Comparative Study between Efficacy of Circuit Training and Interval Training in Improving Exercise Capacity among Chronic Kidney Disease Patients

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Abstract

Introduction: Exercise has several benefits in general population in reducing risk of cardiovascular mortality. Aerobic, resistance and combined exercise are several forms of exercises suggested in CKD to improve quality of life. Circuit training and interval training are two important forms of high intensity aerobic resistance training. There is a limited data that compares these two forms of exercise and their benefits in CKD. Hence this study was designed to find and compare the effectiveness of circuit training and interval training in improving exercise capacity amongst CKD.

Materials and Method: This was an intervention study. Patients aged between 36-71 years with CKD stage 2-5, who were hemodynamically stable, who could perform activities and not having associated co morbid conditions were included. Those with chronic heart failure and co morbid conditions were excluded. 82 patients were recruited, with 41 in each of circuit training and interval training group. The intervention (circuit based and interval based) lasted for 8 weeks in total, with exercise sessions lasting for 50-55 minutes at a frequency of 3 sessions per week. The progression of intensity, frequency and duration was monitored and controlled by Borg's perceived exertion scale applied for resistance exercise. 6 minutes walk test prior and after exercise at baseline and after 8 weeks was recorded along with vitals.

Results and Discussion: 120 patients were screened from February 2016 through January 2017 for eligibility to participate in this study, patients assessed for eligibility to participate, 38 individuals were excluded because they did not meet inclusion criteria or declined to participate in the study after the initial screening according to inclusion criteria selected the sample 41 patient each has selected for each group rest of them excluded from the study. Conducted study for total duration of 1 year, each patient had trained for 8 weeks. 2 weeks supervised and 6 weeks home based. All were performed well during training period.

Conclusion: Baseline characteristics were similar and both circuit and interval exercise intervention showed improvement in 6 minutes walk test.

Keywords: *Chronic kidney disease, Exercise capacity, Circuit training, Interval training.*

Introduction

Age adjusted CKD (Chronic kidney disease) prevalence in India is reported to be 229/million population and > 1,00,000 patients enter renal replacement annually.[1] Exercise has several benefits in general population in reducing risk of cardiovascular mortality, control of diabetes and hypertension, which are also amongst the common causes of CKD and hence deemed beneficial. Aerobic, resistance and combined exercise are several forms of exercises suggested in CKD to improve quality of life. Several studies have suggested

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that exercise in CKD improves physical functioning, help in better management of hypertension.[2] Circuit training and interval training are two important forms of high intensity aerobic resistance training. While circuit training improves muscle endurance, interval training achieves better cardiovascular performance. There is a limited data that compares these two forms of exercise and their benefits in CKD. Hence this study was designed to find and compare the effectiveness of circuit training and interval training in improving exercise capacity amongst CKD.

Materials and Method: This was an intervention study conducted in Yenepoya Medical College, Mangalore after obtaining informed consent from the patients. Patients aged between 36-71 years with CKD stage 2-5, who were hemodynamically stable, who could perform activities and not having associated co morbid conditions were included. Those with chronic heart failure, pregnancy, uncontrolled diabetes mellitus and hypertension, cardiac arrhythmia, osteoporosis, orthopaedic diseases, who required support for ambulation, with psychiatric illness, who started exercise recently, known cases of neuro muscular disease and had taken antibiotics for a course of infection within last month were all excluded from the study. Diagnosis of CKD, assessment of inclusion and exclusion criteria was done by nephrologists, after the recommendation from whom the patients were recruited. The data were collected from pre assessed health files of hospital records. 82 patients were recruited, with 41 in each of circuit training and interval training group. Sample size was calculated for a significance level of 0.05 and power of 0.8.

The intervention lasted for 8 weeks in total, with exercise sessions lasting for 50-55 minutes at a frequency of 3 sessions per week. The progression of intensity, frequency and duration was monitored and controlled by Borg's perceived exertion scale applied for resistance exercise. [3] The Borg RPE scale is a numerical scale that ranges from 6 to20, where 6 means no exertion at all and 20 means maximal exertion. (6 – No exertion at all; 7 – Extremely light;8,9 – Very light; 10,11 – Light; 12,13 – Somewhat hard;14,15 – Hard;16,17 – Very hard;18,19 – Extremely hard). Interval training consisted of 10 minute warm up including stretching of general group of muscles hamstring, quadriceps, pectoralis major, biceps, triceps and calf muscles. Warm up was followed by 30-35 minutes of aerobic and resistance training that included static cycling only. Finally 10 minutes of cool down period was offered. Circuit training was done using moderate intensity exercise without rest periods. Similar 10 minutes warm up with stretch exercise was done followed by 30-35 minutes of aerobic and resistance training. Aerobic training included 3 minutes each of static cycling, stepping activities and walking in order respectively. Resistance training included 3 minutes each of bicep curls using light hand weights, chest press using light hand weight and 5 minutes of rest after one session in that order and repeated. Finally 10 minutes of cool down period was offered. Exercise capacity of each group was measured by using 6 minutes walk test (6 MWT) before and after the exercise intervention of 8 weeks in each group. This was achieved with 2 weeks of supervised training following which they were sent home, but were asked to perform same activities at home with same intensity for the rest of 6 weeks. The instructions were given through phone.

