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CURRENT OPINION

Recommendations on pre-hospital and early hospital management of acute heart failure: a consensus paper from the Heart Failure Association of the European Society of Cardiology, the European Society of Emergency Medicine and the Society of Academic Emergency Medicine – short version

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Despite several critical steps forward in the management of chronic heart failure (CHF), the area of acute heart failure (AHF) has remained relatively stagnant. As stated in the updated ESC HF guidelines, clinicians responsible for managing patients with AHF must frequently make treatment decisions without adequate evidence, usually on the basis of expert opinion consensus.[2] Specifically, the treatment of acute HF remains largely opinion-based with little good evidence to guide therapy.

The opinions expressed in this article are not necessarily those of the Editors of the *European Heart Journal* or of the European Society of Cardiology.

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Acute heart failure is a syndrome in which emergency physicians, cardiologists, intensivists, nurses, and other healthcare providers have to cooperate to provide 'rapid' benefit to the patients. We hereby would like to underscore the wider experience grown in different settings of the area of intensive care on acute heart failure, actually larger and more composite than that got in specialized Care Units. The distillate of such different experiences is discussed and integrated in the present document. Hence, the authors of this consensus paper believe a common working definition of AHF covering all dimensions and modes of presentations has to be made, with the understanding that most AHF presentations are either acute decompensations of chronic underlying HF or the abrupt onset of dyspnoea associated with significantly elevated blood pressure. Secondly, recent data show that, much like acute coronary syndrome, AHF might have a 'time to therapy' concept. Accordingly, 'pre-hospital' management is considered a critical component of care. Thirdly, most patients with AHF have normal or high blood pressure at presentation, and are admitted with symptoms and/or signs of congestion. This is in contradiction to the presentation where low cardiac output leads to symptomatic hypotension and signs/symptoms of hypoperfusion, a circumstance that is relatively rare, present in coronary care unit/intensive care unit (CCU/ICU) but associated with a particularly poor outcome. Hence, it is important to note that appropriate therapy requires appropriate identification of the specific AHF phenotype.[3] The aim of the current paper is not to replace guidelines, but, to provide contemporary perspective for early hospital management within the context of the most recent data and to provide guidance, based on expert opinions, to practicing physicians and other healthcare professionals (*Figure 1*). We believe that the experience accrued in the different settings from the emergency department through to the ICU/CCU is collectivel valuable in determining how best to manage the patients with AHF. Herein, a shortened version mainly including group recommendations is provided. Full version of the consensus paper is provided as Supplementary material online.

