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A Prospective Observational Study Among Patients On Long Term Hemodialysis For Changes In Serum Electrolytes With Varying Urine Outputs And Impact Of Patient Counselling On Their Quality Of Life

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ABSTRACT

Aim: To study changes in serum electrolytes with varying amount of urine output in chronic hemodialysis patients and assessing the impact of patient counselling on their quality of life. **Methods**: A prospective observational study was carried out in 60 patients undergoing hemodialysis. The study was conducted by categorizing them into three groups based on their varying amount of urine output per day i.e. <200ml/day, 200-500ml/day and >500ml/dayrespectively. Their electrolytes were analysed for variation according to varying amount of urine output. Quality of life in patients was assessed by using Kidney Disease Quality of Life-13 Questionnaire Form before and after patient counselling. **Result:** Patients with greater urine output per day have significantly lower serum sodium, potassium, phosphate, urea and creatinine. These patients also have higher serum calcium and bicarbonate levels in their body as compared to other groups with lower urine output per day.The overall quality of life in chronic hemodialysis patients after the patient counselling has been improved as the mean score has decreased to 37 ± 3.51 from 96.26 ± 8.94. **Conclusion**: Urine output has a significant role in maintenance of electrolytes level in our body since the patients having greater urine output had better control on serum electrolytes level. The quality of life in patients undergoing hemodialysis has been markedly improved after the patient counselling which was assessed by KDQOL-13 Questionnaire Form.

KEYWORDS: Hemodialysis, End Stage Renal Disease, Urine Output, Electrolytes, Kidney Disease Quality of Life

INTRODUCTION

The primary goal of hemodialysis is to restore the intracellular and extracellular fluid environment that is characteristic of normal kidney function. Sodium is the chief cation of the extracellular fluid which is required for the maintenance of osmotic pressure and fluid balance. Hyperkalemia is common in ESRD patients due to progressive reduction in urinary output, potassium clearance, shift of potassium from the intracellular to the extracellular space [5]. This hyperkalemia predisposes to cardiovascular disturbances and sudden death. Post hemodialysis serum potassium decrement also has an arrhythmogenic effect. Estimation of serum sodium and potassium is of importance in case of renal failure because kidney regulates and maintains electrolytes within a narrow range [3].

Dialysis patients have a higher risk of morbidity and mortality than the general population. The presence of greater urine output is associated with a lower risk of morbidity and mortality in dialysis patients. They have better control of serum potassium, phosphate, and bicarbonate levels. Hemodialytic patients with greater urine output have a greater ability to excrete electrolytes, acids, and fluid compared to patients with low urine output, who are likely to have less body accumulation of these elements. There are few studies comparing patients with varying amount of urine output regarding serum electrolyte levels (sodium, potassium, calcium, and phosphate)[2].

Health-related quality of life (HRQOL) is a critically important outcome for patients with end-stage renal disease (ESRD). The National Quality Forum selected the Kidney Disease Quality of Life Short-Form survey (KDQOL™-36) as the tool of choice for assessing this outcome in adult patients with ESRD. This 36-question survey instrument was published in 2000, based upon a longer KDQOL instrument first developed in 1994. The KDQOL™-36 contains 5 subscales: the Physical Component Summary (PCS), Mental Component Summary (MCS), Burden of Kidney Disease (BKD), Symptoms and Problems of Kidney Disease (SPKD), and Effects of Kidney Disease (EKD) .

CHRONIC KIDNEY DISEASE

Chronic kidney disease (CKD), also called chronic renal insufficiency, is defined as a progressive loss of function occurring over several months to years and is characterized by the gradual replacement of normal kidney architecture with parenchymal fibrosis [1]. A CKD classification system has been developed by the working group of the Kidney Dialysis Outcomes and Quality Initiative (K/DOQI) of the National Kidney Foundation (NKF), which is based on the presence of structural kidney damage and/or functional changes in glomerular filtration rate (GFR) present for a period of 3 months or more. The risk factors for CKD are numerous and diverse, and many of them are not traditionally thought to have a direct influence on the causal pathway. To assist clinicians in stratifying the overall risks of individual patients, the K/DOQI working group has recommended categorising CKD risk factors as susceptibility factors, initiation factors, or progression factors [1].

