STANDARD TREATMENT GUIDELINES

CARDIOLOGY

DEPARTMENT OF HEALTH AND FAMILY WELFARE
GOVERNMENT OF KERALA
STANDARD TREATMENT GUIDELINES IN CARDIOLOGY

Two sections

Section I

Evaluation and management of patients presenting with Acute coronary syndrome in secondary and tertiary care hospitals

Section II

Evaluation and management of heart failure
Committee for Development of Standard Treatment Guidelines

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“Driven by the inspiration drawn from Shri Rajeev Sadanandan IAS, Additional Chief Secretary, Department of Health and Family Welfare, Government of Kerala, the process of preparation of Standard Treatment Guidelines (STG) was initiated by the Director of Medical Education Dr Remla Beevi. A. The process of developing and finalizing the STG’s were coordinated by Dr. Sreekumari. K. Joint Director Medical education and Dr. Suma T K, Professor of Medicine and ably supported by a dedicated team of experts, including external faculty”.
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The Government is taking many initiatives to ensure providing quality health care to all. Out of the five missions launched by the Government, the Aardram mission is primarily focussed to improve Primary Health Care to provide standard health care facilities to people at grassroots. This initiative is complemented by strategic investment for the improvement of infrastructure in secondary and tertiary health care institutions to provide quality health care services.

I am happy to note that the Department of Health is also taking initiatives to bring standardization in treatment for various disciplines like Cardiology, Critical care, Diabetes Mellitus, Cancer Care, etc. It is a noteworthy initiative to improve the qualitative aspects of the health service delivery. I appreciate the efforts taken by the experts from Government sector and private sector from Kerala and also the subject experts from outside the state. I am hopeful that the introduction of standard guidelines for diagnosis and treatment will ensure better quality and consistency in health care.

I wish all the success to this endeavour.

Pinarayi Vijayan
Chief Minister
No:047/Press/H&SI/2019

Message

With health indicators comparable to the developed countries, Kerala has always been a role model for other States. Both public health infrastructure and private sector health care services have a wide network covering the entire length and breadth of the State.

But instead of sitting on its past laurels, the State is now gearing up to take public health care system to the next level under the revolutionary programme Aardram. The mission’s main objective is to completely transform public health sector making it people friendly, affordable for poorest and provide substantial state of the art infrastructure facilities.

The government is committed to regulate treatment costs, provide free medicines for life style diseases. Treatment protocols will be put in place for major diseases. Universal training to doctors and support staff will keep them updated on the latest developments in their respective fields. On the whole Aardram Mission promises to bring a total revolution in health sector like never before.

I am happy to inform that Government of Kerala is publishing a book on the Standard Treatment Guidelines for multiple disciplines like Cardiology, Critical Care, Diabetes, Hypertension and may other ailments. The Protocol would serve as a unified standardized protocol for initiation of treatment and follow up of cases in medical colleges and other tertiary institutions both in the private and public sector. Experts from various medical colleges, Professional Associations, Subject experts from various parts of the country had worked together for publishing the initiative. I appreciate the whole team and various stakeholders for the efforts taken and wishing everyone success in this endeavour.

K K Shailaja Teacher

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Patient care has moved away from management by an individual based on personal knowledge and skill to an evidence based, team managed operation. Decisions are reviewed more rigorously post facto and their alignment verified with standard practice. With the mode of payment for care moving from out of pocket payments to third party payers there will be a demand for rigorous documentation and evidence of having conformed to standard practice. When analysis of big data and machine learning becomes the norm it will require a standard set of procedures to act as the baseline from which to measure deviations and differences in impact.

To meet the requirement of these developments in the field of medicine, it is necessary to have explicit, objectively verifiable set of standard operating procedures. They have to be prepared based on international guidelines with the highest acceptance, but have to be modified to suit local knowledge and practice, so that there is local ownership. Government of Kerala has been trying to get the guidelines prepared for some time now. I would like to thank and congratulate Dr. Sreekumari, Joint Director of Medical Education and Dr. T.K.Sumam, Professor of Medicine, T.D. Medical College, Alappuzha who took on the task of preparing standard treatment guidelines and completed it through a long, consultative process. I also thank the conveners of the different thematic groups who coordinated the work in their field as well as the innumerable number of participants, in government and private sector, who contributed their effort and knowledge to improve the guidelines. Professional associations have also contributed in their fields. Their efforts have resulted in a product they and Kerala can be proud of.

Treatment guidelines cannot be static if they are to remain relevant. They must be updated based on new knowledge and the
experience of treatment based on these guidelines. To do this the
group which prepared the guidelines has to remain active and have
a system for collecting data on the results of practice based on
these guidelines. I hope such an activity is institutionalised and
periodic revisions of the guidelines are prepared and published.

I wish that these guidelines contribute to raising the quality of
patient care in Kerala.

Rajeev Sadanandan IAS
Addl Chief Secretary
Health & Family Welfare
Department
Section I

Evaluation and management of patients presenting with Acute coronary syndrome in secondary and tertiary care hospitals

1. Scope

Population

Adults more than 18 years of age

Key clinical issues covered:

Definition, clinical features, investigations, risk stratification and management of acute coronary syndromes

Clinical issues that will not be covered:

Management of non-cardiac causes of chest pain, methods of coronary intervention, cardiopulmonary resuscitation and management of heart failure. The following are only a guide and always the clinician has to exercise own judgment and clinical experience.

Health care setting:

Secondary and tertiary health care, as defined later

Outcome:

Early diagnosis and management of acute coronary syndrome, early reperfusion in STEMI, prevention of cardiac arrest and mortality.
2. Abbreviations.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACLS</td>
<td>Advanced Cardiac Life Support</td>
</tr>
<tr>
<td>ACS</td>
<td>Acute Coronary Syndrome</td>
</tr>
<tr>
<td>CAD</td>
<td>Coronary Artery Disease</td>
</tr>
<tr>
<td>CAG</td>
<td>Coronary Angiogram</td>
</tr>
<tr>
<td>CKMB</td>
<td>Creatine Phosphokinase MB fraction</td>
</tr>
<tr>
<td>CPR</td>
<td>Cardiopulmonary Resuscitation</td>
</tr>
<tr>
<td>CVA</td>
<td>Cerebrovascular Accident</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular Disease</td>
</tr>
<tr>
<td>ECG</td>
<td>Electrocardiogram</td>
</tr>
<tr>
<td>ED</td>
<td>Emergency Department</td>
</tr>
<tr>
<td>GFR</td>
<td>Glomerular Filtration Rate</td>
</tr>
<tr>
<td>LBBB</td>
<td>Left Bundle Branch Block</td>
</tr>
<tr>
<td>LMWH</td>
<td>Low Molecular Weight Heparin</td>
</tr>
<tr>
<td>MI</td>
<td>Myocardial Infarction</td>
</tr>
<tr>
<td>MR</td>
<td>Mitral Regurgitation</td>
</tr>
<tr>
<td>NSTEACS</td>
<td>Non ST Elevation Acute Coronary Syndrome</td>
</tr>
<tr>
<td>NSTEMI</td>
<td>Non ST Elevation Myocardial Infarction</td>
</tr>
<tr>
<td>PCI</td>
<td>Percutaneous Coronary Intervention</td>
</tr>
<tr>
<td>PTCA</td>
<td>Percutaneous Transluminal Angioplasty</td>
</tr>
<tr>
<td>RBBB</td>
<td>Right Bundle Branch Block</td>
</tr>
<tr>
<td>RBS</td>
<td>Random Blood Sugar</td>
</tr>
<tr>
<td>STEACS</td>
<td>ST Elevation Acute Coronary Syndrome</td>
</tr>
<tr>
<td>STEMI</td>
<td>ST Elevation Myocardial Infarction</td>
</tr>
<tr>
<td>UA</td>
<td>Unstable Angina</td>
</tr>
<tr>
<td>UFH</td>
<td>Un-fractionated Heparin</td>
</tr>
<tr>
<td>VSR</td>
<td>Ventricular Septal Rupture</td>
</tr>
</tbody>
</table>

Section I

STANDARD TREATMENT GUIDELINES - CARDIOLOGY
3. Diagnosis, investigations and risk stratification of acute coronary syndrome (ACS)

3.1. Introduction

Chest pain due to myocardial ischemia can be life threatening and early diagnosis and appropriate management is needed to reduce mortality and morbidity. Detailed history, physical examination and investigations are useful in diagnosis and proper management. History of cardiac pain, typical electrocardiographic (ECG) changes and rise and fall of biomarkers like cardiac troponin or creatine phosphokinase MB fraction (CKMB) are the most important tools to diagnose acute coronary syndrome (ACS).

3.2. Definitions

3.2.1 Health care setting. For the purpose of this guideline we define the level of health care setting for acute coronary syndrome (ACS) management as follows.

- **Primary care setup** is a hospital where a basic qualification doctor is available; ECG can be done but has no facility to manage ACS as inpatient.
- **Secondary care setup** is a hospital where ECG, cardiac Troponin and basic blood investigations are available and medical management including thrombolysis can be done but cathlab based interventional management is not possible.
- **Tertiary care setup** is a hospital where there is facility to manage ACS both medically and by cathlab based interventional management.

3.2.2 Acute Coronary syndrome refers to clinical situations that are compatible with acute myocardial ischemia. They classically present with ischemic cardiac pain or angina, though atypical symptoms (like abdominal discomfort or dyspnoea) or even 'silent' ischemia (where there may not be a significant symptom) can occur. ECG changes of myocardial ischemia/infarction or biomarker elevation may or may not be present at presentation, but usually become evident over a period of time.

ACS consists of myocardial infarction (MI) and unstable angina (UA). Cardiac ischemia without development of myocardial infarction is called unstable angina. Presentation of UA can be one among the following, angina at rest, a new onset effort angina, or rapid worsening of the preexisting effort angina. In UA, cardiac ischemic biomarkers will not be elevated to the range diagnostic of myocardial infarction (MI).

Acute myocardial infarction is defined as a rise and/or fall of cardiac
biomarker values [preferably cardiac troponin (cTn)] with at least one value above the 99th percentile (or upper reference limit of normal) and with at least one of the following:

- Symptoms of ischaemia.
- New or presumed new significant ST-segment–T wave changes (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

In studies of disease prevalence by the **World Health Organization (WHO)** myocardial infarction was defined by a combination of two of three characteristics: typical symptoms, biomarker elevation and a typical ECG pattern. This definition seems to be suitable in context to applicability compared to the Universal definition of myocardial infarction.

