Management of acute decompensated heart failure and cardiogenic shock

Arintaya Phrommintikul
Department of Medicine
CMU
Acute heart failure: spectrum
Case

- 64 y/o M with Hx of non-ischemic DCM (LVEF=25-30%)
- Previously able to walk 1km, currently cannot walk more than 10 feet before developing dyspnea
- PND 3 times per night, 4 pillow orthopnea, increasing lower extremity edema, 4 Kg weight gain
- Exam: JVP=10cm, bibasilar rales, 2+ pitting edema, warm extremities, BP=115/78, P=82
- Creat=1.6 (baseline=1.2), hs-Tn- WNL
- Current Meds: carvedilol 12.5mg bid, enalapril 5mg bid, spironolactone 25 mg od, furosemide 40 mg od
Management

1. Does he have ADHF?
2. Should I admit him?
3. Treatments should be prescribed?
4. Any urgent/emergent management?
Management of AHF

Phase I: urgent/emergent
   establish diagnosis, identify etiology and precipitating factor, stabilize
Phase II: hospital care
   diuretics, RAAS blockage, beta blocker
Phase III: pre discharge planning
Phase IV: post discharge management (early follow up)
AHF: Initial assessment

1. Does the patient have HF or is there an alternative cause for symptoms and signs (COPD, anemia, ARF, PE)?

2. If the patient does have HF, is there a precipitant and does it require immediate treatment or correction (arrhythmia or ACS)?

3. Is the patient’s condition immediately life-threatening because of hypoxemia or hypotension leading to under-perfusion of the vital organs?
Initial management of a patient with acute heart failure

Patient with suspected AHF

Urgent phase after first medical contact

1. Cardiogenic shock?
   - Yes → Circulatory support
     - Pharmacological
     - Mechanical
   - No → Immediate stabilization and transfer to ICU/CCU

2. Respiratory failure?
   - Yes → Ventilatory support
     - Oxygen
     - Non-invasive positive pressure ventilation (CPAP, BiPAP)
     - Mechanical ventilation
   - No → Identification of acute aetiology:
     - C: Acute Coronary syndrome
     - H: Hypertension emergency
     - A: Arrhythmia
     - M: Acute Mechanical cause
     - P: Pulmonary embolism
     - No → Immediate initiation of specific treatment
     - Yes → Follow detailed recommendations in the specific ESC Guidelines

Immediate phase (initial 60–120 minutes)

Diagnostic work-up to confirm AHF
Clinical evaluation to select optimal management
Low blood pressure

\[
BP = CO \times SVR
\]

\[
BP = (SV \times HR) \times SVR
\]

Stroke volume: ejection fraction preloads after load
What causes low stroke volume?
Cardiogenic shock

- Evidence of hypoperfusion
  - Cold clammy skin feet/hand
  - Cloudy conscious
  - Oliguria
- Systolic BP < 80-90 mmHg
- Persistence after correction of non cardiac factors (hypovolemia, hypoxia, acidosis)
- LVEDP ≥ 18 mmHg
- Evidence of primary cardiac abnormality
- Cardiac index ≤ 1.8 L/min/m²
Management of cardiogenic shock

• Echocardiogram
• Invasive hemodynamic monitoring
• Optimize LV filling pressure
• Inotropic agents
• Mechanical hemodynamic support
  – intraaortic balloon pump (IABP)
  – ECMO
• Correct cause
Initial management of a patient with acute heart failure

Patient with suspected AHF

Urgent phase after first medical contact

1. Cardiogenic shock?
   - Yes
     - Circulatory support
       - Pharmacological
       - Mechanical
   - No

2. Respiratory failure?
   - Yes
     - Ventilatory support
       - Oxygen
       - Non-invasive positive pressure ventilation (CPAP, BiPAP)
       - Mechanical ventilation
   - No

Immediate stabilization and transfer to ICU/CCU

Immediate phase (initial 60–120 minutes)

Identification of acute aetiology:
- C - acute Coronary syndrome
- H - Hypertension emergency
- A - Arrhythmia
- M - acute Mechanical cause
- P - Pulmonary embolism

- No
- Yes

Immediate initiation of specific treatment

Follow detailed recommendations in the specific ESC Guidelines

Diagnostic work-up to confirm AHF
Clinical evaluation to select optimal management
### Diagnosis of AHF:
Limited accuracy of signs and symptoms

