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A Prospective Observational Study On Assessment Of Electrolyte Imbalance In Patients Undergoing Hemodialysis

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Abstract

In hemodialysis patients, altered serum electrolyte levels and metabolic acidosis are mainly observed. Hyperkalemia, along with hypocalcemia, and hyponatremia are common electrolyte disorders observed in patients undergoing hemodialysis. Dialysis maintains homeostasis (a steady internal environment) in individuals who have either a sudden loss of kidney function (acute kidney injury) or a slow, continuous loss of renal function (chronic kidney disease) (CKD, previously end-stage renal disease, ESRD). The majority of the patients were found to be in the age group of 51-60 yrs(26.7%). Our study found that 98(75.96%) patients were hypertensive followed by 12(9.30%) patients were having ischemic heart diseases (IHD), and 7(5.42%) patients were having Hepatitis (1 patient having HCV &6 patients having HBV). It was found that 56(46.67%)patients were having a maximum range of GFR (4-6 ml/min). And these serum electrolyte disorders can further lead to an increase in cardiovascular and neurological morbidity and mortality rate.

Keywords: Hyperkalemia, Hyponatremia, Hypocalcemia, Interdialyatic Blood Pressure, Cardiovascular Mortality Rate

Introduction

Abnormal serum electrolytes are now a big concern as they should not be elevated or decreased as they can lead to an increase in cardiovascular and neurological morbidity and mortality rate. The kidneys are complex organs that play an important role in maintaining normal physiological functions.[1] Urinary excretion of uremic toxins, as well as the regulation of various physiological systems such as intra and extracellular volume status, acid-base status, calcium and phosphate metabolism, and erythropoiesis, are all regulated by the kidneys.[2] The complex process of aging has an impact on the kidneys' various functions. The glomerular filtration rate (GFR) decreases with normal aging, and the rate at which this decline occurs can be altered by coexisting illnesses.[4] Dialysis is a form of renal replacement therapy. Artificial equipment that eliminates excess water, solutes, and toxins enhances the kidney's role in blood filtration. Dialysis maintains homeostasis (a steady internal environment) in individuals who have either a sudden loss of kidney function (acute kidney injury) or a slow, continuous loss of renal function (chronic kidney disease) (CKD, previously end-stage renal disease, ESRD). In hemodialysis patients, altered serum electrolytes, pre-and post-dialysis, and acid problems are all important factors.[5] Abnormal serum electrolytes lead to an increase in morbidity and mortality rate are as follows:

Hypokalemia [Serum Sodium level <3.5mmol/L] Hypokalemia can be caused by a lack of potassium in the diet or by excessive potassium loss in the urine or through the GI tract. The use of diuretic medicines, endocrine conditions such as primary hyperaldosteronism, kidney abnormalities, and genetic syndromes affecting renal function can all cause excessive potassium output in the urine. Potassium losses in the gastrointestinal tract are typically caused by prolonged diarrhea or vomiting, persistent laxative overuse, intestinal blockage, or infections.[6]

Hyperkalemia[Serum potassium level >5.5mmol/L] is mainly associated with fatigue, and muscle weakness, and can increase the risk of sudden death due to fatal arrhythmia.[7]

Hypocalcemia (Serum Calcium Concentration <8.5mg/dl**)** mainly results from reduced renal calcitriol production and phosphate retention. This condition can further cause bone mineral disease. [8]

Hypercalcemia (Serum Calcium Concentration >10.2mg/dl **)** is the condition that leads to vascular calcification which increases cardiovascular mortality.[8]

Hyponatremia (Serum Sodium Concentration <135mmol/l)) is a common abnormality and is associated with increased neurological morbidity and mortality. Impaired renal water excretion, either due to inadequate extracellular fluid volume or incorrect ADH secretion. Vomiting, diarrhea, bleeding, excessive perspiration, and other causes of extrarenal water and sodium loss.[9]

Hypernatremia (Serum Sodium Concentration >145meq/l) is caused by the primary water deficit thirst mechanism. Causes for hypernatremia include primary water deficit (with or without Na+ loss). Hypernatremia is most commonly caused by a lack of water, which can occur as a result of insufficient intake or increased loss of free water. Inadequate access to water can be caused by advanced age, dementia, or changes in mental condition[9]

Result

Material And Method

The study has been conducted in parul sevashram, a tertiary teaching care hospital. After taking prior consent from patients the data has been collected from all medical notes, including progress charts, consultation sheets, and laboratory investigation reports. The institutional ethics committee on Human Research -Parul University (PU-IECHR)authorized the protocol (PUIECHR/PIMSR/00/081734/3007), and the whole research was conducted at Parul Sevashram Hospital.

