45TH

Egyptian Society of CARDIOLOGY

45th Annual International Congress of the
EGYPTIAN SOCIETY OF CARDIOLOGY
CardioEgypt 2018

# Risk Stratification in ACS (STEMI and NonSTEMI)

By

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## Why should we risk stratify patients with ACS??

- Prognosis
- Management
  - invasive
  - non-invasive
- pharmacotherapy: anti-thrombotic ttt.
- Imaging.
- Discharge.

## Risk Assesment of Mortality, Cardiac events in STEMI Patients

- **Clinical parameters (Clinical examination, ECG, Biomarkers)**
- **Combined Risk factors in certain Scores (TIMI risk score for STEMI, GRACE score)**
- **Assessment before discharge**



## 1. Clinical Risk Assessment

The risk stratification of STEMI patient is crucial. However all STEMI patients are undoubtly in highly critical conditions.

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# 1. Clinical Risk Assessment

- **Extent of myocardial damage,**
- **the occurrence of successful reperfusion,**
- **the presence of clinical markers of high risk of further events including older age, fast heart rate, hypotension, Killip class >I, anterior MI, previous MI, elevated initial serum creatinine, history of heart failure, or peripheral arterial disease.**



## Killip Classification

- Killip class I → signs of heart failure
- Killip class II → Rales and diffuse weezing in the lungs
- Killip Class III → acute pulmonary edema
- Killip Class IV → Cardiogenic Shock

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# 1. ECG in risk assessment

- Anterior MI/ Persisting ST elevation
- Q waves in multiple leads
- RVMI
- High sum of ST elevation
- Reciprocal ( anterior ) ST depression
- Persisting ST depression
- Prolonged QT
- Conduction defects (RBBBB, LBBB) / heart block
- Sinus tachycardia/atrial fibrillation



# 2. Scores for Risk Assessment

- The Global Registry of **Acute Coronary Events (GRACE) risk score is recommended for risk assessment and adjustment**.
- **TIMI** risk score in STEMI patients.

# GRACE Risk Score

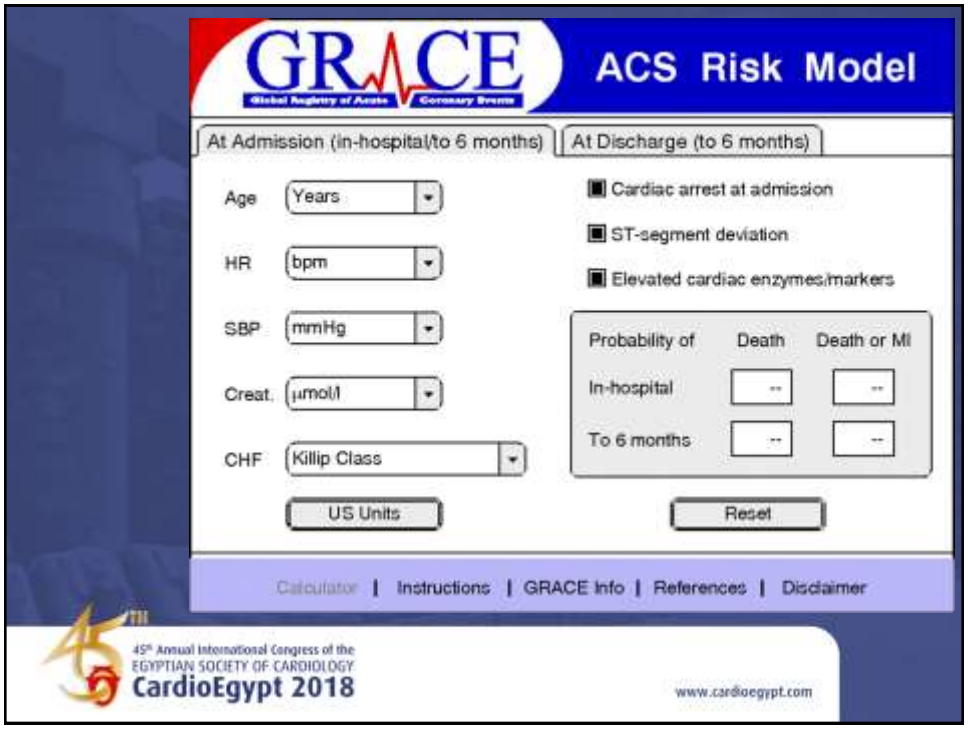
- The GRACE (Global Registry of Acute Coronary Events) risk score has also identified risk factors that are **independently associated with increased mortality**. Although perhaps more accurate, it is more complex than the TIMI risk score and is not easily calculated by hand.

