Management in Acute Heart Failure: Hospital and Post Discharge Treatment

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What we will discussed

Definition of heart failure
Signs and symptoms
Definition of acute heart failure
AHF epidemiology
Precipitants and causes of AHF
Clinical classification-hemodynamic profile
Acute management
After stabilization management
Post discharge management
Definition of HF

• The situation when the heart is incapable of maintaining a cardiac output adequate to accommodate metabolic requirements

• Clinical syndrome arising when delivery of oxygen to the metabolizing tissues is impaired because of defective function of the heart as a pump

* Braunwald. 2008
HF is a clinical syndrome in which patients have the following features:

**Symptoms typical of HF**
- Breathlessness at rest or on exercise, fatigue, tiredness, ankle swelling

**Signs typical of HF**
- Tachycardia, tachypnoea, pulmonary rales, pleural effusion, raised venous pressure, peripheral oedema, hepatomegaly

**Structural or functional abnormality of the heart at rest**
- Cardiomegaly, third heart sound, cardiac murmurs, abnormality on the echocardiogram, raised natriuretic peptide concentration

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Acute Heart Failure

• Acute heart failure (AHF) is defined as a rapid onset or change in the signs and symptoms of HF, resulting in the need for urgent therapy

• AHF may be either new HF or worsening of pre-existing chronic HF

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AHF : The Scope of the Problem

• Acute decompensated heart failure (ADHF) is the most common cause of hospital admission

• UNITED STATES (2009)
  – >1 million hospitalizations
  – $12 billion in costs annually

• INDONESIA (2006)
  – 1687 cases of ADHF/ year
  – 6.7% mortality rate

• NCCHHK (2008)
  – 12% increase in hospitalization and mortality

Indonesian heart failure patients were younger and more new patients, compared to European and US data.

More severe clinical presentation

High rate of in-hospital mortality (6.7-12%)

Mean hospital length of stay in average is 7 days

Need HF service team & preventive management

In Hospital Mortality By Country (%)

- Singapore: 2%
- Thailand: 5.5%
- Indonesia: 6.7%
- Australia: 6.5%
- Malaysia: 7.6%
- Philippines: 5.4%
- Taiwan: 5.4%
- Hong Kong: 0.3%
- Brazil: 8.3%
- Mexico: 7.2%
- Latin America: 8.2%
- Asia Pacific: 4.8%
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Table 19  Precipitants and causes of acute heart failure

<table>
<thead>
<tr>
<th>Events usually leading to less rapid deterioration</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Infection (including infective endocarditis)</td>
</tr>
<tr>
<td>• Exacerbation of COPD/asthma</td>
</tr>
<tr>
<td>• Anaemia</td>
</tr>
<tr>
<td>• Kidney dysfunction</td>
</tr>
<tr>
<td>• Non-adherence to diet/drug therapy</td>
</tr>
<tr>
<td>• Iatrogenic causes (e.g. prescription of an NSAID or corticosteroid; drug interactions)</td>
</tr>
<tr>
<td>• Arrhythmias, bradycardia, and conduction disturbances not leading to sudden, severe change in heart rate</td>
</tr>
<tr>
<td>• Uncontrolled hypertension</td>
</tr>
<tr>
<td>• Hypothyroidism or hyperthyroidism</td>
</tr>
<tr>
<td>• Alcohol and drug abuse</td>
</tr>
</tbody>
</table>
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Clinical Classification AHF

Clinical Profiles of AHF Patients: ESC-HF Pilot

In-hospital patients: clinical profiles (available for 1763 patients, 93%)

- 75.0%: Decompensated HF
- 13.3%: Pulmonary edema
- 4.7%: Hypertension
- 4.7%: Right ventricular HF

### Two Minute Assessment of Hemodynamic Profile

<table>
<thead>
<tr>
<th>Low perfusion at rest?</th>
<th>Congestion at rest?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Warm &amp; Dry</td>
</tr>
<tr>
<td>YES</td>
<td>Cold &amp; Dry</td>
</tr>
<tr>
<td></td>
<td>Warm &amp; Wet</td>
</tr>
<tr>
<td></td>
<td>Cold &amp; Wet</td>
</tr>
</tbody>
</table>