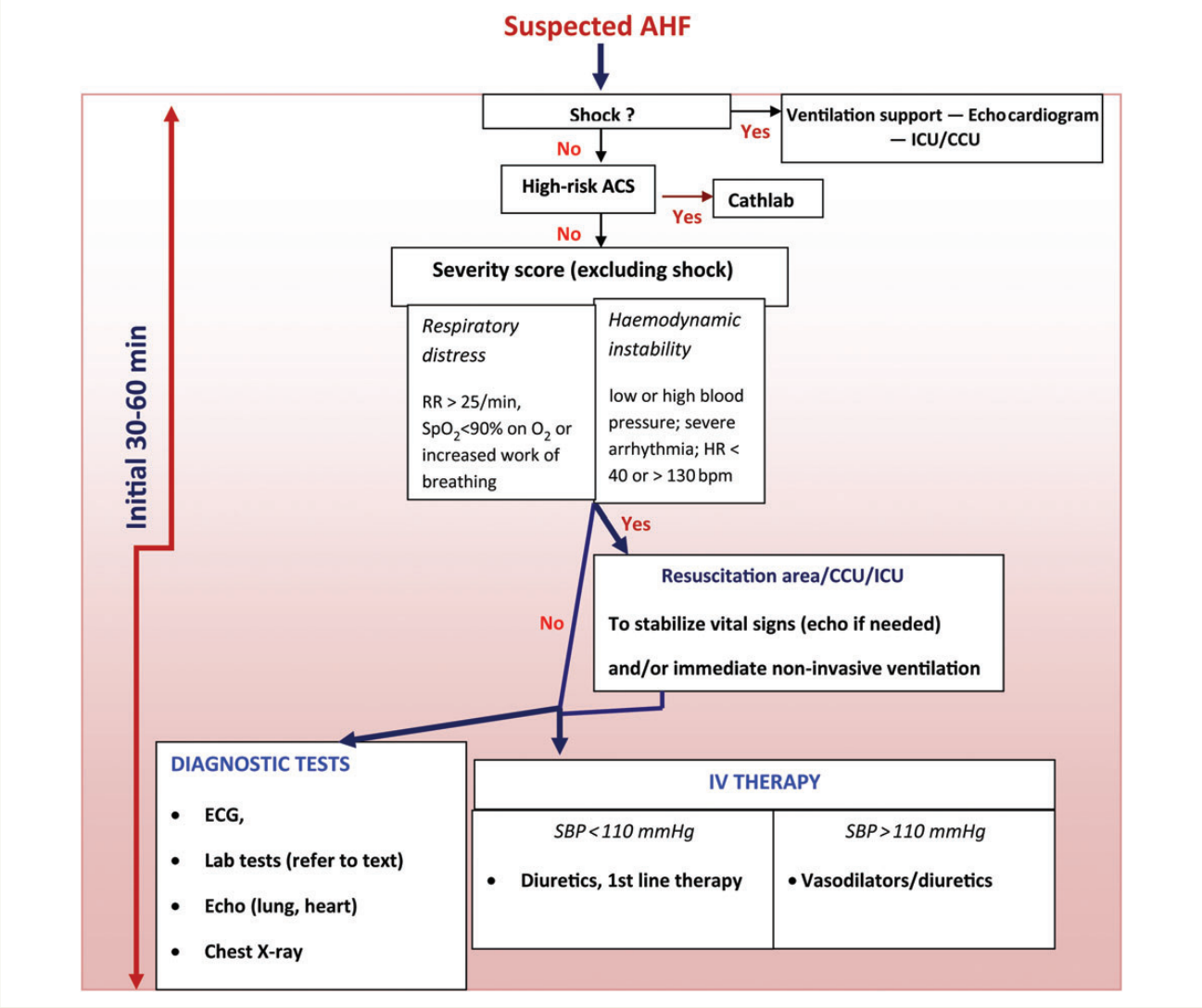

Figure 1 Algorithm for the management of acute heart failure. AHF, acute heart failure; VAS, Visual Analogue Scale for dyspnea assessment; RR, respiration rate; SpO_2, blood oxygen saturation; HR, heart rate; ICU, intensive care unit; Cathlab, cardiac catheterisation laboratory; CCU, coronary care unit; IV, intravenous; SBP, systolic blood pressure; cTn, cardiac troponin, th, therapy, ACS, acute coronary syndrome.

