Introduction to CCU
“Patients & Equipment”
CCU

- **CCU** = Coronary Care Unit
- A hospital ward specialized in the care of patients with heart attack, acute coronary syndrome, decompensated heart failure, serious arrhythmia or other cardiac conditions that require continuous monitoring and treatment
CCU

- Acute Coronary Care Units
  - CCU (Coronary Care Unit)
  - ACCU (Acute Coronary Care Unit)
  - CCCU (Critical Coronary Care Unit)

- Intermediate Coronary Care Units
  - ICCU (Intermediate Coronary Care Unit)
  - SCCU (Subacute Coronary Care Unit)
  - PCCU (Progressive care unit)
CCU Vs ICU
(Coronary care unit Vs Intensive care unit)

• Staff
  – Cardiologist Vs Intensivist/Pulmonologist
  – Specialized medical staffs

• Patients

• Equipment
  – **CCU**: Telemetry, Invasive hemodynamic monitoring, Intraaortic balloon pump, bedside echo, temporary pacemaker, pericardial tapping set etc.
  – **ICU**: Respirator; Advanced respiration monitoring, hemodialysis facility, etc.

• Variation of ICU: Neuro ICU, Trauma ICU, Burn unit, etc.
Patients in CCU

• Coronary disease patients
  – **Acute coronary syndrome (ACS)**
    • ST elevated MI (STEMI)
    • Non-ST elevated MI (NSTEMI)
    • Unstable angina, High risk
    • Sudden Cardiac Death
  – **Chronic CAD with active cardiac problem**
    • Heart failure
    • Arrhythmic problem
    • Etc.
  – **Post PCI/ post CABG**
Patients in CCU

• Non-coronary patients (1)
  – Heart failure
    • Cardiomyopathy: Ischemic & non-ischemic
    • Severe valvular heart disease
    • Diastolic heart failure
  – Cardiogenic shock
    • MI
    • Acute valve regurgitation
    • End stage cardiomyopathy
Patients in CCU

- Non-coronary patients(2)
  - Serious arrhythmia: primary or secondary
    - Tachyarrhythmia: Ventricular arrhythmia, AF with rapid ventricular response, SVT
    - Bradyarrhythmia: high-grade conduction disturbance, sinus pause/arrest
  - Miscellaneous
    - Cardiac tamponade, Infective endocarditis with complication, aortic dissection, etc
  - Post non-coronary intervention / surgery or post-op care for cardiac patients
Coronary artery disease (CAD)
Onset of UA/NSTEMI
- Initial recognition and management in the Emergency Department
- Risk Stratification
- Immediate Management

Hospital Management
- Medications
- Conservative versus Invasive Strategy
- Special Groups
- Preparation for discharge

Management Prior to UA/NSTEMI

Secondary Prevention/Long-Term Management
Acute coronary syndrome

Presentation

Working Dx

ECG

Cardiac Biomarker

Final Dx

Ischemic Discomfort

Acute Coronary Syndrome

No ST Elevation

Non-ST ACS

Unstable Angina

UA

NSTEMI

Myocardial Infarction

NQMI

Qw MI

ST Elevation
<table>
<thead>
<tr>
<th>Clinical Finding</th>
<th>Noncardiac</th>
<th>Stable</th>
<th>Unstable</th>
<th>Non-ST-MI</th>
<th>ST-Elevation-MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atypical Pain</td>
<td>Exertional Pain</td>
<td>Rest Pain, Post-MI, DM, Prior ASA</td>
<td>Ongoing Pain</td>
<td></td>
<td></td>
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<tr>
<td>ECG</td>
<td>Negative</td>
<td>ST-T-Wave Changes</td>
<td>ST Elevation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum Markers</td>
<td>Negative</td>
<td>Positive</td>
<td></td>
<td></td>
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<tr>
<td>Risk Assessment</td>
<td>Low Probability</td>
<td>Low Risk</td>
<td>Medium-High Risk</td>
<td>STEMI</td>
<td></td>
</tr>
</tbody>
</table>

Diagnostic
Rule Out MI/ACS Pathway

ASA, Heparin/LMWH + Anti-ischemic Rx Early Conserv.

