بسم الله الرحمن الرحيم

Sudan University for Sciences & Technology

College of Graduate Studies

College of medical laboratory science

Clinical chemistry

Effect of Chemotherapy in Renal Function Test and Electrolyte in Cancer Patients in Khartoum State

تأثيرالعلاج الكيميائى في اختبار وظائف الكلى والشوارد الكهربائية في مرضى السرطان في ولاية الخرطوم

A Dissertation Submitted in Partial Fulfillment of the Requirement for M.Sc Degree in Medical Laboratory Sciences

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April 2021

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الاية

ۦمَا أُبَرِّئُ نَفْسِي إِنَّ النَّفْسَ لَأَمَّارَةٌ بِالسُّوءِ إِلَّا مَا رَحِمَ رَبِّي إِنَّ رَبِّي غَفُورٌ رَحِيمٌ (53) وَقَالَ الْمَلِكُ ائْتُونِي بِهِ أَسْتَخْلِصْهُ لِنَفْسِي فَلَمَّا كَلَّمَهُ قَالَ إِنَّكَ الْيَوْمَ لَدَيْنَا مَكِينٌ أَمِينٌ (54) قَالَ اجْعَلْنِي عَلَى خَزَائِنِ الْأَرْضِ إِنِّي حَفِيظٌ عَلِيمٌ (55) وَكَذَلِكَ مَكَّنَّا لِيُوسُفَ فِي الْأَرْضِ يَتَبَوَّأُ مِنْهَا حَيْثُ يَشَاءُ نُصِيبُ بِرَحْمَتِنَا مَنْ نَشَاءُ وَلَا نُضِيعُ أَجْرَ الْمُحْسِنِينَ (56)

سورة يوسف الآيات:(53–56)

DEDICATION

I dedicate this thesis to
My father
My mother

My husband

My son
My brothers
My teachers
And to all of my friends

ACKNOWLEDGEMENT

All thanks and praise to ALLAH the lord of all worlds for all givens rewards to me. With sincere thanks and gratefulness, I would like to acknowledge my Supervisor **Dr/ Abdalkreem Awad** for this outstanding, knowledge encouragement, guidance, patience and constructive advice throughout this work.

Abstract

Background: conducted this study to evaluate the type and frequency of affected electrolytes. Electrolyte derangement has been documented during cancer chemotherapy leading to the electrolyte imbalance. and disturbance of renal function.

Objective: to assess frequency of electrolyte and renal function imbalance among cancer patient during chemotherapy

Materials and Methods :This was a cross sectional study concluded samples were collected using non-probability convenient sampling technique,
the study conducted in PORJ AL AMAL hospital to determine the level of sodium , potassium, urea and creatinine .Blood samples were collected for the assessment of the sodium , potassium ,urea and creatine levels with the help of analyzer. A total of 70cancer patients were selected. the range of the included patient was 10 _ 77 years who received single or combination chemotherapy. Data analysis was done using SPSS version 19 . one sample T test use to assess the significant after the treatment with P .value <0.5 and correlation test was done.

Result: the mean age of patients was 38. In our study significant difference existed in
electrolytes parameters. In our study potassium level after the chemotherapy was 3.43 mg/dl ($p<0.001$) while sodium level after the

chemotherapy was 131.77mg/dl ($p<0.001$) . urea level after chemotherapy was 35.30mg/dl ($p<0.001$) . while recorded creatinine levels after chemotherapy
was 0.82 mg/dl ($p<0.001$). Sodium, potassium, creatinine and urea levels show significant
p value.

Conclusion: Our study demonstrates that electrolyte imbalances are common during chemotherapy and monitoring should be done .

المستخلص

خلفية:تم توثيق اختلال الشوارد الكهربائية اثناء العلاج الكيميائي للسرطان مما ادى الى اختلال توازن الشوارد الكهربائي. لذلك نحن اجرينا هذه الدراسه لتقييم نوع وتكرار الشوارد الكهربائية .

الادوات والطرق: كانت هذه دراسة مقطعية وتم جمع العينات باستخدام تقنية اخذ العينات الاحتماليه الملائمة غير المصابة ، اجريت في مستشفى برج الامل لتحديد مستوى الصوديوم والبوتاسيوم واليوريا والكرياتنين.