To facilitate assessment of CKD severity and, the National Kidney Foundation developed criteria, as part of its Kidney Disease Outcomes Quality Initiative (NKF KDOQI™), stratify CKD patients [2]:

- Stage 1: normal estimated GFR ≥ 90 mL/min per 1.73 m2 and persistent albuminuria
- Stage 2: eGFR between 60 to 89 mL/min per 1.73 m2
- Stage 3: eGFR between 30 to 59 mL/min per 1.73 m2
- Stage 4: eGFR between 15 to 29 mL/min per 1.73 m2
- Stage 5: eGFR of < 15 mL/min per 1.73 m2 or end-stage renal disease

END STAGE RENAL DISEASE

End stage renal disease (ESRD) is defined as irreversible decline in a person's kidney function, which is severe enough to be fatal in the absence of dialysis or transplantation. ESRD is included under stage 5 of the National Kidney Foundation Kidney Disease Outcomes Quality Initiative classification of CKD, where it refers to individuals with an estimated glomerular filtration rate below 15 mL per minute per 1.73m2 body surface area, or those requiring dialysis irrespective of glomerular filtration rate [1].

DIALYSIS

Dialysis involves the removal of solute across a semipermeable membrane down the concentration gradient by diffusive clearance and convective clearance mechanisms [6]. The step-by-step procedure includes; 2 thin needles will be inserted into the AV fistula or graft and taped into place. One needle will

slowly remove the blood and transfer it to a machine called a dialyzer or dialysis machine. The dialysis machine is made up of a series of membranes that act as filters and a special liquid called dialysate. The blood after filtration is transferred back to the patient through another needle[7].

INDICATIONS OF HD IN CKD

- Uremic encephalopathy
- Uremic Pericarditis
- Hyperkalemia resistant to medical management
- Chronic kidney disease stage 5
- Metabolic acidosis resistant to medical management
- Fluid overload resistant to medical management
- Oliguria not responding to medical management

COMPLICATIONS

- Intradialytic hypotension
- Muscle cramps
- Dialyzer reactions
- Hemolysis

HEMODIALYSIS

Hemodialysis is achieved through vascular access, either via arteriovenous fistula, graft, or central venous catheter. Toxins and waste products are removed from the bloodstream by connecting the vascular access site to a machine, a dialyzer, which works as a pump that circulates and filters the blood and returns it back to the patient. A single treatment takes 4 to 5 hours to complete and must usually be repeated three times a week [6].

ELECTROLYTES AND FLUID STATUS IN HEMODIALYSIS PATIENTS

- CALCIUM: Calcium is the most plentiful electrolyte in the body, a large percentage of it is used to form the bones. It is mainly absorbed and excreted through the GI system. The majority of calcium resides extracellularly, and it is crucial for the function of neurons, muscle cells, function of enzymes, and coagulation. The normal range for calcium concentration in the body is 8.5 - 10.5 mg/dl [15].
- CHLORIDE: Is the second most abundant electrolyte in the blood, and most abundant in extracellular fluid. Most of the chloride in the body is from salt in the diet. Chloride is part of gastric acid which plays a role in absorption of electrolytes, activating enzymes, and killing bacteria [15].
- MAGNESIUM: Is mostly found in the bones and within cells. Approximately 1% of total magnesium in the body is found in the blood. Magnesium is important in control of metabolism and is involved in numerous enzyme reactions [15].
- POTASSIUM: Potassium is mainly inside the cells of the body, its concentration in the blood can range anywhere from 3.5mEq/L to 5mEq/L. Potassium removal essentially occurs in the first 2 hours of HD treatment [15].
- SODIUM: Sodium is the most abundant electrolyte in the blood. Sodium and its homeostasis in the human body are highly dependent on fluids. The majority of the sodium in the body stays in the extracellular fluid. Normal range was 140mEq/L [15].

QUALITY OF LIFE IN HEMODIALYSIS PATIENTS

Assessing the quality of life in patients with ESRD treated by hemodialysis has been considered an important aspect of therapy [34]. For checking the quality of life, Kidney Disease Quality of Life Questionnaire Form (Validated) is used, it includes 13 questions and the patients who score less show a better quality of life and patients who score more show a poor quality of life. Quality of life is checked

before and after patient counselling. The 13 questions include the; Patient's health- related questions, limitations in daily activities, emotional status, pain during the therapy, effect of kidney disease in day-to-day life, sleep patterns, and education.

MATERIALS AND METHODS

Ethics approval

The study was approved by the Institutional Ethical Committee of Cosmopolitan Hospital, Pvt. Ltd., Trivandrum, on 14th January 2023.

AIM OF THE STUDY

To study changes in serum electrolytes with varying amount of urine output in chronic hemodialysis patients and assessing the impact of patient counselling on their quality of life.