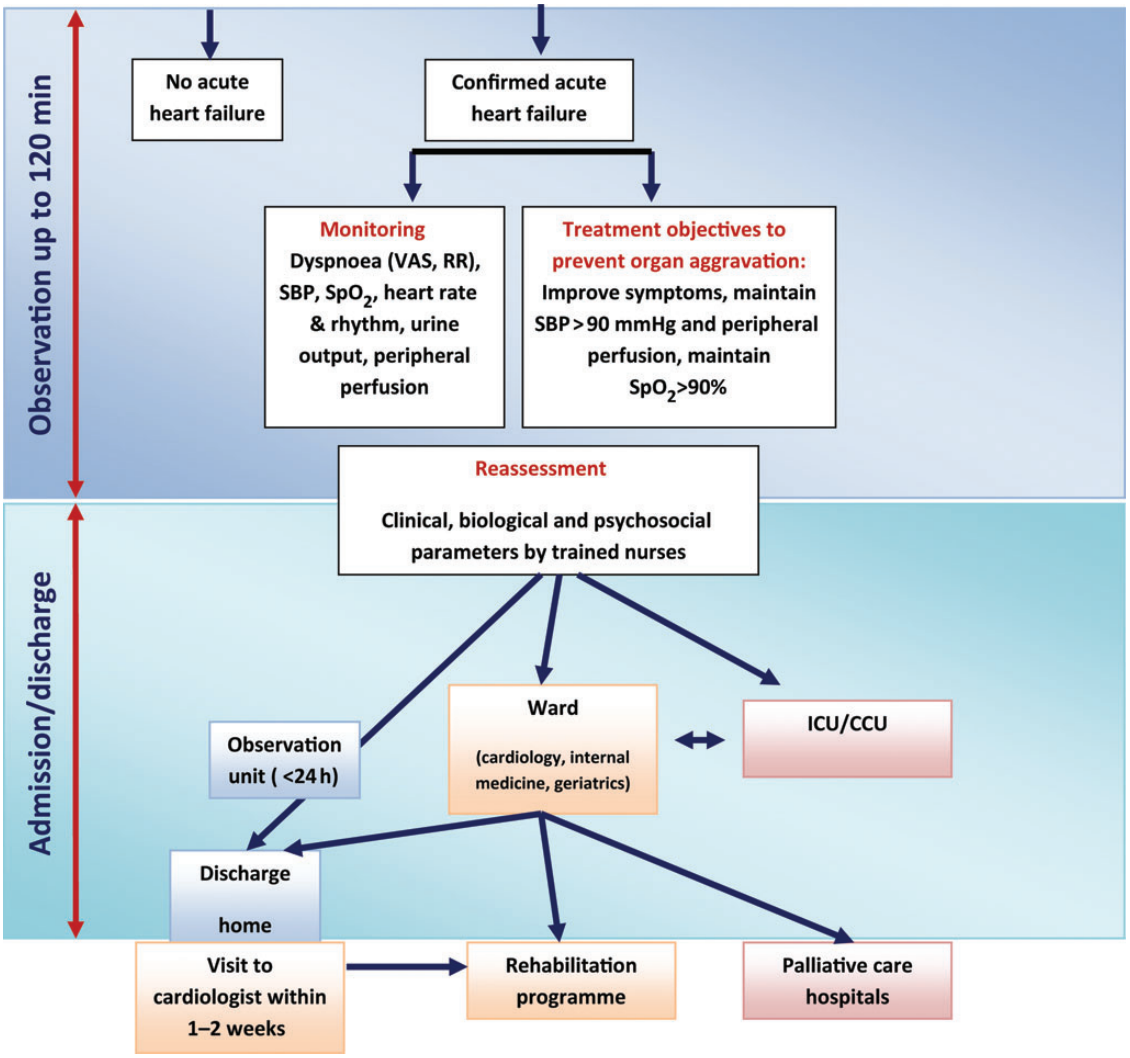

Figure 1 Continued.

Definition and epidemiology of acute heart failure

- Acute heart failure (AHF) is the term used to describe the rapid onset of or acute worsening of symptoms and signs of HF, associated with elevated plasma levels of natriuretic peptides. It is a life-threatening condition that requires immediate medical attention and usually leads to urgent hospital admission.
- Most of the patients with AHF present with normal or high blood pressure and with symptoms and/or signs of congestion rather than low cardiac output.

Table 1 compares the characteristics among patients whose initial management was performed in cardiology/CCU, emergency department (ED), or pre-hospital setting. Clinical characteristics are somewhat different; AHF patients seen early, in the pre-hospital setting or in the ED not only have higher blood pressure but also are more frequently female and older.[4]

Pre-hospital and early management strategies in acute heart failure

- As for acute coronary syndromes, the 'time-to-treatment' concept may be important in patients with AHF. Hence, all AHF patients should receive appropriate therapy as early as possible.
- In the pre-hospital setting, AHF patients should benefit from:
  - Non-invasive monitoring, including pulse oximetry, blood pressure, respiratory rate, and a continuous ECG, instituted within minutes of patient contact and in the ambulance if possible.
  - Oxygen therapy given based on clinical judgment unless oxygen saturation $<90\%$ in which case oxygen therapy should be routinely administered.
  - Non-invasive ventilation, in patients with respiratory distress.