وتم جمع عينات الدم لتقييم مستويات الصوديوم والبوتاسيوم واليوريا والكرياتنين بمساعدة محلل .تم تضمين مجموعة 70مريضا بالسرطان ، وتشمل معايير الاشتمال النطاق العمري 10-77سنة الذين تلقوا العلاج الكيميائي الفردي او المركب .

تم اجراء تحليل البيانات باستخدام الحزمة الاحصائية للعلوم الاجتماعيه الاصدار 19 كان متوسط عمر المرضى 38.

النتائج: في دراستنا كان هناك فرق كبير في مستوى الشوارد الكهربائية. في دراستنا كان مستوى البوتاسيوم بعد العلاج الكيميائي 3.43 مجم/ دسيليتر (القيمة الاحتماليه اصغر من 0.001) بينما كان مستوى الصوديوم بعد العلاج الكيميائي 131.77 مجم /ديسيليتر (القيمة الاحتماليه اصغر من 0.001) كان مستوى اليوريا بعد العلاج الكيميائي 35.3 مجم /ديسليتر (القيمة الاحتماليه اصغر من 0.001) بينما سجلت مستويات الكرياتنين بعد العلاج الكيميائي كان 0.82 مجم/ ديسيليتر (القيمة الاحتماليه اصغر من 0.001) تظهر مستويات الصوديوم والبوتاسيوم والكرياتنين واليوريا بشكل كبير نتيجة للقيمة الاحتمالية.

الخاتمة: توضح دراستنا ان الاختلالات في الشوارد الكهربائيه شائعة اثناء العلاج الكيميائي ويجب المراقبة.

List of figures

Chapter one

1.1introduction

Cancer patients are usually encountered by number of different issues one of them include electrolyte imbalance (Bowman BT.,2017).

Other causes of electrolyte imbalance include para neoplastic syndrome or those associated with chemotherapeutic regimes (Nriagu J et al., 2016). Life threatening complication has been documented because of these malignant specific electrolyte disorders they may require urgent therapy and correction. Therefore on time proper recognisation and urgent treatment of such patients are overall important (Kumar RV and Bhasker .,2015). Among the electrolyte disorder in malignant patient's hyponatremia is the most common. In one of the study 14% of patients presented were cancer related (Allolio B et *al*.,2014). About half of hyponatremia patients are hospital acquired cases suggesting that proper care and management plan can help to prevent development of hyponatremia (Moritz ML and Ayus JC.,2014) Changes in potassium level in cancer patients especially hyperkalemia is attributable to rahabdomylsis (Lameire N *et al* ., 2010) , renal injury or tumor lysis syndrome Potassium imbalance especially hypokalemia is the second most common electrolyte imbalance documented in cancer patients(Carvalho F et al., 2015) These potassium related imbalance can be because of other causes, some medications like as ifosfamide, cisplatin, amphotericin B, and amino glycoside antibiotics are responsible for tubular damage leading to kidney and get losses of potassium leading to hypokalemia.

1.2Rationale

Cancer cell treated with different type of therapy one of the therapy method is chemotherapy and it is effect cell and cause damage. Measuring of renal profile and electrolyte help in monitoring the patient and its treatment during chemotherapy .if there any abnormal mean that chemotherapy effect on renal function.

1.3objective

1.3.1General objective

Assessment of renal function in cancer patients under chemotherapy.

1.3.2 specific objectives

To measure urea and creatinine .

To measure sodium and potassium.

To correlate between age and renal function abnormalities

Chapter Two

2 . Literature review

2.1renal physiology

Renal system consist of : Kidneys ,blood supply(renal arteries and veins) Ureter ,urinary bladder ,urethra. (Bowman BT.2017).

2.1.2 function of kidney

Water balance

,Electrolyte balance

Plasma volume

Acid-base balance

Excretion Hormone secretion(Bishop *et al* ., 2010).

2.2Electrolyte

Electrolytes are anions or cations depending on whether they move in an electrical field toward the anode or the cathode that is whether they have a positive or negative charge. The major electrolytes included are sodium (Na), potassium (K) , calcium (Ca), magnesium (Mg), chloride (Cl), bicarbonate (HCO3), phosphate (HPO4), sulphate (SO4) , and lactate as well as few other organic anions and trace elements(Bishop *et al* ,. 2010) .