<table>
<thead>
<tr>
<th>Symptoms due to cardiac ischemia</th>
<th>Stable effort angina</th>
<th>Acute coronary Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiac pain of ischemic nature for less than 20 minutes, only on effort, relieved by rest, no hemodynamic changes, no recent worsening in severity</strong></td>
<td><strong>Cardiac pain of ischemic nature at rest/ or new onset effort angina/ or effort angina with recent worsening/ or prolonged cardiac pain/ or cardiac ischemic symptoms with hemodynamic disturbance (like pulmonary congestion, hypotension) or with persistent ECG changes or cardiac biomarker positivity</strong></td>
<td></td>
</tr>
</tbody>
</table>
ST elevations ACS vs Non ST elevation ACS

- **ST elevation ACS** have essentially ST segment elevation in the ECG, of \( \geq 0.1 \text{ mV} \) (or \( \geq 1 \text{ mm} \) in normal standardization) in two contiguous leads (except \( V_2 \) \( V_3 \), where the elevation should be \( \geq 2 \text{ mm} \) in males \( >40 \text{ years} \), \( >2.5 \text{ mm} \) in males \( <40 \text{ years} \) and \( >1.5 \text{ mm} \) in females). ST segment elevation is measured at the J point. J point is the junction of QRS and ST segment. **Non-ST elevation ACS** is diagnosed in a patient having ACS but the ECG diagnostic criteria for ST elevation are not satisfied. It comprises of **unstable angina (UA)** and **Non ST Elevation myocardial infarction (NSTEMI)**. In the very early phase of ACS, biomarker elevation need not be present and hence it is impossible to distinguish between NSTEMI and UA. Hence they are grouped as NSTEMI/UA initially and further classified into NSTEMI or UA once the disease evolves.
4. Assessment in suspected cases of ACS

4.1 History

Among unselected patients presenting with acute chest pain to the emergency department of tertiary care center, 5–10% have STEMI, 15–20% NSTEMI, 10% unstable angina, 15% other cardiac conditions and 50% have non-cardiac diseases. The background risk of the patient to develop atherosclerotic event and the description of the pain are very important in the early evaluation of acute chest pain.

Typical ischemic chest pain is characterized by a retrosternal sensation of pressure or heaviness ('angina') radiating classically to the left arm (less frequently to both arms or to the right arm), neck or jaw, which may be intermittent (usually lasting several minutes) or lasting for more than 30 minutes. Though right arm radiation is less frequent, radiation to right arm and lower jaw is more specific for cardiac pain (Fig 1). Cardiac pain lasting for more than 30 minutes is more likely to result in myocardial infarction than short duration pain and hence short episode of pain is provisionally considered as angina and longer duration as myocardial infarction. Additional symptoms such as sweating, nausea, abdominal pain, dyspnoea and syncope may be present. Exacerbation of symptoms by physical exertion and relief with rest favours cardiac ischemic pain. Relief of symptoms after nitrate administration is suggestive but not specific for cardiac pain.
Other presentations. Acute pulmonary oedema or cardiac arrest can be presenting symptom of ACS. In patients with longstanding diabetes mellitus, silent myocardial infarction (infarction without significant symptoms) can occur.

Atypical presentations of ACS include
- Epigastric pain
- Indigestion-like symptoms
- Isolated dyspnoea
- Fatigue
- Syncope.

Atypical pain or ischemic symptoms are more often observed in the elderly, in diabetic patients, in women and in patients with chronic renal disease and dementia. Ischemia can present with syncope, dyspnoea or abdominal pain without chest pain. Hence in high risk patients presenting with atypical symptoms, due care should be given to exclude ACS.

The following pain descriptions are not suggestive of myocardial ischemia.
- Pleuritic type pain, sharp or knife-like pain occurring on respiratory movements or cough
- Primary or sole location of discomfort in the middle or lower abdominal region
- Pain that can be localized with tip of one finger
- Pain reproduced with movement or palpation of the chest wall or arms
- Constant pain that persists for many days
- Very brief episodes of pain that last a few seconds or less
- Pain that radiates into the lower extremities
<table>
<thead>
<tr>
<th>Causes of chest pain other than due to cardiac ischemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastro-oesophageal reflux disease (GERD)</strong></td>
</tr>
<tr>
<td><strong>Pericarditis</strong></td>
</tr>
<tr>
<td><strong>Pleurisy</strong></td>
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<tr>
<td><strong>Pulmonary embolism</strong></td>
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<tr>
<td><strong>Dissection of aorta</strong></td>
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<tr>
<td><strong>Musculoskeletal</strong></td>
</tr>
<tr>
<td><strong>Acute cholecystitis/pancreatitis</strong></td>
</tr>
</tbody>
</table>
It is important to identify clinical circumstances that may precipitate or exacerbate ACS, such as anaemia, infection, fever and metabolic or thyroid disorders. Every patient suspected of having acute coronary syndrome should be asked for history of bleeding, for example melena. Identify conditions which puts patient at higher risk for bleeding like bleeding diathesis, use of oral anticoagulants or recent surgery or trauma. This is because ACS management essentially involves aggressive antithrombotic therapy.

4.2 Physical examination.

The first step in clinical evaluation is to identify any life-threatening situation with a view to preventing death. Rapidly evaluate for signs of high risk. Look for evidences of

- Shock - hypotension, feeble pulse, cold and clammy extremities
- Acute heart failure – dyspnea or orthopnea, tachycardia and tachypnoea with bi-basal lung crepitation, 3rd heart sound and desaturation
- Arrhythmia - very high or low heart rate especially with rhythm irregularity.

Shock, acute heart failure and arrhythmia need urgent intervention. In case of no features needing urgent intervention continue to do a quick but focused physical examination.

- A fast but focused physical examination is to be done when ACS is suspected. In stable patients a complete physical examination is to be done.
- Is the patient in distress, sweating, dyspnoeic, pale /or cold? Hypotension, acute pulmonary oedema, bradycardia or tachycardia may be the reason and are indications for immediate emergency care.
- Look for anemia which may the primary reason for cardiac ischemia.
- Pulse- rate, volume and pulse asymmetry are very important. Tachycardia and irregular rhythm are suggestive of arrhythmia.
- Both high blood pressure and hypotension are important. If there is pulse asymmetry and aortic dissection is suspected, blood pressure should be evaluated in lower limbs also.
- Respiratory rate and oxygen saturation by pulse oximetry may be measured in all patients whenever possible.
In the focused physical examination one has to look for anemia, evaluate the pulse (in all limbs) including rate, rhythm, volume and pulse symmetry, check blood pressure (BP) both systolic and diastolic (in all limbs when there is pulse asymmetry which will give a clue to dissection of aorta), respiratory rate, saturation by pulse oximetry, JVP and heart sounds including 3rd and 4th heart sound. Auscultate for systolic murmur (which can be due to mitral regurgitation/ventricular septal rupture) and pericardial rub. Look for evidence of atherosclerotic cardiovascular disease like stroke, peripheral vascular disease and carotid bruit. A respiratory system evaluation for pneumothorax or pleural effusion and an abdominal examination for possible diseases like cholecystitis/pancreatitis is to be done in quick time. Vital signs can be used to determine subsequent evaluation and cause of chest pain. For example, hypoxemia increases suspicion for pulmonary or cardiac etiologies of chest pain, while fever raises suspicion for infection.

4.3 Investigations

4.3.1 Electrocardiogram

A 12 lead ECG is mandatory, if the history is suggestive of cardiac ischemia. It is preferable to obtain V3R and V4R recordings also. **The resting 12-lead ECG may be obtained as early as possible and preferably within 10 minutes of the patient's arrival.** Initial ECG can be normal even in acute MI and a normal early ECG does not exclude ACS, if the history is suggestive of ACS. Repeat ECG may show ischemic changes. When clinical presentation is suggestive of ACS and initial ECG is normal, ECG may be repeated after ½ an hour and at 4 hour interval if the patient is not having continuing symptom or more frequently at ½ hour interval, if the patient has symptoms of continuing cardiac ischemia.

- Look for ischemic changes like ST elevation, ST depression, T inversions, or pathological Q waves (width of Q wave equal to or more than 40 msec or 1mm). New ECG changes like significant ST shift and T inversion and evolving ECG changes are highly suggestive of ACS. (Fig 2 & 3)

- Very tall T may occur before ST elevates and may be the first change in MI. T inversion of cardiac ischemia is typically symmetric and arrow shaped.
Combination of ST elevation localized to an arterial territory (indicative changes) and ST depression in oppositely placed leads (reciprocal changes) is highly suggestive of MI. ST elevation can be used to localise the culprit artery.

Right ventricular myocardial infarction (RVMI) is diagnosed when there is ST elevation in V₃R and V₄R in patients with inferior wall MI (Fig 4). ST elevation in right sided chest leads and JVP elevation usually normalizes early and hence recording of the right sided chest leads at presentation is important to diagnose RVMI.

Special leads V₇ V₈ V₉ may be recorded to look for ST elevation in posterior wall MI.
STEMI - naming based on the leads showing ST elevation

- Anterior  ST elevation in Chest leads
- Inferior  ST elevation in 2,3,aVF
- Lateral  ST elevation in I, aVL, V5,V6
- Posterior  ST elevation in V7,V8,V9 & ST depression chest leads
- RV  ST elevation in right sided chest leads

- Asymmetric low amplitude (<3 mm) T inversions may occur at times in precordial and inferior leads in normal young people, especially in obese females and do not suggest ischemia. T inversion can occur in many non cardiac conditions also.

- Rate and rhythm-look for presence of tachy or brady arrhythmias. Identify bundle branch block which will have wide QRS (≥120 millisec or ≥3 mm in normal paper speed). Atrioventricular block including PR interval prolongation are to be identified.

- Normal ECG does not exclude ACS in a patient with high likelihood presentation and serial ECG evaluation is very important to look at evolving changes.

- Apart from making diagnosis, ECG is useful for risk stratification. It also gives clues to the diagnosis of other conditions like pulmonary embolism (Right axis deviation; T inversion in V1 to V3; S1,Q3,T3; RBBB), or pericarditis (diffuse concave upward ST elevation in most leads, no reciprocal ST depression, PR segment depression).

- Q wave is the first and negative deflection in QRS. Leads I, aVL, V5 and V6 normally show a physiological q wave which is narrow. Q wave seen in evolved myocardial infarction is wider (≥ 40 m.sec - 1mm in standard ECG) and deeper (more than 2 mm. or > 25 % or R wave height).(Fig 5)
Examples of some arrhythmias are given below. Atrial fibrillation (Fig. 6) will have absence of P wave, presence of fibrillary waves and irregularly irregular RR interval.

In complete heart block (Fig. 7) there will be dissociation of P and QRS waves and regularly occurring P at a faster rate than regularly occurring QRS. Complete heart block is more common in inferior wall MI.

Ventricular tachycardia is regular tachycardia with wide QRS (>120 msec or 3 mm in regular ECG) and presence of atrioventricular dissociation (P and QRS occurring independently). (Fig 8.)
- Presence of RBBB in anterior wall STEMI (Fig 8) is highly suggestive of block in the proximal left coronary vessel and hence indicates poor outcome. ST elevation in aVR and V1 are also suggestive of proximal left coronary occlusion. When there is ST elevation in V3R and V4R in inferior wall STEMI, RV MI is also present and outcome can be worse than isolated inferior wall MI.

4.3.2 Biomarkers

Measurement of a biomarker of cardiomyocyte injury is to be done in all patients with suspected ACS whenever facility permits. Cardiac troponins are more sensitive and specific markers of cardiomyocyte injury than creatine kinase (CK), creatine kinase MB isoenzyme (CK-MB) and myoglobin and hence cardiac troponin I or T is preferred and should be available in all secondary or tertiary care hospitals. Elevation of cardiac troponin above the 99th percentile or the upper reference limit indicates MI. Troponin starts rising by 4-6 hours (Fig. 10) after chest pain. If the first value is negative, troponin can be repeated after six hours in cases of continuing pain or after 24 hours to rule out ACS.
Cardiac troponin may take hours to become elevated (biomarker blind period). Therefore very early treatment is not based on troponin elevation.