METHODOLOGY

Study was conducted after getting clearance from the Institutional Ethical Committee.
Patients satisfying the inclusion and exclusion criteria and who were willing to participate in the study were included after obtaining their informed consent. Data was collected using a suitably designed proforma. The study was conducted in three group on the basis of urine output, first group <200ml/day, second group 200 to 500ml/day and third group >500ml/day respectively and their electrolytes level were evaluated.Quality of life in patients was assessed by using Kidney Disease Quality of Life-13 Questionnaire Form before and after patient counselling. The baseline parameters of the patients were analysed at first day of visit and the follow-up was obtained after one month of patient counselling. The impact of patient counselling was determined by comparing all the scores obtained from the baseline.

Study period and study setting

The study period was 6 months after getting clearance from Institutional Ethical Committee in the Department of Nephrology, Cosmopolitan Hospital Post Graduate Institute of Health Science and Research, Thiruvananthapuram, Kerala.

Study design

A prospective observational study was conducted in hemodialysis patients from the Department of Nephrology in Cosmopolitan Hospital, Thiruvananthapuram, a tertiary care centre after obtaining permission for collecting data from the Institutional Ethical Committee.

Inclusion criteria:

• Patients undergoing hemodialysis who were willing to participate in the study.

• Patients above 18 years old.

• Patients on hemodialysis for >1 month.

Exclusion criteria:

• Patients who were unable to measure urine volume.

• Patients who were preparing for kidney transplantation.

• Patients who were not willing to participate in counselling.

Study procedure

A prospective observational study was carried out at the Nephrology department of a tertiary care hospital. Written informed consent was obtained as per ICMR biomedical research guideline from the hemodialysis patients satisfying the inclusion and exclusion criteria. All the information relevant for the study were collected from case records and by directly interviewing the patients. The scoring of quality of life in hemodialysis patient was done by using Kidney Disease Quality of Life- 13 Questionnaire Form.

Statistical analysis

ANOVA was used to analyse the statistical difference between three groups and Student t- test was used to analyse the quality of life in patients before and after patient counselling. Data were entered using Microsoft Excel and analysed by SPSS software. The electrolytes and quality of life were expressed as Mean ± SD. p value <0.05 with a confidence intervalof 95% was considered as statistically significant.

RESULT

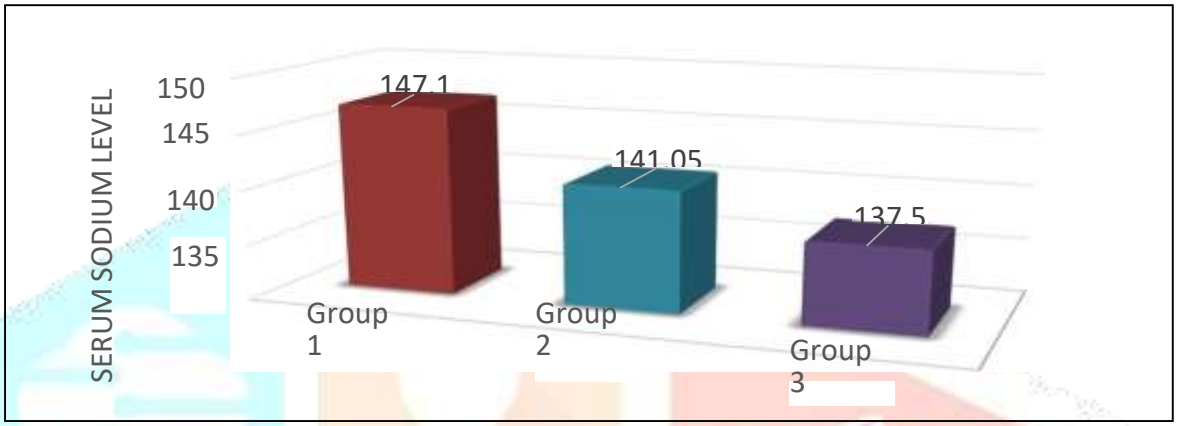
As per the study criteria 60 patients undergoing hemodialysis were enrolled into the study from the Nephrology Department. Patients were divided into three groups on the basis of daily urine output: Group1 (<200ml/day), (Group2 (200-500ml/day) and Group3 (>500ml/day) respectively. During the study period, 60 patients had completed their follow- up of 1 month.

EVALUATION OF SERUM ELECTROLYTES LEVEL IN PATIENTSWITH VARYING URINE OUTPUT

ASSESSMENT OF SERUM SODIUM LEVEL

From the table, it was observed that patients with urine output greater than 500ml/day havemean serum sodium level 137.5mEq/L, patients with urine output between 200-500ml have 141.05mEq/L while patients with urine output less than 200ml/day have 147.1mEq/L. Thus from below table, it can be concluded that patients with greater urine output/day have serumsodium levels within normal range.