2.2.1potassium

Potassium is an essential mineral and a major electrolyte found in the human body. It plays an important role in electrolyte regulation, nerve function, muscle control, and blood pressure. Potassium is found within all cells of the body, and its levels are controlled by the kidneys. Primarily, potassium functions to regulate water and mineral balance throughout the body Potassium works with sodium to maintain the body's normal blood pressure. Research suggests that increasing dietary potassium may provide a protective effect against hypertension (high blood pressure) by increasing

the amount of sodium excreted from the body. A high potassium intake has also been linked to a reduced risk of death due to cardiovascular disease.(Colorada state university2013).

2.2.1.1 Distribution of potassium (K) in the body

Most of potassium is located in body cells. Note entry of potassium into the small intestine, where it is extensively reabsorbed. Potassium may be secreted in the colon.

Potassium exit from the body is mediated both by the kidney and to a lesser extent ,by the colon.

The distribution of potassium between extra- and intracellular fluid is dependent and regulated by a pump-leak mechanism involving both Na-K-ATP ase and membrane K channels.(G Giebisch *et* ., 2007).

2.2.1.2 Hypokalemia

Hypokalemia (serum potassium level less than 3.6 mEq per L [3.6 mmol per L]) occurs in up to 21% of hospitalized patients and 2% to 3% of outpatients. (ANTHONYJ *et al.*,2015).

2.2.1.3Hyperkalemia

Hyperkalemia is caused by excess potassium intake, impaired potassium excretion, or transcellular shifts. The etiology of hyperkalemia is often multi factorial, with impaired renal function, medication use, and hyperglycemia as the most common contributors.

Hyperkalemia (serum potassium level more than 5 mEq per L [5 mmol per L] in adults, more than 5.5 mEq per L [5.5 mmol per L] in children, and more than 6 mEq per L [6 mmol per L] in neonates) occurs in up to 10% of hospitalized patients and approximately 1% of outpatients. (Anthonyj *et al.*,2015).

Because healthy individuals can adapt to excess potassium consumption by increasing excretion, increased potassium intake is rarely the sole cause of hyperkalemia, and underlying renal dysfunction is common (Evans KJ , Greenberg A.2005).

2.2.2sodium

Under normal conditions, plasma sodium concentrations are finely maintained within the narrow range of (135-145) m mol/l despite great variations in water and salt intake. Sodium and its accompanying anions, principally chloride and bicarbonate, account for 86% of the extracellular fluid osmolality, which is normally 285-295 mosm/kg and calculated as (2× [Na]mmol/l + [urea]mmol.l + [glucose]mmol/l. The main determinant of the plasma sodium concentration is the plasma water content, itself determined by water intake (thirst or habit), “insensible” losses (such as metabolic water, sweat), and urinary dilution. The last of these is under most circumstances the most important and is predominantly determined by arginine vasopressin, which is synthesized in the hypothalamus and then stored in and released from the posterior pituitary. In response to arginine vasopressin, concentrated urine is produced by water re absorption across the renal collecting ducts. This is mediated by specialized cellular membrane transport proteins called a quaporins.(Klein L *et al* ., 2005)

2.2.2.1Hyponatremia

Hyponatremia (low blood sodium) is a condition that means you don't have enough sodium in your blood. You need some sodium in your bloodstream to control how much water is in and around the cells in your body. It can happen because of certain medical conditions, some medicines you might be taking, or if you drink too much water. Because of the low sodium, the amount of water in your body rises and causes your cells to swell. This can lead to many problems. Some are mild, but others can be serious and even life-threatening. How low is too low? Your blood sodium level is normal if it's 135 to 145 milli equivalents per liter (mEq/L). If it's below 135 mEq/L, it's hyponatremia. Your doctor will be able to tell you whether your level is too low.(Anderson R J. 1986).

2.2.2.2 Hypernatremia

Hypernatremia is a common electrolyte problem that is defined as a rise in serum sodium concentration to a value exceeding 145 mmol/L. [1, 2, 3] It is strictly defined as a hyperosmolar condition caused by a decrease in total body water (TBW) , relative to electrolyte content. Hypernatremia is a "water problem," not a problem of sodium homeostasis. (Anderson R J. 1986) .

