INTRODUCTION

Ischemic heart diseases represent a huge burden on both the individual & the society.

The coronary heart disease (CHD) epidemic has been extremely dynamic over the last half century, with marked variation in its characteristics among different regions of the world—both between neighboring nations and even regions within a country. In the USA and most countries of the European Union, the age-standardized CHD mortality rates have decreased significantly ***(De Becker, 2009)*** this may lead paradoxically to an increase in the prevalence of CHD in these countries—indeed, better survival of CHD patients and demographic changes have resulted in more elderly people suffering from CHD. In other parts of the world, the incidence of CHD is still on the increase, and it is estimated that in the coming years the number of CHD patients will increase substantially, especially in developing and transitional countries. Recent developments in the epidemic in the USA and Europe additionally suggest that the spectacular decline in CHD in the last half of the 20th century may have halted, especially in younger subjects. CHD is also an important source of disability, which can be translated into disability-adjusted life years (DALYs) ***(De Becker, 2009).***

The CHD burden in terms of DALYs is also projected to rise in the coming years, especially in countries in transition. There are also important regional differences in CHD burden within countries. If these differences are well understood, lessons can be learned and the knowledge applied in order to reduce the burden in less well-off communities. Coronary heart disease (CHD) is now the leading cause of death worldwide; it is on the rise and has become a true pandemic that respects no borders." This statement, made in 2014 ***(WHO, 2015)*** and is not that different from the warning issued in 1969 by the executive board of the World Health Organization: "Mankind's greatest epidemic: coronary heart disease has reached enormous proportions striking more and more at younger subjects. It will result in coming years in the greatest epidemic mankind has faced unless we are able to reverse the trend by concentrated research into its cause and prevention ***(WHO, 2015).***

This may give the wrong impression that nothing has changed over the last 40 years. On the contrary, the epidemic of CHD has been, and still is, extremely dynamic and influenced by environmental factors, resulting in rises and falls in morbidity and mortality over relatively short time periods. Furthermore, during the last 40 years, results from observational and intervention studies have clearly shown that CHD is partially preventable. Knowledge of this has been implemented in some populations more than in others, which may explain the heterogeneous changes that have taken place in CHD incidence and mortality among different places around the world ***(WHO, 2015).***

Aim of the Work

To evaluate the effect of bicycle ergometer on the functional capacity and quality of life in patient with post myocardial infarction who did primary percutaneous angioplasty.

PRIMARY PCI FOR MYOCARDIAL INFARCTION WITH ST-SEGMENT ELEVATION

THE CLINICAL PROBLEM:

Coronary heart disease is the leading cause of death in the United States, with myocardial infarction a common manifestation of this disease. In 2006, approximately 1.2 million Americans sustained a myocardial infarction. Of these, one quarter to one third had a myocardial infarction with ST-segment elevation ***(Smith et al., 2006).***

Of all patients having a myocardial infarction, 25 to 35% will die before receiving medical attention, most often from ventricular fibrillation ***(Zheng et al., 2001).*** For those who reach a medical facility, the prognosis is considerably better and has improved over the years: in-hospital mortality rates fell from 11.2% in 1990 to 9.4% in 1999 ***(Rogers et al., 2000).*** Most of the decline is due to decreasing mortality rates among patients with myocardial infarction with ST-segment elevation ***(Furman et al., 2001)*** as a consequence of improvements in initial therapy, including fibrinolysis and PCI. In an analysis by the National Registry of Myocardial Infarction, the rate of in-hospital mortality was 5.7% among those receiving reperfusion therapy, as compared with 14.8% among those who were eligible for but did not receive such therapy ***(French et al., 2012).***

PATHOPHYSIOLOGY AND EFFECT OF THERAPY:

The pathogenesis of coronary atherosclerosis is multifactorial. Broadly, endothelial injury and dysfunction result in the adhesion and transmigration of leukocytes from the circulation into the arterial intima as well as the migration of smooth-muscle cells from the media into the intima, thus initiating the formation of an atheroma or atherosclerotic plaque ***(Libby and Theroux, 2005).***

Atherosclerotic plaques cause progressive narrowing of the coronary arteries and eventually can cause a coronary occlusion. However, myocardial infarctions with ST-segment elevation are more typically caused by the sudden thrombotic occlusion of a coronary artery that previously was not severely narrowed. When such an occlusion occurs, the abrupt rupture, erosion, or fissuring of a previously minimally obstructive plaque creates a potent stimulus for platelet aggregation and thrombus formation ***(Freedman, 2005)***. If the stimulus for a thrombosis is robust, on occlusion of the infarct-related artery (**Figure 1**), all the myocardium that is supplied by the artery becomes ischemic, resulting in chest pain and electrocardiographic evidence of transmural (full-thickness) ischemia (ST-segment elevation) in the leads reflective of that region of the heart. Subsequently, necrosis begins within minutes and progresses during several hours in a "wavefront" fashion from the endocardial surface to the epicardial surface.