Figure 10. Pattern of rise and fall of troponin & CKMB in acute MI.

Cardiac troponins can remain elevated for 7-10 days after myocardial infarction. CK-MB shows a more rapid decline and normalize by 24-48 hours after MI and may provide added value for the timing of myocardial injury and the detection of early re-infarction compared to troponin. CK-MB is useful in renal disease where troponin can be elevated.

**High sensitivity troponin** (hs-Trop) can accurately measure smaller quantities of troponin and hence is useful in early rule in and rule out of MI. Rule out and rule in algorithms for MI using hs-Trop are available. However this is not to be used to decide reperfusion strategy in STEMI. The following is a modified chart for decision making in suspected case of ACS. Upper limit of normal (ULN) is the 99\(^{th}\) percentile of value in healthy controls. Both hs-Trop I and hs-Trop T can be used. A value of hs-cTnT>14 ng/l is considered elevated. However ULN Value can vary with the method/manufacturer and hence is to be modified accordingly.

<table>
<thead>
<tr>
<th>Time of Hs-Trop</th>
<th>Rule in ACS</th>
<th>Rule out ACS</th>
<th>Observe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 hour / 3 hour</td>
<td>Clinical probability high and Hs- Trop value more than the Upper limit of normal at 0 hour or at 3 hours, with a rise of more than 1 value between two tests</td>
<td>Pain free, low clinical probability + values of Hs–Trop less than ULN at both 0 hour and 3 hour</td>
<td>Intermediate clinical probability + Rise of troponins in serial testing but not reaching the diagnostic value.</td>
</tr>
</tbody>
</table>
Causes of troponin elevation other than MI. Elevated Cardiac troponins do not always mean ACS. Elevated levels of cardiac troponins can occur several conditions other than ACS and hence troponin elevation should be always analysed on the background of clinical presentation.

<table>
<thead>
<tr>
<th>Causes of Troponin elevation other than ACS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Renal dysfunction.</td>
</tr>
<tr>
<td>• Myocardial injury other than due to ACS, as in the case of myocarditis, myocardial contusion, DC shock given for cardioversion or defibrillation</td>
</tr>
<tr>
<td>• Left ventricular strain from congestive heart failure</td>
</tr>
<tr>
<td>• Hypertensive crisis</td>
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<tr>
<td>• Right ventricular strain from pulmonary embolism or other causes of acute pulmonary hypertension</td>
</tr>
<tr>
<td>• Severe sepsis</td>
</tr>
<tr>
<td>• Stress cardiomyopathy</td>
</tr>
<tr>
<td>• Acute stroke</td>
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<tr>
<td>• Extreme exercise</td>
</tr>
</tbody>
</table>

From the clinical presentation the likelihood of CAD can be classified as low, intermediate or high.

<table>
<thead>
<tr>
<th>Feature</th>
<th>High likelihood</th>
<th>Low likelihood</th>
<th>Intermediate likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Chest or left arm pain or discomfort is the chief symptom and similar to prior documented angina, occurring in known CAD including MI</td>
<td>Chest or left arm pain or discomfort as chief symptom in Age &gt;70, Male sex, Diabetes mellitus</td>
<td>Probable ischemic symptoms in absence of any of the intermediate likelihood characteristic</td>
</tr>
<tr>
<td></td>
<td>+ Any of the following</td>
<td>+ Absence of high likelihood features and presence of any of the following</td>
<td>+ Absence of high or intermediate likelihood features but may have any of the following</td>
</tr>
<tr>
<td>Feature</td>
<td>High likelihood</td>
<td>Low likelihood</td>
<td>Intermediate likelihood</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Examination</td>
<td>Transient MR murmur, Pulmonary edema or rales</td>
<td>Extra cardiac vascular disease</td>
<td>Chest pain reproduced by palpation</td>
</tr>
<tr>
<td>ECG</td>
<td>New or presumably new, transient ST segment elevation (&gt;0.1mV) or T inversion in multiple precordial leads</td>
<td>Fixed Q waves ST depression 0.05 to 0.1 mV or T inversion &gt;0.1mV</td>
<td>T flattening or inversion &lt;0.1mV in leads with dominant R waves or normal ECG</td>
</tr>
<tr>
<td>Cardiac markers</td>
<td>Elevated Cardiac Troponin I or T, or CKMB</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>

4.3.3 Lab investigations

Blood tests to be done in all cases at presentation

- Hemogram
- Serum creatinine and blood urea
- Blood sugar.

Other lab tests

- Liver function test, urinalysis, serum electrolytes, lipid profile, fasting blood sugar/post prandial blood sugar, PT-INR etc. may be done as per the clinical situation. For those needing coronary angiography (CAG), screening for markers of viral infection HBs Ag, HCV and HIV may also be done.
- **Blood Gas evaluation** may be done if available in cases of dyspnoea and shock.

4.3.4 Other investigations

Echo cardiogram

Early evaluation with 2D echocardiography, Doppler and Color Doppler may be done in cases of clinical ventricular dysfunction or hemodynamic disturbance. Echo may be done electively in stable cases. Estimation of left ventricular (LV) function is useful to prognosticate. Echo identifies ventricular wall motion.
abnormality, hypertrophy, abnormality of the valves, pericardial effusion or thrombus, dissection of aorta and may give clue to concomitant diseases. Mechanical complications like acute mitral regurgitation, ventricular septal rupture or free wall rupture can be diagnosed with Echo. In patients with dyspnoea, presence of lung comets or multiple B lines on the chest ultrasound is highly suggestive of pulmonary oedema. (see chapter on heart failure)

Chest X-ray is not routinely needed in the acute setting of every ACS but will be useful in patients with dyspnea / desaturation. It is also useful to detect pneumonia, pneumothorax, rib fractures or other thoracic disorders. CT and pulmonary angiogram is useful in suspected case of pulmonary embolism and dissection of aorta.

<table>
<thead>
<tr>
<th>History</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 65 years</td>
<td>1</td>
</tr>
<tr>
<td>Three or more risk factors for coronary artery disease (CAD)</td>
<td>1</td>
</tr>
<tr>
<td>(family history of CAD, hypertension, hypercholesterolemia, diabetes mellitus, tobacco use)</td>
<td></td>
</tr>
<tr>
<td>Known CAD (coronary stenosis &gt;50%)</td>
<td>1</td>
</tr>
<tr>
<td>Aspirin use in the past 7 days</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe angina (≥2 episodes in 24 hours)</td>
<td>1</td>
</tr>
<tr>
<td>ST deviation ≥0.5 mm</td>
<td>1</td>
</tr>
<tr>
<td>Elevated cardiac marker level</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk of Cardiac events by 14 days</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk score</td>
<td></td>
</tr>
<tr>
<td>Death or MI</td>
<td>Death/ MI/ revascularization</td>
</tr>
<tr>
<td>0-1</td>
<td>3%</td>
</tr>
<tr>
<td>2</td>
<td>3%</td>
</tr>
<tr>
<td>3</td>
<td>5%</td>
</tr>
<tr>
<td>4</td>
<td>7%</td>
</tr>
<tr>
<td>5</td>
<td>12%</td>
</tr>
<tr>
<td>6-7</td>
<td>19%</td>
</tr>
</tbody>
</table>

TIMI score for “NSTEMI”
5. Early risk stratification

Patients with ACS must be evaluated rapidly in order to identify those at risk of life-threatening arrhythmias and therefore needing close surveillance. All patients with ACS need monitoring. Those having continuing pain and high risk ACS need continuous ECG and monitoring of the vitals in an ICU. There are several scoring systems to assess the risk of ACS like TIMI risk scores and Killips classification.

5.1 UA/NSTEMI. The TIMI risk score in NSTEMI uses seven variables in an additive way. A low TIMI score ≤3 usually indicates a low risk and a TIMI score > 3 indicates intermediate or high risk. Decision on medical management or early invasive management can be done based on the risk.

5.2 STEMI. Since early reperfusion therapy is to be done in STEMI presenting in window period, risk scoring is not that important compared to NSTEMI in deciding various strategies in early management. TIMI scoring for STEMI has 8 variables and Killips class is one among them.

TIMI Score for STEMI. The table gives the variables assessed and the chart gives the risk for the score.

<table>
<thead>
<tr>
<th>History</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 75</td>
<td>3</td>
</tr>
<tr>
<td>DM/HTN or angina</td>
<td>1</td>
</tr>
<tr>
<td>Examination</td>
<td></td>
</tr>
<tr>
<td>SPB 100</td>
<td>3</td>
</tr>
<tr>
<td>HR &gt; 100</td>
<td>2</td>
</tr>
<tr>
<td>Killip class-II-IV</td>
<td>2</td>
</tr>
<tr>
<td>Weight &lt; 67</td>
<td>1</td>
</tr>
<tr>
<td>Presentation</td>
<td></td>
</tr>
<tr>
<td>Anterior STEMI of LBBB</td>
<td>1</td>
</tr>
<tr>
<td>Time to treatment &gt; 4 hours</td>
<td>1</td>
</tr>
<tr>
<td>Risk Score 0-14</td>
<td></td>
</tr>
</tbody>
</table>

(Only 1% of patients with STEMI are at high risk with >8 score and 50% have score of 2 or less with a low risk)
Killip class is a very simple tool for risk stratifying. 'Killip class' is based on clinical features at admission, and has independent prognostic value, with Class I at very low risk and Class IV at very high risk.

**Killip class in STEMI**

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No signs of heart failure</td>
</tr>
<tr>
<td>II</td>
<td>S3, elevated JVP, rales less than half of posterior lung fields</td>
</tr>
<tr>
<td>III</td>
<td>Overt pulmonary edema</td>
</tr>
<tr>
<td>IV</td>
<td>Cardiogenic shock</td>
</tr>
</tbody>
</table>

The following are very high risk features in any ACS

- Cardiogenic shock
- Acute heart failure
- Life-threatening arrhythmias or cardiac arrest
- Recurrent or ongoing chest pain refractory to medical treatment
- Mechanical complications of MI
- Recurrent dynamic ST-T wave changes, particularly with intermittent ST-elevation

6. **Management of ACS in secondary care setting.**

Once acute coronary syndrome is diagnosed, early, rapid and aggressive management is to be instituted. Immediate management of any life threatening emergency like hypotension / shock / pulmonary oedema / arrhythmia should be done. The specific management essentially consists of administration of antiplatelets, antithrombotics like heparin, opening of the occluded vessel by reperfusion strategies, high dose statins, hypertension/diabetes management and management of complications like arrhythmia and heart failure.
All patients with ACS should receive the following initially.

- **Aspirin** 300 mg, to be chewed
- **Clopidogrel** 300 mg in patients below 75 years, (75 mg above 75 years of age)
- **High dose atorvastatin** (40 or 80 mg).
- Secure an IV line as soon as diagnosis is made

All **STEMI** patients presenting within 12 hours to be considered for **reperfusion therapy**. Referral to tertiary care center for angioplasty may be considered if angioplasty can be done within 120 minutes of diagnosis of **STEMI** after contacting the tertiary care centre regarding feasibility. If delay of more than 120 minutes expected from STEMI diagnosis to PCI, thrombolysse without delay (start in 10 minutes), if there are no contraindication to thrombolysis.

