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Improving quality of life and muscle strength with resistance training in non-ischemic congestive heart failure patients.

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Abstract

Background: Patients with congestive heart failure often experience difficulties in daily activities, muscle weakness, and psychological distress, impacting their overall quality of life. While exercise is known to benefit heart failure patients, its specific impact on non-ischemic congestive heart failure remains underexplored. This study aimed to assess the effectiveness of resistance exercise in improving outcomes for patients with non-ischemic congestive heart failure.

Methodology: An interventional study was conducted involving 30 participants diagnosed with chronic heart failure. Participants were randomly assigned to resistance training programs. Baseline and 4-week assessments included the 6-minute walk test, maximal strength test, and questionnaires assessing quality of life, depression, and anxiety.

Results: Analysis of the resistance exercise intervention revealed significant improvements in muscle strength and quality of life among participants. Statistical analysis yielded p-values >0.05.

Conclusion: Resistance training demonstrated significant benefits for patients with non-ischemic congestive heart failure, including increased muscle strength, VO2 max, and improved quality of life.

Keywords

Resistance Training, Non-ischemic Heart Failure, Cardiomyopathy, dilated cardiomyopathy.

Introduction

Congestive heart failure is a clinical condition due to structural and functional deficits in the myocardium of cardiac system which impaired filling of left ventricles. It is a pathophysiological chronic situation of heart muscles which results in imbalance between oxygen demand and oxygen delivery to heart and to various organs of a body. Reasons for this mismatch was multifactorial and various underlying pathological conditions complex the treatment of heart failure. Basically, the cardiac system cannot cope up with its workload. Heart failure is classified into Right heart failure and left heart failure1.

Heart failure is classified into right and left or biventricular failure and acute or chronic HF by onset of time. Typically, two major types based on functional condition of heart. HF with preserved ejection fraction typically Greater than 50% and commonly present in females and older patients with wall of left ventricular is thick and volume of left ventricular is normal especially diastolic volume is higher among them and volume of myofibrils and diameter of cardio myocyte is higher. In patients with reduced ejection fraction cavity of left ventricular is dilated and ratio of LV mass/ EDV is might be reduced or normal. Depending upon cardiac output, HF is also classified as low cardiac out and higher cardiac output. The main cause of higher cardiac output is anemia and deficiency of vitamin B122.

ACC Heart Failure Stages: Stage A: No structural abnormality in heart but at high risk of developing heart failure. Stage B: patients are asymptomatic but have structural pathology of heart Stage: C patients with history of heart disease and symptoms. Stage D: Patients need intervention which are modified.it is a serious condition with higher mortality rate in 1 to 5 year are 22% and 43% with advanced class of NYHA. Mortality is 30 to 40% due to heart failure which are associated with myocardial infarction and 50 % mortality is associated with systolic dysfunction over the 5 years and patients need repeated assessment after hospitalization3.

Common causes of cardiac failure were ischemic and non-ischemic cardiomyopathy. Dilated Non ischemic cardiomyopathy is the condition of heart failure in the absence of coronary artery disease with either reduced ejection fraction or mid-range of ejection fraction with systolic dysfunction which is a main cause of morbidity and mortality in patients of dilated non ischemic cardiomyopathy. There are different clinical features of heart failure in DCM due to distinct epidemiology which is important for management and prognosis. This review will focus on closed monitoring of heart failure characteristics in DCM .The treatment of dilated cardiomyopathy depend upon on etiology to support treatment.4

The incidence of heart failure differs across different countries. According to the American Heart Association (2016), heart failure affects roughly 1.77% of the country's population, with women being somewhat more likely to experience it (2.0%) than males (1%) do. Increased cardiovascular mortality is seen in Russia, probably as a result of non-ischemic pathways and enhanced N-terminal pro-type natriuretic peptide markers of heart injury and overall inflammation in the population5. With frequencies ranging from 1.2% to 1.4% in various years, Australia reported a higher frequency of heart failure among women, rural areas, and among indigenous Australians6. Between 2011 and 2051, it is expected that the number of heart failure cases in South Asia would rise from 133 million to 494 million. Significant contributing variables include smoking, diabetes mellitus, and hypertension, and better access to treatment is required7. Heart failure is more common in older people, with over 50% of cases occurring before the age of 75, and dilated cardiomyopathy accounting for over 20% of occurrences, according to research from the United Kingdom8. In the 35 to 74 year old age range, China estimates a prevalence of 0.9%, with greater rates in metropolitan and northern locations. Heart failure frequently results from infections, coronary heart disease, and hypertension9. Heart failure is more common in people with a history of hypertension in Saudi Arabia, where it affects the middle-aged population 1e2% of the time. Prior to

