Electrolyte Imbalance in CKD Patients

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ABSTRACT

The primary function of the kidney is to maintain fluid and electrolyte homeostasis. Each day the kidney must excrete 1500 ml of water and any excess ingested sodium, potassium, magnesium and phosphate. The kidney also plays a key role in calcium homeostasis. Of the total number of patients in intensive care 3–25% will develop acute renal failure and patients with chronic renal disease will frequently present for surgery. The treatments for renal dysfunction may themselves cause disturbance in fluid and electrolyte homeostasis, particularly the use of diuretics and renal replacement therapy. Loss of normal renal function may lead to major changes in fluid and sodium balance. Volume status assessment will be required in patients with renal dysfunction because they are at risk of both hypovolaemia and hypervolaemia. Loss of renal function will lead to retention of potassium and magnesium with serious systemic and cardiovascular consequences including cardio respiratory compromise and collapse and cardiac dysrhythmias. Hypocalcaemia will result from reduced renal calcitriol production and phosphate retention. The identification of fluid and electrolyte imbalances and the management of clinically significant changes are required when treating patients with renal dysfunction on an intensive care unit or who present for anaesthesia.

Keywords: *calcium, dysfunction, electrolyte, failure, fluid, kidney, magnesium, potassium, renal, sodium*

INTRODUCTION

Chronic kidney disease (CKD) causes dysfunction in regulating water homeostasis because of a reduced glomerular filtration rate (GFR)1. Volume overload is highly prevalent in patients with CKD and a 10% to 30% increase in extracellular fluid can be detected, even in the absence of overt edema2. The disorder in homeostasis resulted in hypertension, electrolyte imbalance and edema. Volume overload has been associated with CKD progression and cardiovascular disease (CVD) related morbidity or mortality3. Diuretics are essential in treating fluid balance, blood pressure control, prevention of hyperkalemia and urine amount regulation in CKD population. However, several studies have reported negative outcomes of diuretic usage on renal function, mortality, and hospitalization in patients with heart. In acute kidney injury (AKI), loop diuretics exert no significant effect on renal recovery, the need for dialysis, or mortality In CKD, the long-term effect of diuretic usage in correction of volume overload has not been thoroughly studied.

Sodium imbalance could be secondary to diuretic usage, particularly in patients with CKD, because the ability of kidneys to regulate dilution and concentration becomes impaired as renal disease progressing2. Hyponatremia could be a consequence of fluid overload or a consequence of diuretic usage in these patients. Various epidemiological studies have documented an association between hyponatremia and increased mortality from diseases involving fluid overload and diuretic usage, such as congestive heart failure (CHF) and liver cirrhosis17,18,19,20,21. Recently, Kovesdy et al. discovered that both lower and higher serum sodium levels are associated with higher mortality in patients with CKD, independent of CHF and liver disease22, but renal outcome and the degree of diuretic usage were not reported. Due to the unique disease characteristic that are susceptible to sodium imbalance, hyponatremia could be prognostic indicator in patients with CKD. Thus, the aim of our study was to determine whether diuretic usage and the

related hyponatremia are associated with fluid imbalance and are predictive of adverse clinical outcomes, including renal outcomes, in patients with CKD.

AIMS AND OBJECTIVES:
➢ To determine the prevalence of malnutrition among CKD patient on hemodialysis.
➢ To determine the impact of demographic socioeconomic factors on malnutrition indicators.
➢ To determine the prevalence of chronic kidney disease complications.
➢ To evaluate the diet & fluid compliance among hemodialysis patients.
➢ And to clarify the correlation between dietary intake and malnutrition among hemodialysis patients.

MATERIALS AND METHODS
Location of the study The hospital based study was carried out at the hemodialysis unit of DR. B. R. A. Memorial Hospital Raipur , with the purpose to observe and undertake the protocol followed in the hospital to assess the nutritional status of the patients visiting for hemodialysis and different wards for the treatment of chief complaints and associated co morbidities.

SAMPLE SIZE:-
A convenient sample of 50 adult hemodialysis patients from both sexes was selected for the study.

STUDY SETTING
The study was conducted at the hemodialysis unit at Al-Shifa hospital, in Gaza strip, which is considered the dialysis center in Dr. B. R. A. Memorial hospital raipur with 4 machines and more than 100 patients.

STUDY POPULATION
All hemodialysis patients from both gender diagnosed as an ESRD on hemodialysis for more than six months.

Eligibility Criteria
1 Inclusion criteria:-
➢ Patients with ESRD from both gender aged 19-59 years.
➢ On regular hemodialysis for at least six months or more.