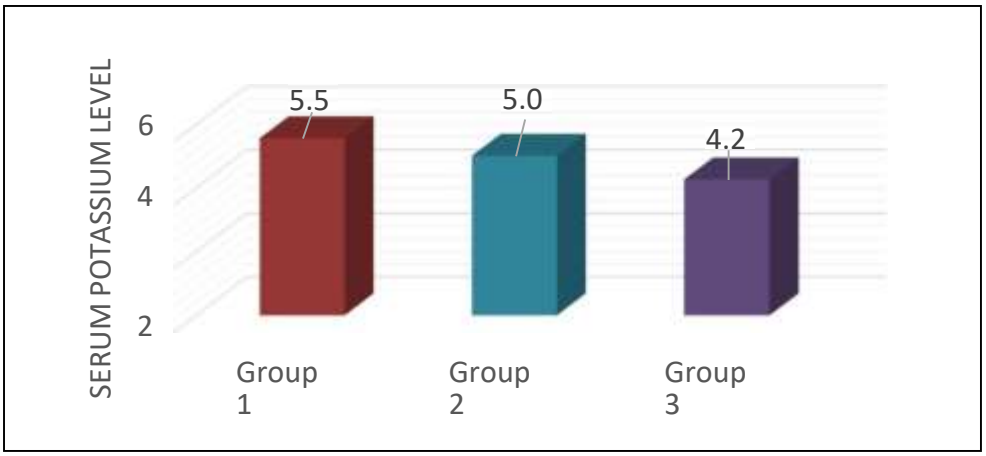
URINE OUTPUT	NO. OF PATIENTS	SERUM SODIUM (mEq/L) MEAN ± SD	p value
Group1 (<200ml/day)	20	147.1±0.9	<0.01
Group2 (200-500ml/day)	20	141.05±2.5	
Group3 (>500ml/day)	20	137.5**±1.09	



ASSESSMENT OF SERUM POTASSIUM

From the table, it is observed that the mean serum potassium of patients with urine output >500ml/day have 4.27 mEq/L, patients with urine output between 200-500ml have 5.02mEq/L while patients with urine output < 200ml/day have 5.57mEq/L. Thus from below table, it can be concluded that patient with greater urine output/day have serum potassium levels within normal range.

URINE OUTPUT	NO. OF PATIENTS	SERUM POTASSIUM (mEq/L) MEAN ± SD	p value
Group1 (<200ml/day)	20	5.57±0.23	<0.01
Group2 (200-500ml/day)	20	5.02±0.22	
Group3 (>500ml/day)	20	4.27**±0.29	

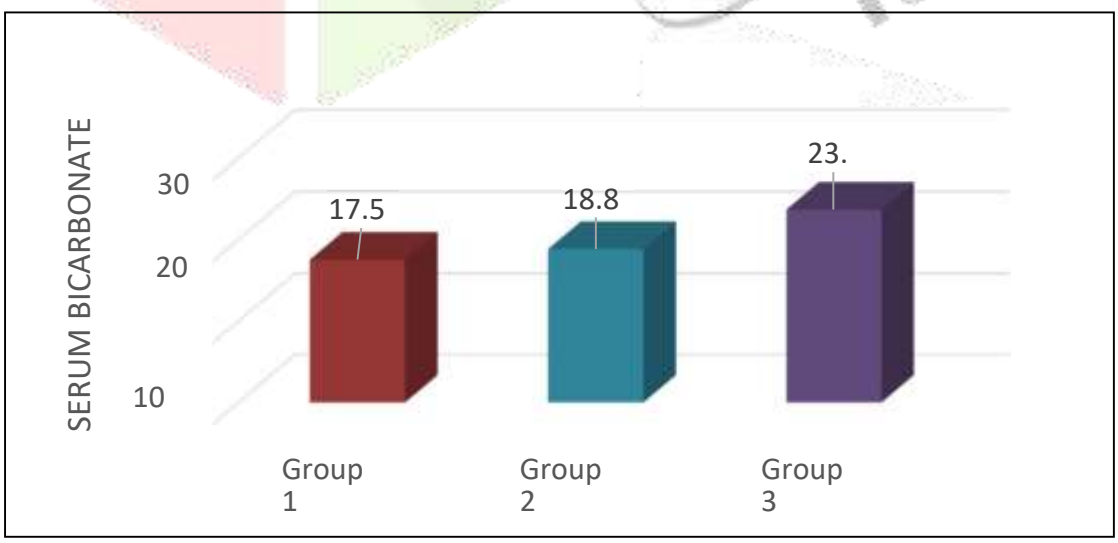


ASSESSMENT OF SERUM BICARBONATE

From the table, it is observed that the mean serum bicarbonate of patients with urine output

>500ml/day have 23.7mEq/L, patients with urine output between 200-500ml have 18.87mEq/L while patients with urine output < 200ml/day have 17.57mEq/L. Thus from below table, it canbe concluded that patient with greater urine output/day have serum bicarbonate levels within normal range.