Identification Of Subjects

We have looked for patients of either gender between the age of 18-80 yrs. Comorbidity, Serum electrolyte levels, Interdialytic Weight, Pre-Post Systemic Blood Pressure, Addiction History, GFR(Glomerular Filtration Rate), Creatinine levels, and Medication Adherence were acquired from the case record and treatment charts. A total number of 120 patient's data were examined.

Sources Of Data Collection

We gathered information such as demographic data, laboratory data, addiction history, comorbidities, socioeconomic status, frequency of dialysis, Interdialytic weight, and pre-post systemic blood pressure. We have also used the MMAS[Morisky Medication Adherence Scale] scale to interpret whether patients were adherent to their medication. we have also categorized patient's according to variables such as age, gender, frequency, addiction, diet, medication adherence, GFR levels, and serum electrolyte levels

Statistical analysis

Data was gathered on Microsoft Excel (2013) and GraphPad prism8.1 represented in percentage worksheets and altered for fulfillment. Descriptive statistics (frequency, percentage) were used, and tables were used as appropriate.

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Figure 1: Gender Wise Distribution Of Patients Undergoing Hemodialysis

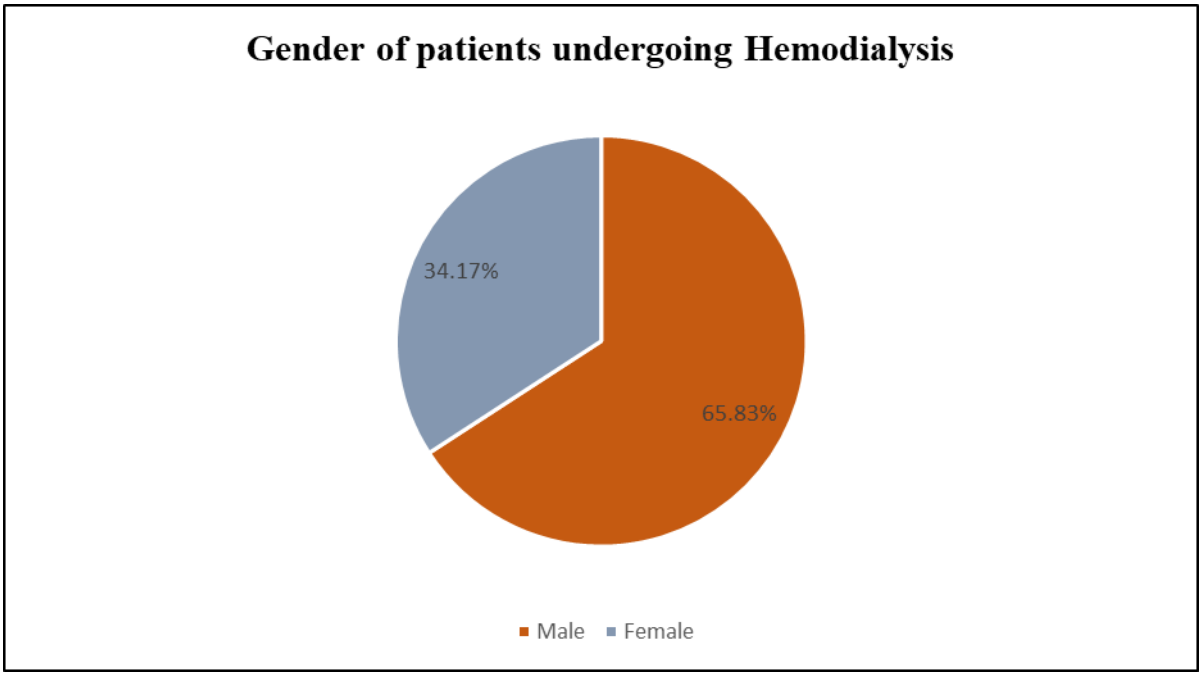

Table – 1 Weight (In Kg) Wise Distribution Of Patients Undergoing Hemodialysis

Variables	Male	Female	Total(%)
1.0-1.9	19 (24.05%)	21 (51.22%)	40 (33.33%)
2.0-2.9	36 (45.57%)	12 (29.27%)	48 (40%)
3.0-3.9	13 (16.45%)	05 (12.19%)	18 (15%)
4.0-4.9	08 (10.13%)	03 (7.32%)	11 (9.17%)
5.0-5.9	03 (3.80%)	-	03 (2.5%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

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Figure 2: Pre And Post Systolic Blood Pressure (In Mmhg) Wise Distribution Of Patients Undergoing Hemodialysis

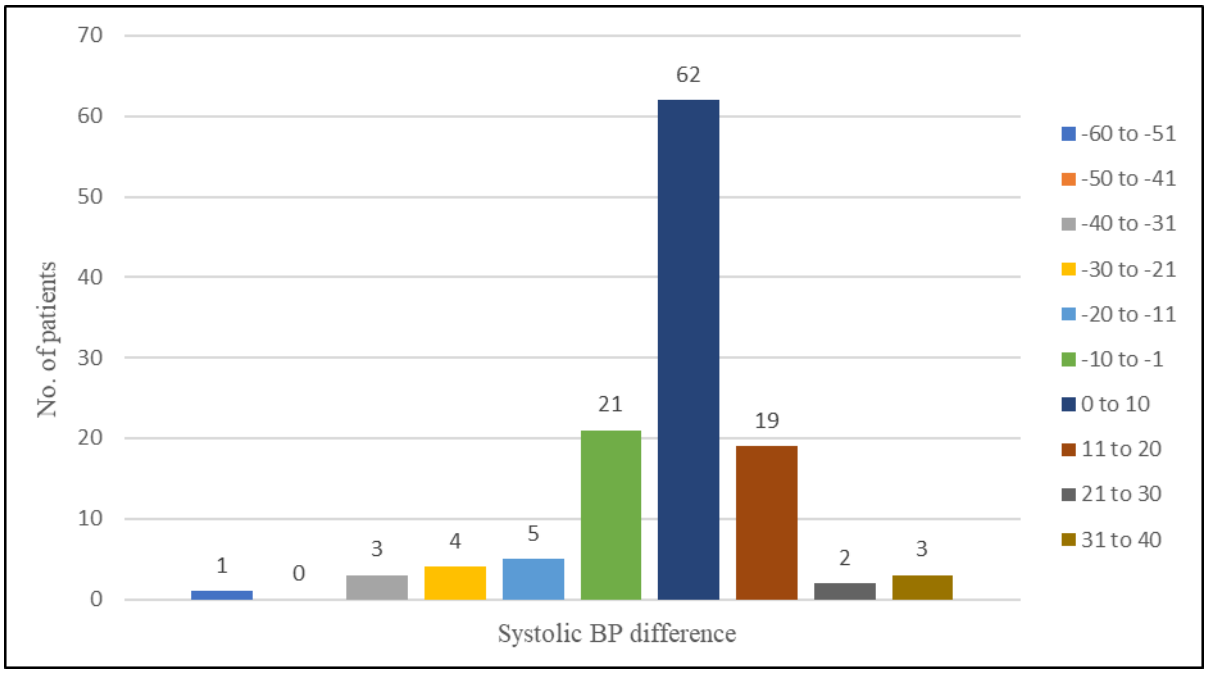

Figure 3: Pre And Post Diastolic Blood Pressure (In Mmhg) Wise Distribution Of Patients Undergoing Hemodialysis