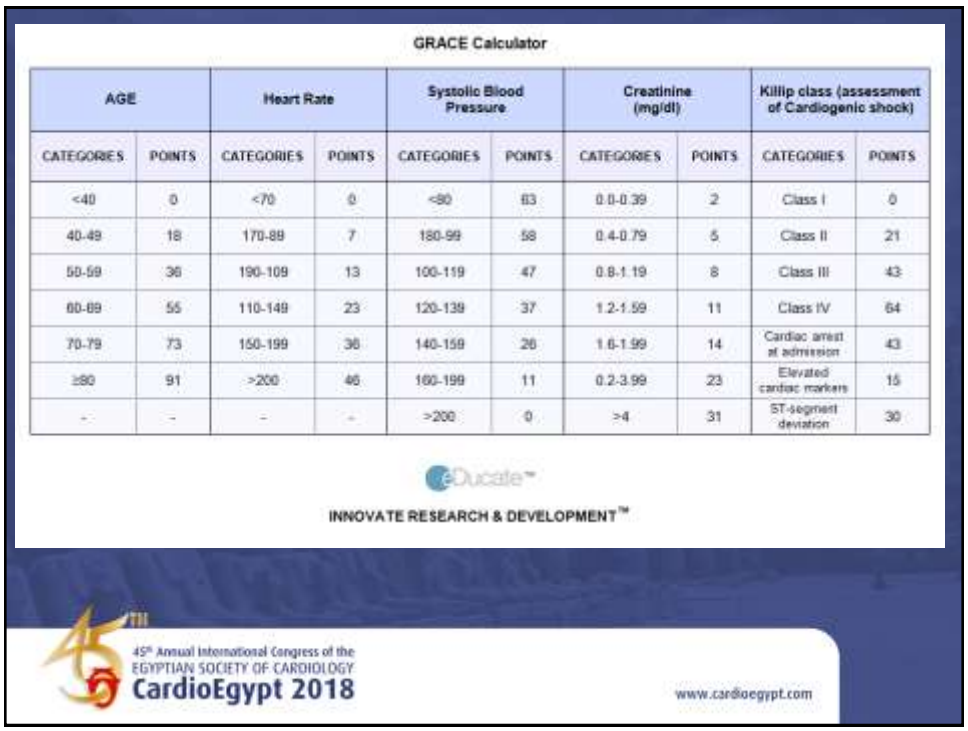


# GRACE Risk Score

| Variable | Odds ratio |
|---|---|
| Older age | 1.7 per 10 y |
| Killip class | 2.0 per class |
| Systolic BP | 1.4 per 20 mm Hg ↑ |
| ST-segment deviation | 2.4 |
| Cardiac arrest during presentation | 4.3 |
| Serum creatinine level | 1.2 per 1-mg/dL ↑ |
| Positive initial cardiac biomarkers | 1.6 |
| Heart rate | 1.3 per 30-beat/min ↑ |

The sum of scores is applied to a reference monogram to determine the corresponding all-cause mortality from hospital discharge to 6 months. Eagle KA, et al. *JAMA* 2004;291:2727–33. The GRACE clinical application tool can be found at www.outcomes-umassmed.org/grace. Also see Figure 4 in Anderson JL, et al. *J Am Coll Cardiol* 2007;50:e1–e157.
GRACE = Global Registry of Acute Coronary Events.




| AGE | | Heart Rate | | Systolic Blood Pressure | | Creatinine (mg/dl) | | Killip class (assessment of Cardiogenic shock) | |
|---|---|---|---|---|---|---|---|---|---|
| CATEGORIES | POINTS | CATEGORIES | POINTS | CATEGORIES | POINTS | CATEGORIES | POINTS | CATEGORIES | POINTS |
| <40 | 0 | <70 | 0 | <80 | 63 | 0.0-0.39 | 2 | Class I | 0 |
| 40-49 | 18 | 70-89 | 7 | 80-99 | 58 | 0.4-0.79 | 5 | Class II | 21 |
| 50-59 | 36 | 90-109 | 13 | 100-119 | 47 | 0.8-1.19 | 8 | Class III | 43 |
| 60-69 | 55 | 110-149 | 23 | 120-139 | 37 | 1.2-1.59 | 11 | Class IV | 64 |
| 70-79 | 73 | 150-199 | 36 | 140-159 | 26 | 1.6-1.99 | 14 | Cardiac arrest at admission | 43 |
| ≥80 | 91 | >200 | 46 | 160-199 | 11 | 0.2-3.99 | 23 | Elevated cardiac markers | 15 |
| - | - | - | - | >200 | 0 | >4 | 31 | ST-segment deviation | 30 |

## TIMI RISK SCORE for STEMI

| HISTORICAL | POINTS |
|---|---|
| Age ≥ 75 | 3 |
| 65-74 | 2 |
| DM or HTN or angina | 1 |
| **EXAM** | |
| SBP < 100 mmHg | 3 |
| HR >100 bpm | 2 |
| Killip II-IV | 2 |
| Weight < 67 kg (150 lb) | 1 |
| **PRESENTATION** | |
| Anterior STE or LBBB | 1 |
| Time to Rx > 4 hrs | 1 |

