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ASSESSMENT OF LEFT VENTRICULAR EJECTION FRACTION IN PATIENTS UNDERGOING CARDIAC REHABILITATION FOLLOWING ACUTE MYOCARDIAL INFARCTION

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Abstract:

Background: *Cardiovascular disorders are the leading cause of mortality and morbidity in the industrialized world and are becoming an increasingly important problem in the developing countries including Pakistan. The left ventricular ejection fraction (LVEF) serves as a good assessment tool to document beneficial effects of cardiac rehabilitation (CR) program in cardiac patients.*

Objective: *The aim of this study was to evaluate the effect of short-term CR program on LVEF in patients with myocardial infarction (MI).*

Methods: *This study was conducted on 100 patients of less than 75 years of age with acute uncomplicated anterior wall or anterolateral wall MI, inferior and RV MI. Cases were randomized into two groups of age and sex matched 50 patients each. Group I (study group) patients were administered secondary prevention advice and were started on the CR exercise protocol, Group II (control group) patients were administered secondary prevention advice only.*

Results: *At baseline, LVEF was 42.5% in the study group and 41.4% in the control group patients and was statistically comparable. After 10 weeks study group showed the LVEF of 47.78% and control group had LVEF of 42.26%. The differences are being statistically significant.*

Conclusion: *Significant improvement in LVEF in patients who had been engaged in CR program besides the secondary prevention strategies when compared with the control group patients who followed secondary prevention strategies only. The present study is amplify the beneficial effects of simple CR program, which additionally improves the key cardiac parameters like LVEF in the recovery period.*

Keywords: *Cardiac rehabilitation left ventricular ejection fraction, secondary prevention*

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INTRODUCTION:

Atherosclerotic diseases, of which coronary artery disease (CAD) is the most common, result in substantial disability and a loss of productivity and contribute considerably to the escalating costs of health-care. For those patients already identified as having cardiovascular diseases, the prevention of subsequent cardiovascular events while maintaining adequate physical functioning and independence and a good quality of life are thus major challenges in preventive cardiology. [1,2] Secondary prevention, through cardiac rehabilitation (CR) programs, is now recognized as an essential component of the contemporary management of patients with various presentations of coronary disease and with heart failure and it should be integrated into the long-term care of all patients with cardiovascular disease.[3,4] There is convincing evidence that the combination of regular exercise with interventions for life-style changes and modification of risk factors favorably alter the clinical course of cardiovascular diseases. [5-9]

Exercise training has assumed a role in CR of patients with CAD because it increases myocardial perfusion and reduces mortality. This has been largely attributed to exercise training-mediated correction of coronary endothelial dysfunction in persons with CAD. Regular physical activity leads to restoration of the balance between nitric oxide (NO) production by NO synthase and NO inactivation by reactive oxygen species in persons with CAD, thereby enhancing the vasodilatory capacity in various vascular beds.[10] CR aims to reverse the limitations that have developed following adverse pathophysiologic and psychological consequences of cardiac events.[11] The rehabilitation protocol used has to be both comprehensive and individualized at the same time.[12] According to the US Public Health Service, CR is defined as a rehabilitative program that involves the following: Medical evaluation, prescribed exercise, education and counseling of patients with cardiac disease.[12] Core components of CR/secondary prevention programs include: Baseline patient assessment; physical activity counseling and exercise training, nutritional counseling; risk factor management (lipids, hypertension, weight, diabetes and smoking); psychosocial management, vocational counseling and optimized medical therapy. The provision of these services by specialized hospital-based teams in an out-patient setting is recommended and a period of 8-12 weeks is considered as an adequate to cover the core components of CR/secondary prevention programs appropriately. [5]

MATERIALS AND METHODS:

The study was conducted in the Departments of Cardiology, Liaquat University Hospital and Hyderabad from 1st January 2014 to 30th June 2014. 100 patients of acute myocardial infarction (MI) less than 75 years of age were included in this study. Patients admitted to emergency room ER with the first event of documented uncomplicated CAD were encouraged to participate in this program. Diagnosis of CAD was made on the basis of Electrocardiogram, cardiac enzymes and the time of induction was 3-4 days prior to their anticipated day of discharge from the hospital. Patients with decompensated cardiac failure, chronic obstructive pulmonary disease, bronchial asthma, recent major surgical procedures and severe orthopedic conditions limiting their movements were excluded. Informed written consent was obtained from all patients.

Patients included were randomized into two groups of 50 patients each:

Group I (study group) patients were administered secondary prevention advice. They were started on the CR exercise protocol as detailed below in TABLE:1.