Thrombolysis is for STEMI only and is not to be given in UA/NSTEMI

Antithrombotics, like heparin are to be given in UA/NSTEMI and post thrombolysis in STEMI

**Other medications based on need**

- **Nitrates**- Sublingual nitrate/IV nitrate may be given to patients with pain if the BP is >100 mm of Hg systolic

- **Beta-blockers** like metoprolol 50 mg orally may be given in selected cases of STEMI, if the patient has tachycardia and high blood pressure with no features of heart failure. In all UA/NSTEMI, early initiation of metoprolol may be done if there is no contraindication.

- **Oxygen administration** is to be considered when the patient is dyspnoeic and having desaturation.

**ACE-I and aldosterone receptor blocker** are indicated in STEMI and LV dysfunction and for hypertension management
6.1 General measures

- With a quick evaluation identify presence of any life threatening situations like shock, significant tachy or brady arrhythmia and pulmonary edema. If any of the above is present, appropriate management for that may be given.

- All cases of STEMI and high risk UA/NSTEMI should have an IV line secured. In case of hypotension, volume supplementation by IV infusion and pressor support may be initiated. Many patients with hypotension will be hypovolemic and unless volume is corrected, the BP will not stabilize.

**Hypotension in ACS**

- Hypovolemia- significant fluid loss can occur due to sweating and vomiting- volume correction needed
- Massive myocardial damage- early reperfusion and inotropes
- Arrhythmia like atrial fibrillation or ventricular tachycardia- DC shock may be needed.
- Bezold-Jarisch reflex- seen in inferior wall MI associated with significant bradycardia and hypotension - atropine and IV fluids to be given
- Drug induced. Many drugs like nitrate, betablocker, and streptokinase can produce hypotension. Adjust the drug dose
- Mechanical complications like ventricular septal rupture/ pericardial tamponade

- **Oxygen administration** is to be considered when the patient is dyspnoeic and having desaturation. Administer oxygen, at 2-4 L/min, to maintain oxygen saturation > 90%. Routine administration of oxygen in stable patients is not needed.

- In patients whose ischemic symptoms are not relieved by nitrates and beta-blockers, small dose of morphine (dose of 2-3 mg i.v. with promethazine 12.5 mg) can be useful if there is no hypotension. There is a concern that morphine may reduce the effectiveness of anti-platelets and hence is to be used in select patients having significant pain or pulmonary oedema.
6.2 Specific treatment of ACS.

6.2.1 Antiplatelets. In all cases of ACS, administer aspirin 300 mg (to chew) immediately (if not administered earlier), followed by 75-150 mg daily unless there is a contraindication for aspirin use. Second antiplatelet agent, a P2Y12 inhibitor, clopidogrel is to be given in addition to aspirin. (other drugs like ticagrelor or prasugrel are preferred over clopidogrel in patients being managed with percutaneous coronary intervention).

- Dose of clopidogrel is 300 mg loading given orally in patients <75 years of age and 75 mg in patients > 75 years of age, when non invasive (medical) management is planned. (The loading dose for clopidogrel in case of angioplasty is 600 mg orally). Clopidogrel maintenance dose is 75mg orally daily.

6.2.2 Statin. High dose statin like atorvastatin 40-80 mg or rosuvastatin 20 -40 mg (in older people above 75 yrs half the dose) is to be given stat at admission and may be continued daily in all patients unless there is a contraindication. The dose of statin is not dependent on lipid level in the ACS setting and hence fasting lipid profile is not needed to initiate high dose statin.

6.2.3 Nitrates are useful in reducing pain and ischemic symptoms by reducing preload (venodilation) and by coronary artery dilation. It also reduces the pulmonary congestion. It is useful in reducing the BP in hypertensive states. It may be given orally/sublingually or intravenously till the pain subsides and if the BP is >100mm of Hg systolic or till the BP is controlled in patients with high BP.

- Sublingual administration of 5 mg of isosorbide dintrate (or nitroglycerine) followed by repeat dose at 15 minutes interval may be given before i.v. line is established.

- Intravenous administration should be under careful blood pressure monitoring. The Starting dose of nitroglycerine (NTG) is 10 mcg /min. by i.v. infusion and the dose should be titrated upwards by 10mcg/min every 15-30 minutes, until symptoms are relieved, unless side effects (notably headache or hypotension) occur.

- In hypertensive patients NTG is given till the mean arterial blood pressure is reduced by at least 25%.

- Nitrates are contraindicated in cases of right ventricular MI and in hypotension.
and sildenafil or other phospho diesterase - 5 (PDE-5) inhibitor use. Right ventricular MI is to be expected in all cases of inferior wall MI especially when there is hypotension.

6.2.4 Reperfusion therapy

Reperfusion therapy is to be considered urgently in all STEMI patients and are of two types.

- pharmacological - thrombolysis or fibrinolysis
- mechanical - Percutaneous coronary Intervention (PCI).

Window period- Reperfusion is indicated if a STEMI patient presents within the window period of 12 hours after the onset of pain and should be given as early as possible. In cases of continuing ischemia, shock or LV failure PCI may be done after 12 hours also. Routine PCI after 48 hours is to be avoided.

Which method of reperfusion?. Reperfusion by angioplasty is prefered over thrombolysis if the procedure can be done within 120 minutes of diagnosis of STEMI by referring to a tertiary care centre. If angioplasty is not possible within in 120 minutes from diagnosis of STEMI (various reasons are delay in decision making and delay in transportation to another centre), thrombolysis is the reperfusion strategy.

Thrombolytic therapy. It is indicated in STEMI patients presenting within 12 hours of onset of pain, when there are no contraindications. In NSTEMI/UA thrombolysis is contraindicated. There are absolute and relative contraindications to thrombolysis in STEMI.

<table>
<thead>
<tr>
<th>Absolute contrindication for thrombolysis</th>
<th>Relative contraindication for thrombolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous intracranial bleed</td>
<td>Oral anticoagulant therapy</td>
</tr>
<tr>
<td>Ischemic stroke in 6 months</td>
<td>Transient ischemic attack in last 6 months</td>
</tr>
<tr>
<td>CNS neoplasms or AV malformation</td>
<td>Pregnancy or within one week postpartum</td>
</tr>
<tr>
<td>GI bleed in one month</td>
<td>Refractory hypertension of &gt;180 mm Hg. systolic or &gt;110 distolic.</td>
</tr>
<tr>
<td>Known active bleeding disorder</td>
<td>Advanced liver disease or active peptic ulcer</td>
</tr>
<tr>
<td>Aortic dissection</td>
<td>Infective endocarditis</td>
</tr>
<tr>
<td>Noncompressible punctures in last 24 hours</td>
<td>Prolonged resuscitation</td>
</tr>
</tbody>
</table>
Thrombolytic agents. Fibrin specific agents like tenecteplase or reteplase are prefered over streptokinase. Streptokinase is not fibrin-specific, requires to be given as an infusion over one hour and may be associated with hypersensitivity reactions. Previous streptokinase administration can result in antibody formation and repeat administration is to be avoided especially within 6 months of previous use. Tenecteplase has the advantage of being fibrin-specific, can be given as a bolus dose, and has a lower incidence of hypersensitivity reactions. Reperfusion is better with tenecteplase compared to streptokinase. Advantage of streptokinase is that is is very cheap compared to tenecteplase. Doses of individual lytic agents are given below. Those getting fibrin specific lytic agents should be given heparin or enoxaparin also(dose given below). Fondaparinux is an antithrombin option after Streptokinase (dose 2.5 mg i.v. followed by 2.5mg/day/s.c)

<table>
<thead>
<tr>
<th>Fibrinolytic agent</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptokinase</td>
<td>1.5 million units as an infusion over 30-60 minutes</td>
</tr>
<tr>
<td>Reteplase</td>
<td>10 units + 10 units iv bolus given 10 minutes apart</td>
</tr>
</tbody>
</table>
| Tenecteplase       | Single IV bolus  
                           30 mg if <60 kg body weight  
                           35 mg if 60 to <70 kg body weight  
                           40 mg if 70 to <80 kg body weight  
                           45 mg if 80 to <90 kg body weight  
                           50 mg if > 90 kg body weight  
                           Half the dose in > 75 years of age  
                           (co-therapy with parenteral anticoagulation with enoxaparin or heparin infusion is to be given, till PCI is performed or if PCI not done for the duration of the hospital stay for minimum of 48 hours and maximum 8 days - dose detailed below) |

6.2.5 Antithrombotics (heparin, enoxaparin or fondaparinux)

- Antithrombotics are indicated in all cases of STEMI with thrombolysis and in all cases of NSTEMI/UA until PCI is done, or till hospital discharge, for maximum 8 days.

- **Dose of antithrombotic** is given in the table. Most commonly used low molecular weight heparin (LMWH) is enoxaparin.

- LMWH should not be given in patients with eGFR <15mL/min and here UFH is preferred.
### Antithrombotic agent

<table>
<thead>
<tr>
<th>Antithrombotic agent</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unfractionated heparin</strong></td>
<td>i.v. bolus of 60–70 IU/kg up to a maximum of 5000 IU, followed by an infusion of 12 -16IU/kg/h up to a maximum of 1000 IU/h, aPTT target 50–75 sec or 1.5– 2.5 times the upper limit of normal.</td>
</tr>
<tr>
<td><strong>Enoxaparin</strong></td>
<td>Post thrombolysis, loading 30mg i.v. followed 15 minutes later by 1 mg/kg s/c twice daily. &gt;75 years of age, avoid bolus and 0.75 mg/kg per dose s/c twice a day. In NSTEMI/UA, loading dose not to be given given. Daily dose same. <strong>When the eGFR is 15-30 mL/mt</strong> reduce to 1mg/kg once a day.</td>
</tr>
<tr>
<td><strong>Fondaparinux</strong></td>
<td>2.5 mg iv bolus followed by 2.5 mg s/c daily for maximum 8 days.</td>
</tr>
</tbody>
</table>

#### 6.2.6 Beta-blockers (BB)

Beta-blockers (BB) reduce myocardial oxygen consumption by lowering heart rate, BP and myocardial contractility and produce 13% relative risk reduction of mortality in the first week following MI. BB are more useful in patients with tachycardia and hypertension. Oral metoprolol may be considered in all cases of UA/NSTEMI in the absence of contraindications. I.V. metoprolol is selectively used in acute phase of STEMI, only if there is tachycardia and hypertension. After acute phase is over, BB may be started by 24 hours, if not already started. BB (carvedilol, metoprolol succinate or bisoprolol) is indicated in patients with reduced LV systolic function (see the chapter on management of heart failure).

**Contraindication for initiating betablocker**

- signs of heart failure-(in heart failure start at low dose, once congestive symptoms are controlled)
- systolic BP <100 mmHg
- heart rate <60 beats/min
- PR interval > 0.24 sec, second or third degree heart block
- active asthma or COPD- relative contraindication
Dose of oral metoprolol is 25-50 mg 12 hourly, titrated up to 100 mg every 12 hour based on BP and HR. In select cases with high BP and tachycardia, if there is no evidence of heart failure, i.v. metoprolol may be given at a dose of 5mg, to be followed by two more doses of 5mg at 5 minute interval, to a maximum of 15 mg, provided heart rate > 60/mt and BP > 100 mm Hg systolic. I.V. metoprolol is to be followed by oral metoprolol 50 mg within 6 hours. When there is LV dysfunction, preferred drugs are carvedilol, bisoprolol or metoprolol succinate to be started at low dose and stepped up gradually.

