AHF - Initial phase in the emergency department: diagnosis and management

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2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)

Developed with the special contribution of the Heart Failure Association (HFA) of the ESC

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AHF - Definition and classification

AHF refers to rapid onset or worsening of symptoms and/or signs of HF

- De novo vs Acute decompensation of chronic HF

- Primary cardiac dysfunction
  - Acute myocardial dysfunction (ischaemic, inflammatory or toxic)
  - Acute valve insufficiency or pericardial tamponade

(and/or) With / without known precipitant factors
Factors triggering acute heart failure

<table>
<thead>
<tr>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute coronary syndrome.</td>
</tr>
<tr>
<td>Tachyarrhythmia (e.g. atrial fibrillation, ventricular tachycardia).</td>
</tr>
<tr>
<td>Excessive rise in blood pressure.</td>
</tr>
<tr>
<td>Infection (e.g. pneumonia, infective endocarditis, sepsis).</td>
</tr>
<tr>
<td>Non-adherence with salt/fluid intake or medications.</td>
</tr>
<tr>
<td>Bradyarrhythmia.</td>
</tr>
<tr>
<td>Toxic substances (alcohol, recreational drugs).</td>
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<tr>
<td>Drugs (e.g. NSAIDs, corticosteroids, negative inotropic substances,</td>
</tr>
<tr>
<td>cardiototoxic chemotherapeutics).</td>
</tr>
<tr>
<td>Exacerbation of chronic obstructive pulmonary disease.</td>
</tr>
<tr>
<td>Pulmonary embolism.</td>
</tr>
<tr>
<td>Surgery and perioperative complications.</td>
</tr>
<tr>
<td>Increased sympathetic drive, stress-related cardiomyopathy.</td>
</tr>
<tr>
<td>Metabolic/hormonal derangements (e.g. thyroid dysfunction, diabetic</td>
</tr>
<tr>
<td>ketosis, adrenal dysfunction, pregnancy and peripartum related</td>
</tr>
<tr>
<td>abnormalities).</td>
</tr>
<tr>
<td>Cerebrovascular insult.</td>
</tr>
<tr>
<td>Acute mechanical cause: myocardial rupture complicating ACS (free wall</td>
</tr>
<tr>
<td>rupture, ventricular septal defect, acute mitral regurgitation), chest</td>
</tr>
<tr>
<td>trauma or cardiac intervention, acute native or prosthetic valve</td>
</tr>
<tr>
<td>incompetence secondary to endocarditis, aortic dissection or</td>
</tr>
<tr>
<td>thrombosis.</td>
</tr>
</tbody>
</table>
Diagnosis and initial prognostic evaluation

• The diagnostic workup needs to be **started in the pre-hospital setting and continued in the emergency department (ED)** in order to establish the diagnosis in a timely manner and initiate appropriate management.

• In parallel, **coexisting life-threatening clinical conditions and/or precipitants that require urgent treatment/correction need to be immediately identified and managed**.

• Typically, an initial step in the diagnostic workup of AHF is to **rule out alternative causes for the patient’s symptoms and signs** (i.e. Pulmonary infection, severe anaemia, acute renal failure).
Initial management of patients with acute HF

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 phase (initial 60–120 minutes)

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

Immediate initiation of specific treatment

Follow detailed recommendations in the specific ESC Guidelines

Immediate stabilization and transfer to ICU/CCU

Diagnostic work-up to confirm AHF
Clinical evaluation to select optimal management
Initial management of patients with acute HF (1)

Patient with suspected AHF

1. Cardiogenic shock?
   - Yes
     - Circulatory support
       - Pharmacological
       - Mechanical
     - Immediate stabilization and transfer to ICU/CCU

Urgent phase after first medical contact
Initial management of patients with acute HF (1)

Patient with suspected AHF

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
## Recommendations for the management of patients with AHF: oxygen therapy and ventilatory support