Table 1: Cardiac rehabilitation program

Phase	Location	Days/weeks	Activity
I	ICCU	3-5 days	Assisted mobilization: Sitting on bedside chair, self-care activities (shaving, oral hygiene, sponge bathing)
	Step down	6-7 days	Sit up and stand (unassisted, supervised)
		8-10 days	Walking in their hospital rooms; start with 5 min daily; increase to 10 min daily
II	OPD/Physiology Department/ Home	1st week	5 days: Home: 10 min normal walk; 2 days: Department of Physiology: 10 min gradual warm up. 10 min walk at normal pace
		2nd week	5 days: Home: 15 min normal walk; 2 days: Department of Physiology: 10 min warm up and 15 min walk at normal pace

Continue……

		3rd week	6 days: Home: 20 min normal walk 1 day: Department of Physiology: 10 min warm up, supervised climbing 1 flight of stairs, 15 min walk at normal pace, 5 min of cool down
		4th week	4 days normal walk for 15 min at home and gradual climbing one flight of stairs on 2 days supervised by family 2 days brisk walk for 5 min at home 1 day at Department of Physiology: 10 min warm up, climbing one flight of stairs, 10 min of brisk walk, 10 min of cool down
III	Home /Physiology Department	5th and 6th Week	Per week, —500 m over 20 min walk 5 days+climbing 1 flight of stairs 2 days at home; follow-up at end of 6 weeks for compliance
		7th and 8th week	Per week, —700 m over 20 min walk 5 days + climbing 1 flight of stairs 2 days at home; follow-up at end of 8 weeks for compliance
		9th and 10th week	Per week, —1 km over 30 min walk 5 days+climbing 1 flight of stairs 4 days at home. Follow-up at the end of 10 weeks for final assessment

ICU- intensive coronary care unit; OPD – out patient department

Group II (control group) patients were administered secondary prevention advice only.

Methods

A detailed history and general and systemic physical examination were carried out for each patient to assess their suitability for being enrolled in the study. Baseline assessment of life-style and risk factors was carried out for all patients inducted into the study and included activity assessment, occupational status, diet (based on 3-day recall), body mass index (BMI), waist circumference (cm), smoking status, blood pressure (BP), lipid profile, blood sugar and medication history. All patients were advised on Secondary Prevention Strategies as per their risk status. All patients were given dietary advice according to the BMI and the biochemical parameters or any underlying disease and hence that they attain their ideal weight. All patients underwent echocardiography to determine their left ventricular ejection fraction (LVEF), which was the single parameter to evaluate the efficacy of CR program in this study. Echocardiography was done on ARTIDA in the cardiology department. Non-compliant patients of either group and patients of Group I who were unable to complete the CR program for any reason were excluded from this study.

Risk assessment and secondary prevention strategies

BMI and waist circumference

Behavioral and nutritional counseling (by Dietician)

Goal - loss of 5-10% of body weight; maintain BMI < 25 kg/m ^{2} ; maintain waist circumference below 100 cm (in men) and below 90 cm (in women).

Smoking

Pick date for cessation of smoking; offers behavioral advice (group counseling if feasible);offer nicotine supplements and/or bupropion.

Goal - long-term abstinence.

BP

Regular BP monitoring if hypertensive; life-style modification, weight management, sodium restriction, moderation of alcohol intake; drug therapy and adherence to therapy

Goal - BP < 140/90 mm Hg (or < 130/85 mm Hg if patient has diabetes, chronic heart failure or renal failure).

Lipid profile

Diet modification; physical activity; statins

Goal: (i) Primary - low-density lipoprotein cholesterol level < 100 mg/dL. (ii) Secondary - high-density lipoprotein (HDL) cholesterol level > 45 mg/dL; triglyceride level < 200 mg/dL.

Blood sugar

Dietary modification, weight control and exercise; oral hypoglycemic and/or insulin: Goal - Maintain fasting plasma glucose level (80-100 mg/dL); glycosylated hemoglobin level <7.0%.

Control group

They followed the following schedule:

At the end of the 4th week: BMI, waist circumference, BP, smoking status and occupational status were reassessed for compliance to secondary prevention strategies and these strategies were emphasized again.
At the end of the 10th week: Risk assessment (including lipid profile and fasting blood glucose) and LVEF were re-assessed.

Study group
Study group followed a comprehensive CR program as mentioned in [Table 1].
Started from the step down phase in the ER (while in the hospital) and continued as an out-patient department (OPD)-based service in the Department of Cardiology,LUH Hyderabad and lasted for 10 weeks after discharge.
The above protocol [Table 1] had been devised taking references from the various CR studies conducted. [11-13] All patients in the study group were contacted weekly telephonically to assess compliance to exercise program and secondary prevention strategies and to detect and to prevent the complications arising out of participation in the program. Patients contacted the investigator and the attending physician on facing difficulty/complication during the study period.

