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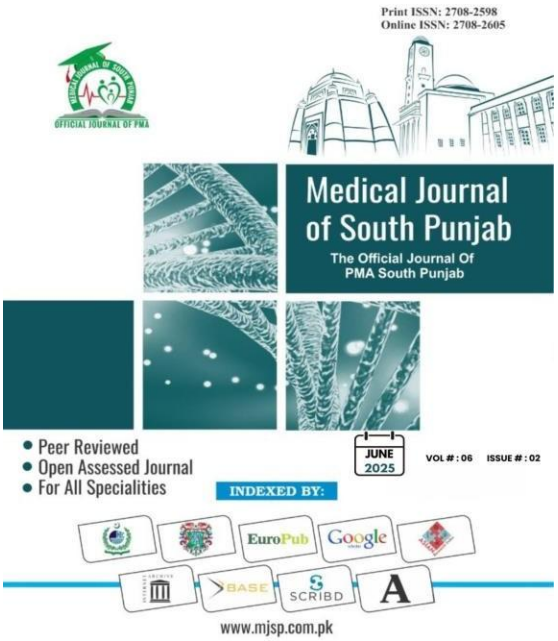

Intra-dialytic serum potassium changes among patients on maintenance hemodialysis thrice weekly

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ABSTRACT

Objective: To determine the mean change in serum potassium levels before and after the maintenance haemodialysis session.

Methods: Total 110 patients were selected according to inclusion criteria. Age, gender, height, weight and comorbids were documented Serum potassium levels of MHD patients were checked before and just after the end of haemodialysis. The duration of dialysis was documented. All the data was entered in SPSS 27 and analyzed. Data will be entered and analysed in SPSS Version 28.0. Quantitative variables were presented as mean and standard deviation. Difference in the pre- and post-dialysis potassium levels was calculated. Qualitative variables were presented as frequency and percentage. Data was stratified for age, gender, comorbids and BMI. Post stratification, independent t test was applied, p value ≤0.05 was considered as significant.

Results: Mean duration of dialysis was 3.93 hours. Mean change in the potassium levels was 1.54±0.23 mmol/L. Mean change in potassium was compared between the groups based on age, BMI, gender and comorbs stratification, however, no statistically significant difference was observed ($p>0.05$). Paired t-test was applied for pre- and post-dialysis and the change was statistically significant ($p<0.001$).

Conclusion: Maintenance hemodialysis session of 4 hours can significantly reduce serum potassium levels and subsequently reducing the risk of arrythmias due to hyperkalemia in ESRD patients.

Keywords: Hemodialysis, Change, serum potassium

1. INTRODUCTION

Chronic kidney disease (CKD) is defined as any structural or functional abnormality that persists for more than 3 months[1]. Because of progressive nature of disease, CKD leads to end stage renal disease (GFR less than 15ml/min)[11]. It is estimated that >100/million new cases of ESRD noted in Pakistan[1]. Hemodialysis is procedure that removes excess water, solutes, and toxins from blood, making it a life sustaining procedure[2]. Despite being a life-saving and generally safe procedure, problems can still occur[13]. The side effects of procedure are generalized weakness, blood pressure fluctuations, itchy skin and electrolyte imbalance[2].

Potassium, principally an intracellular cation regulates proper functioning of excitable cells (cardiomyocytes, neurons) in body[10]. Due to hyperkalemia muscle weakness, fatigue and fatal arrhythmias can occur that's need to be considered in maintenance hemodialysis (MHD) patients[9]. ESRD patient on maintenance dialysis are particularly prone to develop high potassium levels. Currently definitive management plan in ESRD patients is dialysis, followed by dietary potassium & drugs restriction that increase potassium[3]. According to Dialysis Outcomes and Practice Patterns Study in 2012–2015 the dialysate potassium prescribed was 2.0–2.5 mmol/L. Although it varies in different countries[4].

