New Recommendations for Acute Heart Failure Treatment in the Emergency Department

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Objectives:

1) Describe the common clinical characteristics of patients with acute heart failure syndromes (AHFS) in the ED
2) Describe some new recommendations for AHFS therapy
3) Describe the proposed initial AHFS treatment recommendations based on phenotypic presentation

Heart failure is a disease of epidemic proportions whose prevalence will increase due to an aging population, improvements in chronic heart failure care, and increased survival from complications of coronary artery disease.1-4 The majority of heart failure hospitalizations in the United States originate in the emergency department (ED), although current strategies for acute heart failure syndrome (AHFS) treatment have largely been tailored after chronic heart failure guidelines. Prospective ED-based AHFS trials are lacking and current guidelines for disposition are based on either little or no evidence.5-8 As a result, the majority of ED AHFS presentations are admitted to the hospital. Recent registry data suggest there is a significant amount of heterogeneity in AHFS ED presentations and suggests that therapeutics should be individualized to the urgency of the presentation, underlying pathophysiology, and acute hemodynamic parameters such as blood pressure.

Emergency physicians have traditionally assumed a role of performing initial diagnostic and therapeutic interventions in AHFS. However, ED and hospital overcrowding, as well as the evolution of ED-based heart failure observation units have resulted in emergency physicians commonly providing both initial stabilization and more definitive care. This review specifically discusses new treatment recommendations for AHFS and proposes an innovative approach to care which focuses on hemodynamics.

Introduction

Illustrative Case #1: A 60-year old male with a history of non-ischemic cardiomyopathy presents to the ED with weight gain and increasing dyspnea on exertion over the last week. His vital signs are: blood pressure 140/80, pulse rate 90, respiratory rate 16, oxygen saturation 96% on room air and his temperature is 98.9. On exam he is well appearing, has jugular venous distension, an S3 gallop, clear lungs and lower extremity edema. His chest radiograph reveals cardiomegaly and early interstitial edema and he has a b-type natriuretic peptide (BNP) value of 600 pg/ml. The remainder of his blood work is normal with the exception of a creatinine of 1.4 and blood urea nitrogen of 19. The patient’s electrocardiogram reveals sinus rhythm without ischemic changes. He receives a dose of intravenous diuretic, has one liter of urine output over his first 3 hours in the ED, and feels significantly better.

Illustrative Case #2: A 70-year old female with a previous heart failure history presents to the ED in acute respiratory distress. Her vital signs are: blood pressure 180/105, pulse rate 110, respiratory rate 40, oxygen saturation 84% on room air, and her temperature is 98.5. On exam she is diaphoretic and in obvious distress, has jugular venous distension and diffuse pulmonary crackles, but no leg edema. Her chest radiograph reveals diffuse pulmonary edema and her BNP is 1153 pg/ml. She is placed on non-invasive ventilation, a nitroglycerin drip and given a dose of intravenous diuretic. The remainder of her laboratory work-up is normal and her electrocardiogram has no ischemic changes. Her blood pressure and respiratory rate improve dramatically and she is eventually transitioned from non-invasive ventilation to oxygen by nasal cannula.

While both of these cases represent common ED presentations for suspected AHFS, their underlying pathophysiology, acute treatment, short and long-term risk, and ultimate disposition are very different. Historically, AHFS was thought to be more representative of case Illustrative Case #2; a severely ill patient who requires acute intervention to prevent further deterioration. Recent registry data now confirm what has been apparent to the emergency physician for a long time, AHFS has a variety of acute presentations and management must be individualized.9-11 Furthermore, the clinical characteristics of AHFS in the ED are most commonly
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systemic hypertension, preserved left ventricular ejection fraction (LVEF), and predominant congestion. Severe LVEF impairment, hypotension, and symptoms reflective of poor end-organ perfusion are relatively unusual.

A typical patient with preserved systolic function presents with elevated blood pressure and volume redistribution as opposed to total body overload. Further, there are a subset of patients who present with predominant right-sided heart failure as a result of underlying lung and valvular disease. Underlying pathophysiology should influence the acute management of patients with AHFS. For example, the treatment of a patient with preserved systolic function should likely focus on blood pressure control rather than aggressive diuresis.