- **A**: Warm & Dry
- **B**: Warm & Wet
- **C**: Cold & Wet
- **L**: Cold & Dry
Suspected acute heart failure

History/examination (including blood pressure and respiratory rate)
- Chest X-ray
- Echocardiogram or NP (or both)
- Blood chemistry

ECG
- Oxygen saturation
- Full blood count

Simultaneously assess for:
- Life-threatening arrhythmia/bradycardia?
- Blood pressure <85 mmHg or shock
- Acute coronary syndrome
- Acute mechanical cause/severe valvular disease

Urgent action if present:
- Oxygen
- NIV
- ETT and invasive ventilation
- Electrical cardioversion
- Pacing
- Inotrope/vasopressor
- Mechanical circulatory support (e.g. IABP)
- Coronary reperfusion
- Antithrombotic therapy
- Echocardiography
- Surgical/percutaneous intervention
### Table 22 Goals of treatment in acute heart failure

<table>
<thead>
<tr>
<th>Immediate (ED/ICU/CCU)</th>
<th>Intermediate (in hospital)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Treat symptoms</td>
<td>• Stabilize patient and optimize treatment strategy</td>
</tr>
<tr>
<td>• Restore oxygenation</td>
<td>• Initiate and up-titrate disease-modifying pharmacological therapy</td>
</tr>
<tr>
<td>• Improve haemodynamics and organ perfusion</td>
<td>• Consider device therapy in appropriate patients</td>
</tr>
<tr>
<td>• Limit cardiac and renal damage</td>
<td>• Identify aetiology and relevant co-morbidities</td>
</tr>
<tr>
<td>• Prevent thrombo-embolism</td>
<td></td>
</tr>
<tr>
<td>• Minimize ICU length of stay</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-discharge and long-term management</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Plan follow-up strategy</td>
<td></td>
</tr>
<tr>
<td>• Enrol in disease management programme, educate, and initiate appropriate lifestyle adjustments</td>
<td></td>
</tr>
<tr>
<td>• Plan to up-titrate/optimize dose of disease-modifying drugs</td>
<td></td>
</tr>
<tr>
<td>• Ensure assessed for appropriate device therapy</td>
<td></td>
</tr>
<tr>
<td>• Prevent early readmission</td>
<td></td>
</tr>
<tr>
<td>• Improve symptoms, quality of life, and survival</td>
<td></td>
</tr>
</tbody>
</table>
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In patients already taking diuretic, 2.5 times existing oral dose recommended. Repeat as needed.

- **SaO2** <90% or **PaO2** <60 mmHg

Ex. 4–8 mg of morphine plus 10 mg of metoclopramide

**Start an i.v. infusion of dobutamine 2.5 µg/kg/min**

- An adequate response includes reduction in dyspnoea and adequate diuresis (>100 mL/h urine production in first 2 h)

**Measure systolic blood pressure**

- **SBP** <85 mmHg or shock
  - Add non-vasodilating inotrope
- **SBP** 85–110 mmHg
  - No additional therapy until response assessed
- **SBP** >110 mmHg
  - Consider vasodilator (e.g. NTG)

**An adequate response includes reduction in dyspnoea and adequate diuresis (>100 mL/h urine production in first 2 h)**
17. Double dose of loop diuretic up to equivalent of furosemide 500 mg (doses of 250 mg and above should be given by infusion over 4 h).

18. If no response to doubling of dose of diuretic despite adequate left ventricular filling pressure, start i.v. infusion of dopamine 2.5 μg/kg/min. Higher doses are not recommended to enhance diuresis.
Target hemodynamic: Profile A

<table>
<thead>
<tr>
<th></th>
<th>DRY</th>
<th>WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARM</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>COLD</td>
<td>L</td>
<td>C</td>
</tr>
</tbody>
</table>

DIURETICS
VASODILATORS

Stevenson, Eur J Heart Failure 2005
Diuretics

- An i.v. loop diuretic is recommended to improve breathlessness and relieve congestion (Class I, Level B)

- Despite having been prescribed for many years to manage fluid overload, diuretic’s optimal dose and route of administration and overall effects on patient outcomes remain unsettled

Bolus dosing vs Infusion

• Bolus diuretic dosing may be associated with a higher rate of diuretic resistance due to prolonged periods of subtherapeutic drug levels in the kidney

