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Intradialytic Exercise and Biochemical Markers: An Experimental Study

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ABSTRACT

Exercise based rehabilitation like intradialytic exercise program could improve the physical function through its contribution in maintaining electrolyte balance**.** The study was conducted with the aim to determine the effectiveness of intradialytic exercise on biochemical markers among patients on hemodialysis. Quasi experimental research design was embraced to conduct the study with 130 human samples who met the inclusion criteria in hemodialysis unit and samples allocated into experimental group (n=65) and control group (n=65) by convenience sampling technique. The demographic questionnaire was completed at the beginning of the study followed by pre-test for both the groups. Experimental group received intradialytic exercise during initial 2 hours of hemodialysis for 3months besides control group received the routine care. Post test was conducted at the end of 3^{rd} month after the dialysis session. Data were analyzed using Sigma Plot 12 (Systat, USA). After 3 months of intradialytic exercise, a significant reduction was observed in serum creatinine, blood urea, serum potassium, serum phosphate and increase in serum calcium and hemoglobin at the level of $p<0.001$ in the experimental group. The study findings concluded that intradialytic exercise programme is safe, complementary intervention and do not cost the patient extra time and this effective care can be incorporated in the regular care of patients on hemodialysis.

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INTRODUCTION

Chronic diseases have become a significant general medical issue and driving reason for morbidity and mortality (Agarwal and Srivastava, 2009). Globally, End Stage Renal Disease is one among the chronic diseases which possess a greater threat and increased burden in healthcare system and leads to increased morbidity and mortality (Khan *et al.*, 2014). It happens in the fourth through the seventh decade in patients who have diabetes or patients who have been presented to dangerous chemicals or who have some type of kidney ailment. Globally ten percent of the populations globally were affected by chronic kidney ailments and more than two million people received treatment with dialysis and kidney transplant to stay alive (Liyanage *et al.*, 2015). The basic techniques for renal substitution treatments are hemodialysis, peritoneal dialysis and kidney transplantation from which hemodialysis is considered as the most generally utilized treatment assuming a vital role in expanding patients' life span. Liyanage *et al.* (2015) stated in 2010 that, 2.618 million people received RRT globally and it is projected to double more than 5.439 million people mostly by 2030 with the growth in Asia (Girija and Radha,

2013). The prominent objective and goal of clinical care for patients with ESRD is augmenting the patient endurance, upgrading the patients' working and prosperity because these patients have low level of physical fitness and function.

Every physiological system gets affected due to impaired kidneys function and it may have increased incidence of hypertension, anemia, electrolyte imbalances, coronary artery disease etc., As a result of electrolyte imbalances and retained substances such as urea, creatinine, electrolytes and many other substances lead to fatigue, bone pain, muscle weakness, sleeplessness and increased cardiac mortality. Hyperkalemia results from the decreased excretion of the kidneys which lead to fatal arrhythmia when the level of serum potassium level reaches seven to eight meq/lit. Impaired sodium excretion and retention of sodium can lead to hypertension. It also alters the calcium and phosphate excretion leads to hypocalcaemia and hyperphosphatemia results in musculoskeletal abnormalities like osteitis fibrosa, osteomalasia and metastatic calcification. Anemia occurs due to diminished creation of hormone erythropoietin by the impeded kidneys bringing about diminished erythropoiesis by the bone marrow and it needs to be corrected which significant care of patients on hemodialysis.

Various examinations have recommended that activity based recovery program could improve the physical capacity through its contribution in maintaining electrolyte balance. One such program could be exercising during hemodialysis (Mustata, 2004). Studies also give proof supporting the relationship of activity preparing with progress in blood vessel stiffness (Parsons *et al.*, 2004), decline in pulse pressure (Johansen, 2007), increment in oxygen consuming capacity (Miller *et al.*, 2002), diminished requirement for antihypertensive medications (Goldberg *et al.*, 1980), increment in hemoglobin focus and hematocrit levels and lipid digestion (Kirkman *et al.*, 2013). Intradialytic aerobic exercise promotes increased blood flow to the central vasculature and increased vascular permeability, allowing greater area of exchange between the intracellular and intravascular compartments (Kong *et al.*, 1999). (Shukla *et al.*, 2015) This favors the solute efflux from muscles of the lower limbs, which usually remain relatively stagnant with collapsed capillaries during hemodialysis. By considering the potential effects of intradialytic exercise the present study was conducted. The aim of the present study was to determine the effectiveness of intradialytic exercise on biochemical markers among patients on hemodialysis among patients on hemodialysis (Giannaki *et al.*, 2011; Mohseni *et al.*, 2013).