6.2.7 Other medications

- ACE-I and aldosterone receptor blocker in cases of STEMI may be started by 24 hours if there is no hypotension or elevated serum creatinine. ACE-I and Aldosterone receptor blockers are indicated in LV dysfunction both in STEMI or NSTEMI.
- Calcium channel blockers like diltiazem and verapamil are to be avoided in cases of STEMI, and when there are features of heart failure. In NSTEMI/UA with no features of heart failure and not tolerating BB due to wheeze, diltiazem or verapamil may be considered as they reduce heart rate and have antianginal action. Amlodipine may be used for hypertension control as add on therapy in the continuing treatment of MI.

6.3 Referral to tertiary care for PCI

In STEMI.

- Primary angioplasty (angioplasty as the primary mode of reperfusion in STEMI) is preferred over thrombolysis if the angioplasty can be done within 120 minutes of STEMI diagnosis. If the time limit can be met, patient may be immediatley refered to a tertiary care center, preferably after contacting the center to which patient is being refered to. Referal also should consider the clincial situation and risk of transportation and should be done after discussing with the patient/relatives regarding various issues in transportation.
- Angioplasty after thrombolysis may be considered in some situations. They are
  - Rescue PCI. Whenever there is evidence of failed thrombolysis rescue angioplasty may be considered after discussing with the
patient and relatives. Failed thrombolysis is diagnosed when the patient after lytic therapy has continuing ischemia, hemodynamic or electrical instability and absence of ST resolution by at least 50% in the ECG taken at 60-90 minutes after starting lysis.

- **Early CAG after fibrinolysis followed by PCI of culprit vessel.** In cases of stable patients after lysis, a CAG may be considered within 2 to 24 hours after thrombolysis.

When considering referral for angioplasty, the centre to which patient is being referred should be contacted and the feasibility of angioplasty in 120 minutes from diagnosis of STEMI assessed and if angioplasty in time limit is not possible, thrombolysis may be initiated in the secondary care centre. When decided to give thrombolytic therapy, it should be initiated in 10 minutes.

**In NSTEMI/UA.** Early PCI may be done in high risk cases of NSTEMI/UA and patient may be referred to tertiary care after the early management. In very low risk cases of NSTEMI/UA initial medical management is ideal. Use TIMI score or look at high risk features discussed in risk stratification.

**Details to be included in the referral letter when sending to tertiary care centre.** All referred patients may be given a letter with a provisional clinical diagnosis along with ECG and other investigation reports. Drugs given and time of administration are to be mentioned. A copy of the check list can be useful during referral.

### 6.4. Monitoring and follow up.

All high risk cases of ACS should be monitored for a period of 24 hours or till they are stable, preferably in the ICU. Rehabilitation and continuation of the drug therapy are important. Early in-hospital rehabilitation and lifestyle modification are to be instituted. Advise regarding healthy lifestyle and smoking cessation should be given.
### 6.5. Check list for management of ACS in secondary care

Name ……………….age…………sex………weight…….time of presentation………………

Mark appropriately- Yes/No/ select option by circling /or write comment

#### Clinical evaluation

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Chest pain</th>
<th>Classical cardiac pain/ not classical but suggestive/ noncardiac pain</th>
<th>Other symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other history</td>
<td>Diabetes</td>
<td>Any of the following drugs in past 24 hours and dose</td>
<td>Active bleeding/ recent history of bleeding</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>Aspirin</td>
<td>Yes/No</td>
</tr>
<tr>
<td></td>
<td>Family history of CAD</td>
<td>Clopidogrel/prasugrel/ ticagrelor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wheeze</td>
<td>Warfarin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allergy</td>
<td>PDE-5 inhibitor</td>
<td></td>
</tr>
<tr>
<td>Physical exam.</td>
<td>Pallor</td>
<td>Pulse: Rate……Rhythm……….. peripheral pusies,……… Respiratory rate……..</td>
<td>BP</td>
</tr>
<tr>
<td></td>
<td>Yes/no</td>
<td></td>
<td>Pulse oximetry</td>
</tr>
</tbody>
</table>

#### Investigations

<table>
<thead>
<tr>
<th>ECG</th>
<th>Time</th>
<th>ST elevation Yes/No</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ST depression/ T inversion Yes /No Normal</td>
<td>Rhythm regular/irregular PR interval 2&lt;sup&gt;nd&lt;/sup&gt; or 3&lt;sup&gt;rd&lt;/sup&gt; degree AV block RBBB/LBBB</td>
</tr>
<tr>
<td>C.Troponin</td>
<td>RBS</td>
<td>S. Creatinine</td>
<td></td>
</tr>
</tbody>
</table>

#### Provisional diagnosis

<table>
<thead>
<tr>
<th>Unstable angina/NSTEMI</th>
<th>STEMI (early reperfusion strategy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is any of these high risk present?</td>
<td>Acute heart failure</td>
</tr>
</tbody>
</table>

#### Treatment

<table>
<thead>
<tr>
<th>Aspirin 300 mg</th>
<th>Clop/dogrel 300mg</th>
<th>Atorvastatin 40/80mg</th>
<th>nitrate</th>
<th>Metaprolool(BB) Enalapril (ACE-I) spironolactone</th>
<th>Antithrombotic Heparin/enoxaparin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of reperfusion in STEMI</td>
<td>Thrombolysis (only in STEMI)</td>
<td>Contraindication Yes/No Administered Yes/No</td>
<td>PCI in 120 minutes from STEMI diagnosis feasible? Yes/No Referral</td>
<td>High risk NSTEMI? Refer for PCI after early management.</td>
<td></td>
</tr>
</tbody>
</table>

Tertiary care centre for ACS is defined as a centre capable of doing cath lab based interventions for management of acute coronary syndrome, including primary angioplasty, in addition to having facility for medical management. The basic management plan in a tertiary care centre is essentially same as described for secondary care and points in relation to PCI is discussed in this chapter. Three categories of patients with acute coronary syndrome come to tertiary care.

1. Patients directly coming to tertiary care centre
2. Referred from a primary or secondary care setup after receiving basic treatment with antiplatelet and statins.
3. Patients who have received thrombolysis in a secondary care and referred for angioplasty.

7.1 Management strategy in general

- After a quick clinical evaluation and necessary investigations, make diagnosis and risk stratify (see previous discussions). If ACS is diagnosed, basic management is same as the management in secondary care. General care, identification and management of complications like heart failure, arrhythmia and hypotension are to be done without delay. Dual antiplatelets, high dose statins and antithrombotics are to be given in all patients unless contraindicated. Use of drugs like nitrates, ACE-I, BB are as discussed in chapter 2 under secondary care. (See management algorithm also)

- Send blood sample for hemogram, RBS, S. creatinine and screening for viral markers (for HIV, hepatitis B and C) immediately. Other blood investigations depending on the clinical status may be done but less urgently.

- A quick echocardiographic assessment may be done before being taken up for PCI, either in the ED or in the cathlab. However echocardiography should not delay PCI. Elective and complete echocardiogram may be done in all patients during the hospital course.

7.2 Specific management consideration in tertiary care

7.2.1 Antiplatelets. Aspirin 300 mg (to be chewed) is to be administered to all unless there is specific contraindication. Second antiplatelet is also to be given. Ticagrelor or prasugrel are preferred over clopidogrel in patients being managed with percutaneous coronary intervention (PCI). Clopidogrel is preferred in patients to be
thrombolysed.

- Dose of ticagrelor is 180 mg loading followed by 90 mg 12 hourly. For PCI in ACS, in case the patient is already on clopidogrel, if needed, clopidogrel can be switched over to ticagrelor with a loading dose of 180 mg (but not to prasugrel).

- Dose of prasugrel is 60 mg loading followed by 10 mg daily. Prasugrel is contraindicated in patients to be taken up for CABG and in patients with prior stroke/transient ischaemic attack (TIA). It is generally not recommended in patients >75 years of age or with low bodyweight (<60 kg). Prasugrel is not a good choice if patient is already on clopidogrel or ticagrelor.

- Dose of Clopidogrel is 300 mg loading given orally in patients <75 years of age and 75 mg in patients > 75 years of age, when non invasive (medical) management is planned. The loading dose for clopidogrel in case of angioplasty is 600 mg orally. Clopidogrel maintenance dose is 75mg orally daily.

- If the patient has already received adequate dose of antiplatelet from the referral centre, it need not be repeated.

7.2.2 Reperfusion therapy.

- Decide on the mode of reperfusion strategy as early as possible.

- In all STEMI patients presenting in window period of 12 hours from onset of pain, primary angioplasty is the preferred method of reperfusion if it can be done in 120 minutes from the point of STEMI diagnosis. Once decided to do PCI, wire crossing of the occluded vessel may be done within 60 minutes.

- In a patient referred from another centre for primary or rescue angioplasty, do a quick assessment and if PCI option is considered appropriate, shift to cathlab for PCI with minimum possible delay.

- In patients with STEMI, reperfusion with PCI may be considered after 12 hours if the patient is having continuing symptoms or hemodynamic instability.

- Routine PCI after 48 hours of STEMI is not recommended.
If primary angioplasty is not possible in time frame within 120 minutes of STEMI diagnosis (e.g., nonavailability of cathlab for timely intervention due to various reasons), if there are relative contraindications for PCI or if the patient and relatives do not want or cannot afford invasive management with angioplasty, thrombolysis may be administered without delay (if there is no contraindication to lysis).

**Percutaneous coronary intervention.** Different terminologies are used in angioplasty in STEMI

- **Primary PCI** is the term used when angioplasty is the first method of reperfusion in acute STEMI.

- **Rescue PCI.** Whenever there is evidence of failed thrombolysis rescue angioplasty is to be considered after discussing with the patient and relatives. Failed thrombolysis is diagnosed when after lytic therapy, if there is continuing ischemia, hemodynamic or electrical instability and absence of ST resolution of at least 50% in the ECG taken at 60-90 minutes after starting lysis.

- **Early CAG** within 2-24 hours of lysis after fibrinolysis and PCI of infarct related artery may be considered if significant lesion is present in culprit vessel especially in high risk cases.

- **Pharmaco invasive strategy.** Routine PCI 2-24 hours after successful thrombolysis and rescue PCI in case of failed thrombolysis are called pharmaco invasive strategy.

**Thrombolytic therapy.** It is indicated in STEMI patients presenting in 12 hours of onset of pain, when there are no contraindications. **In NSTEMI/UA thrombolysis is not to be given.** In STEMI, when there is a delay of >120 minutes for PCI, immediate fibrinolysis is to be done, if there is no contraindication.

**Time to reperfusion.** Time to reperfusion should be minimised to the lowest in all cases of STEMI. Steps to reduce this are

- Early diagnosis. ECG to be done as early as possible, preferably in 10 minutes.

- Quick decision making on reperfusion strategy after discussing the options with patient and relatives.
• Consider a shift directly to cathlab from ED to prevent time delay, when primary angioplasty is decided.