• Continuous infusion results in a more constant delivery of diuretic to the tubule, potentially reducing this phenomenon

Bolus dosing vs Infusion

• Continuous infusion prevent postdiuretic salt retention completely and has been demonstrated to be a safe and effective treatment in patients with CHF refractory to 250 mg furosemide given orally or intravenously

• The dose of continuous infusions of furosemide ranged from as low as 3 mg/hour with most patients receiving 10–20 mg/hour

De Bruyne LKM. Postgrad Med J. 2003;79:268-71
Footnote 1: In patients’ already taking diuretic, **2.5 times existing oral dose** recommended. Repeat as needed.

Footnote 17: Double dose of loop diuretic up to equivalent of **furosemide 500 mg** (doses of 250 mg and above should be given by infusion over 4 h)
The majority of ADHF hospitalizations are due to volume overload and congestion ➔ can be relieved by IV administration of loop diuretics.

Bolus injection

- Acute decompensated heart failure

Continuos infusion

- Chronic advanced heart failure
- Diuretic resistance
Opiates

• An i.v. opiate (along with an antiemetic) should be considered in particularly anxious, restless, or distressed patients to relieve these symptoms and improve breathlessness (Class IIa, Level C)

• Opiates are also thought to be venodilators, reducing preload, and may also reduce sympathetic drive

Vasodilators

- **Vasodilator focused strategy** (high dose nitrates with low dose diuretics) to a **diuretic focused strategy** (high dose diuretics and low dose nitrates) in patients with ADHF and acute pulmonary edema

- The vasodilator focused strategy led to significantly **lower incidence** of the need for mechanical ventilation and of myocardial infarction

Vasodilators

• An i.v. infusion of a nitrate should be considered in patients with pulmonary congestion/oedema and a SBP >110 mmHg, who do not have severe mitral or aortic stenosis (Class IIa, Level B)

• Although vasodilators such as nitroglycerine reduce preload and afterload and increase stroke volume, there is no robust evidence that they relieve dyspnoea or improve other clinical outcomes

• Excessive falls in BP should also be avoided because hypotension is associated with higher mortality in patients with AHF.
### Vasodilators to treat AHF

<table>
<thead>
<tr>
<th>Vasodilator</th>
<th>Dosing</th>
<th>Main side effects</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitroglycerine</td>
<td>Start with 10–20 μg/min, increase up to 200 μg/min</td>
<td>Hypotension, headache</td>
<td>Tolerance on continuous use</td>
</tr>
<tr>
<td>Isosorbide dinitrate</td>
<td>Start with 1 mg/h, increase up to 10 mg/h</td>
<td>Hypotension, headache</td>
<td>Tolerance on continuous use</td>
</tr>
<tr>
<td>Nitroprusside</td>
<td>Start with 0.3 μg/kg/min and increase up to 5 μg/kg/min</td>
<td>Hypotension, isocyanate toxicity</td>
<td>Light sensitive</td>
</tr>
<tr>
<td>Nesiritide&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Bolus 2 μg/kg + infusion 0.01 μg/kg/min</td>
<td>Hypotension</td>
<td></td>
</tr>
</tbody>
</table>
Non-invasive ventilation

- Non-invasive ventilation may be used as *adjunctive therapy* to relieve symptoms in patients with pulmonary oedema and severe respiratory distress or who fail to improve with pharmacological therapy (Class IIa, Level B)

15. CPAP or NIPPV should be considered in patients without contraindications
Endotracheal intubation and invasive ventilation

- The primary indication for endotracheal intubation and invasive ventilation is respiratory failure leading to hypoxaemia, hypercapnia, and acidosis.

Target hemodynamic: Profile A

- **Dry**
  - **Warm**: A
  - **Cold**: L

- **Wet**
  - **Warm**: B
  - **Cold**: C

**Drugs**
- **Diuretics**: Wet Warm
- **Vasodilators**: Dry Cold
- **Inotropic Drugs**: Cold Warm

Stevenson, Eur J Heart Failure 2005
Inotropes

• Inotropic agents are **NOT recommended** unless the patient is hypotensive (SBP <85 mmHg), hypoperfused, or shocked because of **safety concerns** (atrial and ventricular arrhythmias, myocardial ischaemia, and death) → **Class III, Level C**

• Use of an inotrope such as dobutamine should usually be reserved for patients with such **severe reduction in cardiac output** that vital organ perfusion is compromised.

