EFFECT OF ULTRAFILTRATION RATE ON DIALYSIS CLINICAL INDICATORS AMONG A HEMODIALYSIS PATIENTS

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Abstract

Background: Hemodialysis is a treatment option for patients with end-stage renal disease (ESRD) who have lost most or all of their kidney function. Clinical indicators are used to measure the effectiveness of hemodialysis treatments; Ultrafiltration is a vital component of hemodialysis and is responsible for removing excess fluid from the patient's bloodstream. To optimize hemodialysis treatment and achieve optimal outcomes, healthcare professionals must carefully monitor ultrafiltration rate (UFR) and adjust this treatment parameter as needed. By doing so, they can help patients maintain good health and improve their quality of life.

Objective: To assess the effect of ultrafiltration rate on dialysis clinical indicators among hemodialysis patients

Methods: A Quasi-experimental design with Comparison group approach, which was conducted in the dialysis unit of Shaikh Zayed Hospital in Lahore. A purposive sample of 60 patients undergoing hemodialysis with varying ultrafiltration rates was selected for the study. The patients were divided into two groups, with 30 patients in each group, based on their ultrafiltration rate. The researchers used a self-structured tool to assess clinical indicators; data were analyzed using an independent t-test to compare both groups with a significance level of $P<0.05$

Results: This study found that there were 40% women and 60% men. The study compared the dialysis protocols of two groups; interventional and comparative group on various clinical parameters and related indexes show a significant difference between two group with $p<0.05$. However serum creatinine shows no significant difference between the two groups with a p equal to 0.381.

Conclusion: Optimal UFR is around 10-13 ml/kg/hour, and moderate UFR has been associated with improved clinical outcomes, including reduced hospitalization rates and improved quality of life. Clinicians should carefully monitor UFR in patients undergoing dialysis to ensure optimal treatment outcomes.

Key word- Ultrafiltration rate, clinical Indicators and hemodialysis patients

I. INTRODUCTION

Hemodialysis is a life-saving treatment for individuals who suffering from chronic kidney disease, it also a most common medical procedure in Pakistan (1). The number of cases rise on daily base in developing country especially in Pakistan and Afghanistan, particularly among middle-aged and elderly individuals, due to factors such as poor dietary habits, limited access to clean drinking water, and a lack of basic healthcare facilities in many areas (2). Hemodialysis is one of the most effective ways to manage the symptoms of chronic kidney disease and prolong the lives of those suffering from it. Dialysis is a crucial medical procedure used to treat patients suffering from end-stage renal disease (ESRD) (3). It involves the removal of excess waste and fluid from the blood, which the kidneys are unable to eliminate. However, the effectiveness of dialysis can be influenced by various factors, including patient characteristics, dialysis modality, and dialysis prescriptions. To ensure optimal dialysis outcomes, it is essential to follow evidence-based guidelines for dialysis treatment. Ultrafiltration is a critical component of the dialysis process and is responsible for removing excess fluid from the patient's bloodstream (4).

The ultrafiltration rate (UFR) is a crucial factor in determining the effectiveness and safety of the dialysis procedure. The UFR refers to the volume of fluid that is removed from the patient's bloodstream per unit time (5). High UFRs can lead to rapid removal of fluid, which can cause various complications, including hypotension, cramps, and headaches (6). On the other hand, low UFRs can result in inadequate removal of excess fluid, leading to complications such as pulmonary edema and hypertension (7).

Several studies have investigated the effect of UFR on blood pressure during hemodialysis. In general, higher UFR rates have been associated with greater reductions in blood pressure. For instance, a study by Armiyati, Hadisaputro (8) found that a higher UFR rate was associated with a greater reduction in systolic blood pressure during hemodialysis. Similarly, a study by Thongdee, Phinyo (9) reported that higher UFR rates were associated with lower blood pressure during hemodialysis. Ultrafiltration rate

important role in achieving effective and efficient dialysis (10). Dialysis parameter like the ultrafiltration rate can depend on the time of dialysis session, volume filtration and the target weight. If the clearance of the fluid exceeds the plasma filling rate of the peripheral tissue decrease (11). Highlight the effect of low-flow versus high-flow dialysis in a hemodialysis patient (12).

Clinical indicators are used to monitor the effectiveness of dialysis treatment and can include blood pressure, electrolyte levels, and urea clearance (13). Many observational and several interventional studies indicate that; body weight affects the ultrafiltration rates linked to varying levels of increased mortality risk and effect dialysis efficacy (14). So a more indications are needed to assess its effects on the patient clinical indicators. The findings of this study will highlight the need for further research into sensitive findings related to identify the best practices for determining optimal UFR levels to achieve optimal outcomes for patients undergoing dialysis.