URINE OUTPUT	NO. OF PATIENTS	SERUM BICARBONATE (mEq/l) MEAN ± SD	p value
Group1 (<200ml/day)	20	17.57±0.27	<0.01
Group2 (200-500ml/day)	20	18.87±0.67	
Group3 (>500ml/day)	20	23.7**±1.34	

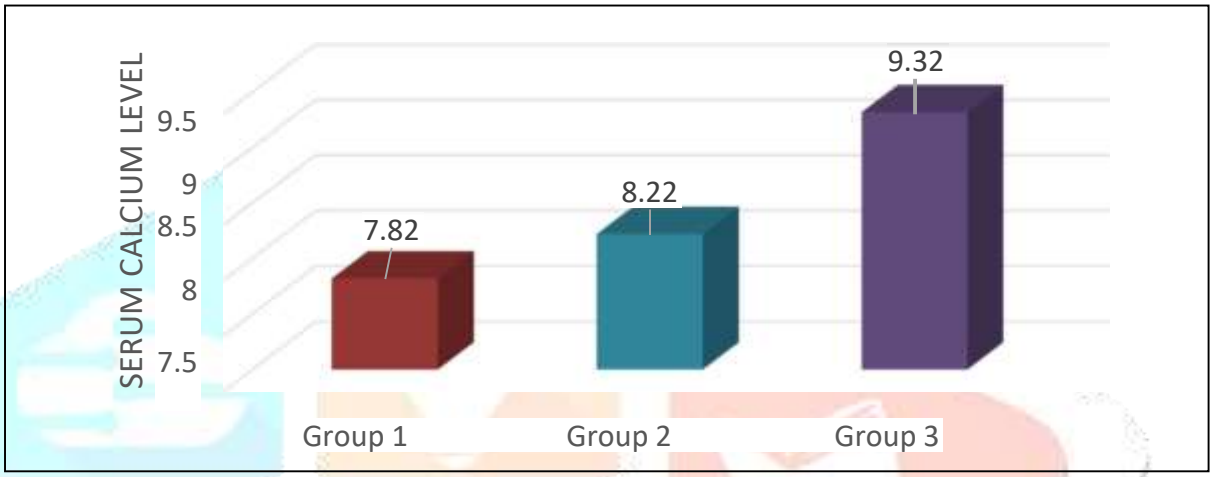


ASSESSMENT OF SERUM CALCIUM

From the table, it is observed that the mean serum calcium of patients with urine output

>500ml/day have 9.32mg/dl, patients with urine output between 200-500ml have 8.22mg/dl while patients with urine output < 200ml/day have 7.82mg/dl. Thus from below table, it can beconcluded that patient with greater urine output/day have serum calcium levels within normal range.

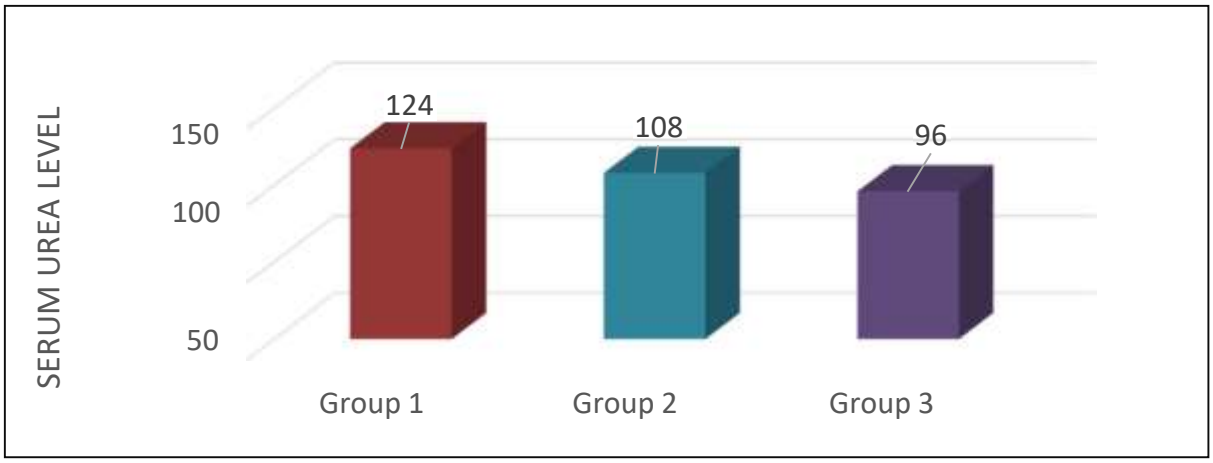
URINE OUTPUT	NO. OF PATIENTS	SERUM CALCIUM (mg/dl) MEAN ± SD	p value
Group1 (<200ml/day)	20	7.82±0.22	<0.01
Group2 (200-500ml/day)	20	8.22±0.35	
Group3 (>500ml/day)	20	9.32**±0.18	



