The Role of Cardiac Magnetic Resonance in Assessment of Myocardial Contractile Function After Exercise Training Based Cardiac Rehabilitation Program in Anterior ST-Elevated Myocardial Infarction Patients Treated with Primary Percutaneous Coronary Intervention.

Thesis

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Rana Lateef Hasssan

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List of Abbreviations

AACVPR	:	American Association of Cardiovascular and Pulmonary Rehabilitation,
ACC	:	American College of Cardiology
ACEI	:	Angiotensin-converting enzyme inhibitor
ACS	:	Acute coronary syndrome
AF	:	Atrial fibrillation
AHA	:	American Heart Association
AL	:	Apical lateral
AMI	:	Acute myocardial infarction
ARBs	:	Angiotensin receptor blockers
BA	:	Basal anterior
BACPR	:	British Association for Cardiovascular Prevention and Rehabilitation
BI	:	Basal inferior segment
BP	:	Blood pressure
bpm	:	beat per minute
CABG	:	Coronary artery by bass graft
CAD	:	Coronary artery disease
CCS	:	Canadian Cardiovascular Society
CG	:	Control group
CHD	:	Coronary heart disease
CMR	:	Cardiac magnetic resonance
CR	:	Cardiac rehabilitation
CT	:	Computed tomography
CTN	:	Cardiac troponin
CVD	:	Cardiovascular disease
CWB	:	Cine white Blood Technique
DAPT	:	Dual antiplatelet therapy
DES	:	Drug-eluting stent
DM	:	Diabetes mellitus
DSMR	:	Dobutamin stress magnatic resonace

EACPR	:	European Association of Cardiovascular Prevention and Rehabilitation ECG: Electrocardiography
EF	:	Ejection fraction
ESC	:	European society of cardiology
FHX	:	Family history of premature cardiovascular disease
HDL	:	High-Density lipoprotein
hs-ctnt	:	High Sensitivity Cardiac Troponin test
HT	:	Height
HTN	:	Hypertension
IS	:	Infarct Size
KG	:	Kilogram
LDL	:	Low density lipoprotein
LGE-MR	:	Late gadolium enhancement magnetic resonance
LV	:	Left ventricle
METs	:	Metabolic equivalents
MHR	:	Maximum heart rate
MI	:	Myocardial infarction
mmHg	:	Millimeter mercury
NICE	:	National Institute for Health and Care Excellence
NSTEMI	:	Non-ST segment elevation myocardial infarction
NYHA	:	New York Heart Association
PCI	:	Percutaneous coronary intervention
RPE	:	Rating perceived exertion
SD	:	Standard deviation
SPAMM	:	Spatial Modulation of Magnetization
SPECT	:	Single photon emission Computed tomography
SPSS	:	Statistical Package for Social Science
SSFP	:	Steady-State Free Precession Pulse
STEMI	:	ST-segment elevation myocardial infarction

TG	:	Training group.
THR	:	Training heart rate
TMRI	:	Tagged magnetic resonance imaging
TTE	:	Trans-Thoracic Echocardiography
VF	:	Ventricular fibrillation
VO2max	:	Maximal aerobic capacity
WHO	:	World Health Organization
WMSI	:	Wall motion score index

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Introduction

ST elevation myocardial infarction (STEMI) represents an acute cardiovascular emergency that requires early reperfusion within ≤12 hours from the onset of the symptom with persistent ST-segment elevation, by either primary percutaneous coronary or thrombolysis, a primary PCI strategy is recommended over fibrinolysis within indicated timeframes [1]

Mortality statistics show that cardiovascular disease (CVD) remains the most common cause of death in Europe, accounting for 45% of all deaths; 49% of deaths among women and 40% among men. With 1.4 million of these deaths occur before the age of 75 years [2].

Cardiovascular disease mortality in Egypt account for 46% of total deaths, all ages and both sexes, WHO (2014)

The decreased mortality rate has been noticed due to the decline in the incidence of STEMI along with the absolute reduction of overall mortality of AMI. This outcome results from the efficacy of current therapeutic strategies focused on the early reopening of the infarct artery, either by the use of thrombolytic agents or by the primary percutaneous coronary intervention (PCI). The PCI represents the most effective pathway in limitation of the infarct size (IS) and reduction of the transmural extension of the necrosis [3].

Cardiac rehabilitation (CR) is an exercise based program that promotes a healthy and active lifestyle, intending to improve quality of life through increased cardiac function, increased exercise tolerance and decreased cardiovascular symptoms [4].