Thrombolysis Primary PCI

Acute myocardial infarction (AMI)

- ST elevated MI
- Non-ST elevated MI
ST Elevated MI (STEMI)

Diagnosis

• Ongoing chest pain
• ECG
• Cardiac enzymes
STEMI

- Early reperfusion treatment is important
  - Coronary angioplasty
  - Thrombolytic treatment
1. Clinical Evaluation

- STEMI → reperfusion

2. Diagnosis/Risk Assessment

- ACS possible
  - Evaluation:
    - Quality of chest pain
    - Symptom-orientated physical examination
    - Short history for the likelihood of CAD
    - Electrocardiogram (ST elevation?)
  - Validation:
    - Response to antianginal treatment
    - Biochemistry/troponin
    - ECG
    - Echocardiogram
    - Calculated risk score (GRACE)
    - Risk criteria (Table 9)
    - Optional: CT, MRI, scintigraphy

3. Coronary angiography

- urgent <120 min
- early <24 h
- <72 h
- no/elective
TIMI Risk Score for UA/NSTEMI

7 Independent Predictors

- Age ≥65 years
- ≥3 CAD risk factors
  (↑ chol, FHx, HTN, DM, smoking)
- Prior CAD (cath stenosis >50%)
- ASA in last 7 days
- ≥2 Anginal events ≤24 hours
- ST deviation
- Elevated cardiac markers (CK-MB or troponin)

AMI Management-Phases

- Acute Evaluation Phase
- CCU Phase
- Hospital Phase
- Pre-discharge Phase
- Convalescence
- Long Term Management
  - Secondary prevention critical to preserve acute mortality benefits
# Acute Phase Risk Stratification: Importance of LV dysfunction

<table>
<thead>
<tr>
<th>Killip Classification</th>
<th>% patients</th>
<th>Mortality (%)</th>
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</thead>
<tbody>
<tr>
<td>I No CHF</td>
<td>30-50</td>
<td>5</td>
</tr>
<tr>
<td>II Rales, S3, Pulmonary venous hypertension</td>
<td>33</td>
<td>15-20</td>
</tr>
<tr>
<td>III Pulmonary edema</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>IV Cardiogenic shock</td>
<td>10</td>
<td>80-100</td>
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</table>
## Acute Phase Risk Stratification: Importance of LV dysfunction

<table>
<thead>
<tr>
<th>Forrester Hemodynamic Classification</th>
<th>Mortality % (Clinical Dx)</th>
<th>Mortality % (Hemodynamic Dx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I  PCW &lt; 18  CI &gt; 2.2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>II PCW &gt; 18  CI &gt; 2.2</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>III PCW &lt; 18  CI &lt; 2.2</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>IV PCW &gt; 18  CI &lt; 2.2</td>
<td>60</td>
<td>51</td>
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</table>
Post MI Management
Acute Phases

• Acute Evaluation and Management
  – ASA
  – Plavix (NSTEMI/PCI)
  – Glycoprotein IIB/IIIA inhibitors
  – Heparin, LMWH
  – Thrombolytics (STEMI,LBBB)
  – Direct PCI
  – IV β-blocker
  – IV NTG

• Complication Surveillance in CCU
  – CHF
  – Cardiogenic shock
  – Pericarditis
  – Recurrent ischaemia
  – Mechanical complication
    • ventricular septal rupture
    • papillary muscle dysfunction or tear
  – LV thrombus
Clinical signs: Shock, hypoperfusion, congestive heart failure, acute pulmonary edema
Most likely major underlying disturbance?

