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Original Article

THE STUDY OF HYPOKALEMIA AND HYPERKALEMIA IN VARIOUS DISEASES

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ABSTRACT

Fluid & Electrolytes imbalance is often observed in many disease conditions particularly in hospitalized patients. Potassium is one of the important electrolytes; alteration of serum levels (Hypokalemia & Hyperkalemia) will lead to various metabolic complications witch may be fatal. Early diagnosis will help in the treatment & overall management. This will help in reducing the morbidity & mortality.

In this background we tried to enumerate, the causes of hypokalemia & hyperkalemia in the patients admitted in various Dept. of Mamata General Hospital, Khammam.

INTRODUCTION

Potassium is a chemical element. It has the symbol K (Arabic: al qalija → Latin kalium) and atomic number 19. The name "potssium" comes from the word "potash", as potassium was first isolted from potash. Potassium is a soft silvery-white metallic alkali metal tht occurs naturally bound to other elements is seawater and many minerals. It oxidizes rapidly in air and is very rective, especially towards water. In many respects, potassium and sodium are chemically similar, although organims in general, and animal cells in particulars, tret them very differently.

- Potassium is the principal intracellular cat ion. It is equally important in the extra cellular fluid for specific function.
- The total body potassium of a 70 kg subject is ~ 3.5 mol (40-59 mmol/kg) of which 75% is in skeletal muscle only 1.5 to 2% is present in ECF. Nevertheless, plasma k^1 is relatively good indicator of total Potassium stores with only a few exception.

Potassium is essential to the life of every cell of a living being and is among the most generously and widely distributed of all the tissue minerals. It is found principally in the intracellular fluid where it plays an important role as a catalyst in energy metabolism and in the synthesis of glycogen and protein. The average adult human body contains 120 g. as potassium and 245 g. as potassium chloride. Out of this body potassium, 117 g. is found in the cells and 3 g. in the extra cellular compartment. Potassium is important as an alkalizing agent in keeping a proper acid-alkaline balance in the blood and tissues. It is essential for muscle contraction and therefore, important for proper heart function. It promotes the secretion of hormones and helps the kidneys in detoxification of blood. Potassium prevents female disorders by stimulating the endocrine hormone production. It is involved in the proper functioning of the nervous system and helps overcome fatigue. It also aids in clear thinking by sending oxygen to the brain and assists in reducing blood pressure.

- Potassium deficiency may occur during gastrointestinal disturbances with severe vomiting and diarrhea, diabetic acidosis and potassium-losing nephritis. It causes undue nervous and body tiredness, palpitation of the heart, cloudiness of the mind, nervous shaking of the hands and feet, great sensitivity of the nerves to cold, and excessive perspiration of the feet and hands. In simple cases of potassium deficiency, drinking plenty of tender coconut water daily can make up for it. It is advisable to consume plenty of muscle activities.
- Depolarization and contrition of heart require potassium.
- It required for regulation of Acid-Base balance in the cell.
- The enzyme pyruvatekinase (of) is dependent on potassium for optimal activity.
- Potassium is required for the transmission of nerve impulse.
- Adequate intracellular concentration of potassium is necessary for biosynthesis of proteins by ribosome's.

DIETARY REQUIREMENTS:

Potassium requirement is 3 – 4 g/day

Normal value of potassium:

Plasma potassium level is 3.5 – 5 meq/L.

ABSORPTION:

The absorption of potassium from the gastrointestinal tract in very efficient (90%), Very little is lost through feces.

In diarrhea good proportion of potassium is lost in the feces.

EXCRETION:

Potassium is mainly execrated through urine. The maintenance of acid base balance influences potassium excretion. Aldosterone increases excretion of potassium.

Potassium is the major intracellular cation. It is widely distributed in the body fluids and tissues as follows

Whole blood	: 200 mg / dl
Plasma	: 20 mg / dl
Cell	: 440 mg / 100 g
Muscle tissue	: 250 – 400 mg / 100 g
Nerve tissue	: 530 mg/ 100 g

- Average normal human body contains 3.6 moles of potassium. (The normal conc plasma potassium 3.5 – 5 m eq/L).
- Potassium is also excreted in gastrointestinal tract, saliva, gastricjuice, bile and pancreatic & intestinal jucies.
- Potassium is continuously filtered by glomeruli of the kidney reabsorbed by the cells proximal convoluted tubules.

SOURCES: Banana, Orange, Pineapple, Potato, Beans chicken, liver and Tender coconut water are a rich sources of potassium.