• Thrombolytic therapy may be initiated in ED itself, when thrombolysis is the reperfusion strategy

7.2.3 Antithrombotics

• Antithrombotic (heparin, enoxaparin or bivaluridine) is to be given in all cases of PCI at the time of intervention but need not be continued after PCI unless there are high risk features for thrombosis and embolism, like atrial fibrillation (AF) or left ventricular (LV) clot. Heparin is the preferred antithrombotic.

• Antithrombotics are to be given in patients going for medical management both in STEMI and NSTEACS. Dose and drugs is discussed along with management in secondary care.

• Antithrombotic agents used in PCI are un-fractionated heparin (UFH), low molecular weight heparin (LMWH- like enoxaparin) and bivalirudin. Dose of UFH in PCI is weight-adjusted administration with an initial bolus of 70-100 IU/kg in case of no GPIIb/IIIa administration and 60-70 IU/kg in case of GPIIb/IIIa co-therapy, under ACT monitoring.

• Fondaparinux is not to be used in angioplasty

<table>
<thead>
<tr>
<th>Antithrombotic agent</th>
<th>Dose With PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfractionated heparin</td>
<td>Initial bolus of 70-100 IU/kg in case of no GPIIb/IIIa administration and 60-70 IU/kg in case of GPIIb/IIIa co-therapy, under ACT monitoring</td>
</tr>
<tr>
<td>Enoxaparin</td>
<td>0.5 mg/KG iv bolus</td>
</tr>
<tr>
<td>Bivalirudine</td>
<td>In heparin induced thrombocytopenia. 0.75mg/kg iv followed by 1.75mg/kg/hour infusion for maximum of 4 hours</td>
</tr>
</tbody>
</table>

7.2.4 PCI in NSTEMI/UA. PCI is indicated in higher risk cases of NSTEMI/UA and may be considered urgent or elective as per the risk at presentation. In very low risk cases of NSTEMI/UA early medical management is ideal.
### 7.3 Monitoring and follow up.

All high risk cases of ACS should be monitored for a period of 24 hours or till they are stable, preferably in the ICU. All patients who had PCI should be followed up with s. creatinine estimation. Care of arterial access site and observation for any bleeding are important. Early inpatient rehabilitation and lifestyle modification are to be instituted. Advise regading healthy lifestyle and smoking cessation should be given.

### 7.4. Check list for early management of ACS in tertiary care centre

Name ……………….age………….sex…………….weight…………….time of presentation………………

Mark appropriately- Yes/No/ select option /or write comment

| Symptoms | Chest pain | Classical cardiac pain/ not classical but suggestive/ noncardiac pain | Time of onset | Dyspnoea | Palpitaion | Syncope | comments |
|----------|------------|-------------------------------------------------|--------------|---------|-----------|---------|
| Other history | Diabetes | Any of the following drugs in last 24 hours | Active bleeding or Contraindication to lytic therapy | Yes/No | Previous fibrinolysis Agent | Previous PCI |
| | Hypertens. | Asprin Clopidogrel/prasugrel ticagrelor warfarin PDE-5 inhibitor | | | | |
| | Wheeze | Allergy | | | | |
| Physical exam. | Pallor Yes/no | Pulse: Rate Rhythm peripheral pulses | BP UL LL | JVP Normal/ elevated | 3rd heart sound | Pulse oximetry Respiratory rate Crepitations |
| Investigations | ECG | Time | ST elevation Ys/No Leads No ST elevation | Rhythm PR interval AV block | Rate | Axis | RBBB LBBB LAHBA/LPHB |
| | Other investigation | C. Trop T/ I | Time | Time | Time | Time | Result | Result | Hb | RBS | S.Creatinine S. potassium |
| | Echo Cardiogram | EF | RWMA Yes/No Site | Pericardial effusion | Clot | MR/VSR | Other |
| Provisional diagnosis | STEMI NSTEMI/ UA | STEMI Area Anterior/septal Lateral/inferior /posterior/RV | Time of diagnosis of ACS | STEMI window period= time from onset of symptoms to revascularisation time | TIMI score | eGFR |
| Very high risk features | Acute heart failure shock | Recurrent pain inspite of medical Trt. | Dynamic ST shift | Cardiac arrest | Mechanical complication | High risk/ low risk |
8. Facilities to be available in hospitals for ACS care.

- Every health care centre should have a functioning ECG machine available 24 hours a day. Health workers at these centers should be trained to interpret the ECG so that treatment can be initiated without delay.
- Finger pulse oximeter to assess saturation to be available in all hospitals.
- Blood investigations like hemogram, S.creatinine, RBS in all hospitals.
- High sensitivity troponin evaluation in tertiary care. Regular troponin in secondary care.
- A handheld echo machine/portable echo machine is desirable in the ED or ICU in tertiary care centre. Every emergency care physician should be trained in basic echocardiogram to assess LV function, valve dysfunction and regional wall motion abnormalities, to look for pericardial effusion and to look for lung comets of pulmonary oedema (see chapter on heart failure).
- Facility to do angioplasty (tertiary care) and thrombolyse (tertiary care and secondary care) including facility for continuous monitoring of ECG and vitals and availability of defibrillator.
- It is useful to have risk calculators/ drug dose calculator/drip calculator in the smart phone of the healthcare provider and several algorithms/apps available in the internet may be downloaded to help in decision making.
9. Management Algorithm for ACS in ED

Symptoms suggestive of ACS:
A quick but focused history including bleeding risk and rapid assessment in 10 minutes

Emergency care needed
Arrhythmia/cardiac arrest
Heart failure/Pulmonary edema
Shock

Appropriate care of the situation urgently and simultaneous with ischemia management

Secure IV line oxygen if the saturation is < 90% to keep >90% continuous cardiac monitoring

Aspirin 300 mg to chew and swallow
Second antiplatelet clopidogrel/ticagrelor/prasugrel (see text)
Atorvastatin 40-80 mg stat and daily
Nitrate orally/sublingually/IV, if no contraindication

ACS diagnosis made

Focused Physical examination
Pallor, pulse, BP, respiratory rate, JVP, pulse oximetry, S3, murmurs, lung auscultation for rales, wheeze

Initial tests
12 lead ECG in 10 minutes
Send for RBS, Hb, S.creatinine, Biomarkers like C-Troponin but do not wait for blood result for early management

ST elevation in ECG
No ST elevation in ECG

Classification and risk stratification
ST elevation in ECG
<12 hours
Delay to PCI
>120 minute
<120 minute
PCI non-capable center
PCI capable center
Immediate Lysis preferred
Refrer for PCI after alerting that center – to meet <120-minute target, if not possible - Thrombolyse

High risk, TIMI score >3
Low risk, TIMI score ≤3

No thrombolysis in NSTEMI
NSTEMI/UA
TIMI scoring

STEMI

Window period from onset of pain
>12 but ≤48 hrs.
Continuing ischemia.
No
yes
PCI option
Heparin/enoxaparin
As indicated
ACE-I
BB
Aldosterone R. blocker.
Manage complications
Heart failure management
Treatment of thrombus/MI/VS

Diabetes care
Hypertension management
In-hospital rehabilitation
Lifestyle modification
Discharge advice
Dual antiplatelet, high dose statin, BB. ACE-I, Aldosterone blocker in STEMI/ LV dysfunction
Stress test/echo elective CABG - as required - PCI/CABG

And

Rescue PCI
Systematic PCI
Immediate PCI
Very high risk - Urgent CAG
and as required PCI/CABG
Intermediate risk - Elective CAG
and as required PCI/CABG

Antithrombotic
Beta blockers
Rate lowering CCB like verapamil or diltiazem if BB is contra indicated
10. References


4. Clinical Management Guidelines for Coronary Artery Disease for National Programme for Prevention and Control of Diabetes, Cardiovascular Disease and Stroke Partners, developed by Department of Cardiology and Community Medicine, Post Graduate Institute of Medical education and Research, Chandigarh, India.

5. Guidelines for the management of cardiovascular diseases in india, Part 1, Ministry of Health & Family Welfare Govt. of India, New Delhi.


Section II
Section II

Evaluation and management of heart failure

1. Scope

Population
Adults more than 18 years of age; not applicable to paediatric population

Key clinical issues covered:
Evaluation of heart failure
Management of Heart Failure
Acute decompensated heart failure

Clinical issues not covered:
Detailed description of drugs and interventions

Health care setting:
Secondary and tertiary health care, patient presenting in the outpatient department or emergency department

Outcome:
Early diagnosis of heart failure with appropriate management and reduction in mortality and morbidity.
### 2. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACEI</td>
<td>Angiotensin Converting Enzyme Inhibitor</td>
</tr>
<tr>
<td>ADHF</td>
<td>Acute Decompensated Heart Failure</td>
</tr>
<tr>
<td>ARB</td>
<td>Angiotensin receptor blocker</td>
</tr>
<tr>
<td>ARNI</td>
<td>Angiotensin Receptor Blocker Neprilysn Inhibitor</td>
</tr>
<tr>
<td>BB</td>
<td>Beta Blocker</td>
</tr>
<tr>
<td>CAD</td>
<td>Coronary Artery Disease</td>
</tr>
<tr>
<td>CBC</td>
<td>Complete Blood Count</td>
</tr>
<tr>
<td>COPD</td>
<td>Chronic Obstructive Pulmonary Diseases</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular Disease</td>
</tr>
<tr>
<td>DCM</td>
<td>Dilated Cardiomyopathy</td>
</tr>
<tr>
<td>ECG</td>
<td>Electrocardiogram</td>
</tr>
<tr>
<td>EF</td>
<td>Ejection fraction</td>
</tr>
<tr>
<td>HCM</td>
<td>Hypertrophic Cardiomyopathy</td>
</tr>
<tr>
<td>HF</td>
<td>Heart Failure</td>
</tr>
<tr>
<td>HFrEF</td>
<td>Heart Failure with Reduced Ejection Fraction</td>
</tr>
<tr>
<td>HFpEF</td>
<td>Heart Failure with Preserved Ejection Fraction</td>
</tr>
<tr>
<td>IHD</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>LVD</td>
<td>Left Ventricular Dysfunction</td>
</tr>
<tr>
<td>MI</td>
<td>Myocardial Infarction</td>
</tr>
<tr>
<td>NP</td>
<td>Natriuretic Peptide</td>
</tr>
<tr>
<td>OMT</td>
<td>Optimal Medical Therapy</td>
</tr>
<tr>
<td>PND</td>
<td>Paroxysmal Nocturnal Dyspnoea</td>
</tr>
</tbody>
</table>
3. Evaluation of Heart Failure

3.1. Introduction

Patients with heart failure (HF) present with various symptoms and signs. The predominant symptom of heart failure is dyspnoea. Dyspnoea can occur in other conditions, the commonest being chronic obstructive pulmonary disease (COPD). Similarly the major sign of HF, oedema, can be caused by many other conditions especially renal failure. It is important to diagnose HF early and to start appropriate treatment as the short term and long term mortality of HF are high.

3.2. Definition

HF is defined as a clinical condition in which the heart is unable to pump blood to meet the requirements of the body or is able to do so at increased filling pressures. In other words the cardiac output is decreased or there is elevation of venous pressures.

