

An Experimental Study to Analyse the Effect of Cardiopulmonary Rehabilitation in Improving Functional Capacity and Pulmonary Function Test in Patients with Post Renal Transplantation

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Abstract: ***Aim:** An experimental study of cardiopulmonary rehabilitation of post renal transplantation individuals with decreased pulmonary capacity and study is a pre - test and post - test experimental design. **Materials and methods:** 11 subjects were selected and treated with course aerobic exercise and active resisted breathing exercise. This study was done to assess the pulmonary changes and functional capacity using the pulmonary function test and Six Minute Walk Test (SMWT) in patients following kidney transplantation. This study was conducted in a multi specialty hospital after getting approval from the Institutional ethical committee. The outcomes were measured using the Modified Borg Scale and six - minute walk test. **Results:** The results of the study show that there was and decrease in pulmonary dysfunction among the people who underwent renal transplant both LRRT and DDRT. They were found to have decrease in pulmonary function, physical activity and functional capacity immediately after transplantation, the pulmonary functions improved and plateau during 1 - 2 years after transplantation and after 2 years the parameters again declined. **Conclusion:** There was a reduction in pulmonary functions (FEV1, FVC, FEV1/FVC andPEFR) after Kidney transplantation patient more than the pre - operative status, which was pronounced after 2 years of transplantation. The physical activity level was reduced after Kidney transplantation. There was a reduction in the functional capacity after Kidney transplantation. The reduction in pulmonary function, physical activity level and functional capacity was more in deceased donor transplantation than live related donor transplantation.*

Keywords: Renal transplantation, aerobic exercise, active breathing exercise, pulmonary capacity, six - minute walk test, respiratory distress

1. Introduction

Renal transplantation is the remedial measure in the management of End stage renal disease (ESRD). The kidney transplant is a surgical procedure in patients with ESRD, receive a new kidney which take ups the renal functions. The outcomes of renal transplantation is multi factorial depends on the type of transplantation, new kidney's health status, recipient co - morbidities, type of medication regimen administered, patient follow - up with medical care, physical activity, nutrition, exercise adherence (Zella *et al.* 2019).

Chronic Kidney disease is characterized by reduction in glomerular filtration rate and retention of blood urea, which increases the risk of heart and vessel diseases in long run. Early detection and treatment prevent complications otherwise, it leads to kidney failure, which requires dialysis or transplantation. Maintenance dialysis forms the main stay of treatment prior to kidney transplantation. Chronic renal disease is associated with a variety of respiratory manifestations indifferent stages. The Hemodialysis or peritoneal dialysis regulates the kidney functions for a while, but these patients are at risk of developing many complications due to dialysis and medications consumed to maintain the kidney functions (Rajapaksa *et al.*, 2019).

Impaired pulmonary function and alter bronchial responsiveness inpatients on hemodialysis is caused by several mechanisms that impairs pulmonary function, which include strapping of neutrophils, increased extra - vascular

lung water, left ventricular hypertrophy. The muscles of respiratory function, such as the diaphragm and intercostals show decreases in muscle strength and endurance due to uremicmyopathy. The important causes for renal transplant failure are the infection and tissue rejection; in order to counter act them, patients receive anti bacterial coverage as well immuno suppressant medications to make the body to accept the new organ transplanted. But, the anti - rejection medications have a large number of possible side effects because the body's immune defenses are suppressed (Holdase *et al.* 2003 (Kibera & Panek, 2008)

Although the occurrence of chronic rejection as a cause of renal transplant failure has decreased in recent times, pulmonary complications are more prevalent. In about 60% of all cases of kidney transplantation, pulmonary complications take an important place in prognosis of the patient. The complications can be caused by many factors such as interstitial and alveolar edema, pleural effusion due to volume overload or increased capillary permeability, pulmonary hypertension, hemosiderosis, and weakness of the pulmonary muscles. Hemodialysis patient present increased interstitial fluid volume, weak muscles, and decreased diffusion capacity.

Tarasevich *et al* (1992) has studied the involvement of diaphragm in the uremia and has concluded that loss of strength occurs in severe uremia. The ventilator deficit due to this impairment in respiratory muscles, combined with other lung tissue impairments, compromises the functioning

of pulmonary system, there by contributing toward decreased lung capacity and functional capacity (G. J Kemp et al 2004, G. K Saka's *etal*2003 (Abdalla, 2013)).

The change in pulmonary function after renal transplantation leads to reduced work capacity after transplantation. The association between changes in pulmonary functions with physical activity and functional capacity is not established. The changes in Pulmonary function after renal transplantation is sparsely studied in our population and hence this cross - sectional study to analyze the changes in pulmonary function after renal transplantation was taken up.

