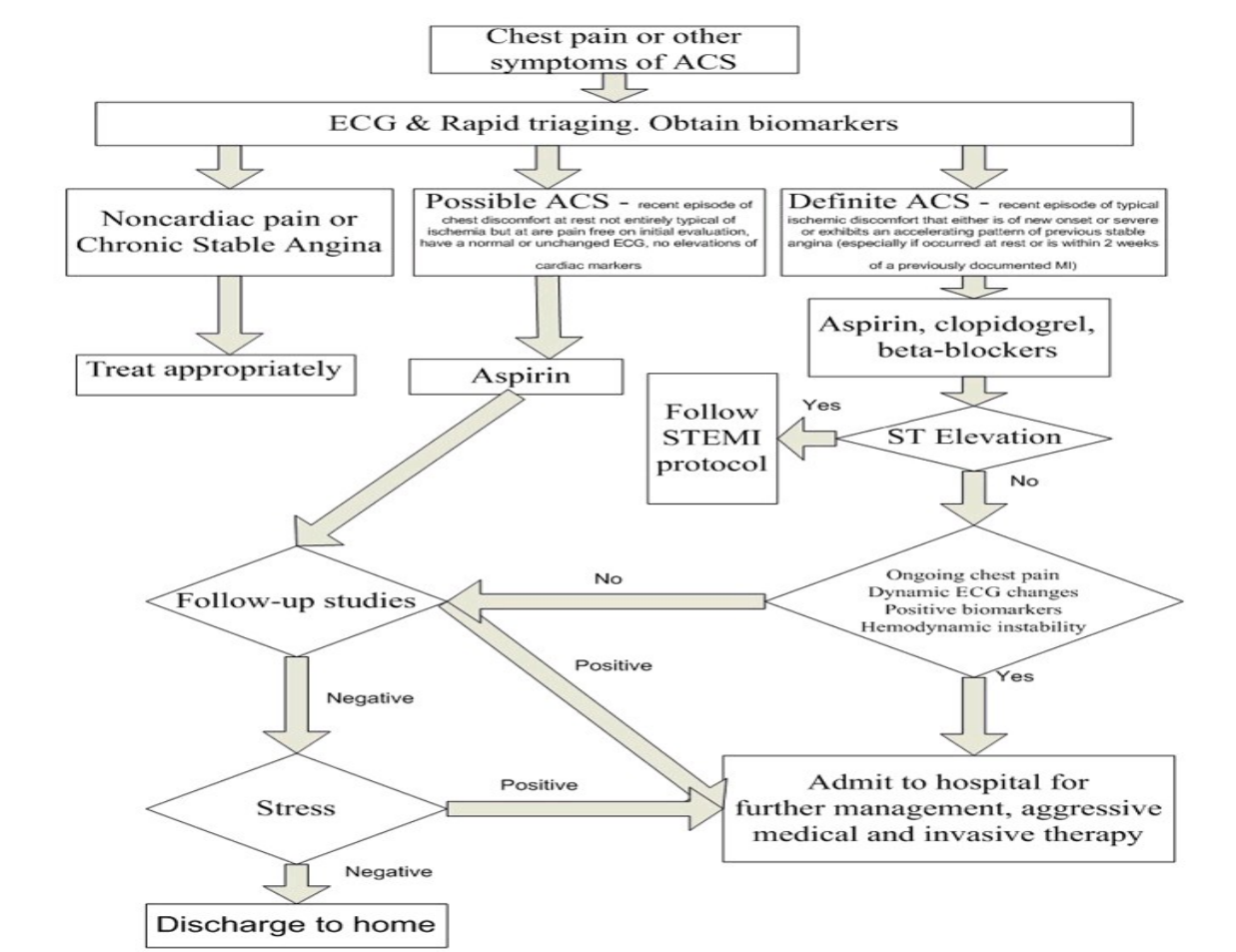
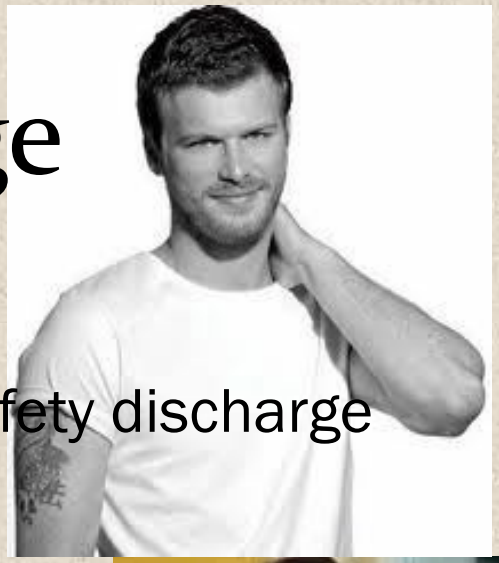