Acute pulmonary edema

- Administer
  - Furosemide IV 0.5 to 1.0 mg/kg
  - Morphine IV 2 to 4 mg
  - Oxygen/intubation as needed
  - Nitroglycerin SL, then 10 to 20 mcg/min IV if SBP greater than 100 mm Hg
  - Dopamine 5 to 15 mcg/kg per minute IV if SBP 70 to 100 mm Hg and signs/symptoms of shock present
  - Dobutamine 2 to 20 mcg/kg per minute IV if SBP 70 to 100 mm Hg and No signs/symptoms of shock

1st Line of Action

Hypovolemia

- Administer
  - Fluids
  - Blood transfusions
  - Cause-specific interventions
  - Consider vasopressors

Low Output - Cardiogenic Shock

- Check Blood Pressure

Arrhythmia

- Bradycardia
- Tachycardia

See Section 7.7 in the ACC/AHA Guidelines for Patients with ST Elevation Myocardial Infarction

2nd Line of Action

Check Blood Pressure

- Systolic BP Greater than 100 mm Hg and Not less than 30 mm Hg Below Baseline

Systolic Inhibitors

- Short acting agent such as captopril (1 to 6.25 mg)

Further diagnostic/therapeutic considerations (should be considered in non-hypovolemic shock)

Diagnostic
- Pulmonary artery catheter
- Echocardiography
- Angiography for MI/ischemia
- Additional diagnostic studies

Therapeutic
- Intra-aortic balloon pump
- Reperfusion/ revascularization
Mechanical Complication

Ventricular Septal Rupture

Free Wall Rupture

Mitral Regurgitation (Papillary muscle rupture)
Role of Echocardiography in ACS

• Diagnostic guidance
  – Regional wall motion abnormality
  – Exclude similar condition e.g. aortic dissection

• Risk stratification
  – LV function (LVEF), pulmonary pressure estimation

• Complications of MI
  – Thrombus
  – Aneurysm
  – Papillary muscle rupture/dysfunction → acute MR
  – Septal rupture → acute VSD
  – Free wall rupture → cardiac tamponade
Post MI Management-Phases

Post CCU- Early ambulation
- ASA
- β-blocker
- ACE- inhibitor
- Lipid lowering
  - usually statin
- Anti-coagulation
  - Atrial fib/DVT/CHF/LVT

- Telemetry for arrhythmia
- Echo for LV function/thrombus
- Patient education & counseling
  - dietary
  - risk factors
  - further Ix
- Screening for complications
- Risk stratification
Post MI Management
Convalescence Phases

At time of discharge patient should be on:

- ASA unless contra-indication
- Plavix if PCI/NSTEMI (duration minimum 1 year)
  • Longer duration of Plavix if DES in critical location or complex lesion
- β-blocker unless contra-indication
- Ace inhibitor for CHF or LV dysfunction
  • All for vascular protection?
- Statin for LDL to < 2.0 mmol/L (minimum 50% reduction)
Indications for Angiography

NB: In interventional environment many patients undergo early angiography

• High Risk
  – extensive ECG changes
  – anterior/ infero-posterior/ prior MI
  – Prior MI

• Residual ischaemia
  – post MI angina
  – positive TMT/ perfusion scan
  – non-Q MI
  – ischaemia at a distance

• Complicated MI
  – CHF/ flash pulmonary edema
  – shock
  – heart block
  – RBBB
  – sustained ventricular arrhythmias
Post-PCI Care

• Intermediate CCU or step-down unit
• Observation, early detection & early management for possible complication
Post PCI: potential complications

- Access site complication
  - Arteriovenous (AV) fistula, retroperitoneal bleed, pseudoaneurysm
- Cardiac tamponade
- Contrast nephropathy
- Vasovagal reaction
- Acute pulmonary edema or pulmonary hemorrhage
- Cardiogenic shock
- Stroke
- Dissection
- Stent Thrombosis → re-infarct
Non – Acute Coronary Patients in CCU
• Heart Failure
• Serious Arrhythmia