II- MATERIALS AND METHODS

The research design chosen for this study was a quasi-experimental design with Comparison Group, which was conducted in the dialysis unit of Shaikh Zayed Hospital in Lahore. A purposive sample of 60 patients undergoing hemodialysis with varying ultrafiltration rates was selected for the study. The patients were divided into two groups, with 30 patients in each group, based on their ultrafiltration rate. Comparison had a conventional ultrafiltration protocol A with rate ranging from 1 to 1.5 L per hour or greater than 13ml/kg/hr, while Interventional had a new guideline-based protocol B with rate of 10-13 ml/kg/hour. The study population included male and female patients aged 18-60 years who were undergoing permanent hemodialysis. Patients with poor survival prognosis and other comorbidities besides CKD and hypertension were excluded from the study. The researchers used a self-structured tool to assess clinical indicators, which had a content validity index (CVI) of 0.91 and a reliability of 0.724. The data was displayed through frequency distribution and analyzed using an independent t-test to compare both groups with a significance level of P<0.05.

III-RESULTS:

Descriptive Statistics analyzed by frequency 'n' and percentage

Table No 1: Socio Demographic Variables of Hemodialysis Patients

Demographic Variable		n	%
Gender	Male	36	60.0
	Female	24	40.0
Age in Year	18-29	2	3.3
	30-39	14	23.3
	40-49	18	30.0
	50-60	26	43.3
Patient Residency	Urban	42	70.0
	Rural	18	30.0
Duration of HD	1-5 month	32	53.3
	6-11 month	24	40.0
	1-2 year	4	6.7

'%'

According to the statistics in Table 1, men were round about 36(60%) while women reported 24(40%). Furthermore, 42(70%) of the participants were from urban areas, with 18(30%) from rural ones. According to their age, 26(43.3%) of patients were between the ages of 50 and 60 while only 2(3%) were with age of 18 to 29. The statistics also shows that the majority of patients 32(53.3%) had been undergoing permanent hemodialysis for the previous five months, 24(40%) for the previous six to eleven months, and only 4(6.7%) for the past two years.

Table 2: Ultrafiltration rate on dialysis clinical indicators: comparing mean

Clinical Indicators	UFR Protocol A N=30	UFR Protocol B N=30	
	X±S.D	X±S.D	P-value
Serum creatinine (Cr): < 2.5 mEq/dL	3.94±2.05	4.43±2.26	0.381
Serum Potassium (K):3.5 – 5 mEq/dL	4.51±1.19	3.98±0.56	0.035
Serum Albumin (Alb): 3.5-5.5 g/dl	3.08±1.17	4.0±0.82	0.001
Serum calcium (Ca): 8.5-10.2 mg/dl	6.27±1.26	6.98±1.14	0.026
Serum hemoglobin (Hb): 11-12 g/dl	10.6±1.26	11.5±1.14	0.004

Analyzed by independent t test with mean (X), Standard deviation (S.D) and P<0.05

The study compared the effects of two dialysis protocols, A and B, on various clinical parameters and related indexes. The results showed that there was no significant difference in serum creatinine levels between the two groups (p=0.381). However, the comparison of potassium levels showed that group B had a significantly greater reduction in potassium than group A (p=0.035). The study also found that group B had better maintenance of serum albumin levels (p=0.001) and better control of calcium removal (p=0.026) compared to group A. Additionally, there was a significant difference in serum hemoglobin levels between the two groups (p=0.004). Overall, the study indicated that dialysis with protocol B in intervention group, was more effective in improving dialysis indicators compared to protocol A in comparative group, as shown in Table 2

Table 3: Ultrafiltration rate on dialysis clinical indicators: comparing mean

Analyzed by independent t test with mean (X), Standard deviation (S.D) and P<0.05

Clinical Indicators	UFR Protocol A N=30	UFR Protocol B N=30	
	X±S.D	X±S.D	P-value
Systolic Blood Pressure (SBP) 110 - 150 mmHg	107±14.3	128±15.3	0.000
Diastolic Blood Pressure (DBP) 70 – 80 mmHg	63±10.2	72±7.28	0.000
Intradialytic weight gain (IDWG): kg	2.13±0.68	1.50±0.57	0.000

The study found a statistically significant difference (p=0.000) in the reported SBP between the two groups. The mean SBP for group A (comparative) was 107 mmHg and for group B (interventional group) was 128 mmHg, suggesting that there is a risk of hypotension with high ultrafiltration rates. Similarly, the comparison of DBP showed a significant difference, with group A having a mean of 63 mmHg and group B having a mean of 72 mmHg. In addition, there was a significant difference in intradialytic weight gain between the two groups (p=0.000), indicating that weight gain should be controlled by following UFR guidelines during dialysis as shown in the table no 3.

IV- Discussion

The UFR is a crucial parameter that determines the amount of fluid removed during dialysis. Several studies have shown that high UFR can lead to adverse outcomes in dialysis patients, including hypotension, cardiovascular events, and intradialytic complications. A study conducted by Raimann, Wang (15) reported that high UFR is associated with increased mortality risk in patients undergoing hemodialysis. Another study by Lee, Okuda (16) showed that high UFR leads to increased inflammation and oxidative stress, which can contribute to cardiovascular disease and mortality. On the other hand, low UFR can lead to inadequate fluid removal, which can cause fluid overload, hypertension, and other complications.