http://emedicine.medscape.com/article/1910735-overview

# Discharge



- There is no clear rules for safety discharge from ER
- So?
- Age<40
- Normal serial EKG findings
- No risk factor
- Normal serial cardiac biomarkers

# Take home massages

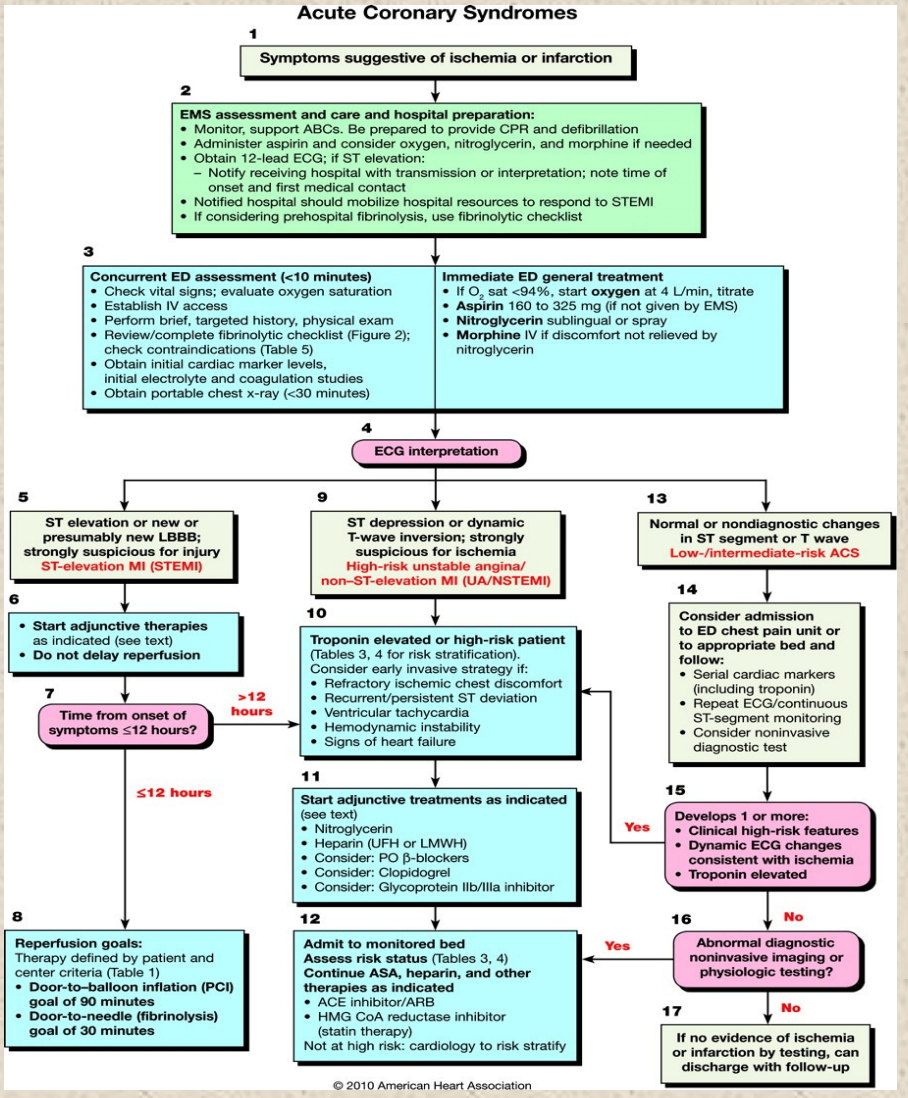
- In the ED, cardiac risk factors are poor predictors of risk for MI or other ACSs
- Scoring systems are useful for the prognosis of hospitalized patients.
- They are not recommended for ED discharge decision
- Diaphoresis, nausea, vomiting, dizziness, usually accompanied