Table 1 Clinical characteristics of the AHF patients according to the different sites of initial contact and management

Admission site	Cardiac ICU/CCU		Emergency department		Pre-hospital setting	
	Euro-HF II $n = 3580$	EFICA $n = 599$	ADHERE $n = 159\,168$	ATTEND $n = 1100$	Ducros *et al.* $n = 207$	Sporer *et al.* $n = 319$
Male (%)	61	59	49	59	41	47
Age (years)	70	73	73	72	81	77
SBP > 140 mmHg at admission (%)	63	60	74	71	75	77
CS or SBP < 90 mmHg (%)	3.9	29	3	NA	1	3
Initial SBP	135	126	144	147	170	167

Of note, EFICA includes only ICU patients.
Euro-HF II,[8] EFICA,[9] ADHERE,[10] ATTEND,[11] Ducros *et al.*,[12] Sporer *et al.*[13]
SBP, systolic blood pressure; ICU, intensive care unit; CCU, coronary care unit; CS, cardiogenic shock.

  - Medical treatment should be initiated based on blood pressure and/or the degree of congestion using vasodilators and/or diuretics (i.e. furosemide).
  - Rapid transfer to the nearest hospital, preferably to a site with a cardiology department and/or CCU/ICU.
- On arrival in the ED/CCU/ICU, initial clinical examination, investigations and treatment should be started immediately and concomitantly.

Initial clinical evaluation and investigations at arrival in the emergency department/coronary care unit/intensive care unit

- In the initial evaluation of suspected AHF (excluding cardiogenic shock), the critical first step is determination of the severity of cardiopulmonary instability based on the level of dyspnoea, haemodynamic status, and heart rhythm. To facilitate this, results of the following assessments should be recorded (*Figure 1*):
  - Objective measurement of dyspnoea severity, including the respiratory rate, intolerance of the supine position, effort of breathing, and degree of hypoxia.
  - Systolic and diastolic blood pressure.
  - Heart rate and rhythm.
  - Objective determination of body temperature and signs/symptoms of hypoperfusion (cool extremities, narrow pulse pressure, mental status)
- The next step should include a search for congestion including peripheral oedema, audible rales (especially in the absence of fever), and elevated jugular venous pressure,
- Additional testing that may be useful includes:
  - ECG, recognizing that in AHF this is rarely normal, and rarely diagnostic but necessary to exclude ST segment elevation myocardial infarction
  - Laboratory tests (see below)
  - Bedside thoracic ultrasound for signs of interstitial oedema (*Figure 2*) and abdominal ultrasound for inferior vena cava diameter (and ascites) if expertise is available