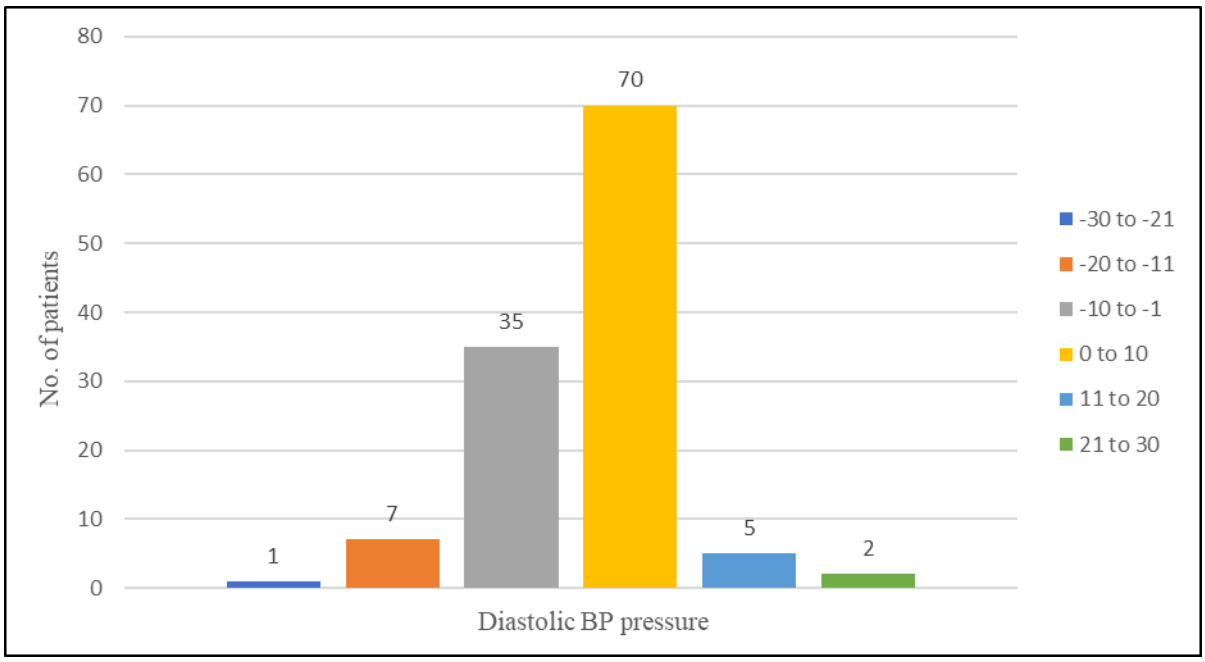

Table –2 Frequency Wise Distribution Of Patients Undergoing Hemodialysis

FrequencyofDialysis	Male (%)	Female (%)	Total (%)
Once a week	2 (2.53%)	1 (2.44%)	3 (2.5%)

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Twice a week	25 (31.65%)	16 (39.02%)	41 (34.16%)
Thrice a week	52 (65.82%)	24 (58.54%)	76 (63.34%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Age-Wise Distribution Of Patients Undergoing Hemodialysis

Age (in a year)	Male (%)	Female (%)	Total (%)
18-20	2 (2.53%)	3 (7.31%)	5 (4.16%)
21-30	9 (11.40%)	6 (14.63%)	15 (12.5%)
31-40	17 (21.51)	9 (21.95%)	26 (21.6%)
41-50	19 (24.05)	9 (21.95%)	28 (23.34%)
51-60	20 (25.31%)	12 (29.30%)	32 (26.7%)
61-70	9 (11.40%)	1 (2.43%)	10 (8.4%)
71-80	3 (3.80%)	1(2.43%)	4 (3.3%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Diet-Wise Distribution Of Patients Undergoing Hemodialysis

Diet	Male (%)	Female (%)	Total (%)
Veg	28 (35.44%)	23 (56.10%)	51 (42.5%)
Non-veg	51 (64.56%)	18 (43.90%)	69 (57.5%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Addiction Wise Distribution Of Patients Undergoing Hemodialysis

Addiction	Male (%) (n=79)	Female (%) (n=41)	Total (%) (n=120)
Tobacco	16 (20.25%)	04 (9.76%)	20 (16.67%)

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Alcohol	08 (10.13%)	01 (2.44%)	9 (7.5%)
Smoking	06 (7.59%)	-	6 (5%)
All	02 (2.54%)	01 (2.44%)	3 (2.5%)
None	47 (59.49%)	35 (85.36%)	82 (68.33%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Co-Morbidities Wise Distribution Of Patients Undergoing Hemodialysis