If ischemia persists for several hours, transmural infarction results ***(Reimer et al., 1977)***. In contrast, if blood flow is restored during the period of progressive necrosis, the ischemic myocardium is salvaged and the size of the infarct is reduced. Since morbidity and mortality from a myocardial infarction correlate with the size of the infarct, prompt restoration of blood flow would also be expected to improve left ventricular function and survival ***(Cleland et al., 2005).***

Primary PCI consists of urgent balloon angioplasty (with or without stenting), without the previous administration of fibrinolytic therapy or platelet glycoprotein IIb/IIIa inhibitors, to open the infarct-related artery during an acute myocardial infarction with ST-segment elevation. Primary PCI restores angiographically normal flow in the previously occluded artery in more than 90% of patients ***(Keeley and Hillis, 2007)*** whereas fibrinolytic therapy does so in only 50 to 60% of such patients.

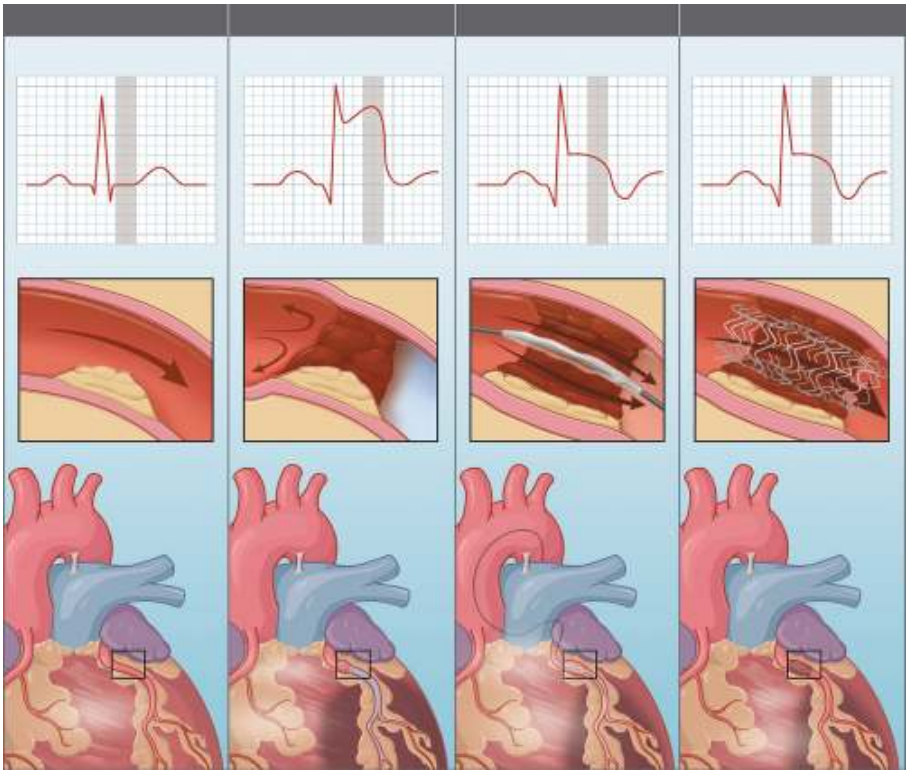

Figure (1): Myocardial Infarction with ST-Segment Elevation before, during, and after PCI. Symptomatic, electrocardiographic, morphologic, and anatomical findings in a patient with a myocardial infarction with ST-segment elevation are shown before onset (Panel A) and during the infarction (Panel B), and after primary PCI with balloon angioplasty (Panel C) or stent placement (Panel D) ***(Keeley and Hillis, 2007).***

TIME IS MUSCLE:

Reperfusion therapy (mechanical or pharmacologic) is indicated for patients with chest pain consistent with a myocardial infarction with a duration of 12 hours or less in association with ST-segment elevation greater than 0.1 mV in two or more contiguous electrocardiographic leads or a new (or

presumed new) left bundle-branch block. Candidates for reperfusion therapy should be identified by an emergency department physician; the process can be initiated by emergency-medical-services personnel to minimize delay.