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>SENSITIVITY</th>
<th>SPECIFICITY</th>
<th>ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of HF</td>
<td>62</td>
<td>94</td>
<td>90</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>56</td>
<td>53</td>
<td>54</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>47</td>
<td>88</td>
<td>72</td>
</tr>
<tr>
<td>Rales</td>
<td>56</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>S3</td>
<td>20</td>
<td>99</td>
<td>66</td>
</tr>
<tr>
<td>JVD</td>
<td>39</td>
<td>94</td>
<td>72</td>
</tr>
<tr>
<td>Edema</td>
<td>67</td>
<td>68</td>
<td>68</td>
</tr>
</tbody>
</table>

CXR in AHF

- Misses cardiomegaly in 20% of echo proven cardiomegaly.
- ADHF patients had no sign of congestion in 18.7% of ED CXR
- Never rule out AHF with CXR
RAPID MEASUREMENT OF B-TYPE NATRIURETIC PEPTIDE IN THE EMERGENCY DIAGNOSIS OF HEART FAILURE

Figure 1. Box Plots Showing Median Levels of B-Type Natriuretic Peptide Measured in the Emergency Department in Three Groups of Patients. Boxes show interquartile ranges, and I bars represent highest and lowest values.

A ‘rule out’ test – very high negative predictive value

Differentiate between HF and other cause of dyspnea

Differentiate between HF and other cause of dyspnea

<table>
<thead>
<tr>
<th>Predictor</th>
<th>P Value</th>
<th>Odds Ratio (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.04</td>
<td>1.02 (1.00–1.03)</td>
</tr>
<tr>
<td>History of congestive heart failure</td>
<td>&lt;0.001</td>
<td>11.08 (6.55–18.77)</td>
</tr>
<tr>
<td>History of myocardial infarction</td>
<td>&lt;0.001</td>
<td>2.72 (1.63–4.54)</td>
</tr>
<tr>
<td>Rales</td>
<td>&lt;0.001</td>
<td>2.24 (1.41–3.58)</td>
</tr>
<tr>
<td>Cephalization of vessels</td>
<td>&lt;0.001</td>
<td>10.69 (5.32–21.47)</td>
</tr>
<tr>
<td>Edema</td>
<td>&lt;0.001</td>
<td>2.88 (1.81–4.57)</td>
</tr>
<tr>
<td>Jugular venous distention</td>
<td>0.04</td>
<td>1.87 (1.04–3.36)</td>
</tr>
<tr>
<td>B-type natriuretic peptide ≥100 pg/ml</td>
<td>&lt;0.001</td>
<td>29.60 (17.75–49.37)</td>
</tr>
</tbody>
</table>

*The odds ratio reflects the odds for patients with the characteristic in question, as compared with those without the characteristic. The odds ratio for age represents the exponent for each year of age in the logistic equation. CI denotes confidence interval.
BNP added on standard Dx reduced time to treatment in acute dyspnea

<table>
<thead>
<tr>
<th>End Point</th>
<th>B-Type Natriuretic Peptide Group (N=225)</th>
<th>Control Group (N=227)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to treatment — min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>63</td>
<td>90</td>
<td>0.03†</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>16–153</td>
<td>20–205</td>
<td></td>
</tr>
<tr>
<td>Time to discharge — days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>8.0</td>
<td>11.0</td>
<td>0.001†</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>1.0–16.0</td>
<td>5.0–18.0</td>
<td></td>
</tr>
<tr>
<td>Hospitalization — no. (%)</td>
<td>169 (75)</td>
<td>193 (85)</td>
<td>0.008</td>
</tr>
<tr>
<td>Admission to intensive care — no. (%)</td>
<td>33 (15)</td>
<td>54 (24)</td>
<td>0.01</td>
</tr>
<tr>
<td>Cost of intensive care — $</td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Median</td>
<td>874</td>
<td>1,516</td>
<td></td>
</tr>
<tr>
<td>95% Confidence interval</td>
<td>423–1,324</td>
<td>989–2,043</td>
<td></td>
</tr>
<tr>
<td>Total treatment cost — $</td>
<td></td>
<td></td>
<td>0.006</td>
</tr>
<tr>
<td>Median</td>
<td>5,410</td>
<td>7,264</td>
<td></td>
</tr>
<tr>
<td>95% Confidence interval</td>
<td>4,516–6,304</td>
<td>6,301–8,227</td>
<td></td>
</tr>
<tr>
<td>In-hospital mortality — no. (%)</td>
<td>13 (6)</td>
<td>21 (9)</td>
<td>0.21‡</td>
</tr>
<tr>
<td>30-day mortality — no. (%)</td>
<td>22 (10)</td>
<td>28 (12)</td>
<td>0.45‡</td>
</tr>
<tr>
<td>30-day readmission rate — no. (%)</td>
<td>26 (12)</td>
<td>23 (10)</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Mueller, C et al. NEJM 2004
Natriuretic peptides in HF diagnosis: ESC 2016