While these recent data have provided insight into AHFS patients, mortality and post-discharge recidivism have remained largely unchanged over the last decade.9-13 Recognizing that diagnosis and risk stratification has been addressed elsewhere, this review addresses both common and new treatment recommendations and proposes a phenotypic approach to initial management.14-24

Acute Heart Failure Therapy

There is a paucity of controlled clinical data to guide AHFS treatment. Most of the evidence is weak and focused on symptom relief in normotensive patients with reduced LVEF. However, a recent heart failure practice guideline25 has been among the first to provide specific recommendations for AHFS treatment.

*Initial triage based on high-risk features which require immediate stabilization*

Potential AHFS patients must undergo two levels of triage and concurrent treatment as diagnostic testing occurs. The first level should focus on initial stabilization in the small subset of patients who present critically-ill and must have abnormal vital signs addressed immediately to prevent further deterioration. Those patients with significant tachypnea, hypoxia, and mental status changes require aggressive intervention with non-invasive ventilation or possible endotracheal intubation to prevent respiratory failure while definitive care is being established. Non-invasive positive pressure ventilation not only reverses underlying pathophysiologic derangements, it reduces mortality and the need for endotracheal intubation. This modality does require patient cooperation; patients with significant mental status changes are poor candidates.16-27 Conversely, patients who present with hypotension and evidence of end organ hypoperfusion, including altered mental status, reduced urine output, and poorly perfused extremities with concurrent pulmonary edema, may require aggressive fluid resuscitation and possibly inotropic therapy. This rare subset of critically-ill patients whose hemodynamic status is unclear may benefit from right heart catheterization and most often need intensive care unit admission for close monitoring and continued treatment.28

*Secondary triage and categorization after initial stabilization*

Patients who proceed to the next level of triage either do not have initial high-risk features or have high-risk features that have been stabilized. Secondary triage focuses on categorizing patients into one of two general categories so that initial therapy can be tailored to the underlying pathophysiology (Table 1). While there is some overlap in these diagnostic categories, they are a useful starting point to drive therapeutics.

**Normotensive Heart Failure**

Approximately one-third of patients will present with mild, subacute worsening of symptoms over several days to weeks. These patients tend to be younger, have systolic dysfunction and a history of coronary artery disease. Symptoms are primarily a result of gradual total body fluid overload, as opposed to respiratory distress from acute hypertension and pulmonary edema. Such patients benefit from aggressive diuresis with a therapeutic goal of relieving congestion, reducing total body fluid, and peripheral edema. Blood pressure control is often not as problematic as it is in the hypertensive AHFS patient, and generally can be controlled with topical nitroglycerin along with resuming the patient’s antihypertensive regimen. This group of patients also needs to be re-triaged after initial therapy. Those patients with an initial blood pressure in the low-normal range (90-120 mmHg) may “run out” of blood pressure after initial diuresis, and care must be taken to maintain a pressure associated with adequate perfusion.

**Hypertensive Heart Failure**

Approximately half of AHFS patients will present with a systolic BP over 140 mmHg.9-12 These patients tend to be...
older, female, have a history of preserved LVEF, and often have acute symptoms which have been present for only 24-48 hours. Because of the shorter symptom duration they are more likely to have acute pulmonary edema, both on examination and chest radiography, rather than systemic edema. Symptoms are often the result of a significant increase in afterload and fluid maldistribution rather than total body fluid overload. Initial treatment should focus on blood pressure control and minimal diuretic use. Initial over-aggressive use of diuretics in this patient subset can lead to significant deleterious effects 24-48 hours later with decreases in blood pressure and renal dysfunction.12

Options for initial blood pressure control include sublingual or topical nitroglycerin, angiotensin converting enzyme inhibitors (sublingual and intravenous) or intravenous hydralazine. Concurrent administration of a small dose of furosemide, less than 80 mg in a patient with normal renal function, may also occur at this time. Response to initial therapy will then determine the next course of action. An intravenous vasodilator such as nitroglycerin, nesiritide, or nitroprusside can be utilized in those patients who remain hypertensive (BP>160/100) and symptomatic, with a goal of continued, sustained blood pressure reduction. Patients with an adequate response to initial antihypertensive therapy (BP<160/100) can be transitioned off intravenous therapy to topical nitroglycerin with simultaneous oral administration of the patient’s previous antihypertensive regimen.

