INTRODUCTION

Due to population ageing, there is an increase in the prevalence of chronic diseases. Heart Failure (HF) is an urgent public health need with national and global implications. It is one of the most important causes of morbidity and mortality in the industrialized world ***(Fonarow et al., 2005 and Redfield et al., 2003).***

HF is one of the main causes for disability regarding the self-limitation of physical activity. This limitation is closely connected to the activities of daily living, to quality of life (QOL), and to changes in the lifestyle imposed by the disease. Patients with HF have their lives affected by the disease and even optimized care seems to have impacts on their quality of life ***(Santos et al., 2009).***

Rehabilitation of cardiac patients is the sum of activities required to influence favorably the underlying cause of the disease, as well as the best possible physical, mental and social conditions, so that they may, by their own efforts preserve or resume when lost, as normal a place as possible in the community. The objective of cardiac rehabilitation services is to improve both the physiologic and psychosocial status of cardiac patients ***(Jette et al., 1991).***

Several trials have shown that cardiac rehabilitation improves disease-related symptoms, quality of life, and clinical

outcomes. Overall, prescribed exercise attenuates the fatigue and dyspnea that limit exercise intolerance. The improvements ranged from 15 to 30% in peak oxygen consumption (VO2), which is greater than or equal to the gains in exercise capacity observed in many clinical drug trials ***(Giannuzzi et al., 1997).***

Exercise training in patients with heart failure is associated with improvements in shortness of breath, the ability to perform activities of daily living, anxiety, depression, and general well-being ***(Kokkinos et al., 2000).***

In contrast to the often debated New-York Heart Association (NYHA) classification, the 6 minute walk test (6MWT), submaximal exercise test, allows an objective assessment of the exercise capacity of patients with congestive heart failure (CHF). This test simply measures the distance covered by walking on a hallway level within 6 minutes. The 6MWT has been shown to be a predictor of morbidity and mortality in CHF, with its predictive value being independent from left ventricular ejection fraction (LVEF) and other potential prognostic parameters. In CHF patients a walking distance < 300 m is associated with a one-year-mortality of up to 50%, whereas the one-year-mortality in patients reaching a walking distance > 450 m amounts to only a few percent ***(Bautmans et al., 2004).***

Aim of the Work

To measure the magnitude of benefit of cardiac rehabilitation program in patients with stable heart failure in terms of quality of life questionnaire and 6 minutes walk test.

Heart Failure

Introduction

Heart Failure is an urgent public health need with national and global implications. It is one of the most important causes of morbidity and mortality in the industrialized world ***(Redfield et al., 2003).***

According to the European Society of Cardiology (ESC), within 51 European countries representing a population of 900 millions, it is estimated that there are at least 15 million patients with HF ***(Dickstein et al., 2008).***

More than 5 million Americans have HF. According to the American Heart Association (AHA), there are 825 000 new HF cases annually in the USA ***(Alan et al., 2014).***

The prevalence of HF is estimated at 1–2% in the Western world, and the incidence is estimated 5–10 per 1000 persons per year ***(Mosterd and Hoes, 2007).***

The rise in the incidence and prevalence of HF globally is the result of improved care of acute myocardial infarction combined with the ageing of the population and the emerging pandemic of cardiovascular disease in the developing countries ***(Schocken et al., 2008).***

A. Definition of heart failure

According to the 2012 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure, HF can be defined as an abnormality of cardiac structure or function leading to failure of the heart to deliver oxygen at a rate commensurate with the requirements of the metabolizing tissues, despite normal filling pressures (or only at the expense of increased filling pressures) ***(McMurray et al., 2012).***

According to the 2013 AHA Guidelines for the Management of HF, HF is a complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood ***(Yancy et al., 2013).***

In its 2013 edition, the AHA guidelines emphasized that HF is not synonymous with either cardiomyopathy or Left Ventricular (LV) dysfunction; these latter terms describe possible structural or functional reasons for the development of HF ***(Yancy et al., 2013).***

B. Burden of heart failure

I. Heart failure mortality

The results of both the Framingham Heart Study ***(Levy et al., 2002)*** and a population-based study in Olmsted County, Minnesota ***(Roger et al., 2011)*** suggested decreases of age-adjusted mortality rates in patients after the onset of HF in the last decades.