RESULTS:
The present study had patients of both sexes in the age range of 38-?5 years who had experienced Ml for the first time. The mean + standard deviation of age of patients in the study and control group was (56.98 + ?.U3E!) and (58.60 + 10.22) years respectively. The sex ratio in the two groups was comparable with males (76%) and females (24%) in the study group and males [B09-tr) and females (2D%} in the control group. There was statistically insignificant variation in the presence of family history of CAD in the two groups (24% in the study group and 18% in the control group, P-value - 0.37). Almost one-third of the patients in both groups were found to be diabetic (% in the study group and 28% in the control group). None of the patients included in this study had a previous history of precordial pain or angina pain. era was no statistically significant difference in the occurrence of these common symptoms in the two groups. The number of active smokers or those who were social alcohol consumers in the two groups were also comparable. The distribution of patients as per regional infarct showed a preponderance of the anterior wall MI over anterolateral MI, the difference between two groups being statistically insignificant as shown in table 2 .

Table 2: Various parameters of study and control group

Parameters	Cases *(n =50)* (%)	Controls *(n =50)* (%)	*P* value
Age (mean-I-SD) years	56.98±7.038	58.60±10.224	NS
Males	76	80	NS
Females	24	20	NS
Family h/o CAD	12 (24)	8 (16)	NS
Diabetes	15 (30)	13 (26)	NS
Hypertension	15 (30)	13 (26)	NS
Angina	3 (6)	3 (6)	NS
Dyspnea	13 (26)	9 (18)	NS
Palpitations	6 (12)	8 (16)	NS
Fatigue	12 (24)	9 (18)	NS
Smoker	10 (20)	9 (18)	NS
Alcohol	13 (26)	11 (22)	NS
Anterolateral MI	11 (22)	7 (14)	NS
Anterior MI	39 (78)	43 (86)	NS

NS — Non-significant; MI — Myocardial infarction; CAD — Coronary artery disease; SD — Standard deviation

Table 3: Assessment of left ventricular ejection fraction in study and control group at baseline and after 10 weeks

LVEF	Study group	Control group	*P* value
Baseline	42.5	41.14	0.133
After 10 weeks	47.78	42.26	0.0**

* *P*< 0.05; **P<0.01; LVEF — Left ventricular ejection fraction

At baseline

LVEF was 42.5% in a study group and 41.4% in the control group patients and was statistically comparable.

Patients in both groups were advised secondary prevention strategies based on pre inductionassessment of vital signs and ejection fraction.

Patients in group I were started on the CR exercise protocol. Patients in both groups were regularly assessed thereafter at 1, 2, 3, 4 and 10 weeks on the basis of vital signs and weight.

After 10 weeks

Risk assessment was performed again to ensure compliance and LVEF assessment was done. Group I showed the LVEF of 47.78% and Group II had LVEF of 42.26%.Table 3 There was a significant difference in terms of ejection fraction between patients who had been engaged in CR program besides the secondary prevention strategies when compared with group II patients who followed secondary prevention strategies only.

DISCUSSION:

Our study showed a significant improvement in the ejection fraction of patients who had undergone a regular exercise regimen when compared with patients who did not jatilitm exercise. Similar results have been observed in other studies. Participation in rehabilitation was independently associated with decreased mortality and recurrent MI. Prognostic value of assessment of left ventricular function in patients undergoing CR following acute VI can be seen. Multiple studies have shown that LVEF is a powerful 11 2 .111 predictor of cardiac events. Angiographically measured LVEF has been previously reported as a better predictor of survival, compared with the angiographically demonstrated a number of diseased coronary vessels. FL Various studies have been done to examine and evaluate improvements in cardiorespiratory fitness, psychological well-being, quality-of-life and vocational status in post MI patients during and after a comprehensive 12 month exercise rehabilitations program, which show

significant improvement in cardiorespiratory a fitness, psychological profile and quality-of-life more were recorded in the treatment population when compared with their matched controls. In some cases with exercise training, reduction in the severity of coronary atherosclerosis is observed; however, in the presence of advance CAD, exercise training has been shown to induce ischemic preconditioning of the myocardium a process by which transient myocardial ischemia during exercise enhances tolerance of the myocardium to subsequent more prolonged ischemic stress. In addition, exercise training and regular physical activity can result in moderate losses in body weight and adiposity. Endurance exercises also can promote decrease in BP and serum triglycerides, increase HDL cholesterol and improvement in insulin sensitivity and glucose hemostasis, which along with modest weight reduction have been shown to reduce the risk of type 2 diabetes mellitus in individuals with glucose intolerance [19,21]

Aerobic exercise training also may decrease the risk of sudden cardiac death due to ventricular tachyarrhythmia by reducing sympathetic and enhancing parasympathetic activity, as evidenced by increased heart rate variability and increased baroreceptor sensitivity [21,22]

CONCLUSION:

In conclusion, addition of an exercise schedule to secondary prevention strategies in the post-infarction period can result in reduced morbidity and mortality and thus helps the patients to return back to their normal life sooner. The present study reinforces the beneficial effects of simple CR program, which improves the key cardiac parameters such as LVEF in the recovery period. Improvement in LVEF is bound to show improved work efficiency, exercise tolerance, general sense of well-being and is also likely to reduce the incidence of re-infarction, as such patients do tend to adhere to such precautions as would be beneficial to their cardiovascular status in the future.

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