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RESEARCH ARTICLE

EVALUATIONS OF SERUM ELECTROLYTES LEVELS IN KIDNEY FAILURE SUBJECTS UNDERGOING DIALYSIS IN OWERRI

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Abstract

This study was carried out to determine serum electrolytes levels in kidney failure subjects undergoing dialysis in Owerri. Sixty (60) subjects between the age of eighteen and seventy years were selected for the study. Sodium & Potassium were determined by Emission Flame Photometry and Chloride was determined by Mercuric Nitrate method. The test was calculated statistically to get the means. P<0.05 was considered statistically significant while P>0.05 was considered not statistically significant. The levels of these ions were correlated. Sodium ion concentration was statistically and significantly decreased (p=0.001) in kidney failure subjects undergoing dialysis when compared with the control subjects. There was statistical significant difference (p=0.000) in the mean value of potassium ion concentration in kidney failure subjects undergoing dialysis when compared with the control subjects. There was statistical significant difference (p=0.001) in the mean value of chloride ion concentration in kidney failure subjects undergoing dialysis when compared with the control subjects. There was statistical significant difference (p=0.000) in the mean value of bicarbonate ion in kidney failure subjects undergoing dialysis when compared with the control subjects. There was a significant negative correlation of sodium ion with potassium and bicarbonate ion (r= -0.107, p=0.000; r=-0.192, p=0.000 respectively which indicates an increase in sodium with decrease in potassium and bicarbonate. There was a significant positive correlation of sodium ion with chloride ion (r=-0.185, p=0.000) which indicates increase in sodium leading to increase in chloride. There was a significant negative correlation of potassium ion with chloride (r= -0.130, p=0.000) which indicates increase in potassium leading to a decrease in chloride. There was a significant positive correlation of potassium ion with bicarbonate ion (r=-0.760, p=0.000) which indicates increase in potassium leading to increase in bicarbonate. There was significantly no correlation between chloride ion with bicarbonate ion (r=-0, p=0.000). Sodium, Chloride and Bicarbonate ion concentrations were statistically and significantly increased in kidney failure subjects undergoing dialysis when compared with the control subjects indicating hypernatremia and hyperchloremia and alkalosis respectively while Potassium ion concentrations was decreased indicating hypokalemia. The use of dialysis is effective in balancing the levels of these ions that were abnormally low and high respectively in Kidney failure subjects.

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Introduction:-

Kidney failure occurs when the kidneys lose the ability to sufficiently filter waste from blood. Many factors can interfere with your kidney health and function, such as: toxic exposure to environmental pollutants or certain medications. Certain acute and chronic diseases(Cheunget al., 2005). Kidney failure is classified either as acute kidney failure, which develops rapidly and may resolve and chronic kidney failure, which develops slowly and can often be irreversible (Ahmadet al., 2008; Obeagu et al., 2014; Obeagu, 2016)).

Hemodialysis removes wastes and water by circulating blood outside the body through an external filter, called a dialyzerthat contains a semi-permeable membrane. The blood flows in one direction and the dialysate flows in the opposite. The counter-current flow of the blood and dialysate maximizes the concentration gradient of solutes between the blood and dialysate, which helps to remove more urea and creatinine from the blood(Obeagu et al., 2016; Emmanuel et al., 2018; Oloro and Obeagu, 2022). The concentrations of solutes normally found in the urine are undesirably high in the blood, but low or absent in the dialysis solution, and constant replacement of the dialysate ensures that the concentration of undesired solutes is kept low on this side of the membrane (Ahmadet al., 2008).

In peritoneal dialysis, wastes and water are removed from the blood inside the body using the peritoneum as a natural semi-permeable membrane. Wastes and excess water move from the blood, across the peritoneal membrane and into a special dialysis solution, called dialysate, in the abdominal cavity(Loteet al., 2012).

Dialysis regulates the level of Membrane potential electrolytes Sodium, Potassium and Chloride in Kidney Failure Subjects preventing Hyponatremia (decreased blood sodium level), Hyperkalemia (increased blood potassium level) and Hypochloremia (decreased Chloride concentration in the blood), uncontrolled Hypertension and other neurological disorder symptoms which result due to the failure of the kidneys to regulate wastes, water and electrolytes balance in the body (Pendseet al., 2008).

Materials And Methods:-

Study Area

This study was carried out at Federal Medical Centre Owerri, the capital city of Imo State in the tropical rain forest of South-Eastern part of Nigeria.

Advocacy, Mobilization and Pre-survey Contact

A letter of introduction was obtained from the Head of Department, Medical Laboratory Science and formal consent was sought.

The letter of introduction and a proposal detailing the essence and nature of my research were submitted to the ethical committee of Federal Medical Centre Owerri. An ethical approval was obtained to collect samples. Informed consent was sought on the subjects and adequate verbal information was provided for the subjects to enable them know the essence of collecting blood/serum samples and nature of the research work.