According to our study finding there a significant improvement in the dialysis indicators through UFR protocol B with a rate of 10-13 ml/kg/hour. The study compared the effects of two dialysis protocols, A and B, on various clinical parameters and related indexes show a significant difference between two group with p<0.05. Several studies have suggested that a moderate UFR of 10-13 ml/kg/hour is optimal for patients undergoing dialysis (17). A study by Cheung et al. (2019) reported that moderate UFR was associated with improved clinical outcomes, including reduced hospitalization rates, improved cardiovascular function, and improved quality of life. This finding is supported by Griva, Nandakumar (18) concluded that intervention facilitate hemodialysis potassium level

The similar results have been reported by Mohamed (19) the findings have revealed a significant increase in serum calcium 7.03 md/dL pre intervention and 7.86 mg/dL post with (P<0.001), serum albumin 3.67 g/dL versus 3.80 g/dL (p=0.045); While the serum hemoglobin no significant between the pre and post interventions Hb with a statistical p > 0.05. Additionally Wang, Rao (20) study result showed that serum albumin and total serum protein were higher in the study group after the intervention (P<0.05). However the Stumm, Benetti (21) study the efficacy of this intervention was demonstrated by a significant drop in blood creatinine levels before and after nursing intervention. This drop was statistically significant, according to the study's analysis (P=0.001) with mean differences 2.61+0.85.

The majority of studies discovered that a change in systolic blood pressure of at least 10 mmHg from pre to post dialysis was associated with increased hospitalization and mortality in both prevalent and incident hemodialysis patients (22). Our study found a statistically significant difference (p=0.000) in the reported SBP between the two groups with a mean 107 mmHg versus 128 mmHg between two group with a different UFR protocol, suggesting that there is a risk of hypotension with high ultrafiltration rates. Similarly, the comparison of DBP mean of 63 mmHg and group B having a mean of 72 mmHg. In addition, there was a significant difference in intradialytic weight gain between the two groups (p=0.000), indicating that weight gain should be controlled by following UF guidelines during dialysis.

This result was supported by Başer and Mollaoğlu (23) in terms of the patients' mean values for intardialytic weights, pre-dialysis systolic blood pressures, and post-dialysis diastolic blood pressures. Further Bayoumi (24), mean arterial pressure (MAP), Diastolic blood pressure and systolic blood pressure (MAP)scores show statistically significant control after nurse intervention (P=0.000). According to Sharaf (25) the patients' average intardialytic weight increase was 4.39 kg prior to the intervention and significantly dropped to 3.71 kg after intervention (P=0.001). Another study of Düzalan and Pakyüz (26) revealed that Pre-dialysis weight and diastolic blood pressure were significantly different between group with a P<0.05. similarly the Bayoumi (24) found that weight gain during dialysis ranged from 1 kg to 6 kg; which was significantly controlled after nursing start dialysis through evidence-based practice as well as there were a statistically significant improvements in SBP and DBP scores with a P=0.000.

Furthermore the study of Jamshidzehi, Kiani (27) stated that higher ultrafiltration rates (UFR) for hemodialysis the weight loss was greater for patients with a systolic blood pressure fall of greater 20 mmHg with a significance of p < 0.05). Regarding newly revised guidelines the patient's dry weight, as defined by Ashby, Borman (7) serves as the goal for each dialysis treatment. Another name for it is a target weight. If the patient should gain a weight more than 1 kg between treatments it indicate ineffective dialysis. This statement was supported by the study of Ghaleb and Sharaf (28) reported that the average intradialytic weight gain of the participants before implementation of intervention was 3.15 kg; which dropped to 2.68 kg after guideline base practice this shows statistically significant differences in participants with intradialytic weight with a P=0.001. This evidence were supported by the study of Rosdiana, Cahyati (29) shows the average weight gain was 5.85 kg versus 4.85 kg. Similarly study of Sacrias,

Rathinasamy (30) reported that 95% of participant with IDWG which reduce to 75% after intervention with P<0.01. Its means that Patients should be educated on fluid restriction and encouraged to adhere to their prescribed fluid intake. Ultrafiltration rates should be individualized based on the patient's fluid status and hemodynamic stability and body weight. Monitoring of blood pressure and volume status should be done frequently, and adjustments made as needed.

V-CONCLUSION

The ultrafiltration rate is a critical component of dialysis treatment, and its effects on clinical indicators have been extensively studied. High UFR can lead to adverse outcomes, including increased mortality risk, while low UFR can lead to inadequate fluid removal and other complications. Optimal UFR is around 10-13 ml/kg/hour, and moderate UFR has been associated with improved clinical outcomes, including reduced hospitalization rates and improved quality of life.

VI- RECOMMENDATION

Clinicians should carefully monitor UFR in patients undergoing dialysis to ensure optimal treatment outcomes. Further research is needed to better understand the optimal UFR and its impact on other dialysis parameter and complications.

VII- CLINICAL IMPLICATIONS

It's important to note that the ultrafiltration rate should be determined and adjusted by qualified healthcare professionals based on individual patient characteristics, clinical considerations, and the goals of the treatment. The practical implications may vary depending on the specific needs and circumstances of each patient.

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