Acute HF Rule out thresholds:
- BNP < 100 pg/mL
- NT-proBNP < 300 pg/mL

Acute HF Rule in thresholds:
- BNP > 500 pg/ml
- NT-proBNP
  - 450 (age <
  - 900
  - 1800
## Factors affecting natriuretic peptides

<table>
<thead>
<tr>
<th>Higher Natriuretic Peptide Levels Than Expected</th>
<th>Lower Natriuretic Peptide Levels Than Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing age*</td>
<td>Obesity</td>
</tr>
<tr>
<td>Acute coronary syndrome*</td>
<td>Flash pulmonary edema</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>Pericarditis/tamponade</td>
</tr>
<tr>
<td>RV dysfunction*</td>
<td>Genetic polymorphisms</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>End-stage cardiomyopathy</td>
</tr>
<tr>
<td>Pulmonary hypertension*</td>
<td></td>
</tr>
<tr>
<td>Pulmonary embolism*</td>
<td></td>
</tr>
<tr>
<td>Anemia/high-output states*</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td></td>
</tr>
<tr>
<td>Mitral regurgitation*</td>
<td></td>
</tr>
</tbody>
</table>
A schematic representation of the pathophysiology of acute heart failure

VHD
Cong. HD
DCM

Hypertension, ACS, arrhythmias, infections, renal dysfunction, nonadherence, medications

Myocardial
• Decreased CO
• Diastolic dysfunction
• Myocyte injury
• Mitral regurgitation
• Ventricular interdependence
• Tachycardia

Renal
• Sodium and volume retention
• Acute kidney injury
• RAAS activation

Vascular
• Endothelial dysfunction
• Increased arterial stiffness
• Vasoconstriction
• Afterload contractility mismatch
• Volume redistribution
• Capillary leakiness

Neurohormonal
• RAAS activation
• SNS activation
• Oxidative stress
• Inflammation

Congestion
End-organ dysfunction

FIGURE 36.1: A schematic representation of the pathophysiology of acute heart failure. ACS: Acute coronary syndrome; CO: Cardiac output; RAAS: Renin-angiotensin-aldosterone system.
Substrates of HF

- 40 y/o W with worsening DOE 1 weeks
  - AF, R 111 bpm
  - BP 90/60 mmHg
  - JVD+
  - Loud S1, loud P2
  - DRM gr III apex

- 60 y/o M with worsening DOE 1 week
  - AF, HR 110 bpm
  - BP 90/60 mmHg
  - JVD+
  - Soft S1, S3+
  - PSM Gr II apex

Different substrates, different pathway
Evaluation based on fluid status and tissue perfusion may be helpful to guide treatment: Thai HF Guideline

- Fluid status can be considered as wet or dry according to the presence or absence of congestion.
- Tissue perfusion can be characterized as cold or warm according to the presence or absence of signs of peripheral tissue hypoperfusion.

- "cardiac type" for patients with fluid accumulation
- "vascular type" for patients with elevated BP without fluid accumulation
# Clinical trials in AHF