MATERIALS AND METHODS

Quasi experimental research design was adopted to conduct the study with 130 samples in Dialysis Unit, Saveetha Medical College and Hospital from June 2017 to November 2017 after obtaining approval from the hospital authority. The study protocol was approved by Institutional Human Ethical Clearance of Saveetha University with reference number 014/05/2016/IEC/SU. All participants were received the verbal clarification of the nature and aim of the study and written informed consent was obtained from each participant. Samples who met the inclusion criteria allocated into experimental group (n=65) and control group (n=65) by convenient sampling technique.

The inclusion criteria were Patients with End Stage Renal Disease and on hemodialysis for more than three months with age group between 25 to 65 years of both male and female, receiving hemodialysis three times/week or two times/week for four hours per management, using bicarbonate dialysate solution for hemodialysis, willing to sign an informed consent and participate in the study, vital signs are within safe guidelines for intradialytic exercise, no medical contraindications for the proposed intervention as determined by the nephrologist and having no problems in arterio venous fistula. Patients on hemodialysis with symptomatic cardiovascular disease such as unstable angina, recent MI, CCF Grade II, body temperature more than 101^0 F, persistent hyperkalemia before dialysis, active liver disease, musculoskeletal limitations, severe peripheral polyneuropathy, dementia or other mental disorders, on other exercise programme, hemodynamically unstable during the dialysis treatment and lower limb amputation were excluded from the study.

The demographic questionnaire was finished at the initial stage of the study. Pre-test was conducted by obtaining 5ml of blood samples from the arterial line by the same staff to determine the biochemical markers like blood urea, serum creatinine, serum potassium, serum calcium, serum phosphate and hemoglobin in both the group. Intradialytic exercise was prescribed for 10 to 15 minutes a day for three times/week for twelve weeks during first two hours of hemodialysis session according to the tolerance of the samples by using bicycle ergometer to the experimental group besides control group received the routine hospital care. Tolerance of the samples especially target heart rate for doing exercise period

was calculated by Karvonen formula, monitored the vital signs as blood pressure, heart rate during exercise and informed the client to report any side effects like dyspnea, dizziness, and palpitation. Pre demonstration on exercise was demonstrated prior to initiate the exercise. The sort of the dialysis apparatus, dialyzer membrane and the blood flow and dialysate flow rates were kept unaltered for all patients during the investigation. Post test was conducted at the end of 12 weeks immediately after the treatment of dialysis. Blood samples were drawn by the same staff nurse in the dialysis unit throughout the study. Confidentiality was maintained throughout the procedure.

Effectiveness of intradialytic exercise on biochemical parameters of the clients was determined in experimental group and compared between the study group and control group was done using Sigma Plot 12 (Systat, USA). The data were expressed as Mean ± SE and as frequency distribution. Paired 't' test and Unpaired 't' test were utilized for the correlation of means. A probability of 0.05 or less was taken as statistically significant.

RESULTS AND DISCUSSION

The data presented in reveals that Majority of the samples were male (87.69% in experimental group, 83.08% in control group) and fall in the age group between 51-70 (60% in experimental group, 55.38% in control group) years in both experimental and control group. No noteworthy changes was found in socio segment attributes between the experimental and control group in age, sex, residence, marital status, educational status, occupational status and income. It is evident that no noteworthy change was observed in the clinical variables between the study and control group such as family history of chronic kidney disease, duration of end stage renal disease since diagnosis, cause for Kidney Disease, duration of hemodialysis and number of hemodialysis treatment per week.

When considering the effect of intradialytic exercise on biochemical markers, the summary of all biochemical markers of serum creatinine, blood urea, serum potassium, serum calcium, serum phosphorous and hemoglobin score of control and experimental group before and after the administration of intervention were shown in tables and figures. Comparison of control and experimental group pretest and post-test mean score. Baseline data of the serum creatinine, blood urea, serum potassium, calcium, phosphate and hemoglobin level were compared (Unpaired 't' test) between experimental group and control group and found no significant changes between the groups. The serum creatinine, blood urea, serum potassium, and hemoglobin level of the control group in pre-test and post-test was not significant (paired t test) however significant ($p<0.001$) changes was found in the serum calcium and serum phosphate. But in the experimental group, significant ($p<0.001$) changes were observed in the post-test score of biochemical markers level than the pre-test level. Though there was a significant change in the experimental group, the percentage of improvement of serum creatinine, blood urea, serum potassium, calcium, phosphate and hemoglobin were 4.4%, 0.16%, 7.87%, 3.97%, 14.28 and 5.91% respectively.