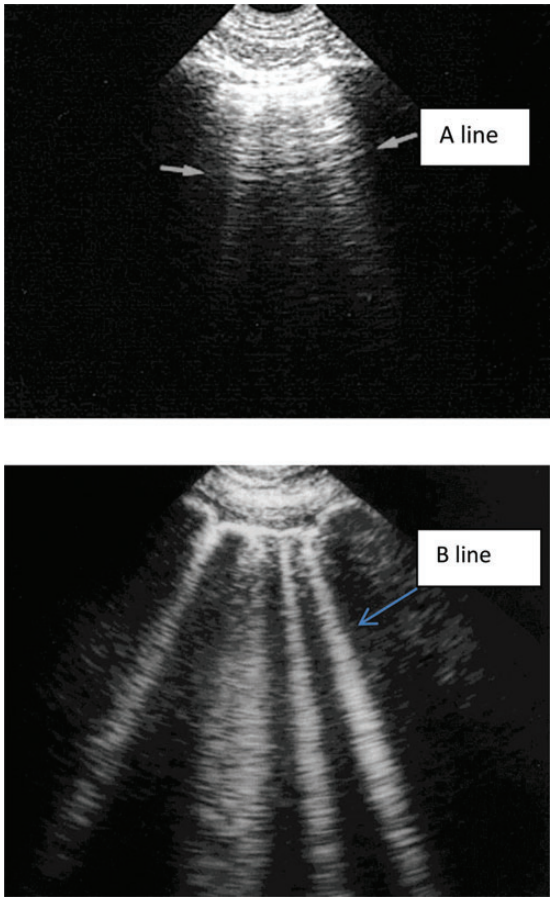

Figure 2 (*A* and B) Thoracic ultrasound images in normal and AHF patients. (*A*) From the pleural line, one repetition of the pleural line, a horizontal line [A line], parallel to the pleural line, is visible, indicating normal lung with no pulmonary oedema. Note some ill-defined vertical comet-tail artefacts, not to be confused with lung rockets. Arrows indicate A lines. (*B*) Four or five B-lines arise from the pleural line, creating a pattern called lung rockets. B lines are vertical, long, well-defined artefacts erasing the A-lines and moving in concert with lung sliding. B lines indicate pulmonary oedema. From Whole Body Ultrasonography in the Critically Ill, Springer 2010 (with kind permission of Springer Science).

  - Chest X-ray to rule-out alternative causes of dyspnoea, though, in nearly 20% of patients, it may be normal, limiting overall sensitivity.
- Immediate echocardiography is not needed during the initial evaluation in most cases *except* when haemodynamic instability is present. However, echocardiography is needed after stabilization, especially with *de novo* disease.
- Urinary catheterization should be avoided unless the benefits outweigh the risks of infection and longer term complications related to continence.

Laboratory tests at presentation

- Upon presentation to the ED or CCU/ICU, a plasma natriuretic peptide level (BNP, NT-proBNP, or MR-proANP) should be measured in all patients with acute dyspnoea and suspected AHF, ideally using a point-of-care assay, to help in the differentiation of AHF from non-cardiac causes of acute dyspnoea.
- The following laboratory assessments should be performed at admission in the blood of all AHF patients: troponin, BUN (or urea), creatinine, electrolytes, glucose and complete blood count.
- D-dimer is indicated in patients with suspicion of acute pulmonary embolism.
- Routine arterial blood gas is not needed. However, arterial blood gas may be useful when a precise measurement of oxygen and carbon dioxide partial pressures is needed. Venous sample might acceptably indicate pH and CO_2.

Role of nursing management in acute heart failure

- Specific considerations of nursing management include:
  - Triage to appropriate environment for safe clinical care
  - Objective monitoring for change in signs and symptoms suggestive of response to treatment.
  - Discharge planning and referral to multidisciplinary disease management programme.
- Anxiety of the patient should be addressed by promptly answering questions and providing clear information to the patient and family.
- Relevant changes in clinical status should be promptly addressed and communicated to the physician. Effective and consistent communication should be maintained with the patient and/or family

Oxygen therapy and/or ventilatory support

- Oxygenation should be monitored with pulse-oximetry (SpO_2) (*Figure 3*)
- Acid-base balance, complementing SpO_2 monitoring, should be obtained on admission, especially in patients with acute pulmonary oedema (APE) or previous history of chronic obstructive pulmonary disease, using venous blood or especially in patients with cardiogenic shock through the arterial line