3.3 Diagnosis of heart failure

3.3.1. History

Typical symptoms of heart failure include

i. Dyspnea
ii. Orthopnea
iii. Paroxysmal nocturnal dyspnea
iv. Reduced exercise tolerance
v. Fatigue
vi. Edema

Dyspnoea, one of the typical symptoms of HF, can also be due to respiratory system diseases. The pointers to a cardiac cause are new onset of dyspnoea with no previous history of wheezing or other respiratory symptoms and the presence of paroxysmal nocturnal dyspnea (PND). Patients having PND wake up from sleep 1-2 hours after going to bed with intense breathlessness which makes them sit up or even go out of the room to get air. The dyspnoea subsides in about half an hour after which the patient will have a comfortable sleep with no recurrence in the same night. It may be associated with cough with pink frothy sputum. COPD patients also can have nocturnal dyspnoea. Here the exacerbation occurs in the early morning hours(3 am - 4 am).HF can also present with less typical symptoms like nocturnal
cough, wheezing, bloated feeling, loss of appetite, other gastrointestinal symptoms and confusion (especially in the elderly).

When eliciting history, any underlying cause for HF and any precipitating factor leading to acute worsening have to be looked into. Underlying causes include coronary artery disease, hypertension, valvular heart diseases and the use of cardio toxic medications or radiation. Precipitating factors include anaemia, infection and thyrotoxicosis, intake of drugs retaining salt and water (e.g. NSAIDs) and stoppage of drugs given as treatment for HF.

3.3.2 Physical examination

The following signs can be present

i. Cold extremities

ii. Peripheral edema (ankle, sacral, scrotal)

iii. Tachypnea

iv. Tachycardia

v. Irregular pulse

vi. Narrow pulse pressure

vii. Elevated jugular venous pressure

viii. Cardiomegaly

ix. Third heart sound (gallop rhythm if there is tachycardia)

x. Murmur

xi. Hepatomegaly

xii. Ascites

xiii. Pulmonary crepitations

xiv. Signs of pleural effusion

xv. Cachexia

3.3.3 Investigations

i. Blood

Complete blood count, blood sugar, blood urea, serum creatinine, sodium, potassium, magnesium, thyroid function tests and liver function tests are indicated in all HF patients.
Anemia is a common precipitating factor and needs further evaluation including peripheral smear, serum iron, ferritin and transferrin saturations. Peripheral smear showing microcytic hypochromic anemia indicates iron deficiency while macrocytic anemia indicates vitamin B12 deficiency. Elevated WBC count can be a clue to infection. HF as well as the drugs used to treat HF can lead to renal function derangement. Hence renal function tests are to be closely monitored especially in those getting parenteral therapy for HF. HF therapy can lead to electrolyte imbalance and frequent monitoring is needed. As both hyper and hypothyroidism can lead to or precipitate HF, thyroid function tests should be done.

ii. Chest X-ray

Features of HF include cardiomegaly, prominence of upper lobe vessels, interstitial edema and pleural effusion. X-ray can give a clue about underlying valvular heart disease. However it may be normal especially in recent onset HF. It is also useful to diagnose respiratory diseases like COPD, pneumonia or pneumothorax.

iii. ECG

An abnormal ECG increases the likelihood of HF but has low specificity. Abnormalities on the ECG may provide information on etiology (e.g. myocardial infarction). ECG can help in diagnosing chamber enlargement, arrhythmias and electrolyte abnormalities.

iv. Echocardiogram

Following parameters are to assessed

- LA
- LV size especially LV end systolic diameter
- Ejection fraction to assess the systolic function
- E/A reversal on mitral Doppler to assess diastolic dysfunction
- RWMA- Regional wall motion abnormality
- Left ventricular hypertrophy
- Pulmonary artery pressure
- Right ventricular function
- Inferior venecava – more than 21 mm in diameter and not collapsing by 50% on sniffing indicates fluid overload
v. **Natriuretic peptide** (NP) levels can be assessed in selected cases. It is useful if the diagnosis is in doubt or to prognosticate in diagnosed heart failure or to assess response to therapy. BNP or NT-pro BNP can be used. Values less than 35 pg/ml for BNP and 125pg/ml for NT-pro BNP rules out HF.

vi. **Lung ultrasound** is useful in acute of heart failure to distinguish between exacerbation of COPD and acute pulmonary oedema. This is done by keeping an ultrasound probe in the intercostal spaces and looking for comet-tail artefact. (In the figure below first picture is of a normal person or person with COPD and second picture shows comet tail artefact suggestive of pulmonary oedema)

![](image)

3.3.4. **Risk stratification**

Assess the symptomatic status of patient by NYHA class

<table>
<thead>
<tr>
<th>NYHA Class I</th>
<th>No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnoea or angina</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYHA Class II</td>
<td>Slight limitation of physical activity. Comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnoea, or angina</td>
</tr>
<tr>
<td>NYHA Class III</td>
<td>Marked limitation of physical activity. Comfortable at rest. Less than ordinary activity causes fatigue, palpitation, dyspnoea or angina</td>
</tr>
<tr>
<td>NYHA Class IV</td>
<td>Unable to carry on any physical activity without discomfort. Symptoms of heart failure may be present at rest.</td>
</tr>
</tbody>
</table>
High risk indicators

- NYHA Class III/IV
- Hypotension
- EF <35%
- Severe pulmonary artery hypertension
- Renal failure
- Electrolyte imbalance
- RV Dysfunction

4. Management of Heart Failure

4.1. Introduction

The aims of treatment are to control the HF, stabilise the cardiac status, correct the precipitating factors, prevent progression of the disease and if possible correct the underlying cause. The main stay of treatment is medical in majority of patients so that drug therapy should be optimal with *periodic stepping up or stepping down of the dose of medications*. Other modes of therapy like cath lab based intervention, devices or surgery may be required in selected patients.

4.2. Classification of HF

Classification is done based on the left ventricular function (LV ejection fraction) assessed by echocardiogram.

<table>
<thead>
<tr>
<th>Features</th>
<th>Hf with reduced EF (HFrEF)</th>
<th>Hf with preserved EF (HFpEF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Signs</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>LVEF</td>
<td>&lt; 40%</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>Other Criteria</td>
<td>None needed</td>
<td>Elevated natriuretic peptides and one of the following needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• LV diastolic dysfunction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Structural heart disease</td>
</tr>
</tbody>
</table>

LVEF in the range of 40–49% is called as *HF with mid-range EF*. Generally it is grouped along with HF with reduced EF for treatment purpose.
4.3. Treatment

4.3.1. General measures

- **NYHA Class I and II Patients can be managed as outpatients**
  1. Assess all the drugs patient is taking and make necessary changes- non-steroid anti-inflammatory drugs, steroids and pioglitazone should be stopped.
  2. Salt restriction – less than 4 gm per day
  3. Fluid restriction to 1.2-1.5 litres per day
  4. Oral furosemide 40 mg once or twice daily (daily weight recording is useful to assess the fluid restriction and dose of diuretic especially in severe cases)
  5. If BP is more than 100 mm of Hg systolic, start angiotensin converting enzyme inhibitors (ACE-I). Any one of the ACE Inhibitors may be chosen. Enalapril 2.5 mg twice daily is a good choice for initiation and titration. If ACE-I are not tolerated due to cough, angiotensin receptor blocker (ARB) can be considered (see tables 1 & 2 for details)
  6. Beta blocker (BB) is to be considered after careful evaluation if there are no contraindications like bradycardia, hypotension or wheeze (see table 3 for details)

- **NYHA Class III/IV are to be managed as In patients**
  1. Hospitalise the patient and as mentioned above check the drugs patient is taking
  2. Propped up position as needed.
  3. Oxygen inhalation if O2 saturation <90%
  4. Record heart rate, BP, respiratory rate and oxygen saturation by pulse oxymeter twice daily
  5. Weight recording daily- plan to lose at least 0.5 kg per day with proper treatment
  6. Salt restriction
  7. Fluid restriction- 1.2 -1.5 litres daily (including all liquid foods like tea, coffee, kanji and drinking water). This amounts to six or seven glasses of 200 ml.
  8. Blood investigations to be routinely monitored during hospital stay include
Hb, serum levels of creatinine, sodium and potassium

9. Avoid NSAIDs, pioglitazone, systemic steroids and other drugs causing fluid retention

10. Drugs for diabetes, hypertension, COPD or for management of CAD should be continued

4. 3.2. Specific treatment

- Start drugs at low doses
- Titrate up to maximum tolerated dose or maximum recommended dose
- Watch for side effects and make drug change or dose reduction
- Therapy given below has to be modified based on the clinical status of patient

- First two days

1. Parenteral diuretics (oral absorption may be erratic due to gut wall edema) -
   lnj. Furosemide 40 -80mg i.v. 8th hourly or 12th hourly
   Furosemide i.v. infusion of 5-10 mg/hr for 24 hours is an alternative if venous congestion is gross

2. I.V Inotropes- In extremely dyspnoeic patients a short period- 24 to 48 hours- of inotropic support can be helpful. I.V dobutamine can be given as infusion at a dose of 5 microgram/kg/min and can be increased up to 20 microgram/kg/min

3. ACEI- if systolic BP is more than 100 mm of Hg and there is no renal failure or hyperkalemia. Eg: Tab. enalapril 2.5 mg twice daily can be started. (See Table 1 for doses and other ACEI)

4. ARB- if ACEI intolerant(See Table 2 for doses)

5. Spironolactone- 25 mg once daily. Watch for hyperkalemia

- Days 3 to 5- Clinically Improved Patient

1. Change to oral diuretics
2. Start BB- carvedilol 3.125 mg twice daily (See Table 3 for doses and other Beta blockers)
3. Step up ACEI
4. Advise ambulation- walk slowly for short distance in the ward- gradually
5. Discharge by 5 days - Schedule review at 2 to 3 weeks with the following investigations - Hb, Serum levels of creatinine, sodium and potassium

- **Days 3 to 5 - Clinically Not Improved Patient**
  1. Do not start beta blockers
  2. Check for compliance to drugs, salt and fluid restriction
  3. Add a second diuretic if sodium and potassium are normal. Add metolazone 2.5 mg once daily. Can be stepped up if needed with monitoring of electrolytes
  4. Digoxin 0.125 mg once daily may be started (Watch for side effects)
  5. Consider new drugs

- **Day 5-7 - Clinically not improved - Resistant Heart Failure**

  Consider referral to a specialised centre for special investigations and advanced modes of management (see section 5)
Table 1. ACE Inhibitors

<table>
<thead>
<tr>
<th>Drug</th>
<th>Starting Dose</th>
<th>Target dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enalapril</td>
<td>2.5 mg twice daily orally</td>
<td>20 mg twice daily</td>
</tr>
<tr>
<td>Ramipril</td>
<td>1.25 mg twice daily orally</td>
<td>5 mg twice daily</td>
</tr>
<tr>
<td>Lisinopril</td>
<td>2.5 mg once daily orally</td>
<td>20 mg once daily</td>
</tr>
</tbody>
</table>

Table 2. ARBs

<table>
<thead>
<tr>
<th>Drug</th>
<th>Starting Dose</th>
<th>Target dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Losartan</td>
<td>25mg once daily orally</td>
<td>100mg once daily</td>
</tr>
<tr>
<td>Valsartan</td>
<td>40mg twice daily orally</td>
<td>160mg twice daily</td>
</tr>
</tbody>
</table>

Table 3- Beta Blockers

<table>
<thead>
<tr>
<th>Drug</th>
<th>Starting Dose</th>
<th>Target dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carvedilol</td>
<td>3.125 mg twice daily orally</td>
<td>25mg twice daily</td>
</tr>
<tr>
<td>Metoprolol succinate (CR/XL) (sustained release only to be used)</td>
<td>12.5 mg once daily orally</td>
<td>100-200 mg once daily</td>
</tr>
<tr>
<td>Bisoprolol</td>
<td>1.25mg once daily</td>
<td>10mg once daily</td>
</tr>
</tbody>
</table>

New Drugs

1. **Ivabradine** slows heart rate if the patient is in sinus rhythm. Ivabradine is not to be used in atrial fibrillation. Starting dose is 5 mg twice daily and can be stepped up to 7.5 mg twice daily if needed to control heart rate in patients in whom BB cannot be started or are not tolerated or when the heart rate cannot be brought down below 70/min with BB alone.

