

# CONGESTIVE HEART FAILURE AND PUBLIC HEALTH

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## Outline of Chapter

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## 1- Definition

Heart failure (HF) is a chronic disease characterized by the inability of the heart to pump an adequate amount of blood to achieve the demand of the different organ systems and/or doing so at increased filling pressures. It is a serious condition representing the end-stage of a myriad of other cardiac diseases without a curative treatment. Once diagnosed, medication is required for the rest of the patient's life to improve their life quality and survival [1].

## 2- Epidemiology

The treatment and prevention of HF has become a burgeoning public health problem reaching epidemic levels especially for the elderly population. There are more than 20 million people affected worldwide and has a prevalence of 2% in developed countries [2]. According to the American Heart Association, 5.3 million Americans have congestive heart failure (CHF), 660,000 new cases are diagnosed yearly, with an incidence approaching 10 per 1000 population among persons older than 65 years of age. The estimated yearly mortality related to heart failure is around 287 thousand people. Heart failure prevalence follows an

exponential pattern, which rises with age and affects 6-10% of people over age 65 [1,3,4]. It seems that the success in treating other heart conditions like myocardial infarction, valvular heart disease, and arrhythmias has increased the prevalence of heart failure now that patients survive longer. Congestive heart failure is the leading cause of admissions to hospitals among the elderly according to the National Hospital Discharges in the United States. The expected cost of the disease in the United States for 2009 is \$34.8 billion, with hospital admissions being a significant portion of the total costs [3]. According to The Census Bureau and the Centers for Disease Control and Prevention, African Americans (AAs) between the age of 45 and 65 have a 70% higher rate of HF, with mortality rates of 2.5 times more than the Caucasian population. The current estimated number of AAs with heart failure is about 700,000 with an expected increase to 900,000 in 2010. The Hispanic/Latino population has a higher incidence of heart failure than the white non-Hispanic population; however, more population-based studies are needed to accurately estimate the prevalence of HF in the Hispanic population [5]. The Hispanic population tends to have HF at younger ages, die earlier, and have higher admission rates than the Caucasian population [6]. The crest of the problem is still to come over the next decades when the number of senior citizens above age 65 will double to a projection of 70 million. Despite many recent advances in medication, the rate of people with chronic congestive heart failure is rising. Another problem is the increased concerns regarding the prevalence of asymptomatic heart failure yet to be diagnosed which might be as prevalent as symptomatic heart failure [7,8].

### **3- Risk Factors**

The risk factors that contribute to the development of heart failure are similar to risks of coronary artery disease, stroke, and peripheral artery disease. In fact, coronary artery disease and previous history of myocardial infarction (heart attack) is one of the major risk factors in developing HF. Based on the data from the Framingham study, which commenced in the United States back in 1949, hypertension (high blood pressure) is the most important risk factor accounting

for approximately 39% of cases in men and 59% in women. Previous history of heart attack was the second most common risk accounting for 34% in men and 13% in women [9]. Cigarette smoking, elevated cholesterol, obesity, and diabetes are the major preventable risk factors for both congestive heart failure and coronary artery disease. Other less common diseases and risk factors are valvular heart disease, cardiomyopathy (the diseases of the heart muscle), alcohol abuse, or infections.

#### **4- Types and Causes**

Several classification categories have been developed to classify heart failure. These include, acute vs. chronic, left vs. right sided, high output vs. low output, and systolic vs. diastolic heart failure. This chapter will focus more on the latter classification which is the most commonly used because of its implication in the treatment and long term outcome of heart failure patients.

- *Systolic heart failure (depressed ejection fraction)*

This category describes the decrease in the heart muscle's ability to contract and pump blood against the systemic vascular resistance, which usually is increased. Coronary artery disease (CAD) is the predominant cause of heart failure in general and systolic dysfunction, in particular, accounting for 60 to 75% of all cases in industrialized countries. Both hypertension (high blood pressure) and diabetes interact with a genetic predisposition augmenting the development of CAD, as does dyslipidemia. Other etiologies include nonischemic idiopathic cardiomyopathy, valvular heart disease, myocarditis, alcohol, and drugs. Rheumatic fever remains a leading cause of heart failure in Africa and Asia, particularly in the young population.

- *Diastolic heart failure (preserved ejection fraction)*

In this category, the contractility of the cardiac muscle is intact or increased, however, the relaxing phase of the cardiac cycle is impaired.

The heart chambers are thickened and rigid. The vascular resistance is increased to increase the filling volume of the heart. The most common cause of diastolic heart failure is hypertension, which contributes also to the development of coronary artery disease and systolic dysfunction. Other less common causes include primary hypertrophic cardiomyopathies, valvular heart disease, restrictive cardiomyopathy, amyloidosis, and constrictive pericarditis.