ASSESSMENT OF SERUM UREA

From the table, it is observed that the mean serum urea of patients with urine output >500ml/day have 96mg/dl, patients with urine output between 200-500ml have 108mg/dl whilepatients with urine output < 200ml/day have 124mg/dl. Thus from below table, it can be concluded that patient with greater urine output/day have better control on serum urea levels.

URINE OUTPUT	NO. OF PATIENTS	SERUM UREA (mg/dl) MEAN ± SD	p value
Group1 (<200ml/day)	20	124±3.04	<0.01
Group2 (200-500ml/day)	20	108±0.52	
Group3 (>500ml/day)	20	96**±0.82	

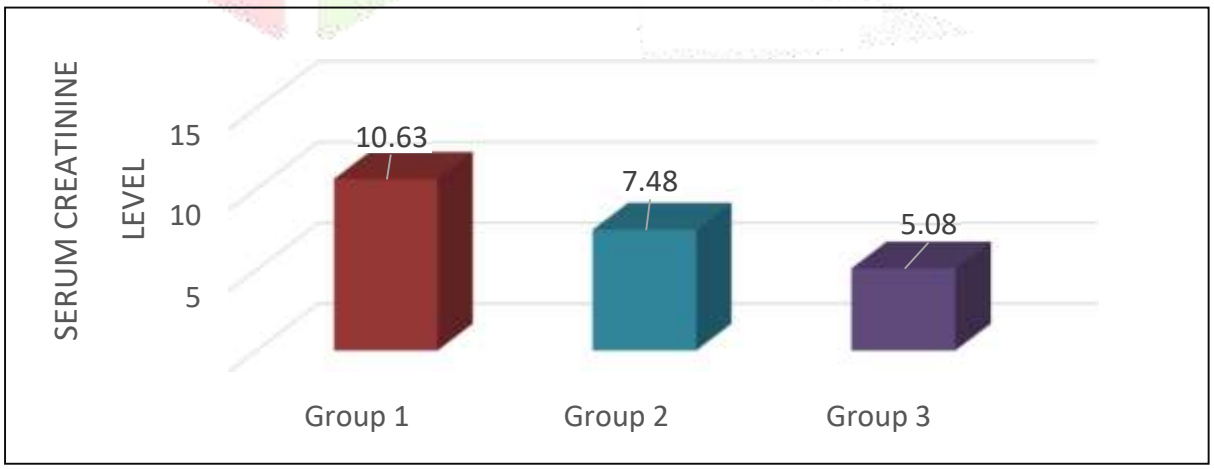


ASSESSMENT OF SERUM CREATININE

From the table, it is observed that the mean serum creatinine of patients with urine output

>500ml/day have 5.08mg/dl, patients with urine output between 200-500ml have7.48mg/dl while patients with urine output < 200ml/day have 10.63mg/dl. Thus from below table, it can be concluded that patient with greater urine output/day have better control on serum creatininelevel.

URINE OUTPUT	NO. OF PATIENTS	SERUM CREATININE (mg/dl) MEAN ± SD	p value
Group1 (<200ml/day)	20	10.63±0.19	
Group2 (200-500ml/day)	20	7.48±58	<0.01
Group3 (>500ml/day)	20	5.08**±0.01	