**RISK SCORE = Total points (0 -14)**

| RISK SCORE | 30-DAY MORTALITY IN TIMI II(%)* |
|---|---|
| 0 | 0.8 |
| 1 | 1.6 |
| 2 | 2.2 |
| 3 | 4.4 |
| 4 | 7.3 |
| 5 | 12 |
| 6 | 16 |
| 7 | 23 |
| 8 | 27 |
| >8 | 36 |

*Entry criteria: CP > 30 min, ST ↑, ix onset < 6hrs, fibrinolytic-eligible

## 3. Before discharge Risk Assessment

**LVEF, severity of CAD and completeness of coronary revascularization, residual ischemia, occurrence of complications during hospitalization, and levels of metabolic risk markers, as well as renal function.**

## 4. Imaging role in STEMI assessment

### Summary of indications for imaging and stress testing in ST-elevation myocardial infarction patients

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| Recommendations | Class | Level |
|---|---|---|
| **At presentation** | | |
| Emergency echocardiography is indicated in patients with cardiogenic shock and/or haemodynamic instability or suspected mechanical complications without delaying angiography. | I | C |
| Emergency echocardiography before coronary angiography should be considered if the diagnosis is uncertain. | IIa | C |
| Routine echocardiography that delays emergency angiography is not recommended. | III | C |
| Coronary CT angiography is not recommended. | III | C |



## 4. Imaging role in STEMI assessment

### Summary of indications for imaging and stress testing in ST-elevation myocardial infarction patients *(continued)*

ESC European Society of Cardiology

| Recommendations | Class | Level |
|---|---|---|
| **During hospital stay (after primary PCI)** | | |
| Routine echocardiography to assess resting LV and RV function, detect early post-MI mechanical complications, and exclude LV thrombus is recommended in all patients. | I | B |
| Emergency echocardiography is indicated in haemodynamically unstable patients. | I | C |
| When echocardiography is suboptimal/inconclusive, an alternative imaging method (CMR preferably) should be considered. | IIa | C |
| Either stress echo, CMR, SPECT, or PET may be used to assess myocardial ischaemia and viability, including in multivessel CAD. | IIb | C |

# 4. Imaging role in STEMI assessment

## Summary of indications for imaging and stress testing in ST-elevation myocardial infarction patients *(continued)*

ESC European Society of Cardiology

| Recommendations | Class | Level |
|---|---|---|
| **After discharge** | | |
| In patients with pre-discharge LVEF ≤40%, repeat echocardiography 6-12 weeks after MI, and after complete revascularization and optimal medical therapy, is recommended to assess the potential need for primary prevention ICD implantation. | I | C |
| When echo is suboptimal or inconclusive, alternative imaging methods (CMR preferably) should be considered to assess LV function. | IIa | C |



## Logistical issues for hospital stay *(continued)*

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| Recommendations | Class | Level |
|---|---|---|
| **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/ICCU 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 |

## Risk Assesment of Mortality, Cardiac events in Non STE ACS Patients

- Single Clinical parameters (Clinical examination, ECG, Biomarkers)
- Combined Risk factors in certain Scores (TIMI risk score, GRACE score, Heart Score)
- Acute risk Assesment

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## Single Clinical parameters (Clinical examination, ECG, Biomarkers)

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## Clinical Presentation

- **Age, diabetes and renal insufficiency**, the initial clinical presentation is highly predictive of early prognosis.
- **Chest pain at rest** carries a worse prognosis than symptoms elicited during physical exertion.



## Clinical Presentation

- In patients with intermittent symptoms, an **increasing number of episodes** preceding the index event also adversely affects prognosis.
- **Tachycardia, hypotension, heart failure and new mitral regurgitation** at presentation predict poor prognosis and call for **rapid diagnosis** and **management**

## Electrocardiogram

- **Patients with ST depression** have a worse prognosis than patients with a normal ECG.
- **The number of leads showing ST depression and the magnitude of ST depression** are indicative of the extent of coronary artery disease.



## Electrocardiogram

- **ST depression combined with transient ST elevation identifies a high-risk subgroup**, while associated T-wave inversion does not alter the prognostic value of ST depression.
- While **isolated T-wave inversion on admission has not been associated with worse prognosis compared with the absence of ECG abnormalities**, it frequently triggers a more rapid diagnosis and treatment.

## Biomarkers

- **The higher the high-sensitivity troponin levels** at presentation, the greater the risk of death.
- **Serum creatinine and estimated glomerular filtration rate (eGFR)** should also be determined in all patients with NSTE-ACS because they affect prognosis and are key elements of the Global Registry of Acute Coronary Events (GRACE 2.0) risk calculation.