Study Population

A total number of sixty subjects between the ages of eighteen and seventy years were remitted for this study. Thirty were confirmed kidney failure subjects undergoing dialysis for the past one month at Federal Medical Centre Owerri. Thirty were kidney failure subjects that were not undergoing dialysis, who served as control subjects.

Selection Criteria

A) Inclusion

The participants were those that met the enrollment criteria. The criteria were as follows:

1. Subjects above the age of 18-70 years.
2. Subjects confirmed suffering from kidney failure undergoing dialysis.
3. Apparently healthy individuals that served as control subjects
4. Subjects whose informed consent was sought.

B) Exclusion

The following were excluded from the study

1. Subjects that are below 18and above 70 years of age.
2. Subjects with other complicated diseases.
3. Subjects whose informed consent was not sought.

Sample Collection

Venous blood was collected from each subject using the standard clean veni-puncture technique and dispensed into a properly labeled Litium Heparin container for blood electrolyte test (Sodium, Pottasium, Chloride ions and Bicarbonate).

Laboratory Procedures

All reagents used were commercially procured and the manufacturer's standard operating procedures strictly followed.

Determination of serum sodium by emission flame photometry (Ocheiet al., 2007).

Procedure

Stock Sodium Standard (1.0M): 58.45g sodium chloride was dissolved in distilled water and made up to 1 litre.It was mixed well.The air compressor was switched on and the air pressure adjusted.Deionzed water was introduced through the atomizer.The gas was turned on and the flame adjusted to give fine sharp ones.Appropriate filters were placed for simultaneous sodium estimation.The zero was set with deionised water.Standard was introduced and adjusted 120.0 for Sodium.Standards were checked if they display exact concentration for Sodium.Diluted test serum was introduced and the readings for Sodium noted.

Determination of serum pottasium by emission flame photometry (Ocheiet al., 2007).

Procedure

Stock Potassium Standard (1.0M): 74.55g Potassium chloride was dissolved in distilled water and made up to 1 litre.It was mixed well.The air compressor was switched on and the air pressure adjusted.Deionzed water was introduced through the atomizer.The gas was turned on and the flame adjusted to give fine sharp ones. Appropriate filters were placed for simultaneous Potassium estimation.The zero was set with deionised water.Standard was introduced and adjusted 2.0 for Potassium.Standards were checked if they display exact concentration for Potassium.Diluted test serum was introduced and the readings for Potassium noted.

Determination Of Serum Chloride By Mercuric Nitrate Method (Ocheiet al., 2007).

Procedure

2 drops of indicator was added to 2ml of standard NaCl (10mmol/L) and titrated with mercuric nitrate.The end point was reached when the colour changed to pale violet.It was repeated twice and the average of the three readings taken.0.2ml of plasma was added to 1.8ml of distilled water.2 drops of the indicator was added and titrated with mercuric nitrate.The endpoint was reached when the solution's colour changed from pale yellow to pale violet.2.0ml of Standard chloride was titrated in the same way as plasma.

Determination Of Serum Bicarbonate

Procedure

Three test tubes were labeled test, standard and blank. 1ml of Reagent was put into all the labeled test tubes and was incubated at 37°C for 5 minutes. 10µl of Water was added to the test tube labeled blank and 10µl of standard into the standard test tube, 10µl of sample into the test tube labeled test. They were mixed and incubated for 1 minute at 37°C. Absorbance was read against reagent blank as A_1, after 5 minutes, it was read again as $A_{2.}$

Results:-

Table 1:- The result of the study on Sodium, Potassium, Chloride and Bicarbonate in Kidney Failure Subjects undergoing dialysis (Test) Vs Kidney Failure Subjects not undergoing dialysis (Control) is presented below.

Parameters	Test N=30	Controls t-value N=30	P-value
Sodium ion (mmol/l) Potassium ion (mmol/l)	140.33+2.16	126.83+5.88 -5.28	0.001*

	3.80±0.14	5.45±0.31	12.13	0.000*
Chloride ion (mmol/l)	99.50+1.05	91.33+3.56	-5.39	0.001*
Bicarbonate ion (mmol/l)	32.50+3.27	24.50+1.87	5.20	0.000*

*P<0.05 (Significant)
*P>0.05 (Not significant)

Table 1 shows mean and standard deviation of Sodium, Potassium, Chloride and Bicarbonate in Kidney Failure Subjects undergoing dialysis and Kidney Failure Subjects not undergoing dialysis.

Sodium ion concentration was statistically and significantly increased (p=0.001) in kidney failure subjects undergoing dialysis (140.33+2.16mmol/L) when compared with the control subjects (126.83+5.88mmol/L).