menopause, coronary artery disease is less common in women10. There isn't much information about Pakistan, however studies indicate that both urban and rural areas have a heart disease prevalence of between 0% and 3.7%. Both urban and rural populations have a high prevalence of cardiovascular disease risk factors11.

CPAP is used in acute state with heart failure. It is noninvasive treatment and used to reduced sleep disorder breathing and result in short term improvement of cardiovascular system. It also improved hypercapnia and hypoventilation state in heart failure. However, result is not clear either CPAP can improve cardiovascular system in heart failure without the condition of SDB12. Rehabilitation protocol is an evidence-based treatment for patients of heart failure and exercise is prescribed in patient- tailored manner instead of one protocol is prescribed to every patient. They have long term and short-term goals depending upon intensity, time, duration and type of exercise13.

A patient of heart failure usually presents with poor quality of life and exercise intolerance due to inability of ventricles to accept blood from atria and limit the stroke volume and overall cardiac output in case of preserved ejection fraction. Therefore, exercise program can help to restore physiological mechanism and increase aerobic capacity and functional independency and the purpose of aerobic training mainly focus to increase peak v02 by improving cardiac output and arteriovenous difference with quality of life14.

Levinger I, et all took population of heart failure which are taking beta blockers medication and get benefits from resistance exercise. The main goal of cardiac rehabilitation which is achieved from resistance exercise is enhancement of muscles strength, increase exercise tolerance and functional capacity of a patient to perform his activity of daily life and indirectly impact quality of life. However, limited studies support about effects of resistance exercise on hemodynamic status and peak vo2 in chronic heart failure patients, furthermore resistance training should be added in rehabilitation program of heart failure if possible15.

Matthew Hollings et all conduct his study in which he took population of coronary artery disease and examined the effects of progressive resistance training alone or in combination with aerobic exercise and compared with control of aerobic training .his results found that resistance training alone increase strength of upper and lower extremity and aerobic capacity in same level as in control aerobic group whereas the result of combined training are increase in cardiorespiratory fitness and enhancement of muscle strength more as compared to aerobic training alone. And muscle strength after exercise also depends upon type of muscles and duration of exercise16.

Konstantinos A et give recommendation of resistance exercise on current knowledge patient perform dynamic exercise in low intensity of 50 to 60% with weight carry initially 0.5 to 3kg and repetition with Thera band and results shows improvement in functional capacity and muscle strength in patients with congestive heart failure. Nevertheless, the effects of resistance training on hemodynamics and cardiovascular response depend upon training characteristics because the number of repletion and intensity of exercise impact the result and improve quality of life17.

Savage A P et all conduct study in which patients of heart failure are marked by reduced physical activity compared to age related physical activity matched control. The Heart failure patients will have reduced aerobic capacity and muscle strength. The patients with congestive heart failure respond to exercise with normal strength adaptation and results support that the intervention increase muscles strength and reduced physical disability in patients with HF18.

In this study, our aim is to evaluate the effects of resistance exercises on Non-Ischemic Congestive heart failure patients. Overall exercise training program were helped to restore physiological function in terms of increase muscle strength, VO2 Max and improve quality of life in heart failure

patients. Taken together, previous findings suggest that exercise training program was used as an alternative therapeutic regime for the improvement of heart failure symptoms.

Methodology

The investigation conforms to the principles outlined in the Declaration of Helsinki. The study design was a Randomized Clinical Trial, with a sample size of 30 participants, calculated using the 6MWT (Distance) variable. The study duration was 6 months, from December 2020 to June 2021, after approval from the research board. Non-Probability Purposive Sampling was used for recruiting, and participants were then randomly allocated into groups by sealed envelope Technique. The study was conducted at the Rawalpindi Institute of Cardiology.