Co-morbidities	**Male (%)**	**Female (%)**	**Total (%)**
HTN	63 (74.12%)	35 (79.54%)	98 (75.97%)
DM	01 (1.18%)	-	01 (0.78%)
HTN+DM	07 (8.23%)	02 (4.54%)	09 (6.97%)
HD	09 (10.58%)	03 (6.82%)	12 (9.30%)
Hepatitis	03 (3.53%)	04 (9.10%)	07 (5.42%)
Parkinson	01 (1.18%)	-	01 (0.78%)
Thyroid	01 (1.18%)	-	01 (0.78%)
Total	**85 (100%)**	**44 (100%)**	**129 (100%)**

Table- 3 Sodium(Electrolyte) Profile Of Patients Undergoing Hemodialysis

Range of Sodium	**Male (%)**	**Female (%)**	**Total (%)**
Hyponatremia	22 (27.85%)	15 (36.58%)	37 (30.83%)
Normoneutremia	56 (70.89%)	26 (63.42%)	82 (68.33%)
Hypernatremia	01 (1.26%)	-	01 (0.84%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

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Potassium(Electrolyte) Profile Of Patients Undergoing Hemodialysis

Range of Potassium	Male (%)	Female (%)	Total (%)
Hypokalemia	01 (1.27%)	05 (12.20%)	06 (5%)
Normokalemia	73 (92.40%)	31 (75.60%)	104 (86.67%)
Hyperkalemia	05 (6.33%)	05 (12.20%)	10 (8.33%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Calcium(Electrolyte) Profile Of Patients Undergoing Hemodialysis

Range of calcium	Male (%)	Female (%)	Total (%)
Hypocalcemic	35 (44.30%)	24 (58.54%)	59 (49.16%)
Normocalcemic	35 (44.30%)	12 (29.27%)	47 (39.17%)
Hypercalcemic	9 (11.40%)	5 (12.19%)	14 (11.67%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Bicarbonate(Electrolyte) Profile Of Patients Undergoing Hemodialysis

Rangeof Bicarbonate	Male (%)	Female (%)	Total (%)
Low Bicarbonate	66 (83.55%)	33 (80.49%)	99 (82.5%)
Normal Bicarbonate	13 (16.45%)	08 (19.51%)	21 (17.5%)
High Bicarbonate	-	-	-
Total	**79 (100%)**	**41(100%)**	**120 (100%)**

Glomerular Filtration Rate (Gfr) Wise Distribution Of Patients Undergoing Hemodialysis

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Range of HB	Male (%)	Female (%)	Total (%)
Normal [>11]	05 (6.33%)	03 (7.32%)	08 (6.67%)
Mild [10 – 10.9]	11 (13.92%)	03 (7.32%)	14 (11.67%)
Moderate [7 – 9.9]	57 (72.15%)	29 (70.73%)	86 (71.66%)
Severe [<7]	06 (7.59%)	06 (14.63%)	12 (10%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Figure-4: Drug Utilization Evaluation Of Patients Undergoing Hemodialysis