However, 5-year age-adjusted mortality rates after onset of HF remained high in those two studies, with higher rates in men (50% in men vs. 46% in women for the Olmsted County population based study) ***(Roger et al., 2011).***

The vast majority of patients with HF die from cardiovascular causes; estimates vary from 50 to 90%, depending on the HF population studied. Among cardiovascular causes of death, sudden cardiac death poses a major threat, with up to 50% of HF patients dying of sudden cardiac death ***(Mosterd et al., 1999).***

Importantly, the relative contribution of sudden death to total death rate decreases when the clinical severity of HF increases. It is at its maximum (> 50%) in patients with low LVEF and NYHA class I and II and lowest in patients with advanced HF where patients die mostly from pump failure. This is an important element influencing the relative benefit, and, therefore, the indications for implantable cardiac defibrillators (ICDs) ***(Levy et al., 2002).***

II. Heart failure hospitalization

The hospitalization rate for HF is useful as a measure of the burden of HF, though it may vary with the prevalence, the incidence, and the survival in HF, variations in regional health care systems, and the discharge diagnosis coding practices ***(Mosterd et al., 1999).***

Heart failure hospitalization represents 1–2% of all hospital admissions, which makes it the leading cause of hospitalization for patients older than 65 years ***(Alla et al., 2007).***

Patients hospitalized for HF are at high risk for all cause rehospitalization, with a 1-month readmission rate of 25% ***(Ardehali et al., 2004).***

Interestingly, admission numbers for HF peaked in the 1990s in Scotland, the Netherlands, and Sweden and then started to decline ***(MacIntyre et al., 2000).***

For example, in a Dutch male population, the annual increase in hospitalization rate between 1980 and 1992 was estimated at 4.3%. It was followed by a small annual decrease of 1.5% in the years thereafter ***(Mosterd et al., 2002).***

This decline may be due to improved therapy and management of HF, but also to an increased home-based care by general practitioners for patients with terminal HF ***(Mosterd et al., 1999).***

However, the burden related to HF hospitalization remains huge: when patients are first diagnosed as having HF, they tend to be hospitalized for the disease as frequently as 21.3 events per 100 person-years in white people and up to 53.2 events per 100 person-years in black people ***(Kalogeropoulos et al., 2009).***

C. HF classifications

Both the American College of Cardiology Foundation (ACCF)/AHA stages of HF and the NYHA functional classification provide useful and complementary information about the presence and severity of HF (table 1).

Table (1): Comparison of ACCF/AHA Stages of HF and NYHA Functional Classifications.

ACCF/AHA Stages of HF[38]		NYHA Functional Classification[66]	
A	At high risk for HF but without structural heart disease or symptoms of HF	None	
B	Structural heart disease but without signs or symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.
C	Structural heart disease with prior or current symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.
		II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in symptoms of HF.
		III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes symptoms of HF.
		IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest.
D	Refractory HF requiring specialized interventions	IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest.

ACCF indicates American College of Cardiology Foundation; AHA, American Heart Association; HF, heart failure; and NYHA, New York Heart Association.

1. The ACCF/AHA stages of HF

The ACCF/AHA stages of HF emphasize the development and progression of disease and can be used to describe individuals and populations, and recognize that both risk factors and abnormalities of cardiac structure are associated with HF.

The stages are progressive and inviolate; once a patient moves to a higher stage, regression to an earlier stage of HF is not observed AND Progression is associated with reduced 5-year survival and increased plasma natriuretic peptide concentrations.

Therapeutic interventions in each stage aimed at modifying risk factors (stage A), treating structural heart disease (stage B), and reducing morbidity and mortality (stages C and D) ***(Yancy et al., 2013).***

2. NYHA Functional Classifications

The NYHA classes focus on exercise capacity and the symptomatic status of the disease and gauges the severity of symptoms in those with structural heart disease, primarily stages C and D ***(Yancy et al., 2013).***

It is a subjective assessment by a clinician and can change frequently over short periods of time. for example, a stable patient with mild symptoms can become suddenly breathless at rest with the onset of an arrhythmia, and an acutely unwell patient with pulmonary edema and NYHA class IV symptoms may improve rapidly with the administration of a diuretic ***(Khot et al., 2003).***

Although reproducibility and validity may be problematic, the NYHA functional classification is an independent predictor of mortality ***(Dunlay et al., 2009).***