Vitals including respiratory rate (RR), Pulse rate (PR) by radial pulse palpation, Blood pressure (BP) using sphygmomanometer by auscultatory and palpation method, SPO2 using pulse oximetry were recorded before and after 6 MWT. The body mass index was calculated for each participant by dividing their body weight in kilograms (kgs) by the square of the height (h^2) in meters. All participants were weighed on the equilibrated portable balance scale which would be at zero prior to each weighing to ensure accuracy. The weights were taken without shoes and with light clothes only. They were asked to maintain erect posture; the reading was noted and documented in kilograms. The height was measured without shoes using a stadiometer which was fixed to the wall. The participants were positioned in such a way that their backs were touching against the wall. They were instructed to maintain the erect posture with the head in neutral position, arms at side and heels together. The meter was pulled down to the vertex of their head. The reading was recorded in meters. 6 MWT included patients walking for 6 minutes on a hard flat surface with self pacing and rest along a marked pathway with pulse oximeter attached to monitor. After 6 MWT distance covered was measured in meters by the laps he covered. Maximum heart rate according to age was calculated by subtracting age from 220.

Statistical analysis was done by using SPSS IBM version 22. Descriptive statistics were reported as mean (SD) for continuous variables and frequency (%) for categorical variables. A 2 sample independent t-test'/ Mann Whitney u test was used to compare efficiency of circuit training and interval training exercises based on normality. A paired t test/Wilcox signed rank test was used to compare pre and post intervention for both circuit training and interval training. A 'p value' of < 0.05 was considered statistically significant.

Results: 120 patients were screened from February 2016 through January 2017 for eligibility to participate in this study, patients assessed for eligibility to participate, 38 individuals were excluded because they did not meet inclusion criteria or declined to participate in the study after the initial screening according to inclusion criteria selected the sample 41 patient each has selected for each group rest of them excluded from the study. Conducted study for total duration of 1 year, each patient had trained for 8 weeks. 2 weeks supervised and 6 weeks home based. All were performed well during training period.

Table No. 1: Difference in effect of circuit and interval training on exercise capacity as measured by SBP, DBP, PR and RR before and after 6 MWT

Variable	Circuit training		Interval training		Baseline	After 8 wk
	Baseline Pre 6MWT vs. Post 6MWT	After 8 wk Pre 6MWT vs. Post 6MWT	Baseline Pre 6MWT vs. Post 6MWT	After 8 wk Pre 6MWT vs. Post 6MWT	Circuit-Interval Mean diff±SEM (95% CI) P value	Circuit-Interval Mean diff±SEM (95% CI)
SBP	129.51±4.98	129.51±4.98	130.98±8.31	129.51±4.98	-1.46±1.5 (-4.4 – 1.46) P=0.336	-1.46±1.5 (-4.4 – 1.46) P=0.336
	149.51±5.89	149.51±5.89	148.54±9.37	148.78±8.72	0.98±1.73 (-2.46– 4.42) P=0.574	0.73±1.6 (-2.5-4) P=0.732
DBP	88.05±4.01	88.05±4.01	88.78±7.81	88.78±7.81	-0.732±1.37 (-3.4-1.99) P=0.595	-0.732±1.37 (-3.4-1.99) P=0.595
	98.78±3.31	98.78±3.31	99.02±7	99.02±7	-0.24±1.2 (-2.6-2.16) P = 0.84	-0.24±1.2 (-2.6-2.16) P = 0.84
PR	79.49±1.99	79.49±1.99	74.63±2.52	74.54±2.45	4.86±0.58 (0.5-3.8) P=<0.001*	-3.22±0.36 (-3.9- -2.5) P<0.001*
	86.56±1.83	86.29±1.9	79.83±4.1	79.61±4.22	6.7±0.7 (5.3-8.13) P <0.001*	6.68±0.72 (5.24-8.12) P<0.001*
RR of pre 6MWT	18.98±1.99	18.98±1.99	22.2±1.21	22.2±1.21	-3.22±0.36 (-3.9 - -2.5) P <0.001*	-3.22±0.36 (-3.9 - -2.5) P <0.001*
	24.59±1.07	24.51±1.03	25.59±1.09	25.54±1.14	-1±0.24 (-1.5- - 0.5) P <0.001*	-1±0.24 (-1.5- - 0.5) P <0.001*
6 MWT in meter	284.61±9.16	304.56±9.53	293.17±13.07	312.34±18.02	-8.56±2.49 (-13.5- -3.5) P=0.001*	-7.78±3.18 (-14.1- -1.4) P=0.17
Glucose in mg/dl	159.15±18.16	NA	153.59±18.04	NA	153.59±18.04 P=0.168	NA
GFR in ml/min	21.05±5.05	NA	21.32±6.04	NA	-0.27±1.2 (-2.7 – 2.2) P=0.829	NA