The potassium removal in single hemodialysis varies depend on body size, treatment duration and dialysate potassium[5]. During dialysis, the expected decrease in serum potassium is 1mmol/L in first hour, same rate of decrease in next 2 hours and gradual decline in following hours[4]. The removal is dependent on plasma to dialysate concentration gradient, blood flow rate, dialysate rate and total body potassium stores.[7,8.] Because hemodialysis is an intermittent procedure, there is a rebound in serum potassium levels[4]. According to Elsayed et al,[15] mean serum potassium level of the patients before the session noted was 5.9 ± 0.7 mmol/L, while just after the session was reduced to 4.2 ± 0.8 mmol/L, with a change of 1.7 ± 0.1 mmol/L.

Several studies done on potassium removal using different concentration of dialysate potassium, blood flow rates and treatment duration. So, this study is planned to assess change in serum potassium level after the routine maintenance hemodialysis session, given the duration, dialysate and blood flow rate constant.

2. METHODOLOGY

Current Quasi experimental study was conducted in Department of Nephrology, Sir Ganga Ram Hospital Lahore from 23-01-2025 to 22-04-2025 after taking Ethical approval from IRB. Sample size of 110 patients is estimated using 95% confidence level, absolute precision (d) = 0.02 and mean change in serum potassium level of the patients just after the MHD session was taken as 1.7 ± 0.1.[15] Total 110 patients were selected by nonprobability consecutive sampling technique. All the patients who were diagnosed with ESRD and on maintenance hemodialysis, aged 20-65 years, and both male and female were enrolled in the study. End-stage renal disease was defined as a GFR of less than 15 mL/min. Maintenance hemodialysis was done thrice a week, with each session lasting 4 hours. Patients not consenting, poor adherence to MHD, and those critically ill were excluded from this study.

All participating patients provided written informed consent after receiving a detailed explanation of the procedure and the purpose of the study. Age, gender, height and weight were documented for all the patients. Patients Comorbids were noted if present including DM (HbA1c >6.5%), HTN (BP >130/90 mmHg without treatment or any

reading for patients on antihypertensive therapy), and IHD (ST-T changes in ECG). The dialysis procedure used a standard dialysate composition and maintained a constant dialysate flow rate of 500 mL/min and blood flow rate of 300 mL/min. Serum potassium levels of MHD patients were checked before and just after the end of haemodialysis. Blood sample were collected directly from the dialysis machine line and sent to hospital laboratory. The duration of dialysis was documented and was kept close to ideal time of 4 hours.

All the data was entered in SPSS 27 and analyzed. Data will be entered and analysed in SPSS Version 28.0. Quantitative variables such as age, BMI, serum potassium level and duration of MHD were presented as mean and standard deviation. Difference in the pre- and post- dialysis potassium levels was calculated for all the patients and later presented as mean and standard deviation. Qualitative variables like gender and Comorbids were presented as frequency and percentage. Data was stratified for age, gender, Comorbids and BMI. Post stratification, independent t test was applied, p value ≤0.05 was considered as significant.

3. RESULTS

Mean age of the patients included in the study was 43.11 ± 11.39 years with a mean BMI of 25.54 ± 3.05 kg/m^2. Study population included 55.5% males and 44.5% females. The incidence of Dm, HTN and IHD was 20%, 30.9% and 21.8%, respectively. Mean duration of dialysis was 3.93 hours. Mean change in the potassium levels after the dialysis was 1.54 ± 0.23 mmol/L. Table-I

Mean change in potassium was compared between the groups based on age, BMI, gender and comorbs stratification, however, no statistically significant difference was observed (p>0.05). Table-II

Paired t-test was applied for pre- and post-dialysis and the change was statistically significant (p<0.001).