### **5- Common symptoms and signs**

Some studies suggest that asymptomatic heart failure is as prevalent as heart failure with clinical manifestations. The cardinal symptom associated with HF is shortness of breath, which in the early stages is associated with exertion. As the disease progresses, the dyspnea occurs at rest. At times, the difficulty in breathing is associated with the recumbent position due to the increase in venous return to the heart. This phenomenon is called orthopnea. Patients may also have paroxysmal nocturnal dyspnea (PND), which refers to the sudden development of severe shortness of breath at night that awakens the patient from sleep. All of the previous symptoms are related to pulmonary congestion with accumulation of fluid in the interstitial and alveolar spaces that occasionally might lead to the development of acute pulmonary edema. Other symptoms common in patients with CHF are peripheral edema, fatigue, anorexia, early satiety, liver congestion, confusion, sleeping disorders, and nocturia, frequent awakenings throughout the night in order to urinate.

### **6- Diagnosis**

A careful physical examination is essential for the initial assessment of patients with symptoms that suggest CHF. The diagnosis becomes straightforward when it is associated with cardinal symptoms like exertional dyspnea and peripheral edema. Initial routine laboratory testing with complete blood count, electrolyte panel, blood urea nitrogen, serum creatinine, and hepatic panel would be helpful to assess other causes that might contribute to fluid retention or precipitate heart

failure like severe anemia or kidney failure. A routine 12 lead ECG is of great importance to determine the presence of arrhythmias, left ventricular hypertrophy, or prior myocardial infarction. All patients with heart failure should be screened for dyslipidemia, diabetes mellitus, and thyroid dysfunction. A chest X-ray is not a very sensitive test to confirm or refute congestive heart failure; nonetheless, it might provide useful information about cardiac size, pulmonary vasculature, and interstitial edema. Also, it is useful in evaluating other causes of pulmonary disease that could simulate the presentation of HF. 2-D echocardiography with Doppler has become the gold standard noninvasive test to evaluate ventricular and valvular functions. It provides semiquantitative assessment of ventricular size, thickness, and contractility. The pulsed Doppler is also an invaluable technique to study the valvular apparatus functions and blood flow across the valves. A relatively new biomarker called brain natriuretic peptide (BNP) has a relative sensitivity for the presence of HF with depressed left ventricular function. BNP also has prognostic value, as it has been shown in several studies that elevated levels of BNP were associated with increased mortality and hospitalization. The use of invasive studies like right and left heart catheterization currently are reserved to assess the presence of coronary artery disease or primary pulmonary hypertension, which may require specific treatment.

### **7- Classes and stages of heart failure**

Until November 8, 2001, New York Heart Association (NYHA) classification was the only system used to assess stages of congestive heart failure. This classification concentrated more on functional capacity, ranging from asymptomatic patients to patients with severely limited activity secondary to dyspnea at rest. The American College of Cardiology/American Heart Association (ACC/AHA) stages focus more on the continuum and progressive nature of this condition adding a new stage that includes patient at high risk for the development of heart failure. The outlines of the two classifications are described below.

#### New York Heart Association Classification:

- Class I — No limitation during ordinary activity
- Class II — Slight limitation by shortness of breath and/or fatigue during moderate exertion or stress
- Class III — Symptoms with minimal exertion that interfere with normal daily activity
- Class IV — Inability to carry out any physical activity without shortness of breath, which may be present even at rest

#### ACC/AHA Stages of Heart Failure

- Stage A — High risk for HF, without structural heart disease or symptoms
- Stage B — Heart disease with asymptomatic left ventricular dysfunction
- Stage C — Prior or current symptoms of HF
- Stage D — Refractory end stage HF

### **8- Treatment**

This chapter will emphasize the therapeutic approach to the patient with chronic heart failure. Several societies have issued guidelines for the treatment of patients with congestive heart failure. These include the 2005 American College of Cardiology/ American Heart Association (ACC/AHA) Guidelines, the 2005 European Society of Cardiology (ESC) Guidelines, the 2006 Canadian Cardiovascular Society Consensus Conference, and the 2006 Heart Failure Society of America Guidelines. With the exception of few things, the recommendations are very similar. The treatment of chronic heart failure should begin with recognition by the primary care physician of systemic factors that may precipitate or exacerbate heart failure. A few examples include thyroid malfunctioning including hyper or hypothyroidism, uncontrolled diabetes, worsening renal function, renal artery stenosis, and infections. Medications like nonsteroidal anti-inflammatory drugs, calcium channel blockers, thiazolidinediones, and antiarrhythmic drugs all may contribute to worsening

symptoms of heart failure and fluid retention. Patients should receive influenza and pneumococcal vaccinations per guidelines. Despite the recent advances in drugs with increased survivals, patient education and lifestyle modifications are fundamental in achieving good control of the disease, decreasing hospitalization, and improving survival. First line drugs recommended to treat patient with congestive heart failure are:

1. Angiotensin Converting Enzyme (ACE) inhibitors and Angiotensin II Receptor Blockers (ARBs) are two groups of drugs that improve symptoms by decreasing blood pressure and improving blood flow from the heart to the vessels. Both groups have shown improvement in survival when used in patient with CHF, nevertheless, ACE inhibitors may be slightly more effective than ARBs [10,11,12]. ACE inhibitors should be used as first line therapy; however, side effects like cough, worsening kidney function, or increasing blood potassium levels might develop and limit their use.
2. Beta blockers decrease the heart muscle's requirement for oxygen and heart rate. Some of the beta blockers are selective to the heart muscle, like carvedilol, metoprolol, and bisoprolol. These medications have shown substantial improvement in survival of all classes of heart failure and should be added to ACE inhibitors in all patients with heart failure if tolerated [13].
3. Spironolactone and eplerenone are aldosterone antagonists that prolong survival in patients with moderate to severe heart failure [14]. Eplerenone has less endocrine side effects than spironolactone, nevertheless, both might increase potassium levels and should be used with caution in patients with renal failure.
4. Diuretics are used to control symptoms of fluid retention related to heart failure, with furosemide being the most commonly used drug. Diuretics might improve symptoms associated with HF like shortness of breath and ankle edema, however, no decrease in mortality was observed with the use of these drugs.

Several invasive treatments are used in patients who remain symptomatic despite optimal medical therapy. Cardiac resynchronization therapy (CRT) is indicated to patients with wide QRS complexes on ECG who remains symptomatic despite optimal medical therapy. CRT consists of implanting a pacemaker to improve the coordination of the heart chambers to maximize the pumping ability of the heart. An Implantable Cardioverter Defibrillator (ICD) is used in patients with a low ejection fraction in order to prevent sudden cardiac death from a fatal arrhythmia. Heart transplantation is indicated in some cases when all other treatments have failed to control symptoms.

### **9- Lifestyle Modification**

Although medications are important in the management of heart failure, dietary and lifestyle changes are essential and recommended to all patients with CHF. Most of these recommendations are based upon observational studies and physiologic common sense rationale. Some of the recommendations are:

- Smoking Cessation
- Dietary restriction of sodium to approximately 2 to 3 grams per day (less in some cases) to decrease fluid retention
- Restriction of alcohol consumption to 1 to 2 standard drinks in men and 1 in women
- Indefinite abstinence from alcohol consumption if alcohol is thought to be the culprit of the heart failure
- Daily weight monitoring to detect early fluid accumulation before symptoms develop in order to prevent the need for hospitalization
- Obese people with heart failure should be encouraged to lose weight, with the target goal of weight within 10% of lean body mass
- Routine modest aerobic exercise in stable patients, preferably in a cardiac rehabilitation program

### **10- Heart failure in Minorities**

The Hispanic and African American population account for 15% and 14% of the population, respectively. Several epidemiologic studies have shown that both minorities have higher rates of CHF than the rest of the population, in part because they have higher rates of risk factors including hypertension, diabetes, and obesity [15]. The prevalence of elevated blood pressure in AAs is 29.9% for men and 27.7% for women, 4% higher than the non-Hispanic white population for both sexes [16]. AAs not only have higher rates of hypertension, but their blood pressure is less controlled than the rest of the population as well [16]. Although the Hispanic population has similar rates of hypertension to the general population, they suffer from an outrageous prevalence of poorly controlled diabetes [16]. Although socio-economic, cultural, genetic, and linguistic barriers have been proposed as factors that influence the outcome of cardiovascular disease in minorities, several studies have shown disparity in health care. The disparity may be related to decisions made by patients, physicians, and the health care system. According to a Medicare survey, the rate of coronary artery bypass surgery is performed four times more often in the white population than AAs [17]. Another study found that black men are 25% less likely to receive an ICD when compared to white men, and in comparing women, black women are 50% less likely to have an ICD placement than white women [18]. Another problem related to the treatment of heart failure is that in most landmark studies, minorities were underrepresented, which make the current guidelines less applicable to minorities. For example, the V-HeFT trial showed that African Americans were less likely to benefit from ACE inhibitors than white, and that the combination of hydralazine/ nitrates was more beneficial to black patients [19].