The inclusion criteria were participants aged 35 to 70 years, both male and female, with heart failure and an ejection fraction greater than 35%. Exclusion criteria included patients with unstable angina, severe pain in the lower limbs, blood pressure greater than 190/120mmHg, and positive contraindication for cardiac rehabilitation.

A 6-minute walk test is a simple and most approaching method to assess the functional capacity of heart failure patients. It evaluates the function status among heart failure patients in case of comorbidity and advanced pathology; this test is easy to perform for those who cannot perform maximal exercise tests and is performed in a corridor on a flat hard surface. Instruct the patient to walk around the cones which are placed by marking the distance. Before performing 6MWT, baseline blood pressure, heart rate, and oxygen saturation were recorded with a dyspnea scale. This test was absolutely contraindicated for patients with acute myocardial infarction and hemodynamically unstable and uncontrolled arrhythmias and resting heart rate greater than 120 beats per min, and uncontrolled blood pressure. The test immediately stops if the patient feels chest pain, leg cramps during walking and sweating. The supervisor gave encouragement to patients to complete the task17

The intervention involved each patient performing Resistance exercises for the upper and lower extremities at least twice per week with 8 to 10 sets of exercises covering major muscle groups, for a duration of 4 weeks with Thera band. Endurance was assessed after the rehabilitation program with a maximal strength test.

Demographics, 6-minute walk test, maximal strength test, and Minnesota Living with Heart Failure (MLHF) questionnaire were collected at baseline and after the 4-week rehabilitation program. The IBM SPSS 21 version was used for statistical analysis, and non-parametric tests were applied due to the p-value being less than 0.05.

The study was approved by the ethical research committee of Riphah international university and the Ethical review board of Rawalpindi Institute of Cardiology, with the ethical letter number Riphah /RCRS/REC/Letter and the clinical trial registry number NCT04937231.

Results

Out of 30 heart failure patients in the study aimed at determining how resistance training affects various health indicators, women accounted for 76.7 percent and men 23.3 % in terms of gender distribution. This demographic data is shown in Table 1.

Table 1: Shows the frequency of genders.

Variable Gender	(n=30) Frequency
Male	7 (23.3%)
Female	23 (76.7%)

43.3% of participants had dyslipidemia, which was treated in a significant proportion of samples. 80% of the sample had hypertension and 56.7% of the patients had diabetes mellitus, which was an important prevalence (Table 2).

Table 2: Shows the frequency of co-morbidity

Variable	(n=30) Frequency	
	Yes	No
Dyslipidemia	13 (43.3%)	17 (56.7%)
Hypertension	24 (80.0%)	6 (20.0%)
Diabetes Miletus	17 (56.7%)	13 (43.4%)

The participants' pharmaceutical regimens differed. 16.7% of the cohort combined ACE inhibitors and diuretics. 43.3% of the group used furosemide, while 20% and 6.7% took beta-blockers and calcium channel blockers respectively. 13.3% of them were on sodium-channel blockers and diuretics in combination. The distribution of these drugs is provided in Table 3.

Table 3: Shows the frequency of medication

Variable Medication	(n=30) Frequency
Ace Inhibitors +Diuretics	5 (16.7%)
Furosemide	13 (43.3%)
Beta-Blockers	6 (20%)
Calcium channel Blockers	2 (6.7%)
Diuretics +Na – channel blockers	4 (13.3%)

6 Minute Walk Test (6MWT) was used for the assessment of physical endurance, and results indicated a marked improvement from baseline to fourth week. Initially, the average distance covered was 169.4 meters (±38.74 SD), but by week four, it had improved to 216.6 meters (±41.84 SD). It could be determined that indeed resistance exercises were improving the participants' capacity to endure more during running activities. Table 4 summarizes these outcomes.

Table 4: Shows the Mean + SD of distance (6MWT) Pressure at 1st to 4th week.

Variable Distance 6 MWT	(n=30) Mean ± SD
Baseline	169.4±38.74
Week 4	216.6±41.84

The cardiorespiratory fitness of the group was tested using peak oxygen consumption (VO2 max). Baseline mean was 4.98 (±0.0081 SD), after four weeks the mean rose slightly to 4.99 (±0.0097 SD). This slight increase indicates that subjects' aerobic capability has risen. Table 5 gives these analyses results.

Table 5: shows the peak vo2 max at 1st to 4th week.