Primary PCI is preferred if a skilled interventional cardiologist and catheterization laboratory with surgical backup are available and if the procedure can be performed within 90 minutes after initial medical contact with the patient ***(O'Gara et al., 2013)***. For patients initially presenting to a hospital that does not have interventional capabilities, rapid transfer to such a facility is recommended.

Primary PCI is preferable for certain patients even if the interval between the first medical contact and the procedure (the "door-to-balloon" interval) exceeds 90 minutes. Such patients include those with a contraindication to fibrinolytic therapy ***(O'Gara et al., 2013);*** those with a high risk of bleeding with fibrinolytic therapy, including patients 75 years of age or older (for whom the risk of intracranial hemorrhage with fibrinolytic therapy is increased) ***(Ahmed et al., 2006);*** those with clinical findings (i.e., tachycardia, hypotension, or pulmonary congestion) suggesting a high risk of an infarct-related complicated medical course or death and those with cardiogenic shock ***(Hochman et al., 1999).***

Fibrinolytic therapy is preferred for patients whose first medical contact occurs less than 3 hours after the onset of symptoms but for whom PCI is not immediately available, those who seek medical attention less than 1 hour after the onset of symptoms (in whom the therapy may abort the infarction), ***(Taher et al., 2004)*** and those with a history of anaphylaxis due to radiographic contrast material.

As compared with patients who undergo balloon angioplasty, among those who undergo bare-metal stenting of the infarct-related artery, the rates of restenosis and the frequencies of recurrent angina and repeated revascularization procedures are lower ***(Keeley and Hillis, 2007).*** As a result, stenting of the infarct-related artery is usually preferred. However, balloon angioplasty is preferred for patients in whom clopidogrel is contraindicated (because of thrombocytopenia or the presence of left main or extensive multivessel coronary artery disease, who may require bypass surgery within days after successful primary PCI). Balloon angioplasty is also preferred when the size of the infarct-related artery is insufficient for the placement of a stent. As compared with bare-metal stents, drug-eluting stents appear to reduce further the rates of restenosis within 12 months after primary PCI ***(Laarman et al., 2006)***. If drug-eluting stents are used in this setting, it is imperative that dual antiplatelet therapy (aspirin and clopidogrel) be given for at least 12 months; otherwise, subacute thrombosis may occur. There are no good data on longer-term outcomes.

In addition to oral aspirin and intravenous unfractionated heparin, patients with a myocardial infarction with ST-segment elevation should receive oral clopidogrel ***(Sabatine et al., 2005)*** after it has been determined that emergency bypass surgery is not required. Beta-adrenergic blockers, ***(Kernis et al., 2004),*** and angiotensin-converting–enzyme inhibitors should be initiated, provided that the patient has no contraindications and is stable hemodynamically ***(O'Gara et al., 2013).***

The monetary costs of fibrinolytic therapy and primary PCI are similar. In a report on 4366 primary PCIs performed at 40 sites in the United States between 1990 and 1994, the success rate (the proportion of patients with a patent infarct-related artery at the end of the procedure) was 91.5% ***(Grassman et al., 1997).***

However, although antegrade flow in the epicardial coronary artery may appear normal after most of these procedures, perfusion of the tissue at the microvascular level is restored to normal in only a minority of patients ***(Stone et al., 2002); (De Luca et al.,2005).*** In some patients, embolization of microscopic debris with balloon inflation or stent deployment compromises tissue perfusion. In such patients, the magnitude of the ST-segment elevation does not diminish, even though antegrade flow in the epicardial artery is restored. Among these patients, survival is correspondingly reduced ***(Prasad et al., 2005).***

In about 15% of patients undergoing primary PCI, initial angiography shows a patent infarct-related artery. In these patients, it is presumed that spontaneous fibrinolysis occurred before angiography. In comparison with patients who have diminished or no antegrade flow, these patients are less likely to have hemodynamic instability or left ventricular systolic dysfunction with congestive heart failure or to die as a result of myocardial infarction ***(Prasad et al., 2005).***

GUIDELINES:

According to the guidelines of the American College of Cardiology and American Heart Association, primary PCI is a class I indication in patients with myocardial infarction with ST-segment elevation who can undergo the procedure within 12 hours after the onset of symptoms, provided the procedure is performed in a timely manner (balloon inflation or stent placement or both within 90 minutes after the first medical contact) by experienced operators (those who perform more than 75 interventional procedures per year) in a facility in which more than 200 coronary interventional procedures are performed each year (at least 36 of them being primary in nature) and which has a cardiac surgical capability, in case such surgery is required ***(O'Gara et al., 2013)***. Similarly, the European Society of Cardiology considers primary PCI the preferred reperfusion strategy for patients with myocardial infarction with ST-segment elevation (as a class I indication) ***(Windecker et al., 2014).***