Currently CR programs represent a valuable part of the secondary approach in the prevention of coronary heart disease (CHD) and represent class I recommendation in the current clinical guidelines by the American Heart Association and the American College of Cardiology, as well as the European Society of Cardiology for treatment for patients with CHD [5,6].

Cardiac MRI, the newly used, noninvasive imaging technique in AMI is highly valuable for providing the assessment of the function, perfusion and characterization of the tissue during a single examination even in patients with acoustic window limitations. Also, cardiac MRI represents the gold standard technique in the assessment of cardiac volume, mass and systolic function when compared with other imaging modalities, because it has no geometrical assumptions [7].

Aim of the work

The main objective of this study is to evaluate the change in global and regional left ventricular systolic function, before and after exercise training based cardiac rehabilitation program using cardiac magnetic resonance imaging in patients after anterior STEMI.

Acute myocardial infarction

Epidemiology:

CHD remains responsible for one-third of all deaths in individual over the age of 35years. Nearly one-half of all middle-aged men and one-third of middle-aged women in the USA will develop some manifestation of CHD. The 2016 Heart Disease and Stroke Statistics update of the AHA reported that 15.5 million people in the USA have CHD [8].

Acute myocardial infarction is the most severe manifestation of coronary artery disease, which causes more than 2.4 million deaths in the USA, more than 4 million deaths in Europe and northern Asia [9].

Concordantly, its economic impact is tremendous; in 2010, more than 1.1 million US hospitalizations were a result of myocardial infarction, with estimated direct costs of at least US 450 $ billion [10].

Classification:

To provide immediate treatment strategies acute myocardial infarction is divided into STEMI and NSTEMI. Unstable angina is also considered an acute coronary syndrome (ACS) because it is an imminent precursor to myocardial infarction. Unstable angina has similar pathophysiology to NSTEMI, and they are together referred to as non-ST-segment elevation ACS (NSTE-ACS). They have traditionally been grouped for management decisions [11].

Clinical presentations of myocardial infarction:

The onset of myocardial ischemia is the initial step in the development of MI and results from an imbalance between oxygen supply and demand. Possible ischemic symptoms include various combinations of the chest, upper extremity, mandibular, or epigastric discomfort during exertion or at rest, or an ischemic equivalent such as dyspnea or fatigue. Often, the discomfort is diffuse; not localized, nor positional, nor affected by the movement of the region. It also may present as atypical symptoms such as palpitations or cardiac arrest, or even without symptoms [11].

ECG:

The ECG is an integral part of the diagnostic workup of patients with suspected MI and should be acquired and interpreted promptly (i.e. target within 10 min) after first medical contact. Pre-hospital ECGs reduce the time to diagnosis and treatment and can facilitate the triage of STEMI patients to hospitals with PCI capability if within the recommended time interval (120 min from STEMI diagnosis) [12]. Acute or evolving changes in the ST-T waveforms and Q waves, when present, potentially allow the clinician to time the event, to identify the infarct-related artery, to estimate the amount of myocardium at risk as well as prognosis and to determine therapeutic strategy [11].

Hyperacute T waves in at least two contiguous leads is an early sign that may precede the elevation of the ST-segment. In general, the development of new Q waves

indicates myocardial necrosis, which starts minutes/hours after the myocardial insult. Transient Q waves may be observed during an episode of acute ischemia or (rarely) during acute MI with successful reperfusion [13].

Absence of ST-elevation in the precordial leads, tall, prominent, symmetrical T waves in the precordial leads, up sloping ST-segment depression > 1 mm at the J-point in the precordial leads, and in most cases ST-segment elevation (> 1 mm) in lead aVR or the symmetrical, often deep (> 2 mm), T wave inversions in the anterior precordial leads are associated with significant left anterior descending artery (LAD) occlusion [13]

ST-elevation in lead aVR > 1 mm may accompany anterior or inferior STEMI and is associated with increased 30day mortality in patients with acute MI [14].

Biochemical approach for diagnosing myocardial injury and infarction:

Cardiac troponin (cTn) I and T are structural proteins unique to the heart. Detection of cTn in peripheral blood indicates cardiomyocyte damage. As acute myocardial infarction (AMI) is the most important cause of cardiomyocyte damage, cTn has become an integral part of the diagnosis of AMI. Recent multicenter studies have shown that hs-cTn assays improve the early diagnosis of patients with suspected AMI, particularly the early rule-out. [15].