Patients on hemodialysis are less active when compared to healthy sedentary work individuals and low intrinsic motivation for physical activity. Physical activity results in improvement in physical function and well-being (Parsons *et al.*, 2006). Preparing of activity during dialysis treatments may improve solute expulsion by expanding blood stream to muscle and efflux of urea and different toxins into the vascular compartment where they can be expelled (Makhlough *et al.*, 2012). Intradialytic exercise from a physiologic point of view with the speculation that the expanded muscle blood stream and more prominent measure of open capillary surface area in working muscles will bring about a more prominent transition of urea and associated toxins from the tissue to the vascular compartment for ensuing expulsion at the dialyzer (Orcy *et al.*, 2014). In addition there is a plausibility of decreased exercise resistance during dialysis coming about because of electrolyte and liquid moves and exercise could prompt dialysis-related hypotension (Miller *et al.*, 2002).

The present study demonstrated the 3 months of intradialytic exercise on biochemical markers and physiological parameters among 130 patients undergoing hemodialysis. Patients were allocated into study group (n=65) and control group (n=65) by convenient sampling technique and detailed analysis was done. Among the patients in the study group, pre-test and post-test values were compared (Paired t' test) a statistically significant ($p<0.001$) was observed in the level of Blood urea, Serum calcium and Serum phosphate and Serum potassium and Hemoglobin after the treatment whereas no noteworthy changes were found within the control group. The significant change in the study group is due to the beneficial effect of intradialytic exercise.

A randomized controlled trial was done to determine the impact of an eight week intradialytic exercise program reported that significant betterment in

the levels of serum phosphate (decreased by 1.84 mg/dL) and level of serum potassium and Serum calcium and level of hemoglobin did not change significantly in the exercise group (Orcy *et al.*, 2014). Similarly, Rafael Orcy, et al, 2014 reported that vigorous exercise during HD expands the viability of phosphate evacuation, without evolving urea, creatinine and potassium removal (Farese *et al.*, 2008). Also found an increase in the phosphate mass and clearance in dialysate after three exercise sessions lasting 20 minutes (Adorati, 2000). Interestingly, Adorati (2000) has demonstrated that practice during dialysis diminishes urea bounce back, increments creatinine expulsion and, critically, expands phosphate evacuation, and furthermore adds to the general well-being of the dialysis persistent. The findings of the study reported that there is no significant changes were observed at the end of eighth week when compared with the initial of the study in experimental group in serum potassium, phosphorus and calcium levels (Musavian *et al.*, 2015). However, Musavian *et al.* (2015) observed that phosphorus levels were significantly diminished with the active exercise program. (Mcmurray *et al.*, 2008) quoted that Intradialytic foot pedal exercise has no impact on the phosphate removal which is the contrast to the present study findings (Vaithilingam *et al.*, 2004). This finding is in line with previous studies that could demonstrate an increase in phosphate removal associated with intradialytic aerobic exercise (Falahi and Shahrzad, 2008). According to Fallahi et al, the impact of two months of pedal exercise on hemoglobin reasoned that there was no measurably critical rise of hemoglobin, yet, a slight rise of hemoglobin by 0.6mg dL was observed. As of late Soliman (2015) So had led and found that 8-week of Intradialytic Range of Motion Exercises program, a noteworthy decrease were found in weariness level, serum phosphate and potassium, calcium, urea, creatinine and a slight increment in hemoglobin level (Soliman, 2015).

Thus the present study findings proved the significant impact of decreasing serum creatinine, blood urea, serum potassium, serum phosphate and increasing serum calcium and hemoglobin after 3 months of intradialytic exercise program among patients on hemodialysis.The strength of the current study was interventional study and intensively analyze the impact of intradialytic exercise on biochemical markers. However there are some limitations in the present study. The limitation of the present study was that it lacks to analyze the other biochemical markers related to ESRD and may have an impact by intradialytic exercise such lipid profile, cytokines, blood glucose level. This present study does not compare the quality of life with their biochemical markers such blood urea, serum potassium, serum creatinine and hemoglobin and dialysis adequacy such as Kt/V and Urea Reduction Ration (URR) which are also main influencing factors for maintaining the general wellbeing of the patient. Hence the investigators planned to conduct further study to examine the impacts of activity program on various components like lipid profile, cytokines, blood glucose level, etc.,

CONCLUSION

Thus the present study findings proved the significant impact of decreasing serum creatinine, blood urea, serum potassium, serum phosphate and increasing serum calcium and hemoglobin after 3 months of intradialytic exercise program among patients on hemodialysis. It also found that this exercise programme is safe, complementary intervention and do not cost the patient extra time.

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Conflict of Interest

The author declares that there is no conflict of interest.

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