## Biomarkers

- **B-type natriuretic peptide**, **N-terminal pro-B-type natriuretic peptide** and midregional pro-A-type natriuretic peptide) provide prognostic information on top of cardiac troponin.
- **C-reactive protein and novel biomarkers such as midregional pro-adrenomedullin, growth differentiation factor 15 and copeptin.**

# Combined Risk factors in certain Scores

# (TIMI risk score, GRACE score, Heart Score)



## TIMI Risk Score

Antman EM, et al. JAMA 2000; 284: pp. 835-842

- **The TIMI (Thrombolysis In Myocardial Ischemia) risk score** identifies seven independent risk factors; their sum **correlates directly with death or recurrent ischemic events**.
- It identifies high-risk patients who **can derive benefit from an early invasive strategy and more intensive antithrombotic therapy**. This risk score also predicts the severity of angiographic findings, including the extent of C

## TIMI Risk Score for UA/NSTEMI

- Age >65 years
- 3 or more CAD risk factors
  - HTN, DM, Hyperlipidemia, smoking, + family hx
- Prior CAD (cath stenosis>50%)
- ASA in last 7 days
- 2 or more anginal events in last 24 hours
- ST deviation on admission ECG
- Elevated cardiac markers (troponin/CK-MB)

Antman EM, et al. JAMA.. 2000;284:835-842.

## TIMI Risk Score for UA/NSTEMI: 7 Independent Predictors

1. Age ≥65 y
2. ≥3 CAD risk factors (high cholesterol, family history, hypertension, diabetes, smoking)
3. Prior coronary stenosis ≥50%
4. Aspirin in last 7 days
5. ≥2 anginal events ≤24 h
6. ST-segment deviation
7. Elevated cardiac markers (CK-MB or troponin)


Antman EM, et al. *JAMA*. 2000;284:835-842.

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# GRACE Risk Score

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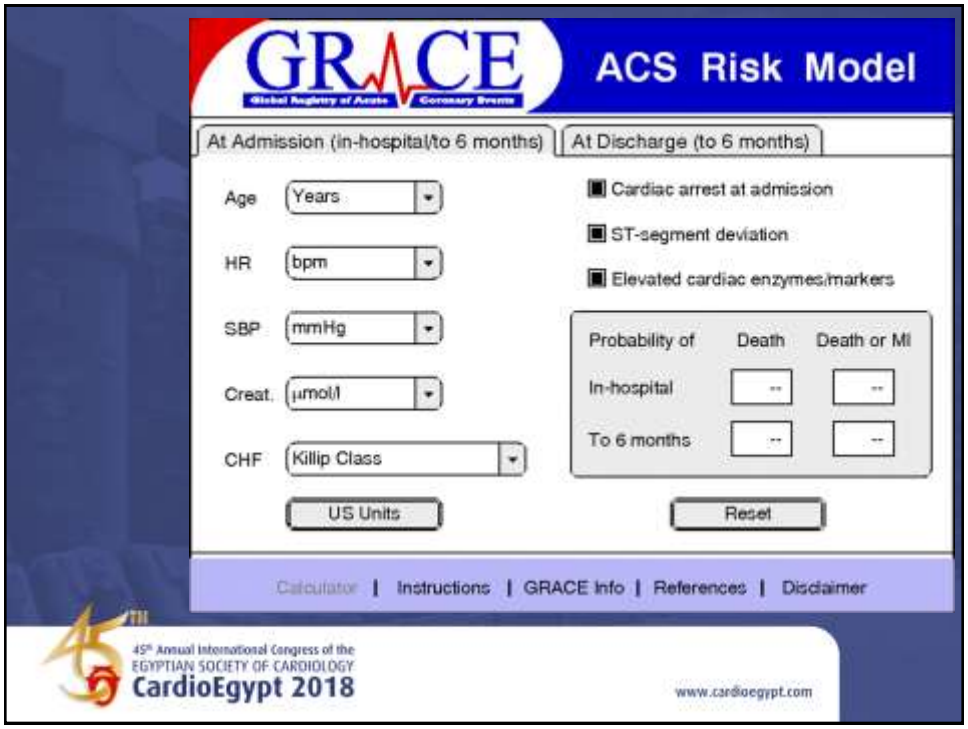