CARDIAC REHABILITATION PROGRAM

Definition:

There are many aspects to the management of CHD, including pharmacological treatment, secondary prevention and revascularization. Secondary prevention consists of a number of activities or measures that may be taken by patients with established disease, in order to reduce their risk of a further event ***(Lockhart, et al., 2000).*** Cardiac rehabilitation (CR) is acknowledged not only as integral in the management of patients with CHD, but also as the primary vehicle in delivering secondary prevention. Many definitions of CR exist, for example the World Health Organization classifies CR as 'The sum of activities required to influence favorably the underlying cause of the disease, as well as to ensure the patient 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 life of the community' ***(WHO, 2015).***

American Association of Cardiovascular and Pulmonary Rehabilitation, subsequently guideline, as follows: 'Cardiac rehabilitation is the process by which patients with cardiac disease, in partnership with a multidisciplinary team of health professionals, are encouraged and supported to achieve and maintain optimal physical and psychosocial health ***(Leon et al., 2005).*** This is perhaps a more succinct definition, which encompasses all the key elements of CR, such as partnership, support, and the aim of optimizing and maintaining the individual's health.

Historical background:

In 1772, four years after his magnificent description of angina pectoris, Heberden reported a case of a patient who improved by working in the woods half an hour per day. Despite some evidence of the benefits of physical activity, mobility restriction was imposed on patients with acute coronary events, often leading to serious deconditioning problems, decline in functional capacity, prolonged hospital stay and increased morbidity and mortality. This incorrect attitude was reinforced after the description of myocardial infarction by Herrick in 1912. In the 1930s, patients with acute coronary events were advised to observe 6 weeks of bed rest. Chair therapy was introduced in the 1940s ***(Levine and Lown, 1951).***

In the early 1950s, a very short daily walk of 3 to 5 minutes was allowed 4 weeks after the coronary events. Gradually, it was recognized that early ambulation prevented many of the complications of bed rest, and that it did not increase the risk.

Early cardiac rehabilitation pioneers like Levine and Lown experienced very strong opposition for advocating early mobilization of patients. However the cumulating evidence of the benefits of early ambulation and physical activity in general helped convince the skeptics. In 1953, Morris' study showed that the bus drivers in London had a higher rate of coronary events compared to ticket sellers ***(Morris and Heady, 1953).***

This was attributed to the fact that ticket sellers were more active going up and down the double-deck buses while drivers sat behind the wheels. Further proofs of the detrimental effects of prolonged immobilization were provided by the training of the candidates for space flight ***(Cardus, 1966).***

In 1968, *Saltin et al.* published the Dallas Bed Rest and Exercise Study which, though small, provided a very powerful proof of the importance of exercise and the detrimental effect of prolonged bed rest ***(Saltin et al., 1968).***

The works of Braunwald, Sarnoff, Sonnenblick, Hellerstein, Naughton and many others helped establish the physiologic basis of exercise benefits and led to the development of Cardiac rehabilitation programs as a multidisciplinary approach to help cardiovascular patients recover and optimize their functional and mental status ***(Naughton et al., 1966).***

Since that time, this approach has been proven to have undeniable morbidity and mortality benefits, and has been recommended as an important therapeutic tool in modern cardiology by most cardiovascular professional societies ***(Piepoli et al., 2010).*** In recent years, a better understanding of the natural history of many cardiac pathologies and the fact that, despite tremendous advances, heart disease remains the number one killer have led to a renewed interest in cardiac rehabilitation ***(Piepoli et al., 2010).***

Objectives and indications of cardiac rehabilitation:

Objectives:

Historically, the first objective of cardiac rehabilitation was to help the patients regain autonomy and improve regular physical activities. The positive impact of regular physical activities on mortality after myocardial infarction has been confirmed by many prevention studies such as the study by Wannametthee ***(Wannamethee et al., 2000).***

Another objective of cardiac rehabilitation is to control the modifiable risk factors. This involves not only smoking cessation and the optimization of medication for blood pressure, diabetes and cholesterol control, but also the therapeutic education that emphasizes the importance of the measures of therapeutic life changes.

Therapeutic education is a structured teaching program using workshops to educate the patients about their conditions. The ultimate goal is to allow the patients to become responsible and autonomous for their medical treatment and lifestyle changes.

Lastly, helping manage psychosocial and professional problems of the cardiac patients is also an objective of cardiac rehabilitation. Psychiatric troubles like anxiety and depression are quite frequent following coronary events and are associated with lower exercise capacity, fatigue and a reduced quality of