2 Exclusion criteria:-
➢ Patients with other types of acute illness, such as pneumonia, acute myocardial infarction or septicemia.
➢ Patients with depression.
➢ Patients <19 and >59 years old.
➢ Patients on hemodialysis for <6 months.

Collection of data
Demographic and socioeconomic data Data regarding socioeconomic status like occupation, marital status, education, family type, family size and monthly family income was collected by interviewing the subjects.

Questionnaire interview
Face to face structured interviews was used to collect data from individuals. Most questions are one of two types: the multiple choice question which offers several fixed alternatives and yes or no question which offers a dichotomous choice. The interviewer explained to all individuals the importance, aim and purpose of the research study. Also all questions were ideally asked in the same way during the data collection to achieve a high degree of validity and reliability.

Diet and fluid compliance data
Also, the following data concerning diet and fluid compliance was collected from patients files and by using questionnaire interview: using of diet regimen, fluid intake, average weight change between hemodialysis sessions (kg) in the last two months ...etc.
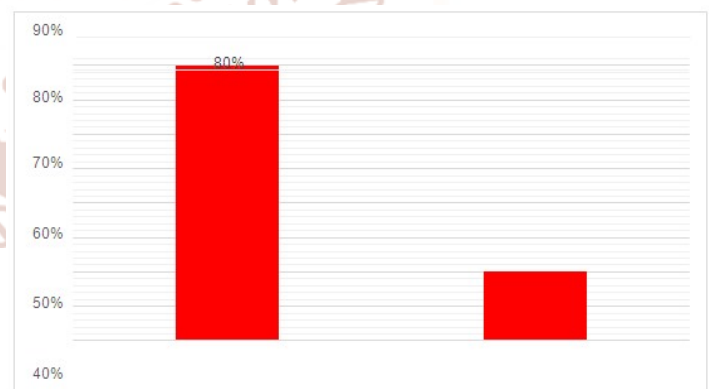

Figure: Showing Distribution of the study population by serum potassium level

Table 5: Distribution of the study population by biochemical indicators of CKD associated bone disease

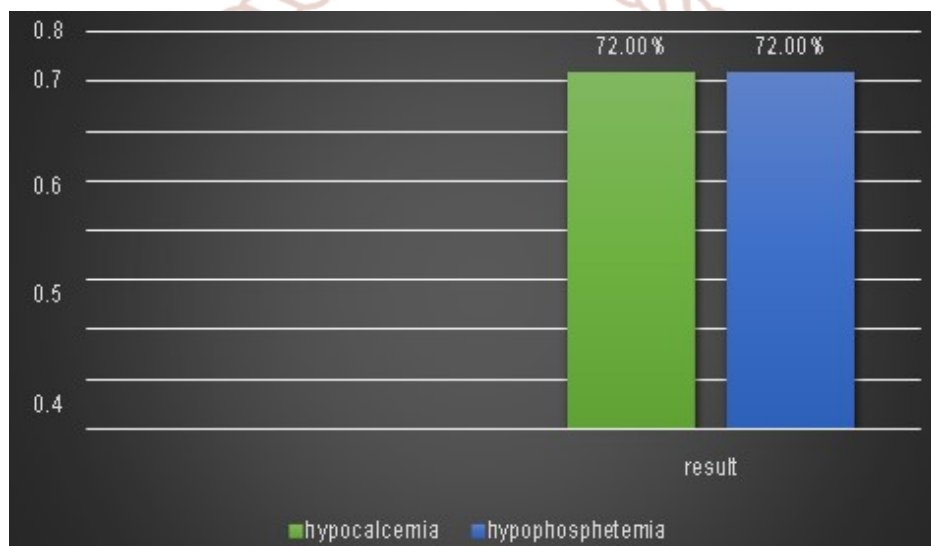| Variable	patient	Frequency (50)	Percentage (100%)
Total calcium (mg/dL)	Normal (8.4-9.5 mg/dL)	14	28.0
	Hypocalcemia	36	72.0
	Males hypocalcemia	23	46.0
	Females hypocalcemia	13	26.0
	M±SD = (7.83±1.05 mg/dL)		
Phosphorous (mg/dL)	Normal (3.5-5.5 mg/dL)	14	28.0
	Hyperphosphatemia	0	
	Hypophosphatemia Males	36	72.0
	hypophosphatemia Females	20	40.0
	hypophosphatemia	16	32.0
	M±SD= (3.16±0.73 mg/dL)		

Figure: Showing Biochemical indicators of CKD- associated bone disease(Hypophosphatemia and Hypocalcemia)

Table 7: Distribution of the study population by blood pressure (mmHg) and serum sodium (mEq/L) variables