• Aortic dissection
• Cardiac Tamponade
• Post-surgery
Heart failure patients

- Acute or decompensated chronic heart failure
- Pulmonary congestion/edema → respiratory failure → may need ventilator support
- Unstable hemodynamic status → may need continuous IV medication (Inotropes, Vasodilator) → IABP support
Heart failure: Causes

• Systolic heart failure
  – Ischemic cardiomyopathy
    • Chronic CAD
    • Acute : ACS
  – Non-ischemic cause
    • Myocardial diseases
    • Valvular diseases
    • Arrhythmia
    • Connective tissue disease
    • Idiopathic

• Diastolic heart failure (Normal LVEF)
  – Hypertensive heart disease
  – Aortic/mitral stenosis
  – Pericardial disease
Clinical Classification of AHF

- Hypertensive AHF
- Acutely Decompensated Chronic HF
- Pulmonary Oedema
- ACS and HF
- Cardiogenic shock
- Right HF
## Causes and Precipitating Factors of AHF

<table>
<thead>
<tr>
<th>Ischaemic heart disease</th>
<th>Circulatory failure</th>
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<tbody>
<tr>
<td>- Acute coronary syndromes</td>
<td></td>
</tr>
<tr>
<td>- Mechanical complications of acute MI</td>
<td></td>
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<tr>
<td>- Right ventricular infarction</td>
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<tr>
<th>Valvular</th>
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<tbody>
<tr>
<td>- Valve stenosis</td>
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<tr>
<td>- Valvular regurgitation</td>
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<tr>
<td>- Endocarditis</td>
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<tr>
<td>- Aortic dissection</td>
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<tr>
<th>Myopathies</th>
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<tbody>
<tr>
<td>- Postpartum cardiomyopathy</td>
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<tr>
<td>- Acute myocarditis</td>
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<tr>
<th>Hypertension/Arrhythmia</th>
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</thead>
<tbody>
<tr>
<td>- Hypertension</td>
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<tr>
<td>- Acute arrhythmia</td>
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<tr>
<th>Decompression of preexisting chronic HF</th>
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<tbody>
<tr>
<td>- Lack of adherence</td>
</tr>
<tr>
<td>- Volume overload</td>
</tr>
<tr>
<td>- Infections, especially pneumonia</td>
</tr>
<tr>
<td>- Cerebrovascular insult</td>
</tr>
<tr>
<td>- Surgery</td>
</tr>
<tr>
<td>- Renal dysfunction</td>
</tr>
<tr>
<td>- Asthma, COPD</td>
</tr>
<tr>
<td>- Drug abuse</td>
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<tr>
<td>- Alcohol abuse</td>
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Heart Failure Management

• Specific treatment
  – Find and treat underlying and precipitating causes

• Supportive treatment
  – Re-establish adequate perfusion and oxygen delivery to end organs
  – Medication (Vasodilators, diuretics, Inotropes), Ventilation, Dialysis (UF), IABP
  – Treat aggravating factors: infection, electrolyte imbalance, endocrine problem, bronchospasm, anemia, renal failure, etc
Initial treatment algorithm

- **Acute Heart Failure**
  - Immediate symptomatic treatment
  - Patient distressed or in pain
    - **YES**: Analgesia, sedation
    - **NO**: Pulmonary congestion
      - **YES**: Medical therapy (diuretic/vasodilator)
      - **NO**: Arterial oxygen saturation < 95%
        - **YES**: Increase FiO₂, consider CPAP, NIPPV, mechanical ventilation
        - **NO**: Normal heart rate and rhythm
          - **YES**: Pacing, antiarrhythmics, electroversion
Goal of treatment in acute HF