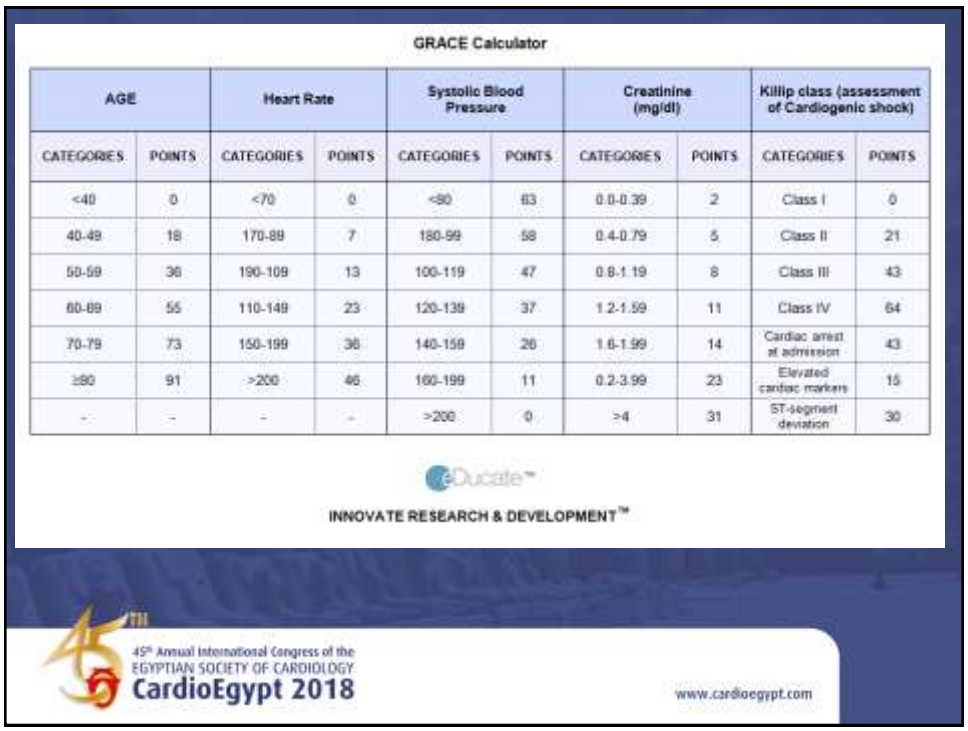


| AGE | | Heart Rate | | Systolic Blood Pressure | | Creatinine (mg/dl) | | Killip class (assessment of Cardiogenic shock) | |
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| - | - | - | - | >200 | 0 | >4 | 31 | ST-segment deviation | 30 |

# Mortality in hospital and at 6 months according to the GRACE risk score

| Risk category (tertile) | GRACE risk score | In-hospital death (%) |
|---|---|---|
| Low | ≤ 108 | < 1 |
| Intermediate | 109-140 | 1-3 |
| High | > 140 | > 3 |
| **Risk category (tertile)** | **GRACE risk score** | **Post- discharge to 6-month death (%)** |
| Low | ≤ 88 | < 3 |
| Intermediate | 89-118 | 3-8 |
| High | > 118 | > 8 |

www.escardio.org/guidelines

European Heart Journal (2011) 32:2999–3054
doi:10.1093/eurheartj/ehr236

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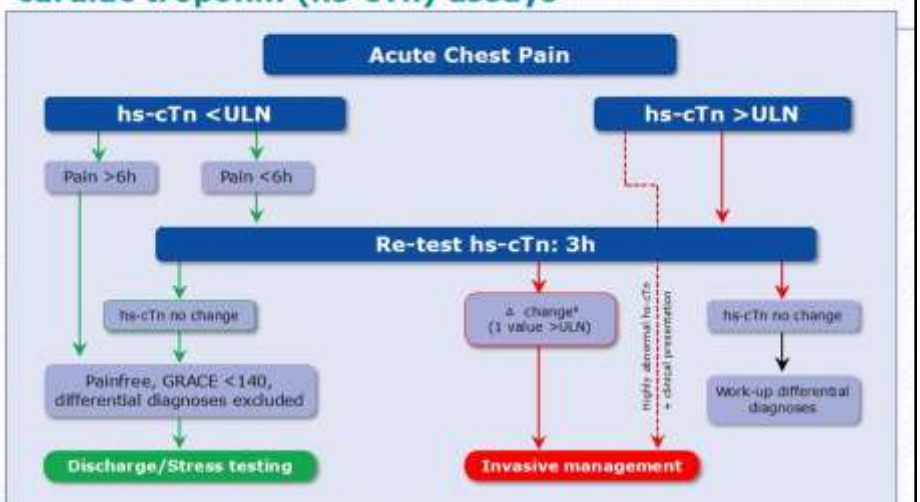
# 0h/3h diagnostic algorithm using high-sensitivity cardiac troponin (hs-cTn) assays




GRACE = Global Registry of Acute Coronary Events score; hs-cTn = high sensitivity cardiac troponin; ULN = upper limit of normal, 99th percentile of healthy controls.

*Δ change, dependant on assay. Highly abnormal hs Tn defines values beyond 5-fold the upper limit of normal.

www.escardio.org/guidelines

European Heart Journal 2016;37:267-315 - doi: 10.1093/eurheartj/ehv320

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## Recommended unit and duration of cardiac rhythm monitoring after established NSTE-ACS diagnosis

| Clinical Presentation | Unit | Rhythm monitoring |
|---|---|---|
| Unstable angina | Regular ward or discharge | None |
| NSTEMI at low risk for cardiac arrhythmias[a] | Intermediate care unit or coronary care unit | ≤24h |
| NSTEMI at intermediate to high risk for cardiac arrhythmias[b] | Intensive/coronary care units or intermediate care unit | >24h |

[a] If none of the following criteria: haemodynamically unstable, major arrhythmias, LVEF <40%, failed reperfusion, additional critical coronary stenoses of major vessels or complications related to percutaneous revascularization.