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring of transcutaneous arterial oxygen saturation (SpO₂) is recommended.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Measurement of blood pH and carbon dioxide tension (possibly including lactate) should be considered, especially in patients with acute pulmonary oedema or previous history of COPD using venous blood. In patients with cardiogenic shock arterial blood is preferable.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Oxygen therapy is recommended in patients with AHF and SpO₂ &lt;90% or PaO₂ &lt;60 mmHg (8.0 kPa) to correct hypoxaemia.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Non-invasive positive pressure ventilation (CPAP, BiPAP) should be considered in patients with respiratory distress (respiratory rate &gt;25 breaths/min, SpO₂ &lt;90%) and started as soon as possible in order to decrease respiratory distress and reduce the rate of mechanical endotracheal intubation. Non-invasive positive pressure ventilation can reduce blood pressure and should be used with caution in hypotensive patients. Blood pressure should be monitored regularly when this treatment is used.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Intubation is recommended, if respiratory failure, leading to hypoxaemia (PaO₂ &lt;60 mmHg (8.0 kPa)), hypercapnia (PaCO₂ &gt;50 mmHg (6.65 kPa)) and acidosis (pH &lt;7.35), cannot be managed non-invasively.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>
Initial management of patients with acute HF (1)

**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

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Initial management of patients with acute HF (2)

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

Immediate stabilization and transfer to ICU/CCU

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
Initial management of patients with acute HF (2)

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

Immediate stabilization and transfer to ICU/CCU

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 and initial prognostic evaluation

1. Assessment of symptoms and signs
   - Fluid overload (pulmonary congestion and/or peripheral oedema)
   - Reduced cardiac output with peripheral hypoperfusion
   - Sensitivity and specificity often not satisfactory

2. Additional investigations
   - Laboratory tests at presentation:
     - **Natriuretic peptides**
       Plasma NP level (BNP, NT-proBNP or MR-proANP) should be measured in all patients with acute dyspnoea
       - Thresholds: BNP <100 pg/mL (vs 35 pg/mL in the chronic setting)
         NT-proBNP <300 pg/mL (vs 125 pg/mL ”)
         MR-proANP <120 pg/mL
<table>
<thead>
<tr>
<th>Causes of elevation of natriuretic peptides levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiac</strong></td>
</tr>
<tr>
<td>Heart failure</td>
</tr>
<tr>
<td>Acute coronary syndromes</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
</tr>
<tr>
<td>Myocarditis</td>
</tr>
<tr>
<td>Left ventricular hypertrophy</td>
</tr>
<tr>
<td>Hypertrophic or restrictive cardiomyopathy</td>
</tr>
<tr>
<td>Valvular heart disease</td>
</tr>
<tr>
<td>Congenital heart disease</td>
</tr>
<tr>
<td>Atrial and ventricular tachyarrhythmias</td>
</tr>
<tr>
<td>Heart contusion</td>
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<tr>
<td>Cardioversion, ICD shock</td>
</tr>
<tr>
<td>Surgical procedures involving the heart</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
</tr>
<tr>
<td><strong>Non-cardiac</strong></td>
</tr>
<tr>
<td>Advanced age</td>
</tr>
<tr>
<td>Ischaemic stroke</td>
</tr>
<tr>
<td>Subarachnoid haemorrhage</td>
</tr>
<tr>
<td>Renal dysfunction</td>
</tr>
<tr>
<td>Liver dysfunction (mainly liver cirrhosis with ascites)</td>
</tr>
<tr>
<td>Paraneoplastic syndrome</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Severe infections (including pneumonia and sepsis)</td>
</tr>
<tr>
<td>Severe burns</td>
</tr>
<tr>
<td>Anaemia</td>
</tr>
<tr>
<td>Severe metabolic and hormone abnormalities</td>
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<tr>
<td>(e.g. thyrotoxicosis, diabetic ketosis)</td>
</tr>
</tbody>
</table>
1. Assessment of symptoms and signs
   - Fluid overload (pulmonary congestion and/or peripheral oedema)
   - Reduced cardiac output with peripheral hypoperfusion
   - Sensitivity and specificity often not satisfactory