Legend to Table No. 2: Both interval training and circuit training improved the exercise performance after 8 weeks. There was no difference between circuit and interval training. 6 MWT steps improved after 8 weeks in both circuit and interval training.

Discussion

We demonstrated that this combined model of supervised and home based exercise training was efficacious, with improvements in exercise capacity. Exercise training for 2 months had significant increases in 6 minute walk distance. Prior studies have demonstrated that improving fitness in high-risk individuals, significant improvement in GFR in participants who followed an endurance training program.(4)Other exercise and physical activity studies have shown no discernible change in GFRs between the exercise and control groups; however, the relatively short duration of exercise interventions, as well as small sample sizes, combined with inherent large variability in CKD progression and the total volume of exercise of the various exercise interventions may not have been sufficient to produce significant effects over short periods in our study.(5)

This study focused on participants with progressive CKD stages 2 to 5, rather than those with more stable kidney function. Late stage of CKD is associated independently with increased risk of CVD (cardiovascular disease). Also considering the small sample size of the study, small exercise dose and variability in responses collected all contributing to less changes in GFR. However, we should emphasize that the aim was to encourage, support and educate patients to alter their lifestyles to be more physically active and meet current minimum physical activity.

Some Studies have identified low self-reported physical activity and fitness as prognostically important for CVD and all-cause mortality in patients with CKD stages 2 to 4. Despite taking great care in the administration of the assessment of self-reported physical activity, the results must be interpreted with care. Physical inactivity is the fourth leading cause of global mortality and contributes to the prevalence of many chronic conditions. Low exercise capacity independently predicts cardiovascular morbidity and mortality in the general population and patients with end-stage kidney disease.(6)

Since no adverse events in the form of cardiovascular morbidity and mortality were noted in this study, which therefore should encourage nephrologists to ensure that exercise is recommended routinely to all patients with CKD. This finding was similar to other studies.(7) But our study was not adequately powered to assess the impact of exercise training on cardiac risk factors or kidney function. The findings from this study suggest that exercise training is effective and safe in patients with CKD. Patients who previously were inactive and deconditioned were able to safely initiate an exercise program and the patients maintained activity levels over an 8 week period. In early stage of kidney disease if given an exercise intervention, can show more improvement in 6 minutes walk test, GFR (Glomerular filtration rate), BMI, exercise capacity, blood pressure, SPO2, Respiratory rate and Pulse rate,than these late stage kidney disease patients.

Similar study indicate that aerobic capacity is improved by all regular exercise training programs regardless of exercise type, intensity, or length of intervention in CKD stages 2-5 groups and showed improved health-related quality of life following regular, high-intensity mixed cardiovascular and resistance training. (8)Physicians should educate their adult patients with CKD about scientific evidence showing that regular exercise of longer than 30 minutes per session 3 times weekly will improve aerobic capacity, blood pressure, muscular strength and health-related quality of life. These benefits occur in adults with CKD stages 2-5, those receiving dialysis and adults with a kidney transplant.

Limitations of this study: The study did not include a control group to compare the findings with physically active and inactive non CKD individuals. A longer follow-up was not possible as the study duration was 1 year, exercise training was 8 weeks. The data was collected from one particular hospital based on convenience. Thus, the results of the study cannot be generalized to the whole population. End stage of kidney disease may not show much improvement in exercise capacity.

Future scope of study is the study can be carried out with large sample size with more duration and effects on parameters of kidney function in exercise intervention can be studied in CKD patients. Same study can be done in early stage kidney disease for more effective and preventive results.

Conclusion

Both circuit and interval exercise training had improvement in exercise capacity of patients with CKD.

Conflict of Interest: Nil

Source of Funding: Self

Ethical Clearance: From ethics Department:

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