<table>
<thead>
<tr>
<th>Trial name</th>
<th>Patient population</th>
<th>Intervention</th>
<th>Primary endpoint</th>
<th>Significant effect?</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTIME-CHF¹</td>
<td>951 patients admitted with exacerbation of systolic HF</td>
<td>i.v. milrinone vs pbo for 48 hours</td>
<td>Length of hospitalization for CV causes</td>
<td>x</td>
</tr>
<tr>
<td>VERITAS²</td>
<td>1,448 patients hospitalized with AHF</td>
<td>i.v. tezosentan vs pbo for 24–72 hours</td>
<td>Change in dyspnea, incidence of death and worsening HF at 7 days</td>
<td>x</td>
</tr>
<tr>
<td>SURVIVE³</td>
<td>1,327 patients hospitalized with AHF</td>
<td>i.v. levosimendan vs dobutamine</td>
<td>All-cause mortality at 180 days</td>
<td>x</td>
</tr>
<tr>
<td>EVEREST⁴</td>
<td>4,133 patients hospitalized with AHF</td>
<td>Tolvaptan 30 mg once-daily vs pbo for 60 days</td>
<td>All-cause mortality and CV death or hospitalization for HF</td>
<td>x</td>
</tr>
<tr>
<td>ASCEND-HF⁵</td>
<td>7,141 patients hospitalized for AHF</td>
<td>i.v. nesiritide vs pbo for 24 hours–7 days</td>
<td>Change in dyspnea and 30-day all-cause mortality or HF hospitalization</td>
<td>x</td>
</tr>
<tr>
<td>PROTECT⁶</td>
<td>2,033 patients hospitalized for AHF</td>
<td>i.v. rolofylline vs pbo for up to 3 days</td>
<td>Composite of survival, HF status and renal function</td>
<td>x</td>
</tr>
<tr>
<td>RELAX-AHF</td>
<td>1,161 patients hospitalized for AHF</td>
<td>i.v. serelaxin vs pbo 48 hr</td>
<td>Dyspnea improvement</td>
<td>✓</td>
</tr>
<tr>
<td>RELAX-AHF²</td>
<td>6,600 patients hospitalized for AHF</td>
<td>i.v. serelaxin vs pbo 48 hr</td>
<td>CV death or WHF in 180 days</td>
<td>x</td>
</tr>
</tbody>
</table>

**Acute Heart Failure Management**  
- **Diuretic use**

### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous loop diuretic is recommended in patients with signs and symptoms of fluid overload to reduce congestive symptoms.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>In patients not receiving oral diuretics, initial 20-40 mg intravenous furosemide is recommended. For those who receive oral diuretics, initial equivalent dose is recommended for intravenous furosemide.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Intravenous loop diuretics can be given either as intermittent boluses or as a continuous infusion, and the dose and duration should be adjusted according to patients’ symptoms and clinical status.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>It is recommended to regularly monitor urine output, body weight, renal function and electrolytes daily during use of intravenous diuretics.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Intravenous loop diuretics dose adjustment should be considered according to individual’s renal function.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>

**Acute HF**
- If needed – Mechanical ventilator, NIPPV, O2
  - Mechanical circulator support
  - CCU admission

Treat life threatening condition e.g. AMI, arrhythmia, HT emergency

**Cold <-> Wet**

- IV loop diuretic
Management of patients with acute heart failure based on clinical profile during an early phase.
Management of volume overload

Furosemide: standard dose, intermittent bolus or continuous infusion
Combination of diuretics (sequential blockage)
Ultrafiltration

<table>
<thead>
<tr>
<th>SEVERITY OF VOLUME OVERLOAD</th>
<th>DIURETIC</th>
<th>DOSE (mg)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Furosemide, or</td>
<td>20-40, or up to 2.5 times oral dose</td>
<td>IV administration preferable in symptomatic patients</td>
</tr>
<tr>
<td></td>
<td>Bumetanide, or</td>
<td>0.5-1.0</td>
<td>Titrate dose according to clinical response.</td>
</tr>
<tr>
<td></td>
<td>Torsemide</td>
<td>10-20</td>
<td>Monitor Na⁺, K⁺, creatinine, BP</td>
</tr>
<tr>
<td>Severe</td>
<td>Furosemide, or</td>
<td>40-160, or 2.5 times oral dose 5-40 mg/hr infusion</td>
<td>Intravenously</td>
</tr>
<tr>
<td></td>
<td>Bumetanide, or</td>
<td>1-4/0.5-2 mg/hr infusion (max, 2-4 mg/hr, limit 2-4 hr)</td>
<td>Bumetanide and torsemide have higher oral bioavailability than furosemide, but IV administration preferable in AHF.</td>
</tr>
<tr>
<td></td>
<td>Torsemide</td>
<td>20-100/5-20 mg/hr</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ultrafiltration</td>
<td>200-500 mL/hr</td>
<td>Adjust ultrafiltration rate to clinical response; monitor for hypotension; consider hematocrit sensor.</td>
</tr>
<tr>
<td>Refractory to loop diuretics</td>
<td>Add HCTZ, or</td>
<td>25-50 twice daily</td>
<td>Combination with loop diuretic may be better than very high dose of loop diuretics alone.</td>
</tr>
<tr>
<td></td>
<td>Metolazone, or</td>
<td>2.5-10 once daily</td>
<td>Metolazone more potent if creatinine clearance &lt;30 mL/min</td>
</tr>
<tr>
<td></td>
<td>Chlorothiazide, or</td>
<td>250-500 mg IV PO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spironolactone</td>
<td>25-50 once daily</td>
<td>Spiromolactone best choice if patient not in renal failure and normal or low serum K⁺, although may not be very potent</td>
</tr>
<tr>
<td>In case of alkalosis</td>
<td>Acetazolamide</td>
<td>0.5</td>
<td>Intravenously</td>
</tr>
<tr>
<td>Refractory to loop diuretics and thiazides</td>
<td>Add dopamine (renal vasodilation), or</td>
<td>dobutamine or milrinone (inotropic agent)</td>
<td>Ultrafiltration, or hemodialysis if coexisting renal failure</td>
</tr>
</tbody>
</table>
**Acute Heart Failure Management**