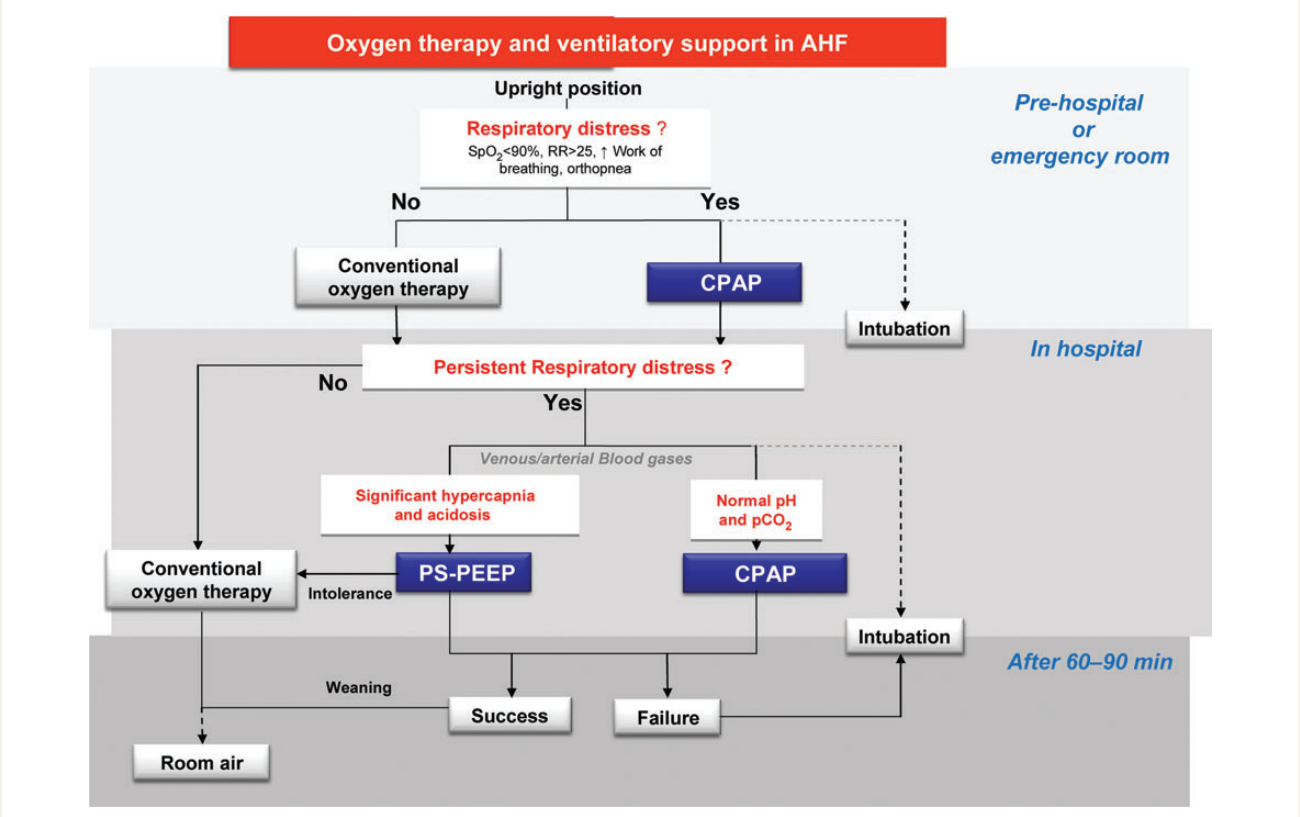

Figure 3 Oxygen and ventilatory support in acute heart failure. PS-PEEP, pressure support-positive end-expiratory pressure. CPAP, continuous positive airway pressure; RR, respiration rate; SpO_2, oxygen saturation.

- Oxygen therapy should be considered in patients with AHF having $SpO_2 < 90\%$
- Non-invasive ventilation (NIV) is indicated in patients with respiratory distress and should be started as soon as possible. Non-invasive ventilation decreases respiratory distress and also reduces the rate of mechanical endotracheal intubation

Early administration of intravenous diuretics and vasodilators

- Initially, 20–40 mg intravenous furosemide can be considered in all AHF patients
- In cases of volume overload, intravenous diuretic dose should be tailored to the type of AHF (*de novo* with lower dose than exacerbation of CHF, *Table 2*).
- When systolic BP is normal to high (>110 mmHg),[2] intravenous vasodilator therapy, might be given for symptomatic relief as an initial therapy. Alternatively, sublingual nitrates may be considered.