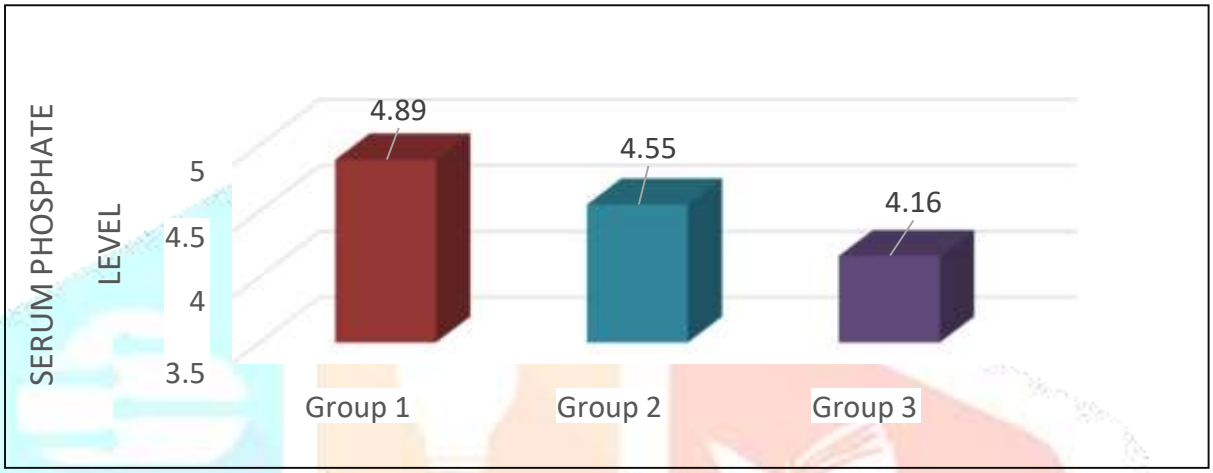


ASSESSMENT OF SERUM PHOSPHATE

From the table no.9, it is observed that the mean serum phosphate of patients with urine output

>500ml/day have 4.16mg/dl, patients with urine output between 200-500ml have4.55mg/dl while patients with urine output < 200ml/day have 4.89mg/dl. Thus from below table, it can beconcluded that patient with greater urine output/day have better control on serum phosphate levels.

URINE OUTPUT	NO. OF PATIENTS	SERUM PHOSPHATE (mg/dl) MEAN ± SD	p value
Group1 (<200ml/day)	20	4.89±0.13	<0.01
Group2 (200-500ml/day)	20	4.55±0.58	
Group3 (>500ml/day)	20	4.16**±0.18	

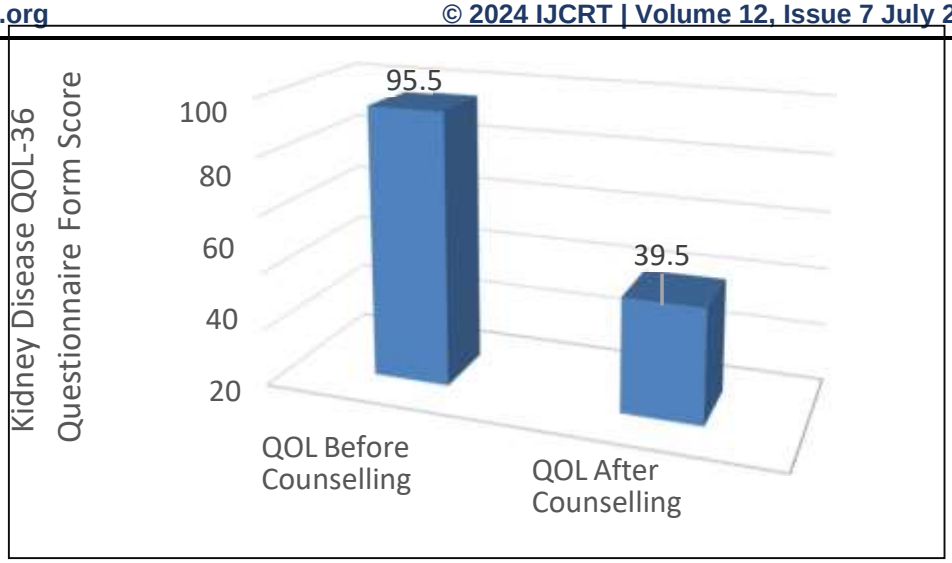


IMPACT OF PATIENT COUNSELLING ON QUALITY OF LIFE IN HEMODIALYSIS PATIENTS USING KIDNEY DISEASE QUALITY OF LIFE-13 QUESTIONNAIRE FORM

ASSESSMENT OF QUALITY OF LIFE BEFORE AND AFTER PATIENT COUNSELLING

It was observed that the mean score of quality of life in hemodialysis patients before counselling is 95.95 ± 11.06 while the mean score after patient counselling is 39.55 ± 4.11. Thus, from below table it can be concluded that the quality of life of patients havebeen improved after the patient counselling as the mean score decreases after the counselling.