Aerobic Exercise

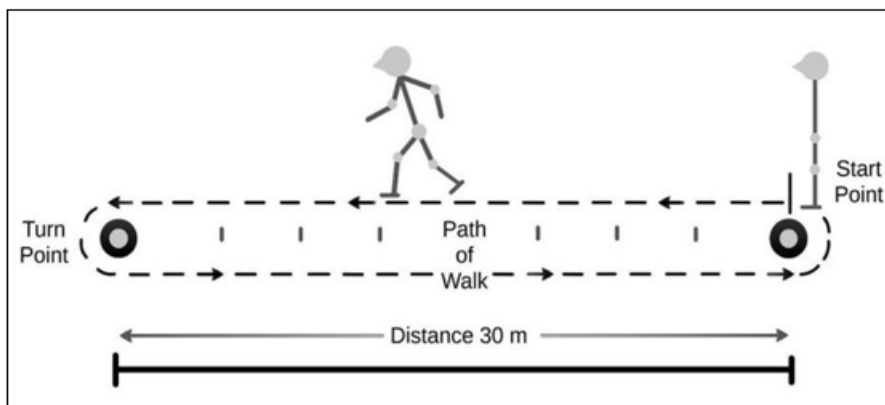
Aerobic exercise is any kind of Cardiorespiratory conditioning exercise. During aerobic exercise breath controls, the amount of oxygen that can make it to the muscles to help them burn fat and move. It is relevant to do aerobic exercise every day. There are 3 methods for progress aerobic fitness - Increase speed, Increase the resistance. Increasing intensity should be done very gradually. The benefits of aerobic exercise are - Improves cardiovascular conditioning, decreases risk of heart disease, lowers blood pressure, increases HDL or "good" cholesterol, helps to better control blood sugar, assists in weight management and/or weight loss and improves lung function. Low impact aerobic exercise includes walking, mild jogging, climbing stairs, and rhythmic movements of limbs with breathing control patterns.

Active Resisted Breathing Exercise

The diaphragm is the most cardinal muscle for breathing. The abdominal muscles help to move the diaphragm and give more power to empty the lungs. This diaphragmatic breathing pattern lowers the heart rate, regulates the blood pressure, relaxes mentally and decreases the release of stress hormone. It is performed in a sitting position or in a comfortable lying position. The procedure is performed with shoulders in a relaxed position and a hand on the chest and the other hand on the stomach. The patient inhales the air through the nose without any strain or pushing until to a point that cannot allow further air inhalation. A feeling of fullness is felt in the abdomen and stomach. The patient further pursues the lip as though sipping through a straw and exhales the air through the lips for 4 seconds. This procedure is repeated over a pre determined time.

6 Minute Walk Test

The next outcome measure used for the study is exercise tolerance testing using a six minutes' walk test (6MWT). The subject of this test is to walk as far as possible for 6 minutes. Therapist will walk back and forth in this hallway. The duration of this test is a long time to walk. The subject will probably get out of breath or become exhausted. So, they permitted to slow down, then stop, and to rest as necessary. For resting patient will lean against the wall, but resume walking as soon as.



Scheme of 6 - Minutes' Walk Test

2. Methodology

This Experimental study was done to assess the pulmonary changes and functional capacity using the pulmonary function test and Six Minute Walk Test (SMWT) in patients following kidney transplantation. In this sample there was no patient with smoking/ coronary artery disease/ COPD. There were few diabetics (2) and Hypertensives (3). The treatment duration of this study was conducted for a period of 8 weeks. The clearance for this study was obtained from the Institutional Ethics Committee (IEC). The list of kidney transplant recipients was taken from the transplant registry of the hospital and the patients were contacted over phone call. Patients who had willingness to participate in this study were screened for inclusion into the study during the review/ physician consultation. The subjects with age range of 18 to 65 years of both gender, with uncomplicated clinical course during hospitalization and having willingness to participate

in the study were included in the study. The subjects with uncontrolled arrhythmias, neurological impairment, musculoskeletal diseases or injury affecting mobility and pulmonary disease were excluded from study. The eligible patients were assessed for the study after obtaining written informed consent.

Among 50 patients in the registry list, 30 patients were contacted and 20 patients showed willingness to participate and 11 patients came for assessment during review from whom the study data was collected. The patients who came for the monthly review at the kidney transplant unit were being referred to the physiotherapy department, the patients were given a hand out a both the study proposal and the informed consent was been taken by them. The patients who gave their consent in participating the study was being screened for inclusion and exclusion criteria.