D. Causes and co-morbidity of heart Failure:

HF is associated with ischaemic heart disease(IHD) (from 46 to 68%), arterial hypertension (from 53 to 66%), diabetes (from 27 to 38%), arrhythmia, especially atrial fibrillation (from 21 to 42%), and renal insufficiency (from 17 to 53%) ***(Zannad et al., 1999).***

There are very little data from developing countries. Rheumatic heart disease (RHD)remains a major cause of HF in Africa and Asia, especially in the young. Hypertension is an important cause in the African and African-American populations. Hypertension and coronary artery disease are the commonest causes of heart failure in middle and old age. Congenital and valvular diseases are the main causes in young age ***(Blair et al., 2008).***

Chagas' disease is still a cause of HF in South America. However, as countries undergo socio-economicdevelopment, the epidemiology of HF becomes increasingly similar to that in Western countries ***(Blair et al., 2008).***

E. Types of heart failure:

I. According to the Ejection Fraction(EF)

The main terminology used to describe HF is historical and is based on measurement of LVEF Mathematically, EF is the stroke volume (which is the end-diastolic volume minus the

end-systolic volume) divided by the end-diastolic volume) ***(Marwick et al., 2010).***

The EF is considered important in HF, not only because of its prognostic importance (the lower the EF the poorer the survival) but also because most clinical trials selected patients based upon EF (usually measured using a radionuclide technique or echocardiography) ***(Paulus et al., 2007).***

- **Heart failure with reduced ejection fraction (HF-REF)**

In patients with reduced contraction and emptying of the LV (i.e. systolic dysfunction), stroke volume is maintained by an increase in end-diastolic volume (because the left ventricle dilates), i.e. the heart ejects a smaller fraction of a larger volume. The more severe the systolic dysfunction, the more the EF is reduced from normal and, generally, the greater the end-diastolic and end-systolic volumes ***(Paterson et al., 2011 and Paulus et al., 2007).***

- **Heart failure with preserved ejection fraction (HF-PEF)**

The term HF-**PEF** was created to describe these patients who do not have an entirely normal EF (generally considered to be >50%) but also do not have a major reduction in systolic function either ***(McMurray et al., 2010).***

Usually these patients do not have a dilated heart and many have an increase in LV wall thickness and increased left

atrial size. Most have evidence of diastolic dysfunction, which is generally accepted as the likely cause of HF in these patients (hence the term 'diastolic HF') ***(Borlaug et al., 2011).***

II. <u>According to to the time-course of heart failure:</u>

a) A patient who has never exhibited the typical signs or symptoms of HF is described as having **asymptomatic LV systolic dysfunction** (or whatever the underlying cardiac abnormality is) ***(McMurray et al., 2010).***

b) Patients who have had HF for some time are often said to have **'chronic HF'**. A treated patient with symptoms and signs, which have remained generally unchanged for at least a month, is said to be 'stable'. If chronic stable HF deteriorates, the patient may be described as 'decompensated' and this may happen suddenly, i.e. 'acutely', usually leading to hospital admission, an event of considerable prognostic importance ***(Chen et al.,2011).***

c) **New ('de novo') HF** may present acutely, for example as a consequence of acute myocardial infarction or in a subacute (gradual) fashion, for example in a patient who has had asymptomatic cardiac dysfunction, often for an indeterminate period, and may persist or resolve (patients may become 'compensated') ***(Marwick et al.,2010).***

F. Pathophysiology of Heart Failure

Whereas clinicians initially viewed HF as a problem of excessive salt and water retention caused by abnormalities of renal blood flow (the cardio renal model) or abnormal pumping capacity of the heart (cardiocirculatory or hemodynamic model),these models do not adequately explain the relentless "disease progression" that occurs in this syndrome ***(Mann et al., 2005).***

I. Neurohormonal Mechanisms:

The neurohormonal model of HF postulates that HF progresses as a result of the over expression of biologically active molecules that are capable of exerting deleterious effects on the heart and circulation (Mann et al., 2005)

1. Activation of the sympathetic nervous system:

Increased sympathetic nervous system activity may contribute to the pathophysiology of CHF by multiple mechanisms involving cardiac, renal, and vascular function as shown in figure (1) ***(Floras et al., 2003 and Tang et al., 2010).***