[b] If one or more of the above criteria are present.

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European Heart Journal 2016;37:267-315 - doi: 10.1093/eurheartj/ehv320

| The HEART Score for Chest Pain Patients in the ED | | |
|---|---|---|
| **History** | • Highly Suspicious<br>• Moderately Suspicious<br>• Slightly or Non-Suspicious | • 2 points<br>• 1 point<br>• 0 points |
| **ECG** | • Significant ST-Depression<br>• Nonspecific Repolarization<br>• Normal | • 2 points<br>• 1 point<br>• 0 points |
| **Age** | • ≥ 65 years<br>• > 45 - < 65 years<br>• ≤ 45 years | • 2 points<br>• 1 point<br>• 0 points |
| **Risk Factors** | • ≥ 3 Risk Factors or History of CAD<br>• 1 or 2 Risk Factors<br>• No Risk Factors | • 2 points<br>• 1 point<br>• 0 points |
| **Troponin** | • ≥ 3 x Normal Limit<br>• > 1 - < 3 x Normal Limit<br>• ≤ Normal Limit | • 2 points<br>• 1 point<br>• 0 points |
| **Risk Factors:** DM, current or recent (<one month) smoker, HTN, HLP, family history of CAD, & obesity | | |
| **Score 0 – 3**: 2.5% MACE over next 6 weeks → Discharge Home<br>**Score 4 – 6**: 20.3% MACE over next 6 weeks → Admit for Clinical Observation<br>**Score 7 – 10**: 72.7% MACE over next 6 weeks → Early Invasive Strategies | | |


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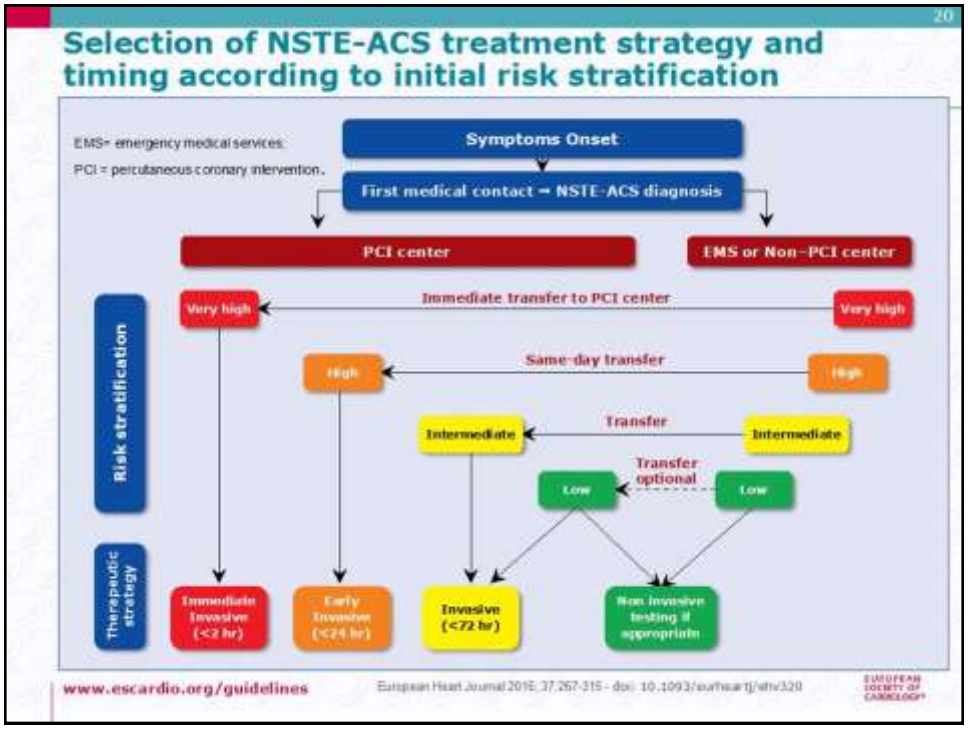
## Risk criteria mandating invasive strategy in NSTE-ACS

| |
|---|
| **Very-high-risk criteria** |
| • 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-T wave changes, particularly with intermittent ST-elevation |
| **High-risk criteria** |
| • 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** |
| • Diabetes mellitus |
| • Renal insufficiency (eGFR <60 mL/min/1.73 m$^2$) |
| • 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** |
| • Any characteristics not mentioned above |

www.escardio.org/guidelines

European Heart Journal 2016; 37:267-315 - doi: 10.1093/eurheartj/ehv320


Selection of NSTE-ACS treatment strategy and timing according to initial risk stratification
EMS= emergency medical services
PCI = percutaneous coronary intervention.
Symptoms Onset
First medical contact = NSTE-ACS diagnosis
PCI center
EMS or Non-PCI center
Risk stratification
Very high
Immediate transfer to PCI center
Very high
High
Same-day transfer
High
Intermediate
Transfer
Intermediate
Transfer optional
Low
Low
Therapeutic strategy
Immediate Invasive (<2 hr)
Early Invasive (<24 hr)
Invasive (<72 hr)
Non invasive testing if appropriate
www.escardio.org/guidelines
European Heart Journal 2016; 37:267-315 - doi: 10.1093/eurheartj/ehv320