Parameters such as blood urea nitrogen (BUN), creatinine hemoglobin were being noted down, the FEV1, FVC, FEV1/FVC RATIO and PEFR values were collected from the pre - operative pulmonary function test report. The patient is been given a questionnaire on physical activity level (IPAQ) the questionnaire is been checked and verified by the therapist and the score for the physical activity is being mentioned on the top right side of the questionnaire. the patient is been explained about the importance of functional capacity and being informed that the functional capacity can be measured by help of a 6 minute walk test, the procedure was explained and the patient was made to do a six minute walk test in a 30 meter corridor with all the precautionary measures taken. The patient was given adequate amount of time to rest (20 - 30minutes) and later was assessed for their pulmonary function, by a pulmonary function test. The patient was explained about the test and given a demonstration to the patient on how it should be done. The FEV1, FVC, FEV1/FVC ratio and PEFR were recorded using Koko software by entering all the patient's demographic data (height, weight, nationality and race) to get all the predictive values. The pre and post - operative pulmonary function test reports the current physical activity level and functional capacity (6MWD) were analyzed to determine if there were any significant changes after renal transplantation.

Subjects in the Control group were given Aerobic Exercises that include walking and mild jogging. They performed it for a period of 8 weeks on alternate days. Each session included 20 minutes of walking in medium phase and 10 minutes of mild jogging either in the same place as spot jogging or over a distance depending on the convenience of the subject. Subjects in the Experimental group were given Deep breathing exercise and Incentive spirometry.

The subjects were given deep breathing exercise by positioning in sitting/crook lying and was instructed to take a deep breath as to fill in the lungs. The subject should feel the heaviness or fullness and the abdomen blows up. When the subject cannot breath in beyond a point, he is instructed to breath out through pursed lips. The deep breathing exercise program were started initially with 10 cycles with 2 repetitions, 15 cycles with 2 repetitions, 20 cycles with 2 repetitions, 25 cycles with 2 repetitions in the 1st, 2nd, 3rd, 4th week respectively and 25 cycles were maintained till eighth week with 3, 4, 5, 6 repetitions in 5th, 6th, 7th and 8th week.

The subjects were given incentive spirometry exercises in a relaxed position (half lying). The program was initiated with 10 - 15 breath/day for first 2 weeks, followed by 15 - 20 breath twice/day on the 3rd, 4th and 5th weeks and 20 breath thrice/day in the next three weeks. At the end of 8 weeks the subjects belonging to both the groups underwent the standard test included in the study in a similar fashion to that of the pre - test measurement and the scores were marked as post - test.

3. Data Analysis

The analysis of data collected from 11 patients for their demographics, clinical variables and outcomes of the study was done as prevalence percentages, mean comparison, and the changes in pulmonary functions, physical activity levels and functional capacity were analyzed using SPSS 15.1 version. The results obtained were tabulated and as follows:

The mean age of the study sample (n=11) was 32.26 with a standard deviation 8.37. The study sample had number of males more than female. The sample outcomes were analyzed by the type and duration of transplantation. The number subjects in live related and deceased donor were 5 and 6 respectively. There were 8 patients above one year and 3 were below one year completed a time of data collection. In this sample there was no patient with smoking/coronary artery disease/COPD. There were few diabetes and Hypertensives

There was significant reduction in pulmonary function in patients who underwent renal transplantation (Table 2.). The reduction in functional capacity and physical activity were more in DDRT than LRRT. After two years when compared to preoperative status, patients had reduced physical activity level and functional capacity (Table 3).

The results of the study show that there was and decrease in pulmonary dysfunction among the people who underwent renal transplant both LRRT and DDRT. They were found to have decrease in pulmonary function, physical activity and functional capacity immediately after transplantation; the pulmonary functions improved and plateau during 1 - 2 years after transplantation and after 2 years the parameters again declined.

Tables

Table 1: Base line characteristics of the study sample #
Expression in %

Variables	Mean ± SD
Age	32.36± 8.37
Gender	
Male#	63.64
Female#	36.36
Clinical parameters	
Bun	12.64 ± 1.8
Creatinine	1.2 ± 0.223
Hemoglobin	23 ± 1.16
Co morbidities	
Diabetes#	18
Hypertension#	27

The results of the study show that there was residual pulmonary dysfunction among the people who underwent renal transplant both LRRT and DDRT. There was reduction in pulmonary functions after two years when compared to pre - operative period which statistically significant (P<0.05). The functional capacity and physical activity were also noted to be reduced; this might have some influences on the development of pulmonary impairment or vice versa, which needs further exploration.