Compared to the normotensive, volume overloaded AHFS patient, where an exacerbation may be more occult, the hypertensive AHFS patient may look much more acutely ill upon initial ED presentation. However, they also have the most to gain from appropriate early management. After initial blood pressure control and mild diuresis this group of patients often has dramatic improvement in their symptoms and, after initial diagnostics return, may be re-triaged to a lower level of care. The downstream effects of all therapeutic options must be considered. Care must be taken not to provide over-aggressive diuresis in this group of patients who tend to not be significantly fluid overloaded. Although patients who are aggressively diuresed may appear to initially improve, this may be at the expense of subsequent dehydration, renal insufficiency, increased hospital length of stay and higher event rates.29, 30

Adverse effects of diuretics

While relief of congestion with diuretics is self-evident, this must be balanced against avoiding hypotension and worsening renal function.
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- reevaluating the presence or absence of congestion
- restricting sodium and fluid
- increasing doses of loop diuretics
- continuous infusion of loop diuretics
- addition of a second type of diuretic orally such as metolazone or spironolactone, or giving IV chlorothiazide
- consideration of ultrafiltration

Anticoagulation

New to practice guidelines for AHFS is the need for venous thromboembolism prophylaxis for admitted patients not already anticoagulated, either through pharmacotherapy, or mechanically if there is a contraindication.25

Self-Care

New recommendations place increased focus on maximizing self-care strategies for AHFS patients and addressing the vulnerable period beginning at time of ED disposition and extending for a few weeks post discharge (Figure 1).

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Figure 1. The vulnerable period in the continuity of acute heart failure syndrome care

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Poor health care education, behavior, or access to routine health care can result in hospitalization and significant morbidity, further contributing to suboptimal disposition decision making.\(^3\)-\(^11\) In addition, while physiologic markers predict short-term event rates, health care behavior likely has a much higher impact on more distant event rates.\(^12\)-\(^40\) Several studies have identified markers of poor health care behavior which predict late events in AHFS patients. Non-compliance (medication and diet), inadequate discharge planning and follow-up, and previous heart failure admissions are associated with 90-day readmission.\(^40\) Inadequate patient knowledge and understanding of illness as well as poor social support has been associated with more heart failure-related readmissions.\(^7\) Implementation of a nurse-directed disease intervention program aimed at education, dietary and medication assessment, discharge planning, and close outpatient follow-up reduced 90-day heart failure hospital readmissions.\(^38\) While these inpatient studies have identified health care behavior as a risk factor for late events, prospective ED quantification of this relationship has not been performed. Further, discharge planning resources in the ED may be limited compared to inpatient units, making it difficult to provide adequate transition of care to the outpatient setting. Thus, even patients without high-risk features, and an initial adequate response to therapy, may still be difficult to discharge directly home from the ED because of anticipated poor health care behavior. An ED-based observation unit may serve as an alternative to the ED because of anticipated poor health care behavior. An ED-based observation unit may serve as an alternative to inpatient units, making it difficult to provide adequate transition of care to the outpatient setting. Thus, even patients without high-risk features, and an initial adequate response to therapy, may still be difficult to discharge directly home from the ED because of anticipated poor health care behavior. An ED-based observation unit may serve as an alternative to admission in non-high risk patients who would benefit from further treatment and risk-stratification while outpatient follow-up is arranged.

Conclusion

Several areas of research are still necessary to advance the treatment of AHFS, with an overall goal of decreasing the hospital admission rate while simultaneously improving short and long-term event rates. Unfortunately, nearly all new therapies studied for AHFS in the past decade have failed to show significant improvement over our current standard of care, dramatically unlike advances in care of patients with acute coronary syndrome. This may be partly due to late enrollment in trials, sometimes many hours to days after inpatient admission, after initial symptoms have improved or abated. This will require substantial ED involvement and enrollment. Such an approach has been suggested and encouraged by the NIH through their first ever working group on acute heart failure.\(^41\) This group established a priority on ED-based clinical trials, risk assessment and stratification, as well as an improved understanding of heterogeneity and its effect on a more phenotypic approach to treatment. Such an approach has been presented in this review along with new recommendations from the first clinical guidelines to significantly address AHFS treatment.

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