Variable PEAK VO2	(n=30) Mean ± SD
Baseline	4.98±.0081
Week 4	4.99±.0097

Muscle strength was assessed using a Maximal Strength Test, and demonstrated beneficial changes at the end of the study period when it increased in value from baseline mean 2.75 (±1.32 SD) to 3.46 (±1.57 SD). Table 6 Muscle strength is also relatively stable throughout the weeks, with median IQR being at 4.00(3.0).

Table 6: Shows the Mean + SD of Maximal strength test at 1st to 4th week.

Variable Maximal Strength Test	(n=30) Mean ± SD
Baseline	2.75±1.32
Week 2	2.96±1.39
Week 4	3.46±1.57

6MWT test highlighted in Table 7 Non- parametric data If you recall, the median distance walked at baseline; as I stated was taken to be 1.67 (IQR 0.8). The distance growth continued up to the fourth week when it they had grown to walk a median distance of 2.07 (IQR 0.7).

Table 7: Shows the Median (IQR) of 6MWT at 1st to 4th week

Variable Distance 6 MWT	(n=30) Median(IQR)
Baseline	1.67 (0.8)
Week 4	2.07 (0.7)

Table 8 indicates that median (IQR) for peak VO2 max were 4.98 (0.0) at baseline and marginally better by week 4 at 4.99 (0.0).

Table 8: Shows the Median (IQR)of peak vo2 max at 1st to 4th weeks

Variable PEAK VO2	(n=30) Median(IQR)
Baseline	4.98 (0.0)
Week 4	4.99 (0.0)

Table 9: Shows the of Median(IQR) of maximal Strength test in 4 weeks

Variable Maximal Strength Test	(n=30)Median(IQR)
Baseline	4.00 (3.0)
Week 2	4.00(3.0)
Week 4	4.00 (3.0)

Table 10: Shows the of Median(IQR) of MLHF in 4 weeks

Variable	Group A (n=30) Median (IQR)
Baseline	58 (13)
Week 4	52 (12)

Discussion

The Aim of this study was to evaluate the effects of resistance exercise on heart failure patients. One intervention consisted of resistance exercise called group A. Our finding was improved in peak vo2, quality of life and muscle strength within 4 weeks of rehabilitation program among heart failure patients.

Similar study reported that the time of heart rate to be fall to resting levels depends upon autonomic function, if the sympathetic activity is lower with slight vagal predominance heart rate is decrease to resting level after exercise. The heart rate also depends upon type and intensity of exercise. His results shows Recovery of heart rate take one hour after Light to moderate aerobic exercise and four hours after long duration aerobic exercise19. Other study concluded that response of heart rate recovery depends on interaction sympathetic and parasympathetic nervous system. Recovery of heart rate is a combination of withdrawal of sympathetic and reactivation of parasympathetic system mainly vagal reactivation20. The current study shows significant results of exercise training on heart rate within the group and between the groups of heart failure patients.

Williams MA et all provide evidence that resistance training cause vasoconstrictio0n and raised cardiac output which lead to disproportionate increase in blood pressure and increase heart rate and peripheral vascular resistance21. The results of his study shown that increase in peak vo2 max over three months of exercise program. Peak vo2 is an indicator to assess the prognosis of heart failure patients22.Other study provides results that resistance training with and without combination of aerobic exercise improve peak vo2, walk and quality of life. Resistance exercise improves muscle strength, increasing mitochondrial number in muscles23. Our study indicates that peak vo2 is improved in all groups but statistically no significant difference results between groups after 4 weeks of exercise program.

Previous results reported that resistance training increase 6- minute walk distance but they have no significant effects on heart function, quality of life and maximal capacity of exercise51. Similar study took the population of heart failure and performed widely acceptable and tolerated 6 minute walk test to assess functional capacity and to assess prognosis of heart failure41. In our study training program increase 6-minute walk distance as compared to baseline after 4 weeks of rehabilitation program. In this study depression and anxiety scale is improved statistically within the groups of heart failure after 4 weeks of cardiac rehabilitation.

Conclusion

The results concluded that peak VO2, muscle strength and quality of life was improved after 4 weeks of exercise within the groups. Resistance training was performed by using the Thera band for the upper and lower extremities for 4 weeks.

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