- In case of diuretic resistant

**Recommendations**

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients with insufficient diuretic response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reevaluate patients’ clinical status for tissue perfusion and volume status.</td>
<td>COR I, LOE C</td>
<td></td>
</tr>
<tr>
<td>• Low sodium diet (Na &lt;2 gram/day) is recommended in patients with recurrent or refractory volume overload despite appropriate diuretics therapy.</td>
<td>COR I, LOE C</td>
<td></td>
</tr>
<tr>
<td>• Increase dose of loop diuretics.</td>
<td>COR I, LOE B</td>
<td></td>
</tr>
<tr>
<td>• Switch from intermittent bolus to continuous infusion of loop diuretics.</td>
<td>COR Iia, LOE C</td>
<td></td>
</tr>
<tr>
<td>• Combination of loop diuretic with either thiazide-type diuretic or spironolactone should be considered in patients with insufficient diuretic response.</td>
<td>COR Iia, LOE ?</td>
<td></td>
</tr>
<tr>
<td>• Tolvaptan (V2-receptor antagonist) should be considered in patients with congestion and/or hyponatremia. It should be given for a short duration.</td>
<td>COR Iia, LOE B</td>
<td></td>
</tr>
<tr>
<td>• Ultrafiltration may be considered in refractory congestion who failed to response to diuretics-based strategy.</td>
<td>COR Iib, LOE B</td>
<td></td>
</tr>
</tbody>
</table>

**Diagram:**

- If needed – Mechanical ventilator, NIPPV, O2
  - Mechanical circulator support
  - C.C.I admission
  - Treat life threatening condition e.g. AMI, arrhythmia, HT emergency

- IV loop diuretic
- Cold → Wet
- 2nd diuretics or UF

See text | See text
Acute Heart Failure Management
- Intravenous vasodilator

### Recommendations

**Intravenous vasodilators** such as sodium nitroprusside, nitroglycerine should be considered

- Blood pressure monitoring is recommended during intravenous vasodilator used. (COR I, LOE C)
- For warm and wet (vascular type), for congestive symptoms relief in patients with normal or elevated blood pressure (SBP > 90 mmHg). (COR IIa, LOE B)
- Patients with signs/symptoms of hypoperfusion and congestion (Cold and wet) with SBP > 90 mmHg, intravenous vasodilators should be considered with caution. (COR IIa, LOE C)
- Intravenous sodium nitroprusside should be avoided in patients with acute myocardial ischemia or renal insufficiency. (COR IIa, LOE C)
**Acute Heart Failure Management**

- **Inotropic agents**

**Recommendations**

Use *inotropic agents* in patients with following conditions:

- Cardiogenic shock (COR I, LOE C)
- Signs/symptoms of hypoperfusion and/or end organ damage with hypotension (MAP < 65 mmHg) despite adequate filling status. (COR I, LOE C)
- Refractory AHF with inadequate response to intravenous loop diuretics or vasodilators. (COR IIb, LOE C)
- Intravenous infusion of milrinone or levosimendan may be considered to reverse the effects of beta blocker if beta blocker is considered as the cause of hypoperfusion. (COR IIb, LOE C)
- Monitoring of ECG and BP closely during intravenous inotropes infusion. (COR I, LOE C)

Inotropic agents are not routinely recommended unless in symptomatic hypotension or hypoperfusion because of safety concerns.
Acute Heart Failure Management
- Vasopressors

**Recommendations**

**Vasopressors** (e.g. norepinephrine) may be considered in patients with cardiogenic shock, despite treatment with inotropic agents.