T Pulmonary functions	Pre – operative	Post - operative			Level of significance
		<1year	1 - 2years	>2years	
b FEV1	95.27	84.25	89.5	85.33	.000
1 FVC	94	84	101	88	.032
eFEV1/ FVC RATIO	113.90	103.25	94.25	97.66	.001
2 PEFR	105.90	79.25	97.25	81.33	.000

The pre/post - operative changes in pulmonary functions at different time point in the study population

Table 3: The physical activity level and 6 - minute walk distance in the study sample

Transplantation type	Physical activity	6minute walk distance
LRRT	1870	516
DDRT	922	478.33
Duration		
<1year	847	430
1 - 2years	1954	556
>2years	858	460

4. Result

Among the people who underwent renal transplant both LRRT and DDRT. They were found to have decrease in pulmonary function, physical activity and functional capacity immediately after transplantation the pulmonary functions improved and plateau during 1 - 2years after transplantation and after 2years the parameters again declined. The subjects of both the Control group and Experimental group were given the intervention for a period of 8 weeks. Before the treatment, the pretest values of Modified Borg Scale and Six – minute walk test values were measured. After 8 weeks of intervention, the post - test values of Modified Borg Scale and Six - minute walk test values were measured. The results conclude that Active Resisted breathing exercise had more influence in that Active Resisted breathing exercise had more influence in decreasing the breathlessness and fatigability than aerobic exercises alone.

5. Discussion

In this study gender shows predominant of male recipients (64%) with organ donated by others. Similarly, previous studies have reported about 67.3% of transplant recipients to be male (Brown G: 2001). The uneven distribution is probably due to gender bias of society as male being considered as bread winner in most of the social system which is prevalent in India too as like other country. The comorbidities of diabetes (18%) and hypertension (27%) were found to be less which probably due to younger aged as well a smaller study sample.

The interaction/association between Physical activity level, functional capacity with Pulmonary functions needs exploration in a larger sample. Moreover, there was a difference in physical level between transplant with LRRT showing better score than DDRT, which is in concurrence with previous study, indicating where in mixed benefits in different type of transplantation (Instar S. Waked *et al* 2015, ElisaJ. Gordon *et al*2005).

The result needs to be tested in a larger sample before

generalization. The effects of exercise training on pulmonary functions and correlation with physical activity and functional capacity could be done as furtherance of this study. Aerobic exercises when performed as regular exercise for 20 - or 60 - minutes duration which might be cycling or walking with an intensity of 55% to 80% of VO₂ max or 60 to 80% of maximum heart rate and 2 - 3 sessions a week enhance the immunological functions of the body without exhaustion. (Alwa2020).

Active Resisted breathing exercises improve the symptoms of dyspnea, relieve anxiety, reduce complications, minimize disability, preserve function and improve quality of life.

In the present study combination of Aerobic exercises and active resisted breathing exercises is proved to be effective in decreasing the breathlessness and fatigability of post transplantation cases. The Paired 't' test was used to compare the Pre - test and Post- test values of Modified Borg Scale and Six - minute walk test for both the groups. Based on the statistical analysis, the result of present study shows there is a significant decrease in breathlessness and fatigability of Group A and Group B following Active Breathing Resisted exercise along with aerobic exercise and Aerobic exercise alone. The Unpaired 't' test was used to compare both the t - values of Modified Borg Scale and Six minute walk test, the result of the present study shows that there is a significant decrease in breathlessness and fatigability in Group B who received Active Resisted breathing exercise along with Aerobic exercise training than in Group A who received Aerobic exercise alone. Paired - t test was done for pre - test and post - test values of Modified Borg Scale for both Group A & Group B. The calculated t - value of Group A is 3.39 and Group B is 12.53 which is greater than the t - table value of 1.6991 significant at level of 0.05 and it shows statistically there is significant decrease in breathlessness level in both the group. The t - value difference between Group A & Group B is 9.14 and the calculated unpaired t – test value is 10.14 that is greater than the t table value 1.6715 and P <0.05. The result is significant at P <0.05. The t - value difference between Group A & Group B is 14.85 and the calculated unpaired t - test value is 8.9 that is greater than the t table value 1.6715 and P <0.05. The result is significant at P <0.05.

6. Conclusion

From the data analysis it is evident that in the study we conclude that post renal transplantation patients who underwent Active Resisted breathing exercise with aerobic exercise training are more effective in reducing breathlessness and fatigability level than aerobic exercise training alone. The alternative hypothesis is accepted in breathlessness and fatigability measure. Hence it is confirmed that Active Resisted breathing exercise with Aerobic exercise training are more effective than Aerobic

exercise training alone. They have improved lung capacity post pulmonary rehabilitation and breathing exercises.

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