# Take home massages

- Evaluate ECG in first 10 min
- Do not forget serial ECG controls
- Be careful for ST - T changes
- Patient could be ACS although not typical chest pain
- Women, DM patients and geriatric population could have atypical presentation

# Can not rule out ACS

- Low risk group
- Relived patient with antiacids or NSAID
- Absence of classic risk factors (HT, DM etc.)
- Normal ECHO findings at rest
- Pain at palpation
- Normal initial troponin


Acute Coronary Syndromes
1
Symptoms suggestive of ischemia or infarction
2
EMS assessment and care and hospital preparation:
• Monitor, support ABCs. Be prepared to provide CPR and defibrillation
• Administer aspirin and consider oxygen, nitroglycerin, and morphine if needed
• Obtain 12-lead ECG; if ST elevation:
– Notify receiving hospital with transmission or interpretation; note time of onset and first medical contact
• Notified hospital should mobilize hospital resources to respond to STEMI
• If considering prehospital fibrinolysis, use fibrinolytic checklist
3
Concurrent ED assessment (<10 minutes)
• Check vital signs; evaluate oxygen saturation
• Establish IV access
• Perform brief, targeted history, physical exam
• Review/complete fibrinolytic checklist (Figure 2); check contraindications (Table 5)
• Obtain initial cardiac marker levels, initial electrolyte and coagulation studies
• Obtain portable chest x-ray (<30 minutes)
Immediate ED general treatment
• If $O_2$ sat <94%, start oxygen at 4 L/min, titrate
• Aspirin 160 to 325 mg (if not given by EMS)
• Nitroglycerin sublingual or spray
• Morphine IV if discomfort not relieved by nitroglycerin
4
ECG interpretation
5
ST elevation or new or presumably new LBBB; strongly suspicious for injury
ST-elevation MI (STEMI)
6
• Start adjunctive therapies as indicated (see text)
• Do not delay reperfusion
7
Time from onset of symptoms ≤12 hours?
>12 hours
≤12 hours
8
Reperfusion goals:
Therapy defined by patient and center criteria (Table 1)
• Door-to–balloon inflation (PCI) goal of 90 minutes
• Door-to-needle (fibrinolysis) goal of 30 minutes
9
ST depression or dynamic T-wave inversion; strongly suspicious for ischemia
High-risk unstable angina/ non–ST-elevation MI (UA/NSTEMI)
10
Troponin elevated or high-risk patient
(Tables 3, 4 for risk stratification).
Consider early invasive strategy if:
• Refractory ischemic chest discomfort
• Recurrent/persistent ST deviation
• Ventricular tachycardia
• Hemodynamic instability
• Signs of heart failure
11
Start adjunctive treatments as indicated
(see text)
• Nitroglycerin
• Heparin (UFH or LMWH)
• Consider: PO β-blockers
• Consider: Clopidogrel
• Consider: Glycoprotein IIb/IIIa inhibitor
12
Admit to monitored bed
Assess risk status (Tables 3, 4)
Continue ASA, heparin, and other therapies as indicated
• ACE inhibitor/ARB
• HMG CoA reductase inhibitor (statin therapy)
Not at high risk: cardiology to risk stratify
13
Normal or nondiagnostic changes in ST segment or T wave
Low-/intermediate-risk ACS
14
Consider admission to ED chest pain unit or to appropriate bed and follow:
• Serial cardiac markers (including troponin)
• Repeat ECG/continuous ST-segment monitoring
• Consider noninvasive diagnostic test
15
Develops 1 or more:
• Clinical high-risk features
• Dynamic ECG changes consistent with ischemia
• Troponin elevated
Yes
16
Abnormal diagnostic noninvasive imaging or physiologic testing?
No
Yes
17
If no evidence of ischemia or infarction by testing, can discharge with follow-up
No
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# благодарение

## References:


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