- IV loop diuretic
- 2nd diuretics or UF
- Vasodilator
- Inotrope if MAP < 65
- Vasopressor if MAP < 65
- If needed – Mechanical ventilator, NIPPV, O2
  - Mechanical circulator support
  - C.C.U admission
  - Treat life threatening condition e.g. AMI, arrhythmia, HT emergency
**Recommendations**

**General management**
- **Optimal medical treatment (OMT)** for chronic heart failure is recommended to apply in AHF patients with HFrEF after hemodynamic stabilization and no contraindication. I (A)
- **Pre-discharge evaluation** and optimization of all medical therapy are recommended. I (C)
- **Multidisciplinary HF management** should be consulted especially in high-risk AHF patients. (IIa, C)
- **Venous thromboembolism** should be assessed and managed accordingly. IIa (C)

---

**Acute HF**

- If needed – Mechanical ventilator, NIPPV, O2
- Mechanical circulator support
- C.C.I admission
- Treat life threatening condition e.g. AMI, arrhythmia, HT emergency

- IV loop diuretic
- 2nd diuretics or UF
- Vasodilator
- Inotrope if MAP < 65
- Vasopressor if MAP < 65

- Treat life threatening condition e.g. AMI, arrhythmia, HT emergency
Acute Heart Failure Management

- Others

### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
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<tr>
<td>Pulmonary artery pressure monitoring may be considered in the following:</td>
<td>See text</td>
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<td>• Persistent hypotension and/or worsening renal function with inadequate</td>
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<td>assessment of left ventricular filling pressure. IIa (due to setting) (C)</td>
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<td>• To assess pulmonary artery pressure and pulmonary vascular resistance</td>
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<td>for heart transplantation or mechanical circulatory support device. IIa (C)</td>
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<td>• Refractory heart failure despite standard treatment of intravenous</td>
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<td>diuretics, intravenous inotropes, intravenous vasodilator. IIba (C)</td>
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<tr>
<td>• Invasive hemodynamic monitoring and right heart catheterization are not</td>
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<td>routinely recommended in AHF. III (B)</td>
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<td>Mechanical circulatory support should be considered in patients with</td>
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<td>cardiogenic shock despite adequate medical therapy. IIa (C)</td>
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<td>General management</td>
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<tr>
<td>Optical medical treatment (OMT) for chronic heart failure is recommended</td>
<td>Ia</td>
<td>C</td>
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<td>to apply in AHF patients with HFrEF after hemodynamic stabilization and no</td>
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<td>contraindication. I (A)</td>
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<td>Pre-discharge evaluation and optimization of oral medical therapy are</td>
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<td>recommended. I (C)</td>
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<tr>
<td>Multidisciplinary HF management should be consulted especially in high-risk</td>
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<tr>
<td>AHF patients. (IIa (C)</td>
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<tr>
<td>Venous thromboembolism should be assessed and managed accordingly. IIa (C)</td>
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</table>

#### Flowchart

- Acute
  - IV loop diuretic
  - 2nd diuretics or UF
  - Vasodilator
  - Inotrope if MAP < 65
  - Vasopressor if MAP < 65
  - Mechanical ventilator, NIPPV, O2
  - Mechanical circulator support
  - CCI admission
  - Treat life threatening condition e.g. AMI, arrhythmia, HT emergency

- Cold
  - Wet
  - If needed
Acute Heart Failure Management
- Discharge planning

- Discharge planning should be considered when patients’ clinical status is stable. Patients and caregiver education should be provided.
- Multidisciplinary HF management should be consulted especially in high-risk AHF patients.

Table X. Predischarge evaluation topics

1. Identify underlying and precipitating causes
2. Patients’ clinical status: volume and perfusion
3. Optimization of medication
4. Guideline directed device therapy
5. Patients and caregivers education emphasize on signs and symptoms of worsening of HF and management
6. Follow up schedule including telephone follow up in high risk HF patients
Acute Heart Failure Management
- Summary

Patient with AHF

Identified respiratory failure and/or shock

Exam specific cause

Evaluate for congestion and perfusion status

MAP > 65

MAP < 65

Discharge planning

Invasive monitoring, MCS

Individualized treatment to improve AHF outcomes

If needed – Mechanical ventilator, NIPPV, O2
- Mechanical circulator support
- CCU admission

Treat life threatening condition e.g. AML

Consider blood tests, EKG, CXR, echocardiogram, lung ultrasound, etc.

IV loop diuretic

2nd diuretics or UF

Vasodilator

Inotrope if MAP < 65

Vasopressor if MAP < 65

Discharge planning