Bleeding Risk Score
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## TIMI and GUSTO Bleeding Definitions Developed for Trials of Thrombolytics

| | |
|---|---|
| **TIMI** | |
| Major | ICH<br>Hb drop ≥5 g/dL<br>Hct drop ≥ 15% |
| Minor | Bleeding: Hb drop ≥ 3 g/dL; Hct drop ≥10%<br>No observed blood loss: Hb drop ≥4 g/dL; Hct drop ≥12% |
| Minimal | Any clinically overt sign of hemorrhage associated with Hb drop <3 g/dL or Hct drop <9% |
| **GUSTO** | |
| Severe | ICH; bleeding that causes hemodynamic compromise and requires intervention |
| Moderate | Bleeding requiring transfusion but does not lead to hemodynamic instability |
| Mild | Bleeding that does not meet criteria for severe or moderate bleeding |

Acute Coronary Syndromes

Chesebro JH, et al. *Circulation.* 1987;76:142-154.[2]
GUSTO Investigators. *N Engl J Med.* 1993;329:673-682.[3]

the heart.org Medscape EDUCATION

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## CRUSADE score of in-Hospital major bleeding

| Predictor | Score |
|---|---|
| Baseline haematocrit, % | |
| < 31 | 9 |
| 31-33.9 | 7 |
| 34-36.9 | 3 |
| 37-39.9 | 2 |
| ≥ 40 | 0 |
| Creatinine clearance, mL/min | |
| ≤ 15 | 39 |
| > 15-30 | 35 |
| > 30-60 | 28 |
| > 60-90 | 17 |
| > 90-120 | 7 |
| > 120 | 0 |

| Predictor | Score |
|---|---|
| Heart rate (b.p.m.) | |
| ≤ 70 | 0 |
| 71-80 | 1 |
| 81-90 | 3 |
| 91-100 | 6 |
| 101-110 | 8 |
| 111-120 | 10 |
| ≥ 121 | 11 |
| Male | 0 |
| Female | 8 |
| Sex | |
| Male | 0 |
| Female | 8 |
| Signs of CHF at presentation | |
| No | 0 |
| Yes | 7 |

| Predictor | Score |
|---|---|
| Prior vascular disease | |
| No | 0 |
| Yes | 6 |
| Diabetes mellitus | |
| No | 0 |
| Yes | 6 |
| Systolic blood pressure, mmHg | |
| ≤ 90 | 10 |
| 91-100 | 8 |
| 101-120 | 5 |
| 121-180 | 1 |
| 181-200 | 3 |
| ≥ 201 | 5 |

www.crusadebleedingscore.org

European Heart Journal (2011) 32:2999-3054
doi:10.1093/eurheartj/ehr236

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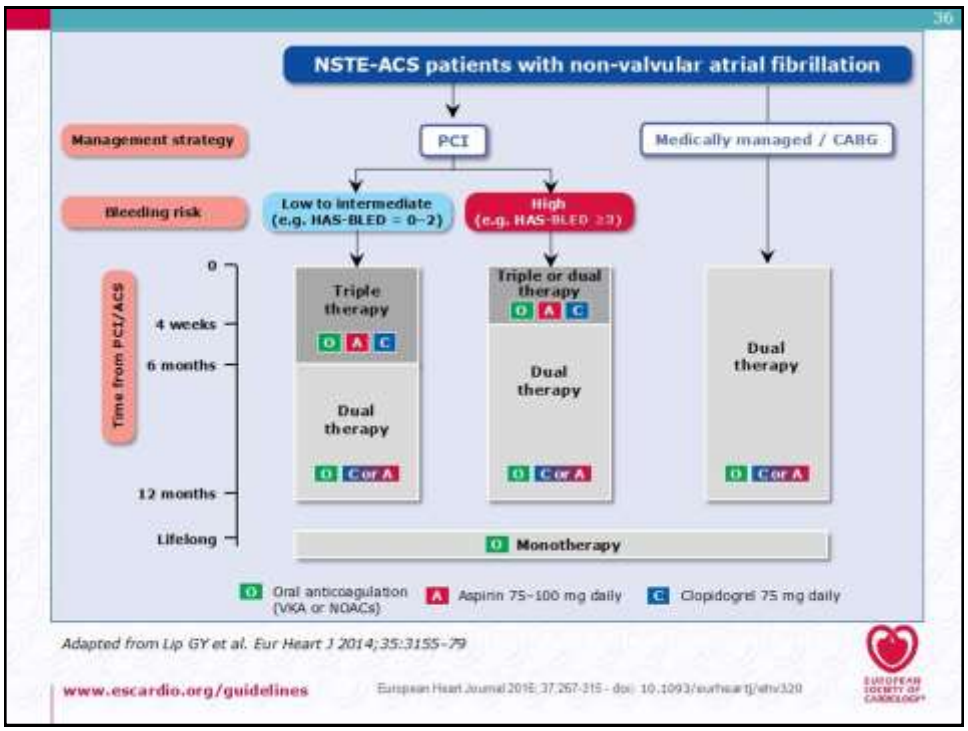
# HAS-BLED