Drugs to be used cautiously in acute heart failure (excluding cardiogenic shock)

- Routine use of opioids in AHF patients is not recommended
- There is only a very limited place for sympathomimetics or vasopressors in patients with AHF excluding cardiogenic shock; they should be reserved for patients who have persistent signs of hypoperfusion despite adequate filling status.

Management of evidence-based oral therapies

- In case of decompensation of CHF, every attempt should be made to continue evidence-based, disease-modifying, oral therapies in patients with AHF (*Table 3*).
- In the case of *de novo* HF, every attempt should be made to initiate these therapies after hemodynamic stabilization.

Discharge from emergency department

- Clinical condition can change dramatically within a few hours of ED arrival. Hence, clinical response to initial treatment is an important indicator of likely disposition.
- Indicators of good response to initial therapy that might be considered in discharge include:
  - Patient-reported subjective improvement
  - Resting HR < 100 bpm
  - No hypotension when standing up
  - Adequate urine output
  - Oxygen saturation > 95% in room air

Table 2 Dose recommendations for diuretic therapy

New-onset HF or no maintenance diuretic therapy	Furosemide 40 mg intravenous
HF on chronic oral therapy	Furosemide iv bolus *at least* equivalent to oral dose

  - No or moderate worsening of renal function (chronic renal disease might be present)
- Fast track discharge from ED should be considered in hospitals with chronic disease management programs, once the trigger for decompensation has been identified and early management commenced
- Patients with *de novo* AHF should not be discharged home from ED

Criteria for hospitalization in ward vs. intensive care unit/coronary care unit

- Patients with significant dyspnoea or haemodynamic instability should be triaged to a location where immediate resuscitative support can be provided if needed.
- Patients admitted to hospital with AHF should be looked after by doctors and nurses with specialist knowledge and expertise
- For high-risk patients, initial care should be provided in a high dependency setting (Coronary Care/Cardiac Care Unit). Patients with AHF and associated acute coronary syndrome should be referred to CCU.
  - Clinical risk algorithms developed to predict the in-hospital mortality of patients admitted with AHF can assist in determining which patients in the ED need the highest level of in-patient care
  - An ED specific algorithm may further improve risk assessment compared with prior methods developed in patients admitted with AHF
  - The criteria for triage at admission for ICU include RR > 25, $SaO_2 < 90\%$, use of accessory muscles for breathing, systolic BP < 90 mmHg,
  - Need for intubation (or already intubated) or signs of hypoperfusion: (oliguria, cold peripheries, altered mental status, lactate >2 mmol/L, metabolic acidosis, $SvO_2 < 65\%$) are also indications for ICU referral
- For those who are admitted to the ICU/CCU, subsequent care should be on a cardiology ward if possible
- Hospitals should have an AHF pathway so all patients have access to cardiology advice.

Monitoring in the hospital

- Patient should be weighed daily and have an accurate fluid balance chart completed
- Standard non-invasive monitoring of pulse, respiratory rate, and blood pressure should be performed
- Renal function and electrolytes should be measured daily
- Pre-discharge measurement of natriuretic peptides is useful for post-discharge planning