2. Additional investigations
   - Laboratory tests at presentation:
     - **Natriuretic peptides**
       Plasma NP level (BNP, NT-proBNP or MR-proANP) should be measured in all patients with acute dyspnoea
       Thresholds: BNP <100 pg/mL (*vs* 35 pg/mL in the chronic setting)
                  NT-proBNP <300 pg/mL (*vs* 125 pg/mL ”)
                  MR-proANP <120 pg/mL
     - **Other laboratory tests.**
       cTn, BUN or urea, creatinine, electrolytes (sodium, potassium), liver function tests, TSH
Diagnosis and initial prognostic evaluation

2. Additional investigations

- **ECG**  - Underlying cardiac disease and potential precipitant (AF, ischaemia)
  - Rarely normal in AHF (high negative predictive value).

- **Chest X-ray**  - Nearly normal in up to 20% of patients with AHF
  - Rule out alternative non-cardiac diseases

- **Echocardiography**  → Within 48 hours (optimal timing uncertain
  Immediate if haemodynamic instability (i.e. cardiogenic shock)
  or suspected acute life-threatening structural/functional CV abnormalities

- **Bedside thoracic ultrasound**  (signs of interstitial oedema and
  pleural effusion) may be useful in expert hands
## Recommendations regarding the use of diagnostic measurements

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon presentation a measurement of plasma natriuretic peptide level (BNP, NT-proBNP or MR-proANP) is recommended in all patients with acute dyspnoea and suspected AHF to help in the differentiation of AHF from non-cardiac causes of acute dyspnoea.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>At admission in all patients presenting with suspected AHF, the following diagnostic tests are recommended:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 12-lead ECG;</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>b. chest X-ray to assess signs of pulmonary congestion and detect other cardiac or non-cardiac diseases that may cause or contribute to the patient’s symptoms;</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>c. the following laboratory assessments in the blood: cardiac troponins, BUN (or urea), creatinine, electrolytes (sodium, potassium), glucose, complete blood count, liver function tests and TSH.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Echocardiography is recommended immediately in haemodynamically unstable AHF patients and within 48 hours when cardiac structure and function are either not known or may have changed since previous studies.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>
Management of patients with acute heart failure based on clinical profile during an early phase
Clinical profiles of patients with AHF based on the presence/absence of congestion and/or hypoperfusion

<table>
<thead>
<tr>
<th>CONGESTION (-)</th>
<th>CONGESTION (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary congestion</td>
<td>Pulmonary congestion</td>
</tr>
<tr>
<td>Orthopnoea/paroxysmal nocturnal dyspnoea</td>
<td>Orthopnoea/paroxysmal nocturnal dyspnoea</td>
</tr>
<tr>
<td>Peripheral (bilateral) oedema</td>
<td>Peripheral (bilateral) oedema</td>
</tr>
<tr>
<td>Jugular venous dilatation</td>
<td>Jugular venous dilatation</td>
</tr>
<tr>
<td>Congested hepatomegaly</td>
<td>Congested hepatomegaly</td>
</tr>
<tr>
<td>Gut congestion, ascites</td>
<td>Gut congestion, ascites</td>
</tr>
<tr>
<td>Hepatojugular reflux</td>
<td>Hepatojugular reflux</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HYPOPERFUSION (-)</th>
<th>HYPOPERFUSION (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold sweated extremities</td>
<td>Cold sweated extremities</td>
</tr>
<tr>
<td>Oliguria</td>
<td>Oliguria</td>
</tr>
<tr>
<td>Mental confusion</td>
<td>Mental confusion</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Dizziness</td>
</tr>
<tr>
<td>Narrow pulse pressure</td>
<td>Narrow pulse pressure</td>
</tr>
</tbody>
</table>

WARM-DRY | WARM-WET

COLD-DRY | COLD-WET

Hypoperfusion is not synonymous with hypotension, but often hypoperfusion is accompanied by hypotension.
Management of patients with acute heart failure based on clinical profile during an early phase