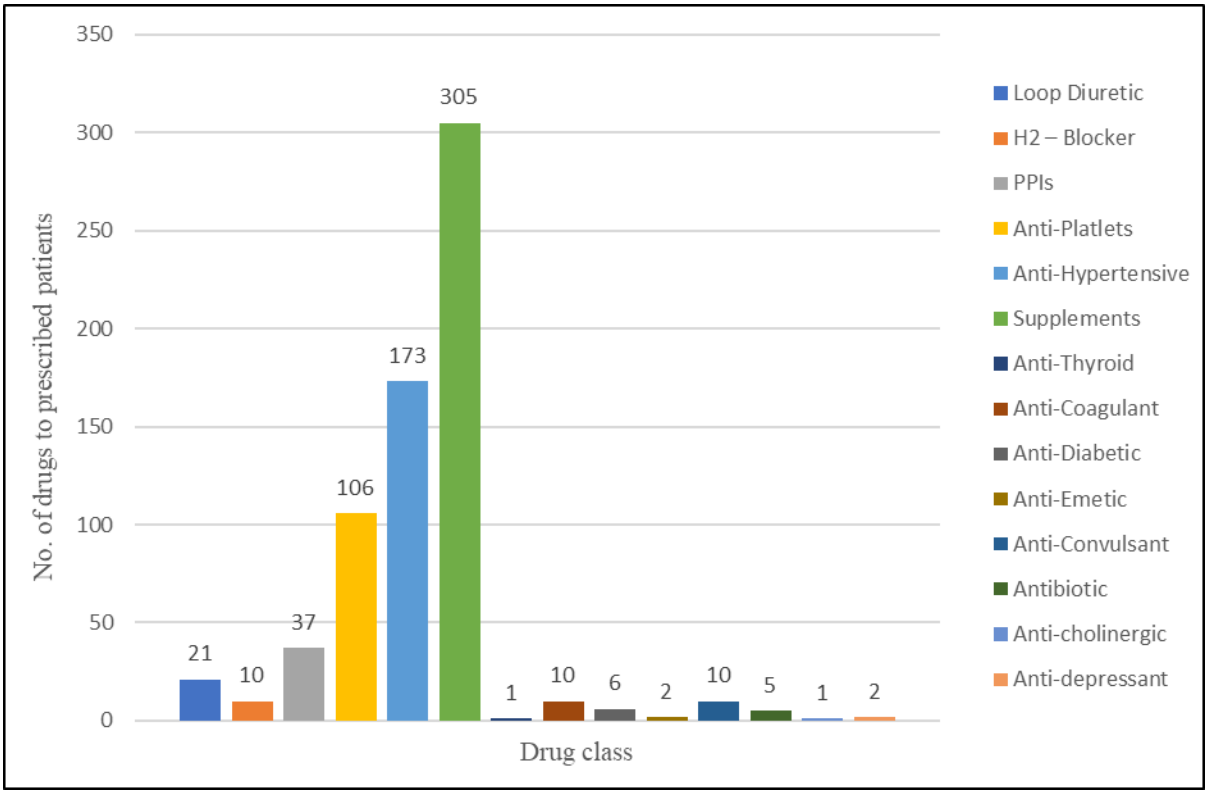

Table – 4 Morisky Medication Adherence Scale [Mmas] Wise Distribution Of Patients Undergoing Hemodialysis

Morisky Medication adherence Scale	Male (%)	Female (%)	Percentage (%)
High [8]	-	-	-
Medium [>6 - <8]	23 (29.11%)	7 (17.07%)	30 (25%)

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Low [<_6]	56 (70.89%)	34 (82.93%)	90 (75%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Kuppuswamy Socio-Economic Scale-Wise Distribution Of Patients Undergoing Hemodialysis

KuppuSwamy Socio-Economic Scale (Score)	Male (%)	Female (%)	Total (%)
26-29 (Upper - IV)	-	-	-
16-25 (Upper Middle - II)	03 (3.80%)	-	03 (2.5%)
11-15 (Lower Middle - III)	09 (11.39%)	01 (2.43%)	10 (8.33%)
5-10 (Upper Lower IV)	61 (77.22%)	30 (73.17%)	91 (75.83%)
<5 (Lower V)	6 (7.59%)	10 (24.40%)	6 (13.34%)
Total	**79 (100%)**	**41 (100%)**	**120 (100%)**

Clinical Outcome

It was observed that the maximum age of patients going under hemodialysis was 51-60 yrs. It was found that 98 (75.97%)patients were having hypertension as a comorbid condition. It was observed that the maximum no of patients were having hypocalcemia, hyponatremia, and low serum bicarbonates levels. 90 (75%)patients were having low medical adherence.

Discussion

A Prospective observational study was conducted in which a total no of 120 patients were enrolled. A detailed analysis of the subject's electrolyte levels, comorbid conditions, demographic data, socioeconomic data, history, addictions, and medication adherence was done

According to the electrolyte imbalance distribution of sodium levels, hyponatremia patients[30.83%] were found maximum than hypernatremia, which was similar to the study performed by Satirapoj B et al.

Based on electrolyte distribution of calcium levels, it was found that (49.16%) of patients were found to be hypocalcemic in undergoing hemodialysis, which was contraindicated from the study done by Seng JJ et al.