The richest sources of potassium are fruits and vegetables. People who eat large amounts of fruits and vegetables have a high potassium intake (8-11 grams/day) (4). A recent dietary survey in the U.S. indicated that the average dietary potassium intake is about 2,300 mg/day for adult women and 3,100 mg/day for adult men (25). The potassium content of some relatively potassium-rich foods is listed in milligrams (mg) in the table below. For more information on the nutrient content of foods, search the USDA food composition database.

Aims and objectives

To analyse various causes of Hypokalemia in Hospitalysed patients.

To analyse various causes of Hyperkalemia in Hospitalysed patients.

MATERIAL AND METHODS

Cases were selected from the samples sent for serum electrolytes analysis from various department of the clinical biochemistry laboratory of Mamata General Hospital, Khammam.

In cases with serum potassium level <3.5 mmol/L were selected and the group of Hypokalemia. Cases with serum potassium level > 5.0 mmmol/L were grouped and Hypoerkalemia. Both the groups were evaluated for diagnosis. Cases were categorized based on the diagnosis.

Mean ± values are calculated sample size was 1556.

Estimation of potassium :

INSTRUMENTS : SMDECS™ 2000 electrolyte analyzer.

PRINCIPLE : Direct potentiomery (Ionselective)

CONTENTS :

Electrode cell assembly contains sodium, potassium membranes and reference with a wash shell which filled with autocalsolution.

Autocal calibrated is used rinse the electrode probel and perform one point calibration. Each time a sample is run. It stored at room temperature (15 – 30^{o}C or 59 – 86^{0}F)

Calset calibrator is used to perform the second point of the two point calibration. It is stored at room temperature (15 – 30^{o}C or 59 – 86^{0}F)

Sample : Serum.

PERFORMANCE SEPECIFICATION :

1. Usable range (m.mol/l) Sodium 10 – 999 Potassium 0.20 – 300.00
2. Resolution (m.mol/l) Sodium 0 – 0
3. Calibration point Sodium 10 – 999 Potassium 4.0 – 8.0

PROCEDURE :

1. Instrument is clibrated with Calset.
2. 200µl of sample is put in sample cup and then analysis is done.
3. Eletrode assembly will diseand down into the sample cup and analysis is done.

RESULTS & DISCUSSION

Table 1: Causes Wise Distribution Of Hypokalemia

S.No.	Name of the Diseases	Mean Value	No.of Cases
1	Insulin therapy in D K A	2.92	20
2	Hypokalemic periodic paralysis	2.17	4
3	Renal tubular Acidosis	3.05	2
4	Diuretics	2.9	4
5	Prolonged Vomiting	2.93	3
6	Diarrhea	2.87	27
7	Intestinal Fistula	2.88	5
8	Post Operative Intravenous Therapy	2.87	6
	TOTAL		**71**

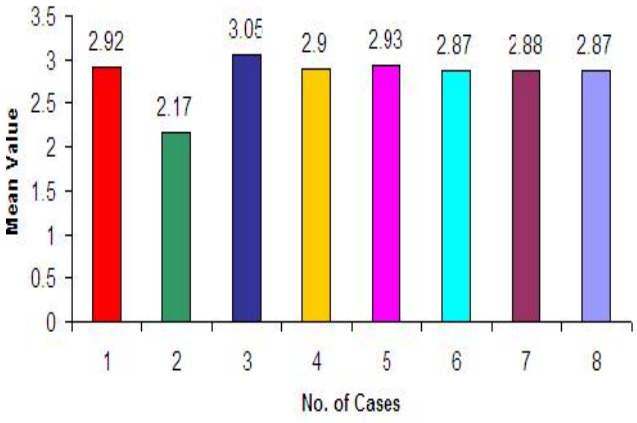

Fig1: Causes Wise Distribution of Hypokalemia

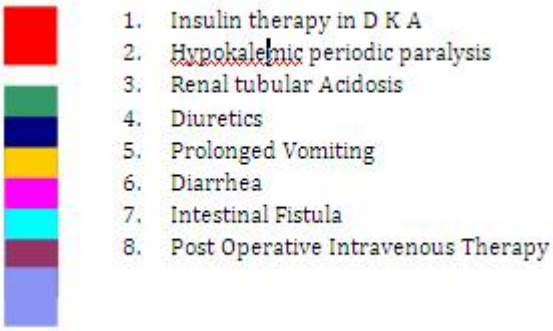

Table 2: Causes Wise Distribution Of Hyperkalemia

S.No.	Name of the Diseases	Mean Value	No.of Cases
1	Diabetic Keto Acidosis	5.99	12
2	Dehydration (Diarrhea)	5.8	8
3	Acute Renal Failure (ARF)	5.95	11
4	Chronic Renal Failure (CRF)	5.89	8
5	Usage of Enalaprial	5.5	2