NO. OF PATIENTS	QOL SCORE BEFORE COUNSELLING (MEAN ± SD)	QOL SCORE AFTER COUNSELLING (MEAN ± SD)	p value
60	95.95± 11.06	39.55± 4.11**	<0.01



DISCUSSION

In chronic kidney disease and end stage renal failure condition, the kidneys get damaged and thereby accumulation of nitrogenous waste products and fluid occurs. Hemodialyis is one of the treatment option for chronic kidney disease and end stage renal failure, which helps to remove the fluid and waste products from the body. Kidney disease quality of life-13 questionnaire form (KDQOL-13) is designed to measure the impact on overall health of dialysis patients [3].

The study demonstrates that there is increase in serum sodium, potassium, urea, creatinine, and phosphate in group1 (urine output- <200ml/day) as compared to group2 (urine output- 200 to 500ml/day) and group3 (urine output >500ml/day) and reduced value in bicarbonate and calcium in group1 as compared to group2 and group3. The observation of our study was similar to the study conducted by Fernando Luiz et al. Their study 'Metabolic and Volume Status Evaluation of Hemodialysis Patients with or without Residual Renal Function in Long Interdialytic Interval' describes patient without RRF had a higher increase in serum potassium, sodium, and phosphate and decreased calcium and bicarbonate level [7].

The observation was similar to the study conducted by 'Takeshi Suda et al on 'The Contribution of Residual Renal Function to Overall Nutritional Status in Chronic Hemodialysis Patients'. Comparative study concluded that, in patients without RRF there is greater rise in inorganic phosphate and potassium while there is decrease in level of bicarbonate.

The result concluded in this study is similar to the study done by J.Winkler et al on 'Effect of Residual Renal Function in Hemodialysis Patients'. A comparative study concluded that, serum potassium and phosphate are significantly lower in patients with RRF [17].

The observation of our study was similar to the study conducted by E Lars Penne et al on 'Role of Residual Renal Function in Phosphate Control and Anemia Management in Chronic Hemodialysis Patients'. This study suggests a strong relation between RRF and improved phosphate.

Quality of life (QOL) is the degree to which an individual is healthy, comfortable and able to participate in or enjoy life events, which is highly specific. In the current study, the QOL of patients was significantly low at the time of baseline. The KDQOL-13 Questionnaire Form score shows that the mean value before counselling was 95.95±11.6 and after counselling 39.55±4.11. The total score is 143 and reduced score value shows better quality of life.

A study conducted by Dena E. Cohen et al on 'Use Of The KDQOL 36 For Assessment Of Health-Related Quality Of Life Among Dialysis Patients In The United States' showed similar improvement in the QOL of patients undergoing hemodialysis [13].

The study conducted by Issa Al Salmi et al on 'Kidney Disease-Specific Quality Of Life among Patients on Hemodialysis' showed that there was a significant effect on patients QOL with age, education, frequency of dialysis, and comorbidities [12].

These outcomes were observed in treatment duration of 6 months, through adequate follow- up. Hence in our study we found that the patients with greater urine output have better control on the serum electrolytes and the patient counselling had greater impact on their QOL.

CONCLUSION

The present study demonstrates the variation in serum electrolytes according to varying urine output and the quality of life in hemodialysis patients. The primary objective of the study was to determine the changes in serum electrolytes on the basis of urine output per day. The study also involves the evaluation of quality of life of these patients before and after the patient counselling. The Kidney Disease Quality of Life-13 Questionnaire Form was used to assess the quality of life. For the study, a total of 60 patients were selected. The study was conducted in three groups based on varying amount of amount of urine output per day: Group1- 200ml/day, Group2- 200 to 500ml/day and Group3- 500ml/day respectively, involving 20 patients in each group. In our study, demographic and socioeconomic data conclude that there are more males who are undergoing hemodialysis as compared to female. According to age wise distribution obtained for our study, shows that age group above 60years accounts for a greater number of patients. Significant variations are observed in serum electrolytes according to daily urine output of hemodialysis patients as the serum sodium, potassium, bicarbonate, calcium and phosphate are within the normal range in patients with greater urine output i.e. in group2 and group3. While the group1 patients show highly imbalanced levels of these electrolytes. Comparing the serum creatinine and urea in different groups shows that the group3 patients have better control on these parameters. The quality of life of patients was assessed by the Kidney Disease Quality of Life-13 Questionnaire Form showed steep improvement in the quality of life, which was assessed before and after patient counselling. The results assessed from the study clearly indicates that the patients undergoing long term hemodialysis with greater urine output (>500ml/day) have better control on serum electrolytes. The quality of life of these patients was also improved after the patient counselling. Although our study yields important results, it has limitations. One of them was the small sample size. In addition, we did not evaluate patients' diet, their comorbidities and medications factors that could have interfered in the results. So, a large group and multi- centre study would be valuable to evaluate the changes in electrolytes and quality of life in hemodialysis patients.

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