According to the distribution of bicarbonates, it was found that (82.5%) of patients were having low bicarbonate levels which mainly lead to metabolic acidosis in patients undergoing hemodialysis which was as similar to the study conducted by Kraut Ja et al.

According to the distribution of potassium levels hyperkalemia (8.33%) was found to be maximum in patients undergoing hemodialysis, which was contraindicated from the study performed by Rezaei Bet al

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Our study found that 689 drugs were prescribed, out of which 173 were antihypertensive,305 were supplements, and the remaining 211(30.62%) drugs were found as essential drugs. From that diuretics were most commonly prescribed cardiovascular drugs followed by beta-blockers and CCBs. In anti-hypertensive drugs frequently used cardiovascular drugs were beta-blocker 44 (25.43%) followed by CCBs 60(34.68%) and alpha-adrenergic agonist 43 (24.86%) which was similar to study done by sontakke SD et al.

Our study also found that (75%) patients were having low medication adherence which was similar to the study done by Chakraborty S et al.

It was found that a maximum (75.96%) number of patients were having hypertension as a comorbid condition in patients undergoing hemodialysis which was similar to the study done by Aster Wakjira Garedow, et al.

Based on addiction-wise distribution out of 120 patients, 38 patients were found to be addicted to tobacco, alcohol consumption, smoking, and these risk factors can increase the risk of mortality rate in patients undergoing hemodialysis which was similar to the study done by Timerga A et al.

According to the weight distribution variation in patients undergoing hemodialysis it was observed that 40% of patients shows weight reduction in a range of 2-3 kgs after hemodialysis. which was contraindicated from the study done by Ipema KJ et al

Based on hemoglobin wise distribution (71.66%) patients were found to be having a moderate range of hemoglobin (7-9.9). it was found that (46.67%) maximum patients were having a low glomerular filtration rate (GFR) is undergoing hemodialysis which can lead to neuropathy, which was as similar to the study done by Krishnan Av et al

In our study ,based on diet wise distribution we found that In our study, according to diet-wise distribution, the maximum no of patients (50%)were found to be non-vegetarian compared to vegetarian patients undergoing hemodialysis, which was similar to the study done by Palmer SC Maggo et al.

Conclusion

Abnormal serum electrolyte levels are mostly observed in patients undergoing hemodialysis, in End-Stage Renal Disease[ESRD]. In our study, we analyzed the patient's abnormal serum electrolyte level, comorbid condition,pre-post bp, weight, addictions, medication adherence.It was found that the maximum number of patients were having an increase in systolic and diastolic blood pressure, which mainly result in interdialytic blood pressure. we also observed weight reduction in patients undergoing hemodialysis. A comorbid condition such as hypertension was found to be maximum in patients undergoing hemodialysis. In our study, we found that the maximum number of patients were hyponatremic, hypocalcemic, and were having low serum bicarbonate levels. Hyponatremia will mainly result in the development of neurological disorders, while hypocalcemia will result in bone mineral disease, and low levels of bicarbonates will mainly lead to metabolic acidosis. Hyperkalemic patients were also observed in our study, which will increase the risk of cardiovascular mortality. The maximum number of patients were having low medical adherence, in undergoing hemodialysis. Serum electrolyte levels should be maintained in patients undergoing hemodialysis as elevated or at a decreased level will mainly increase the risk of morbidity and cardiovascular and neurological mortality rate.

Limitation Of The Study :

1. Lack of information in some case sheets
2. Variations in dialysis timing of patients
3. Time constraints
4. Patients not providing the proper information regarding their addictions.

Future Scope Of The Study:

In this study, our focus was on abnormal serum electrolyte levels in patients undergoing hemodialysis. As abnormal serum electrolytes levels can lead to an increase in the risk of morbidity and mortality rate. Serum electrolytes levels should be maintained in patients undergoing hemodialysis, as the prevalence of hyponatremia, hyperkalemia, hypocalcemia, and low serum bicarbonates levels are higher among maintenance hemodialysis patients. Management of electrolytes and fluid balance requires a complex mixture of dialysis therapy, medications, dietary interventions, and patient medication adherence.

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