	(ACE Inhibitor)		
6	Tumorlysis Syndrome		1
	TOTAL		**42**

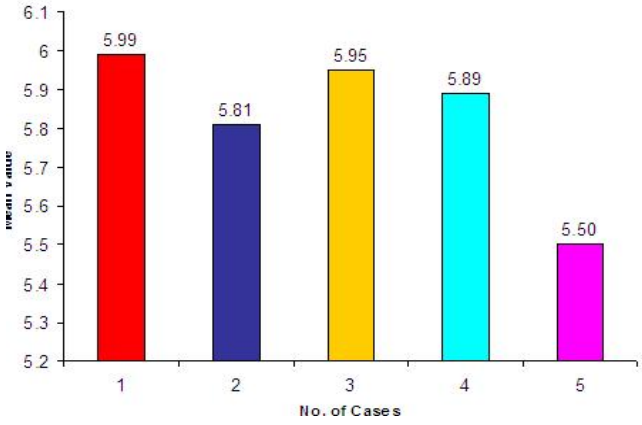

Fig 2: Cause wise Distribution of Hyperkalemia

1. Diabetic Keto Acidosis
2. Dehydration (Diarrhea)
3. Acute Renal Failure (ARF)
4. Chronic Renal Failure (CRF)
5. Usage of Enalaprial (ACE Inhibitor

2. Out of 1556 cases, serum electrolytes estimation, 1443 were found to be normo kelemic. 113 were found to be abnormal, where 71 were Hypokalemia (<3.5 mMol/L) and 42 were found to Hyperkalemia (>5.0 mMol/L). All these cases were evaluated for the cause of alteration of potassium.

Among 71 cases of Hypokalemia
27 patients were due to Diarrhea
20 patients were due to insulin therapy in D.K.A.
6 patients were due to Post Operative Intravenous Therapy
5 patients were due to a Intestinal Fistula.
4 patients were due to a Hypokalemia periodic paralysis
4 patients were due to a Diuretics
4 patients were due to a Prolonged Vomiting
2 patients were due to a Renal tubular Acidosis.
Among 42 cases of Hyperkalemia
12 patients were due to D.K.A.
11 patients were due to Acute Renal Failure (ARF)
8 patients were due to Dehydration (Diarrhea)
8 patients were due to a Chronic Renal Failure (CRF).
2 patients were due to a Usage of Enalaprial (ACE Inhibitor)
1 patient were due to a Tumorlysis Syndrome

Range wise distribution of Hypokalemia cases

In these Hypokalemic patients serum potassium level:
With in the 3.1 to 3.5 mmol/L. Range found in 27 patients.
With in the 2.6 to 3.0 mmol/L. Range found in 25 patients.
With in the 2.12 to 2.5 mmol/L. Range found in 18 patients.
With in the 3.1 to 2.0 mmol/L. Range found in 1 patients.

Range Wise Distribution Of Hyperkalemia Cases

In these Hyperkalemia patients serum potassium level:
With in the 6.6 to 7.0 mmol/L. Range found in 2 patients.
With in the 6.12 to 6.5 mmol/L. Range found in 14 patients.
With in the 5.6 to 6.0 mmol/L. Range found in 17 patients.
With in the 5.12 to 5.5 mmol/L. Range found in 9 patients.

Blood is the liquid connective tissue, carrying a wide array of cat ions and anions in addition to oxygen and essential nutrients. These charged cat ions and an ions play vital role in regulating different biochemical processes in our body.

A definite balance in the level of potassium ranging from (3.5 to 5.5 m.eq/L) must be maintained the fluctuation in their levels can cause deleterious effects both Hypokalemia and Hyperkalemia.

Hypokalemia is observed in Insulin therapy in D.K.A., Hypokalemic periodic paralysis, Renal tubular Acidosis, Diuretics, Prolonged Vomiting, Diarrhea, Intestinal Fistula, Post Operative Intravenous Therapy.

Hyperkalemia is observed in Diabetic Keto Acidosis, Dehydration (Diarrhea), Acute Renal Failure (ARF), Chronic Renal Failure (CRF), Tumorlysis Syndrome, Usage of Enalaprial (ACE Inhibitor).

CONCLUSION

Early detection and prompt management of the fluid electrolyte inbalance is mandatory for the efficient treatment. Mother nature maintains a balanced equilibrium of these electrolytes in us, but in clinical practice under the vigilance of a clinician, their levels are monitored based on the reports from the Bio-Chemistry Lab. Hence the role of a Bio-Chemist is crucial in assisting the clinician for delivery of a better service.

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