| Letter | Clinical Characteristic | Points |
|---|---|---|
| H | Hypertension | 1 |
| A | Abnormal Liver or Renal Function | 1 or 2 |
| S | Stroke | 1 |
| B | Bleeding | 1 |
| L | Labile INR | 1 |
| E | Elderly (age > 65) | 1 |
| D | Drugs or Alcohol | 1 or 2 |
| Maximum Score | | 9 |





## Risk scores validated for dual antiplatelet therapy duration decision-making

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| | PRECISE-DAPT score | DAPT score |
|---|---|---|
| Time of use | At the time of coronary stenting | After 12 months of uneventful DAPT |
| DAPT duration strategies assessed | Short DAPT (3–6 months) vs. Standard/long DAPT (12–24 months) | Standard DAPT (12 months) vs. Long DAPT (30 months) |
| Score calculation | Hb ≥2 11-6 11 10-5 ≤10<br>WBC ≤3 8 10 12 14 16 18 ≥28<br>Age ≤50 60 70 80 ≥90<br>CrCl ≥130 80 60 40 20 0<br>Prior Bleeding No Yes<br>Score Points 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 | Age<br>≥75 −2 pt<br>65 to <75 −1 pt<br><65 0 pt<br>Cigarette smoking +1 pt<br>Diabetes mellitus +1 pt<br>MI at presentation +1 pt<br>Prior PCI or prior MI +1 pt<br>Paclitaxel-eluting stent +1 pt<br>Stent diameter <3 mm +1 pt<br>CHF or LVEF <30% +2 pt<br>Vein graft stent +2 pt |
| Score range | 0 to 100 points | −2 to 10 points |
| Decision making cut-off suggested | Score ≥25 → Short DAPT<br>Score <25 → Standard/long DAPT | Score ≥2 → Long DAPT<br>Score <2 → Standard DAPT |
| Calculator | www.precisedaptscore.com | www.daptstudy.org |

www.escardio.org/guidelines

2017 ESC focused Update on DAPT in Coronary Artery Disease, developed in collaboration with EACTS (European Heart Journal 2017 - doi:10.1093/eurheartj/ehx419)

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| | Hazard ratio (95% CI) | p value |
|---|---|---|
| Age (for each increase of 10 years) | 1·34 (1·11–1·48) | 0·005 |
| Previous bleeding | 4·14 (1·22–14·02) | 0·023 |
| White-blood-cell count (for each increase of $10^3$ cells per µL) | 1·06 (0·99–1·13) | 0·078 |
| Haemoglobin at baseline (for each increase of 1 g/dL) | 0·67 (0·53–0·84) | 0·001 |
| Creatinine clearance (for each increase of 10 mL/min) | 0·90 (0·82–0·99) | 0·004 |

Age was truncated above 90 years and below 50 years. Haemoglobin at baseline was truncated above 12 g/dL and below 10 g/dL. Creatinine clearance was truncated above 100 mL/min. White-blood-cell count was truncated above $20\times10^3$ cells per µL and below $5\times10^3$ cells per µL.

***Table 1:*** **Multivariable analysis for out-of-hospital Thrombosis in Myocardial Infarction major or minor bleeding, study stratified with backward selection at an α level of 0·1**

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**Table 3**

| DAPT Score Factors for Calculation<br>www.daptstudy.org/for-clinicians/score_calculator.htm | |
|---|---|
| Variable | Points |
| Age ≥75 y | -2 |
| Age 65 to <75 y | -1 |
| Age <65 y | 0 |
| Current cigarette smoker | 1 |
| Diabetes mellitus | 1 |
| MI at presentation | 1 |
| Prior PCI or prior MI | 1 |
| Stent diameter <3 mm | 1 |
| Paclitaxel-eluting stent | 1 |
| CHF or LVEF <30% | 2 |
| Saphenous vein graft PCI | 2 |

*Source: Levine GN, Bates ER, Bittl JA, et al. "2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines." J Am Coll Cardiol 2016.*



# Take home messege

- ACS are responsible for a high morbidity and mortality worldwide.
- Risk stratification for those patients including clinical, lab and biomarkers and combined risk score is crucial.
- This will help to identify patients at high risk who benefit from early invasive strategy and intense antithrombotic ttt.
- Risk stratification is important to identify patients at risk of bleeding in whom antithrombotic ttt should be tailored.
- Timing of discharge and future strategy can be planned.

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