There was statistical significant difference (p=0.000) in the mean value of potassium ion concentration in kidney failure subjects undergoing dialysis (3.80+0.14mmol/L) when compared with the control subjects (5.45+0.31mmol/L).

There was statistical significant difference (p=0.001) in the mean value of chloride ion concentration in kidney failure subjects undergoing dialysis (99.50+1.05mmol/L) when compared with the control subjects (91.33+3.56mmol/L).

There was statistical significant difference (p=0.000) in the mean value of bicarbonate ion in kidney failure subjects undergoing dialysis (32.50+3.27mmol/L) when compared with the control subjects (24.50+1.87mmol/L).

Table 2:- Pearson Correlation of Sodium with Potassium, Chloride and Bicarbonate, in Kidney Failure Subjects undergoing dialysis.

Dependent Variable	N	r-value	p-value
Potassium ion	30	-0.107*	0.000
Chloride ion	30	0.185*	0.000
Bicarbonate ion	30	-0.192*	0.000

There was a significant negative correlation of sodium ion with potassium and bicarbonate ion (r= -0.107, p=0.000; r=-0.192, p=0.000 respectively) in Kidney Failure Subjects undergoing dialysis. There was a significant positive correlation of sodium ion with chloride ion (r=-0.185, p=0.000) in Kidney Failure Subjects undergoing dialysis (Table 2).

Table 3:- Pearson Correlation of Potassium with Chloride and Bicarbonate, in Kidney Failure Subjects undergoing dialysis (Test).

Dependent Variable	N	r-value	p-value
Chloride ion	30	-0.130*	0.000
Bicarbonate ion	30	0.760*	0.000

There was a significant negative correlation of potassium ion with chloride (r= -0.130, p=0.000) in Kidney Failure Subjects undergoing dialysis. There was a significant positive correlation of potassium ion with bicarbonate ion (r=-0.760, p=0.000) in Kidney Failure Subjects undergoing dialysis (Table 3).

Table 4:- Pearson Correlation of Chloride with Bicarbonate, in Kidney Failure Subjects undergoing dialysis.

Dependent Variable	N	r-value	p-value
Bicarbonate ion	30	0*	0.000

There was significantly no correlation between chloride ion with bicarbonate ion (r=-0, p=0.000) in Kidney Failure Subjects undergoing dialysis (Table 4).

Discussion:-

10% of the population worldwide is affected by chronic kidney disease (CKD), and millions die each year because they do not have access to affordable treatment. According the 2010 Global Burden of Disease study, chronic kidney disease was ranked 27th in the list of causes of total number of deaths worldwide in 1990, but rose to 18th in 2010. This degree of movement up the list was second only to that for HIV and AIDs (Jha et al., 2013). Over 2 million people worldwide currently receive treatment with dialysis or a kidney transplant to stay alive, yet this number may only represent 10% of people who actually need treatment to live (Couseret al., 2011). Of the 2 million people who receive treatment for kidney failure, the majority are treated in only five countries – the United States, Japan, Germany, Brazil, and Italy. These five countries represent only 12% of the world population. Only 20% are treated in about 100 developing countries that make up over 50% of the world population (Couseret al., 2011). More than 80% of all patients who receive treatment for kidney failure are in affluent countries with universal access to health care and large elderly populations (Jhaet al., 2013).

In the present study, sodium ion concentration was statistically and significantly decreased ($p<0.05$) in kidney failure subjects undergoing dialysis when compared with the control subjects. There was statistical significant difference ($p<0.05$) in the mean value of potassium ion concentration in kidney failure subjects undergoing dialysis when compared with the control subjects. This is backed by the study that Kidney failure is often complicated by elevations in potassium, phosphate, and magnesium and decreases in sodium and calcium (Uhlénet al., 2015).

There was statistical significant difference ($p<0.05$) in the mean value of chloride ion concentration in kidney failure subjects undergoing dialysis when compared with the control subjects. There was statistical significant difference ($p<0.05$) in the mean value of bicarbonate ion in kidney failure subjects undergoing dialysis when compared with the control subjects. This may be due to acid-base imbalance.

There was a significant negative correlation of sodium ion with potassium and bicarbonate ion and a positive correlation with chloride ion in Kidney Failure Subjects undergoing dialysis. There was a significant negative correlation of potassium ion with chloride ion and a positive correlation with bicarbonate ion in Kidney Failure Subjects undergoing dialysis. There was significantly no correlation between chloride ion with bicarbonate ion. Though there is no found study backing this.

Conclusion:-

From the study, Sodium, Chloride and Bicarbonate ion concentrations were statistically and significantly increased in kidney failure subjects undergoing dialysis when compared with the control subjects indicating hypernatremia and hyperchloremia and alkalosis respectively while Potassium ion concentrationswasdecreased indicating hypokalemia. The use of dialysis is effective in balancing the levels of these ions that were abnormally low and high respectively in Kidney failure subjects.

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