Table 3 Management of oral therapy in AHF in the first 48 h

	Normotension/ hypertension	Hypotension		Low Heart rate		Potassium		Renal impairment	
		<100 >85 mmHg	<85 mmHg	<60 >50 bpm	<50 bpm	<3.5 mg/dL	>5.5 mg/dL	Cr < 2.5, eGFR > 30	Cr > 2.5, eGFR < 30
ACE-I/ARB	Review/increase	Reduce/stop	Stop	No change	No change	Review/increase	Stop	Review	Stop
Beta-blocker	No change	Reduce/stop	Stop	Reduce	Stop	No change	No change	No change	No change
MRA	No change	No change	Stop	No change	No change	Review/increase	Stop	Reduce	Stop
Diuretics	Increase	Reduce	Stop	No change	No change	Review/No change	Review/increase	No change	Review
Other vasodilators (Nitrates)	Increase	Reduce/stop	Stop	No change	No change	No change	No change	No change	No change
Other heart rate slowing drugs (amiodarone, CCB, Ivabradine)	Review	Reduce/stop	Stop	Reduce/stop	Stop	Review/stop (*)	No change	No change	No change

CCB, calcium channel blockers (mg/dL); Cr, creatinine blood level (mg/dL); eGFR, estimated glomerular filtration rate ml/min/1.73 m^2; MRA, mineralocorticoid receptor antagonist; (*) amiodarone.

Criteria for discharge from the hospital and follow-up in high-risk period

- Patients admitted with AHF are medically fit for discharge:
  - when haemodynamically stable, euvolemic, established on evidence-based oral medication and with stable renal function for at least 24 h before discharge
  - once provided with tailored education and advice about self-care
- Patients should be:
  - enrolled in a disease management program
  - seen by their general practitioner within 1 week of discharge
  - seen by the hospital cardiology team within 2 weeks of discharge if feasible
- Patients with chronic heart failure should be followed up within a multi-professional heart failure service

Definition, initial management and monitoring of cardiogenic shock including device therapy

- Cardiogenic shock is defined as hypotension (SBP $<$ 90 mmHg) despite adequate filling status and signs of hypoperfusion: (oliguria, cold peripheries, altered mental status, lactate $>$2 mmol/L, metabolic acidosis, $SvO_2 < 65\%$)
- A patient with suspected cardiogenic shock (CS) should undergo immediate assessment
- ECG and echocardiography are required immediately in all patients with suspected CS
- Invasive monitoring with arterial line is needed
- There is no agreement on optimal method of haemodynamic monitoring in assessing and treating the patient in CS, including pulmonary artery catheter
- Fluid challenge (saline or ringer lactate, $>$200 mL/15–30 min) is recommended as the first line treatment if there is no sign of overt fluid overload
- Dobutamine may be used to increase cardiac output; levosimendan may be considered, especially in CHF patients on oral beta-blockade
- Vasopressors should only be used if there is a strict need to maintain systolic BP in the presence of persistent hypoperfusion; if needed, norepinephrine is recommended over dopamine
- All CS should be rapidly transferred to a tertiary care centre which has a 24/7 service of cardiac catheterization, and a dedicated ICU with availability of short-term mechanical circulatory support
- Intraaortic ballon pump is not routinely recommended in CS
- Short-term mechanical circulatory support may be considered in refractory CS depending on patient age, comorbidities and neurological function
- Based on current evidence, we do not recommend one mode of short-term circulatory support over another

Gaps in knowledge and perspectives

In AHF, there are several areas which require further investigation. The use of biomarkers in risk stratification and to guide treatment, which are the most important signs of severity, and which are the best measures of efficacy need more extensive study. There is still a need to better delineate exactly what constitutes clinical improvement with acute therapy, types of rehospitalizations, and mortality (both short-term and long-term). There is also an appealing concept of 'home visit' by 'HF-teams' to avoid or to decrease ED visits and hospitalizations.

Recent phase III or IV investigations have offered future promise in clinical management of Acute Heart Failure. These include RELAX-AHF[5] (serelaxin), ATOMIC-AHF trial[6] (omecamtiv mecarbil), PRONTO[7] (clevidipine), TRUE-AHF[14] (clinicaltrials.gov/ct2/show/NCT01661634?term=TRUE-AHF&rank=1), (clinicaltrials.gov/ct2/show/NCT01733134) ARTS-HF[15] trials.

Supplementary material

Supplementary material is available at *European Heart Journal* online.

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