<table>
<thead>
<tr>
<th>Immediate (ED/ICU/CCU)</th>
</tr>
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<tbody>
<tr>
<td>Improve symptoms</td>
</tr>
<tr>
<td>Restore oxygenation</td>
</tr>
<tr>
<td>Improve organ perfusion and haemodynamics</td>
</tr>
<tr>
<td>Limit cardiac/renal damage</td>
</tr>
<tr>
<td>Minimize ICU length of stay</td>
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<tr>
<th>Intermediate (in hospital)</th>
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<tbody>
<tr>
<td>Stabilise patient and optimise treatment strategy</td>
</tr>
<tr>
<td>Initiate appropriate (life-saving) pharmacological therapy</td>
</tr>
<tr>
<td>Consider device therapy in appropriate patients</td>
</tr>
<tr>
<td>Minimise hospital length of stay</td>
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<tr>
<th>Long-term and predischarge management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan follow-up strategy</td>
</tr>
<tr>
<td>Educate and initiate appropriate lifestyle adjustments</td>
</tr>
<tr>
<td>Provide adequate secondary prophylaxis</td>
</tr>
<tr>
<td>Prevent early readmission</td>
</tr>
<tr>
<td>Improve quality of life and survival</td>
</tr>
</tbody>
</table>
Serious Arrhythmia

• Arrhythmia with
  – Unstable hemodynamic status
  – Life-threatening conditions
    • Syncope
    • Survivor of cardiac arrest
    • Heart failure
    • Cardiogenic shock
  – High chance of progress to advanced conduction problems
  – Documented lethal arrhythmia: VT/VF
Serious Bradyarrhythmia

• Sinus node dysfunction
  – With long ventricular pause
  – Syncope with serious injury

• Advanced AV Block
  – Complete heart block
  – High grade AVB
  – Mobitz II, second degree AV block

• Bradyarrhythmia with profound hypotension

• Asystole/Ventricular standstill
BRADYCARDIA
Heart rate <60 bpm and inadequate for clinical condition

1. Maintain patent airway; assist breathing as needed
2. Give oxygen
3. Monitor ECG (identify rhythm), blood pressure, oximetry
4. Establish IV access

Signs or symptoms of poor perfusion caused by the bradycardia?
(eg, acute altered mental status, ongoing chest pain, hypotension or other signs of shock)

4A. Observe/Monitor

Adequate Perfusion

- Prepare for transcutaneous pacing; use without delay for high-degree block (type II second-degree block or third-degree AV block)
- Consider atropine 0.5 mg IV while awaiting pacer. May repeat to a total dose of 3 mg. If ineffective, begin pacing
- Consider epinephrine (2 to 10 µg/min) or dopamine (2 to 10 µg/kg per minute) infusion while awaiting pacer or if pacing ineffective

Poor Perfusion

5. Prepare for transvenous pacing
6. Treat contributing causes
7. Consider expert consultation

Reminders
- If pulseless arrest develops, go to Pulseless Arrest Algorithm
- Search for and treat possible contributing factors:
  - Hypovolemia
  - Hypoxia
  - Hydrogen ion (acidosis)
  - Hypo-/hypokalemia
  - Hypoglycemia
  - Hypothermia
  - Toxins
  - Tamponade, cardiac
  - Tension pneumothorax
  - Thrombosis (coronary or pulmonary)
  - Trauma (hypovolemia, increased ICP)
Serious Tachyarrhythmia

• Pulseless or with pulse
  – Pulseless arrest \(\rightarrow\) VF/VT \(\rightarrow\) CPR

• Serious tachycarrhythmia
  – **Ventricular tachyarrhythmia**
    • VT
      – Monomorphic
      – Polymorphic
      – Torsades de point
    • VF
      – AF with rapid ventricular rate
      – Incessant SVT
Defibrillation: Shockable Arrhythmia

VT: Ventricular Tachycardia (Monomorphic)

VT: Ventricular Tachycardia (Polymorphic)

VF: Ventricular Fibrillation
Aortic Dissection

- **Type I:** Originates in the ascending aorta, propagates at least to the aortic arch and often beyond it distally.

- **Type II:** Originates in and is confined to the ascending aorta.

- **Type III:** Originates in the descending aorta and extends distally down the aorta or, rarely, retrograde into the aortic arch and ascending aorta.