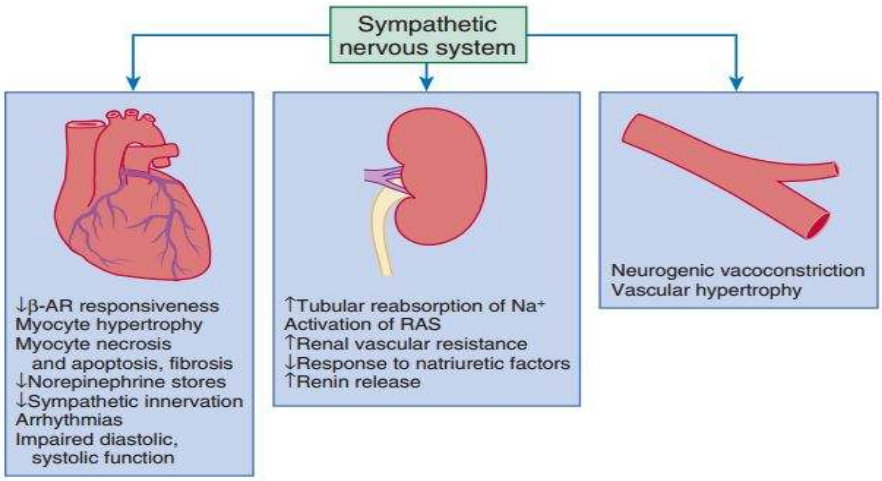

Figure (1): Activation of the sympathetic nervous system.

2. Activation of the renin-angiotensin system (RAS):

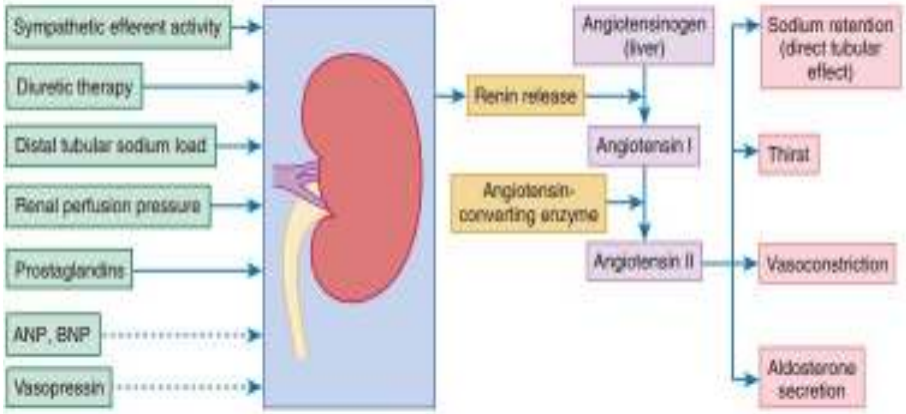

Figure (2): Activation of the renin-angiotensin system.

The major site of release of circulating renin is the juxtaglomerular apparatus of the kidney, where multiple stimuli may contribute to renal release of renin into the systemic circulation, including renal sympathetic efferent activity, decreased distal sodium delivery, reduced renal

perfusion pressure, and diuretic therapy. Natriuretic peptides and vasopressin (dashed arrows) may inhibit the release of renin.

Renin enzymatically cleaves angiotensinogen to form angiotensin II from angiotensin I. Angiotensin II is a potent vasoconstrictor and promotes sodium reabsorption by increasing aldosterone secretion and through a direct effect on the tubules. Angiotensin II also stimulates water intake by directly acting on the thirst center (Figure 2) ***(Dell'Italia et al., 2004)***

A number of counterregulatory neurohormonal systems become activated in HF in order to offset the deleterious effects of the vasoconstricting neurohormones, including the natriuretic peptides whose become blunted with advancing HF, leaving the effects of RAS unopposed ***(Burnett et al., 2003)***

II. Left Ventricular Remodeling:

The process of LV remodeling has an important effect on the biology of the cardiac myocyte, on changes in the volume of myocyte and nonmyocyte components of the myocardium, and on the geometry and architecture of the LV chamber, ultimately leading to deterioration in LV performance and a less favorable clinical course in patients with HF ***(Mann et al., 2005 and Garg et al., 2005 and Deschamps et al., 2005 and Hess et al., 2006).***