1. Bedside assessment to identify haemodynamic profiles

2. Presence of congestion?
   - Yes (95% of all AHF patients)
     - ‘Wet’ patient
     - Adequate peripheral perfusion?
       - Yes
         - ‘Wet and Warm’ patient
           (typically defined by normal systolic blood pressure)
       - No
         - ‘Wet and Cold’ patient

   - No (5% of all AHF patients)
     - ‘Dry’ patient
     - Adequate peripheral perfusion?
       - Yes
         - ‘Dry and warm’ patient
           (Adequately perfused = Compensated)
       - No
         - ‘Dry and cold’ patient
           (Hypoperfused = Hypovolemic)
Management of patients with acute heart failure based on clinical profile during an early phase

ADEQUATE PERIPHERAL PERFUSION?

YES

‘Wet and Warm’ patient
(typically elevated or normal systolic blood pressure)

Vascular type – fluid redistribution
Hypertension predominates

Cardiac type – fluid accumulation
Congestion predominates

NO

‘Dry and warm’
Adequately perfused...

‘Dry and cold’
Hypoperfused,
Hypovolemic

‘Wet and Cold’ patient
## Recommendations for the management of patients with acute heart failure: pharmacotherapy

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diuretics</strong></td>
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</tr>
<tr>
<td>Intravenous loop diuretics are recommended for all patients with AHF admitted with signs/symptoms of fluid overload to improve symptoms. It is recommended to regularly monitor symptoms, urine output, renal function and electrolytes during use of i.v. diuretics.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>In patients with new-onset AHF or those with chronic, decompensated HF not receiving oral diuretics the initial recommended dose should be 20–40 mg i.v. furosemide (or equivalent); for those on chronic diuretic therapy, initial i.v. dose should be at least equivalent to oral dose.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>It is recommended to give diuretics 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>Combination of loop diuretic with either thiazide-type diuretic or spironolactone may be considered in patients with resistant oedema or insufficient symptomatic response.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td><strong>Vasodilators</strong></td>
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<td></td>
</tr>
<tr>
<td>i.v. vasodilators should be considered for symptomatic relief in AHF with SBP &gt;90 mmHg (and without symptomatic hypotension). Symptoms and blood pressure should be monitored frequently during administration of i.v. vasodilators.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>In patients with hypertensive AHF, i.v. vasodilators should be considered as initial therapy to improve symptoms and reduce congestion.</td>
<td>IIa</td>
<td>B</td>
</tr>
</tbody>
</table>
Initial management of patients with acute HF

**Patient with suspected AHF**

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**

**Identification of acute aetiology:**
- C: Acute coronary syndrome
- H: Hypertension emergency
- A: Arrhythmia
- M: Acute mechanical cause
- P: Pulmonary embolism

**Immediate initiation of specific treatment**

**Diagnostic work-up to confirm AHF**
Clinical evaluation to select optimal management

**Patient with acute heart failure**

**Bedside assessment to identify haemodynamic profiles**

**Presence of congestion?**
- YES (95% of all AHF patients)
- NO (5% of all AHF patients)

**Wet** patient

**Adequate peripheral perfusion?**
- YES
  - ‘Wet and Warm’ patient
    - Typically elevated or normal systolic blood pressure
  - Cardiac type
    - Fluid accumulation
    - Congestion predominates
    - Diuretic
    - Vasodilator
    - Ultrafiltration (consider if diuretic resistance)
  - ‘Wet and Cold’ patient
    - Systolic blood pressure <90 mm Hg
    - Inotropic agent
    - Vasodilators
    - Consider inotropic agent in refractory cases
  - ‘Dry and warm’
    - Adequately perfused
    - Compensated
    - Adjust oral therapy

- NO
  - ‘Dry and cold’
    - Hypoperfused, hypovolemic
    - Consider fluid challenge
    - Consider inotropic agent if still hypoperfused

**Dry** patient