Vasopressors

• Sometimes given to severely ill patients with marked hypotension

• These agents are given to raise BP and redistribute cardiac output from the extremities to the vital organs.

• Their use should be restricted to patients with persistent hypoperfusion despite adequate cardiac filling pressures.

Dopamine

• In large doses (>5 mcg/kg/min) dopamine has inotropic and vasoconstrictor activity.

• At lower doses (2,5mcg/kg/min) dopamine may have a selective renal arterial vasodilator activity and promote natriuresis

18. If no response to doubling of dose of diuretic despite adequate left ventricular filling pressure → start i.v. infusion of dopamine 2.5 μg/kg/min. Higher doses are not recommended to enhance diuresis.
## Positive inotropes or vasopressors

<table>
<thead>
<tr>
<th></th>
<th>Bolus</th>
<th>Infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dobutamine</td>
<td>No</td>
<td>2–20 µg/kg/min (β+)</td>
</tr>
<tr>
<td>Dopamine</td>
<td>No</td>
<td>&lt;3 µg/kg/min: renal effect (δ+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3–5 µg/kg/min; inotropic (β+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;5 µg/kg/min: (β+), vasopressor (α+)</td>
</tr>
<tr>
<td>Milrinone</td>
<td>25–75 µg/kg over 10–20 min</td>
<td>0.375–0.75 µg/kg/min</td>
</tr>
<tr>
<td>Enoximone</td>
<td>0.5–1.0 mg/kg over 5–10 min</td>
<td>5–20 µg/kg/min</td>
</tr>
<tr>
<td>Levosimendan(^a)</td>
<td>12 µg/kg over 10 min (optional)(^b)</td>
<td>0.1 µg/kg/min, which can be decreased to 0.05 or increased to 0.2 µg/kg/min</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>No</td>
<td>0.2–1.0 µg/kg/min</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>Bolus: 1 mg can be given i.v. during resuscitation, repeated every 3–5 min</td>
<td>0.05–0.5 µg/kg/min</td>
</tr>
</tbody>
</table>
Mechanical circulatory support
Intra-aortic balloon pump

- The conventional indications for an intra-aortic balloon pump (IABP) are to support the circulation before surgical correction of specific acute mechanical problems, during severe acute myocarditis and in selected patients with acute myocardial ischaemia or infarction before, during, and after percutaneous or surgical revascularization.

- There is no good evidence that an IABP is of benefit in other causes of cardiogenic shock.

### AHF: Recommendations and Levels of Evidence

<table>
<thead>
<tr>
<th>Group</th>
<th>Medication</th>
<th>Class Recommendation, Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diuretics</td>
<td>Indication</td>
<td>I, B</td>
</tr>
<tr>
<td>Vasodilators</td>
<td>Nitrates</td>
<td>IIa, B</td>
</tr>
<tr>
<td></td>
<td>Sodium nitroprusside</td>
<td>IIb, B</td>
</tr>
<tr>
<td>Morphine</td>
<td>Indication</td>
<td>IIa, C</td>
</tr>
<tr>
<td>Inotropics*</td>
<td>Dopamine</td>
<td>IIb, C</td>
</tr>
<tr>
<td></td>
<td>Dobutamine</td>
<td>IIa, C</td>
</tr>
</tbody>
</table>

AHF = acute heart failure

*Hypotension or cardiogenic shock

Other Treatment Options in AHF

1. PDE inhibitor: milrinone
2. Calcium sensitizer: levosimendan
3. AVP antagonist: tolvaptan
4. Adenosine $A_1$ receptor antagonist: rolofylline
5. Natriuretic peptide: nesiritide

Mixed results regarding HF patients’ outcome

AVP = arginine vasopressin; PDE = phosphodiesterase
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ACE – Inhibitor/ARB

• An ACE inhibitor is recommended, for all patients with an EF ≤40% to reduce the risk of HF hospitalization and the risk of premature death (Class I, Level A)

• Administration of loop diuretics to HF pts has been shown to activate the RAA system and the sympathetic nervous system that leads to heart failure progression → the best time to give ACE inhibitor is when the patient still ‘wet’

• The dose should be up-titrated as far as possible before discharge, and a plan made to complete dose up-titration after discharge.