### **11- Cardiac rehabilitation programs**

In the 1970's, exercise was not recommended for patients with HF or after a heart attack because these patients were often complaining of fatigue and shortness of breath with exertion. However, in the late 1980's several observations supported the fact that part of the limited physical activity in these patients was related to the deconditioning and muscle atrophy created from the

lack of activity. Exercise in patients with heart failure has multiple benefits including improvement in the muscle tolerance to exertion, neuro-hormonal changes that favor cardiac hemodynamics, and overall improvement of symptoms of HF [20]. Moreover, exercise not only improves symptoms but also decreases the number of admissions to the hospital and improves survival in patient with HF [21]. Numerous studies have shown benefit of regular physical activity in heart failure, however, all of the studies used supervised training programs of at least 8 week using monitors to target heart rate and oxygen consumption. Moreover, the cost-effectiveness of rehabilitation programs was assessed in several studies. Compared to routine management, structured rehabilitation programs showed an increase in life expectancy of 1.82 years/person over a period of 15 years at a cost of 1,800 dollars per life/year saved [22]. In 2006, most private health insurance companies recognized the benefits of cardiac rehabilitation programs and covered for it, which was soon followed by the approval of Medicare and Medicaid. Currently, most rehabilitation programs integrate a multidisciplinary approach including initial baseline patient assessment, diet education, weight management programs, risk assessment for coronary artery disease and aggressive treatment, psychological support, and exercise training. Currently cardiac rehabilitation programs are distributed nationwide in hospitals and outpatient settings. Several performance measurements were standardized to all of the rehabilitation programs to deliver the most efficient evidence-based training [23, 24]. These programs include three sessions weekly of exercise training with cardiac monitoring for 8 to 12 weeks or longer. The goal of these programs is to instruct and develop an individualized, safe, and beneficial exercise program tailored to each patient. Cardiac rehabilitation programs are distributed nationwide and all patients with stable stage 2 and 3 heart failure should be referred to these programs.

## **12- Public policy**

Heart failure is a major health problem in developed countries with increased prevalence and incidence in the aging population. Hospitalizations from heart

failure increased 159% over the past decade despite the advances in the treatment of the disease [25]. Despite all of the efforts in improvement of life quality and survival, symptomatic heart failure has an overall poor prognosis with a one year mortality of approximately 45%. This is worse than most cancer prognosis [25,26]. Expensive procedures like ICDs and pacemakers, with average costs of 30 to 40 thousand dollars per device, have failed to result in meaningful changes in the course of the disease. Two thirds of patients with heart failure are cared for exclusively by their primary care physician instead of being involved in heart failure clinics and rehabilitation programs specialized in treating the disease. It is paramount at this point to change strategies toward increasing prevention rather than spending more money in expensive and less effective treatments. Controlling risk factors like hypertension, diabetes, and obesity will prevent and delay cardiovascular diseases. More policies to help prevent heart failure need to be established. In the meanwhile, new systems to monitor patients with diagnosed heart failure showed promising results. A remote monitoring system used for heart failure patients after being discharged home showed a significant decrease in hospitalizations and cardiovascular events. Home tele-monitoring systems provide timely intervention to help prevent hospitalizations, improve patients understanding of their condition, and remind patients to take their medications. Another study called Dial trial showed significant improvement in admission rates when patients with heart failure received frequent home phone calls regarding education, counseling, and monitoring after being discharged from the hospital [28]. Reaching minorities and underinsured populations with community programs in order to increase awareness and compliance with treatment is another pillar in controlling the outrageous problem of cardiovascular diseases.

### **13- Beneficial websites and books**

- American Heart Association

<http://www.americanheart.org/presenter.jhtml?identifier=1486>

- American College of Cardiology  
<http://www.acc.org/media/patient/chd/chf.htm>
- Up To Date Heart Failure Patient's Information  
<http://www.uptodate.com/patients/content/topic.do?topicKey=~v7qvi04jNt9fSD>
- National Library of Medicine  
<http://www.nlm.nih.gov/medlineplus/healthtopics.html>
- National Heart, Lung, and Blood Institute  
<http://www.nhlbi.nih.gov/>
- European Society of Cardiology  
[http://www.heartfailurematters.org/English\\_Lang/Pages/index.aspx](http://www.heartfailurematters.org/English_Lang/Pages/index.aspx)
- Heart Failure Online  
<http://www.heartfailure.org/>
- Up to Date Patient Information Low Sodium Diet  
<http://www.uptodate.com/patients/content/topic.do?topicKey=~ksaRDf4t2/t4Bq>
- Up To date Patient Rehabilitation program  
<http://www.uptodate.com/patients/content/topic.do?topicKey=~WQ6zKoLyIHUj1>

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