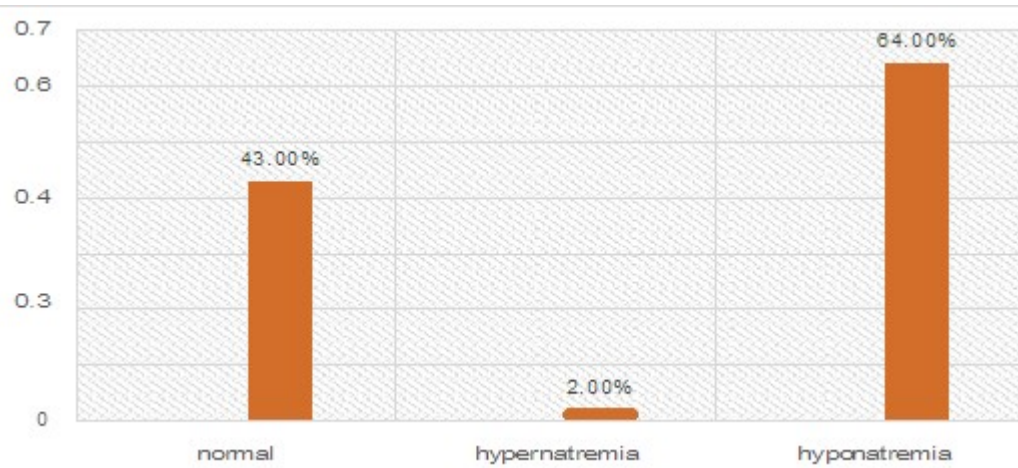| Variable		Frequency (50)	Percentage (100%)
Blood pressure (mmHg)	Normal	14	28.0
	Stage one hypertension Stage	19	38.0
	two hypertension Stagethree	10	20.0
	hypertension HTN	7	14.0
	(males) HTN	26	52.0
	(females)	10	20.0
Serum Sodium level (mEq/L)	**Normal sodium (135-145mEq/L)**	**17**	34.0
	Hypernatremia	**01**	2.0
	Hyponatremia	**32**	64.0
	M±SD = (131.14±7.32 mEq/L)		

Figure : Distribution of the study population by blood pressure (mmHg) and serum sodium (mEq/L) variables

CONCLUSIONS AND RECOMMENDATIONS

Malnutrition is common among hemodialysis patients at Dr. B.R.A. Memorial Hospital Raipur and closely related to morbidity and mortality.

➢ Approximately two thirds of the patients showed a biochemical malnutrition indicators, these include:
A. Hypoalbuminemia (58.0%),
B. Low predialysis serum creatinine level (64.0%),
C. Low serum cholesterol level (84.0%),
D. And 60% of the patients had BMI less than the recommended BMI (23.8 kg/m²) for hemodialysis patients.

➢ There was a marked increase in the prevalence of CKD complications among hemodialysis patients at DR. B. R. A. Memorial Hospital:
A. Anemia – male – 62.0% - female – 38.0%
B. Hypertension (72.0%),
C. High turnover bone disease –hypocalcaemia- 72.0% - hypophosphatemia – 72.0%
D. Hyperkalemia (20.0%),
E. Diabetes mellitus (36%).

And the presence of this co-morbidity has a significant adverse impact on patients survival.

➢ There was a significant positive correlation between patients age (yrs), marital status, and monthly income (NIS) with BMI. The data suggests that demographic socioeconomic factors could contribute to a higher percentage of malnutrition.
➢ There was a significant negative correlation between number of visits to ER and the number of admission days to hospitals over a year with serum albumin level, and BMI. The data suggests that the patients are at a high risk of morbidity and mortality.
➢ There were a significant positive correlations between dietary protein, phosphorous, potassium intake with serum albumin level, serum phosphorous level, serum potassium level respectively. Our results showed that, hemodialysis patients need to decrease consumption of (phosphorous, potassium rich foods) and to increase dietary protein intake, to improve their nutritional status and to reduce CKD complications.
➢ Gastrointestinal symptoms lead to inadequate food intake and may interfere significantly with the patients nutritional status.
➢ The majority (56.0%) of hemodialysis patients didn't have any diet regimen and about (44.0%) of patients deviated from their fluid restrictions.

ABBREVIATIONS:-

UPS	Proteasome-ubiquitin system
CKD	Chronic kidney disease
ESRD	End-stage renal disease
HBV	High biological value
IS	Indoxyl sulfate
pCS	p-Cresyl sulphate
HCl	Hydrogen chloride
H2SO4	Sulfuric acid
H3PO4	Phosphoric acids
NaHCO3	Sodium bicarbonate
TWEAK	TNF-related weak inducer of apoptosis
IL-1	Interleukin-1
IL-6	Interleukin-6