Beta Blockers

• A beta-blocker is recommended, in addition to an ACE inhibitor (or ARB if ACE inhibitor not tolerated), for all patients with an EF ≤40% to reduce the risk of HF hospitalization and the risk of premature death (Class I, Level A)

• Should be started as soon as possible after stabilization, BP and heart rate permitting

• The dose should be up-titrated as far as possible before discharge, and a plan made to complete dose up-titration after discharge.
Beta Blockers

• Three key trials
  – CIBIS II (Cardiac Insufficiency Bisoprolol Study II)
  – COPERNICUS (Carvedilol Prospective Randomized Cumulative Survival)
  – MERIT-HF (Metoprolol CR/XL Randomised Intervention Trial in Congestive Heart Failure)

• Beta-blocker treatment reduced mortality (RRR 34% in each trial) and HF hospitalization (RRR 28–36%)

CIBIS II
(Cardiac Insufficiency Bisoprolol Study II)

- Double-blind, placebo-controlled, randomised trial
- 2647 patients with HF NYHA III-IV
- Bisoprolol administered on top of standard therapy (diuretic + ACE Inhibitor)
- Bisoprolol have **benefits for survival** in stable HF pts

CIBIS II. The Lancet 1999; 353 (9146):9-13
CIBIS II
(Cardiac Insufficiency Bisoprolol Study II)

34% reduction in all-cause mortality with bisoprolol
Beta Blockers

- BBs should usually be initiated in **stable patients**, and used only with caution in recently decompensated patients (and **only initiated in hospital** in these patients).

- Continuation of beta-blocker treatment during an episode of decompensation has been shown in an RCT to be **safe**, although **dose reduction** may be necessary.

- Temporary discontinuation is advised in shocked or severely hypoperfused patients.

- Re-institution of treatment should be attempted **before discharge**.

An MRA is recommended for all patients with persisting symptoms (NYHA class II–IV) and an EF ≤35%, despite treatment with an ACE inhibitor (or an ARB if an ACE inhibitor is not tolerated) and a beta-blocker, to reduce the risk of HF hospitalization and the risk of premature death (class I, Level A).

As the dose of MRA used to treat HF has a minimal effect on blood pressure, even relatively hypotensive patients may be started on this therapy during admission.

Digoxin

• In patients with reduced EF, digoxin may be used to control the ventricular rate in AF, especially if it has not been possible to up-titrate the dose of beta-blocker.

• Digoxin may also provide symptom benefit and reduce the risk of HF hospitalization in patients with severe systolic HF (Class IIb, Level B)

Ivabradine

- Its effect is to slow the heart rate in patients in sinus rhythm

- SHIFT Trial: Ivabradine reduced mortality or hospitalization by 18% in NYHA II – IV HF patients with heart rate $\geq 70$ bpm after given optimal recommended therapy (including diuretic, digoxin, ACE-I, ARB, beta-blocker, MRA) $\rightarrow$ Class IIa, Level B

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Readiness for discharge

- The acute episode of HF should have resolved and congestion should be **absent** and a **stable oral diuretic regimen** established for at least 48 h.

- Long-term disease-modifying therapy (**including a beta-blocker**) should be optimized as much as possible.

- Appropriate education provided to the patient and family/caregivers.

Sodium and fluid restriction

- Limiting the daily dietary salt consumption to < 2 gr/day
- Fluid restriction to 1.5 – 2 lt/day
- Avoidance use of non-steroidal anti-inflammatory drugs (NSAIDs) → NSAIDs are major cause of diuretic resistance

McDonagh TA. Future Cardiol. 2008;4(5):517-525
Summary

• AHF is a life threatening condition that requires urgent therapy

• The majority of AHF patients do not need hospitalization because volume overload condition can be relieved by loop diuretics

• Every effort should be made to reach optimal medication (diuretics, B blocker, RAS blocker) to prevent recurrences and improve prognosis

• Knowledge of indications, contraindications, adverse effects and its management are the key in managing HF patients
Thank You