Table-I:Baseline and demographic Data

Variable	Values (n=110)
Age, years	43.11 ± 11.39
BMI, kg/m^2	25.54 ± 3.05
Gender. Male / female, N (%)	61 (55.5) / 49 (44.5)
DM, N (%)	22 (20.0)
HTN, N (%)	34 (30.9)
IHD, N (%)	24 (21.8)
Duration of MHD, hours	3.93 ± 0.18
Pre-dialysis K^+, mmol/L	5.28 ± 0.31
Post-dialysis K^+, mmol/L	3.74 ± 0.36
Change in K^+, mmol/L	1.54 ± 0.23

Data is mentioned as mean and S.D. unless mentioned otherwise

Table-II:Baseline and demographic Data

Variables	Stratification of data		Mean change in K^+ (n=110)	P
Age	20-40 years	(N=39)	1.52 ± 0.23	0.396
	42-65 years	(N=71)	1.56 ± 0.23	
Gender	Male	(N=61)	1.57 ± 0.22	0.396
	Female	(N=49)	1.52 ± 0.23	
BMI	≤25 kg/m^2	(N=71)	1.56 ± 0.23	0.396
	>25kg/m^2	(N=39)	1.52 ± 0.22	
DM	Yes	(N=22)	1.54 ± 0.23	0.917
	No	(N=88)	1.55 ± 0.23	
HTN	Yes	(N=34)	1.57 ± 0.23	0.389
	No	(N=76)	1.53 ± 0.22	
IHD	Yes	(N=24)	1.51 ± 0.21	0.424
	No	(N=86)	1.55 ± 0.23	

Data is mentioned as mean and S.D.

4. DISCUSSION

Current study observed a significant change in the level serum potassium after the dialysis (p<0.001). However, when the data was stratified and no effect was observed of age, gender, BMI and comorbids.

A study[16] reported an average reduction in serum potassium levels of −1.2 ± 0.1 mEq/L following hemodialysis. Notably, 40% of the immediate post-dialysis blood samples demonstrated hypokalemia, highlighting the substantial decline in potassium that can occur during the dialysis process. This finding underscores the importance of closely monitoring serum potassium levels around the time of dialysis,

as such fluctuations may have clinical implications, particularly concerning cardiac stability and overall patient safety.

Dialysate potassium is generally prescribed to reduce elevated serum and total body potassium levels that accumulate during the interdialytic period. Emerging evidence has highlighted the concern that post-hemodialysis hypokalemia—particularly when preceded by pre-HD hypokalemia—is associated with increased all-cause mortality.[17] Although dialysate potassium concentrations below 2 mEq/L were infrequently used in our study and are now less common in clinical practice, our findings show that lower dialysate potassium is linked to a more pronounced drop in serum potassium. Notably, 40% of dialysis sessions resulted in immediate post-HD potassium levels below the lower reference limit, and 29% showed hypokalemia 30 minutes after HD. While serum potassium levels tend to rebound within 6 hours post-HD, this data emphasizes a higher-risk window during and immediately after dialysis—a period that coincides with the peak risk for clinically significant arrhythmias as observed in the primary analyses of the MiD study.[18,19] Overall, our results underscore the occurrence of post-MHD significant reduction in potassium levels.

In another study, the mean serum potassium concentration was 4.48 ± 0.83 mmol/L before dialysis and decreased to 3.69 ± 0.65 mmol/L after dialysis, representing a statistically significant reduction with a p-value < 0.001.[20] in study by Seethalakshmi C et al.[21], the mean serum potassium level decreased significantly from 5.73 ± 1.24 mmol/L before dialysis to 3.72 ± 0.75 mmol/L after dialysis, with a p-value < 0.001, indicating a highly significant reduction. This substantial drop in potassium underscores the effectiveness of hemodialysis in correcting hyperkalemia but also highlights the potential risk of inducing hypokalemia in the immediate post-dialysis period.

Meenakshi GG et al.[22] observed a decline in serum potassium level from 5.2 mmol/L before dialysis to 3.6 mmol/L after dialysis, a statistically significant decrease with a p-value of 0.01.

All the data shows that hemodialysis effectively lowers serum potassium levels, although it may also increase the risk of post-dialysis hypokalemia if not carefully managed. While patients are at risk of hyperkalemia-induced arrhythmias before dialysis, they may also face a significant risk of arrhythmias following dialysis due to the development of severe hypokalemia. This highlights the importance of monitoring potassium levels both pre- and post-dialysis to minimize cardiac complications.

5. CONCLUSION

Maintenance hemodialysis session of 4 hours can significantly reduce serum potassium levels and subsequently reducing the risk of arrythmias due to hyperkalemia in ESRD patients.

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