2. **ARNI** is ARB (valsartan) combined with neprilysin inhibitor (Sacubitril). Natriuretic peptides naturally promote diuresis and are degraded by neprilysin. Thus neprilysin inhibitor raises levels of peptides and induces diuresis. When introducing ARNI, if the patient is already on ACEI, stop ACEI and start ARNI only after 36 hours. If the patient is on ARB, it can be directly
switched over to ARNI without waiting period.

3. **Tolvaptan**: To be considered in cases with hyponatremia and fluid overload for a short term use. Better to use for in-patients only with careful monitoring of electrolytes.

4.3.3. Follow UP

**v First review - 2 weeks after discharge**

a) See investigation results- Hb, S. creatinine, sodium and potassium and take corrective steps.

b) Reduce diuretics if no fluid overload

c) Step up enalapril if BP is more than 100 mm of Hg

d) step up carvedilol if heart rate is high and BP is more than 100 mm of Hg

e) Consider H Influenza and pneumococcal vaccination in cases with repeated hospitalization

**v Second review - 1 month after first review**

a) Do investigations as in previous step and correct if needed

b) Try to step up ACEI and BB depending on BP and heart rate

**v Long term follow up**

a) Reduce diuretics to minimum possible dose or stop

b) Continue ACEI and BB at maximum tolerated/ maximum recommended dose

**v Problems during follow up**

a) Dry cough: Can be due to ACEI - change to ARB if sleep is disturbed

b) Cramps: Electrolyte imbalance due to diuretics. Correct by oral supplementation and by reducing diuretics

c) Painful gynaecomastia- due to spironolactone or digoxin. Try changing to eplerenone

d) Anemia: Evaluate for the type and cause and correct appropriately. Consider IV Iron in selected cases( ferric carboxy maltose)
4.3.4. Advanced Investigations

1. **Trans esophageal Echocardiogram (TEE)**—Consider in cases of poor trans thoracic window, prosthetic valve malfunction and suspected infective endocarditis

2. **Coronary angiography (CAG)**—In patients with previous history of IHD, having angina pectoris or ECG and Echo evidence of CAD (after stabilizing the CHF)

3. **SPECT**—(Single Photon Emission Computerized Tomography)—to look for viability of myocardium prior to revascularization

4. **Cardiac Magnetic Resonance Imaging (CMR)**—to rule out suspected inflammatory / infiltrative conditions or cardiomyopathy

4.3.5. Special modes of treatment

1. **Implantable cardioverter defibrillator (ICD)**—to be considered in HF patients who have survived a cardiac arrest. Can be considered in patients with symptomatic HF with LVEF $\leq$ 35% despite $\geq$ 3 months of OMT.

2. **Cardiac resynchronization therapy (CRT)**—For HF patients who continue to be symptomatic despite OMT and in sinus rhythm with QRS morphology of LBBB type and QRS duration more of than 150 milliseconds

3. **Mechanical circulatory support (Left Ventricular Assist Devices LVAD)**—can be considered in HF patients **as a bridge to transplant**. It can be considered in patients with severe symptoms for last 2 months despite optimal medical and device therapy if LVEF <25%, and there are $\geq$ 3 HF hospitalizations in last 1 year

4. **Cardiac Transplantation**—May be considered for end-stage HF patient with severe symptoms, a poor prognosis, and no remaining alternative treatment options. Patient should be motivated, well informed, and emotionally stable and capable of complying with the intensive treatment required postoperatively
4. 3.6. Heart failure with preserved EF

Clinical presentation can be similar to patients with heart failure with reduced EF. Management is mainly control of basic diseases like hypertension, CAD, diabetes mellitus etc. Symptomatic management with diuretics to reduce congestion and management of arrhythmia like atrial fibrillation is indicated. Diuretic use has to be judicious.

5. Acute Decompensated Heart Failure (ADHF)

5.1 Definition and classification

ADHF is the rapid onset or acute worsening of symptoms and signs of heart failure. It requires urgent evaluation and treatment as it is a life threatening emergency. ADHF may present as a first occurrence (20% cases) or, more frequently, as a consequence of acute decompensation in chronic HF patients (80% cases). In ADHF the symptoms can be of congestion (systemic and or pulmonary-the WET cases) or of low cardiac output (the DRY cases). There can be four different classes of patients.

1. Wet and warm : congestion with normal cardiac output
2. Wet and cold : congestion with low cardiac output
3. Dry and cold : no congestion but low cardiac output
4. Dry and warm : no congestion and normal cardiac output
5.2 Symptoms and signs

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Congestion - Systemic / Pulmonary</th>
<th>Low cardiac output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dyspnoea at rest</td>
<td>Fatigue</td>
</tr>
<tr>
<td></td>
<td>Orthopnoea</td>
<td>Decreased urine output</td>
</tr>
<tr>
<td></td>
<td>Paroxysmal nocturnal dyspnoea</td>
<td>Altered mental status</td>
</tr>
<tr>
<td></td>
<td>Leg edema</td>
<td>Nausea/ vomiting</td>
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<tr>
<td></td>
<td>Early satiety</td>
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<td></td>
<td>Abdominal distension</td>
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<td></td>
<td>Bloating</td>
<td></td>
</tr>
<tr>
<td>Signs</td>
<td>Edema</td>
<td>Cool extremities</td>
</tr>
<tr>
<td></td>
<td>Tachypnea</td>
<td>Low volume pulse</td>
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<tr>
<td></td>
<td>Tachycardia</td>
<td>Hypotension</td>
</tr>
<tr>
<td></td>
<td>Low oxygen saturation</td>
<td>Altered mental status</td>
</tr>
<tr>
<td></td>
<td>Elevated jugular venous pressure</td>
<td>Worsening renal function</td>
</tr>
<tr>
<td></td>
<td>Basal lung crepitations</td>
<td></td>
</tr>
</tbody>
</table>

5.3 Investigations (Similar to Chronic Heart Failure)

1. **X-ray Chest**: Confirms pulmonary congestion (may even show the typical bat's wing appearance of pulmonary edema) and excludes respiratory causes.

2. **ECG**: Assess rhythm and any ongoing ischemia.

3. **Natriuretic Peptides**: Plasma BNP levels less than 100 pg/ml or NT-Pro BNP less than 300 pg/ml excludes AHF (Cut off values are higher in the acute setting).

4. **Echocardiogram**: Limited bedside Echo can assess LV function by noting the ejection fraction, systemic congestion by noting. Inferior venecaval distension more than 21 mm and pulmonary congestion by noting comet sign on lungs. Echo also helps to differentiate acute HF from conditions like pulmonary embolism, cardiac tamponade, exacerbation of COPD.

5. **Lung Ultrasound**: Look for comet tail artefacts in lung fields which are specific for acute pulmonary edema.
5.4. Management

a) Identify the cause or precipitating factor of AHF and correct it. It may be high blood pressure, arrhythmia, acute ischemia, infection or drugs.

b) Oxygen can be given to all patients to relieve dyspnoea. Non-invasive and even invasive ventilation can be given if oxygen saturation remains persistently low.

c) Intravenous Diuretics- Furosemide can be given IV. Dose can be decided based on blood pressure. If systolic BP is above 90 mm of Hg, 40-60 mg furosemide can be given. If BP is lower than 90 mm of Hg smaller doses 20-40 mg can be given.

d) Intravenous vasodilators: Are to be given if blood pressure is high. The agents used are Nitroglycerin- start with 20 micro gram/min; can go up to 400 microgram/min

Nitroprusside- start with 10 micro gram/min; can go up to 350 microgram/min

e) Intravenous inotropes: are to be given if BP is low and there are signs of hypo perfusion. The agents used are

Dopamine: 5-10 micro gm/kg/min can increase to 10-15 micro gm/kg/min

Dobutamine: 5-10 micro gm/kg/min can increase to 10-20 micro gm/kg/min

Milrinone: bolus 50 micro gm/kg followed by 0.125 – 0.75 micro
Levosimendan: loading dose of 6-12 microgm/kg followed by 0.05 – 0.2 microgm/kg/min as infusion

f. Adjustment of pre-existing drugs

i. ACEI/ARB- can be continued in most cases. Temporary withdrawal or reduction in dose may be needed in case of severe symptomatic hypotension or creatinine rise

ii. Beta Blockers : Can be withheld if patient has pulmonary edema

iii. Mineralocorticoid antagonists : With hold if creatinine is more than 2.5 mg/dl or potassium more than 5.5 meq/L

iv. Digoxin can be started if not already being given

If not improving

Ultra filtration: can be tried if diuretics are not producing adequate response
LV assist devices
Look for any unidentified underlying cause
Refer to a dedicated heart failure team
5.5. Management algorithm

Presence of congestion

Yes

Adequate Peripheral Perfusion

Yes

Wet Warm Patient

Diuretics
Vasodilators
Ultra filtration

No

Wet Cold Patient

Systolic BP < 90

Yes

Inotropes
Vasopressor
Mechanical Support

No

Diuretics
Vasodilators
Inotropes in refractory cases

No

Dry Warm Patient

Adjust oral therapy

No

Dry Cold Patient

Fluid challenge
Inotropes if no response
6. References

1. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure - European Heart Journal (2016) 37, 2129–2200


10. Cardiological Society of India Update 2015- Heart Failure

The road ahead -

The Department of Health has been going ahead with a systematic approach of taking various initiatives with the focus on prevention along with improving health care services. Health care service delivery is one of the most important services and always seen as a barometer to assess the Governance. While giving importance to the infrastructure development, essential prerequisite is to develop systems and processes to bring in standardization in the management of a patient care. The Department of Health has conceptualized various crucial fifteen themes, constituted expert groups and conducted series of deliberations and brought out 'Standard Treatment Guidelines', one of the most valuable resources for the practitioners.

Now, it is everybody's responsibility to ensure its application. The team has updated the guidelines as it is a live document needing updating periodically. We are planning to have institutional mechanism to annually revisit the Standard Treatment Guidelines, develop a structured mechanism of capacity building and go for futuristic approaches such as converting STGs in the mobile applications. There are other exciting opportunities to understand the patient management by analysing information of Karunya Arogya Suraksha Padhati (KASP), the insurance program rolled out in the state, and work on the 'balance score card' regarding the management of a patient in context of the standard treatment guidelines by the individual and institution. This will enable to have 'the feedback loop' inbuilt in the system and encourage all to improve management of a patient at the individual as well as the institutional level.

The foundation is laid and we take up the challenge to work on the unfinished agenda.

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