2.2.3 Urea

Urea is the chief nitrogenous end product of the metabolic breakdown of proteins in all mammals and some fishes. These amino groups are converted to ammonia (NH3), which is toxic to the body and thus must be converted to urea by the liver. The urea then passes to the kidneys and is eventually excreted in the urine(Higgins C ,.2016).

2.2.3.1 A urea cycle disorder(UCD)

A urea cycle disorder (UCD) is an inherited disease that affects how the body removes the waste that is made from breaking down protein. Everyone needs protein, which is found in foods like dairy products, meat and fish. When a person eats food that contains protein, the body breaks it down into amino acids (the building blocks of protein that are used by the body for growth and tissue repair) and uses only what it needs. It changes the rest into nitrogen, which must then be removed by the body(Higgins C ,.2016) .

2.2.4 Creatinine

Creatinine is a biological waste product formed by the degradation of creatine in the muscle cell . it transported into the kidney through the blood and eliminated from the body in urine ,the amount of creatinine in the blood is proportional to the muscle mass in the body in healthy person . blood creatinine reflect the amount of kidney function .(University of Maryland Medical Center . 2017) .

2.2.5Creatine

Creatine is produced in liver, kidney, and pancreas and transported into skeletal muscles through the blood. Creatine can also be taken as a

supplement ,The non-enzymatic degradation of creatine in the skeletal muscles produces creatinine, which is excreted from the body as a waste.

Creatine is used in providing energy to the skeletal muscles during their high intensive functioning.

Creatinine is used in revealing kidney function. The main difference between creatine and creatinine is the function of each compound in the body (University of Maryland Medical center,.2017) .

Table(2. 1) shows the comparison between Creatinine and creatine

	Creatine	Creatinine
Compound	2-carbamimidoyl- methyl-amine acetic acid .	2-amino – 1- methyl -5h-imidazol -4-one .
Molecular Formula	C4H9N3O2	C4H7N3O
Molecular Structure	Linear molecule	Heterocyclic structure
Significance	Used as supplement to increase the muscle mass	Waste product of creatine metabolism
Produce in	Liver , kidney and pancreas	Skeletal muscles
Role	Supply energy to muscles	Diagnosing the functioning of the kidney

2.2.5.1Creatine disorders

There are two known disorders of creatine synthesis (both transmitted as autosomal recessive traits): arginine: glycine amidino transferase (AGAT)

deficiency; OMIM 602360; and guanidine acetate methyl transferase (GAMT) deficiency (OMIM601240)) and one disorder of creatine transport (X-linked recessive SLC6A8 Creatine transport deficiency (OMIM 300036)). (NicolaLango *et al* .,2011).

2.6 Chemotherapy

2.6.1Definition Chemotherapy

Drugs kill or disable cancer cell in the breast or other places in the body . it helps lower the risk of the cancer returning (Susan G.,2020) .

2.6.2 Common Chemotherapeutic Agent

Platinum-derived drugs include cisplatin, carboplatin, oxaliplatin and nedaliplatin , Nephrotoxicity represents the limiting factor of these drugs . Compared with cisplatin and nedaliplatin, carboplatin and oxaliplatin appear to be less nephrotoxic and associated with less electrolyte derangements . Cisplatin nephrotoxicity results from cell damage in the S3 segment of the proximal tubule, distal convoluted tubules and collecting ducts .

Electrolyte disorders are also related to cisplatin-induced DNA damage of thiazide-sensitive sodium-chloride co-transporter genes and to the apoptosis of distal tubule cells . Cisplatin treatment may cause hyponatremia through SIADH, related to both higher secretion of and sensitivity to ADH .

Nausea and vomiting, which are common side effects of platinum-derived chemotherapy, are also powerful stimuli for ADH secretion. The incidence of hyponatremia can reach 59% (severe hyponatremia 12%) with cisplatin, whereas 20% is reported with carboplatin . Rarely, cisplatin-related hyponatremia may result from Renal Salt Wasting Syndrome .

Hypernatremia can also develop with cisplatin due to acquired nephrogenic diabetes insipidus with ensuing hypotonic polyuria .(Veronica Torres da Costa e Silva *et al* .,2018).

Chapter Three

3. Material and methods

3.1 Materials:

3.1.1 Study design

This study was descriptive ,analytical ,hospital based cross sectional study.

3.1.2 Study area

The study was conducted **in POROJ ALAMAL HOSPITAL** located in Khartoum state.

3.1.3 Study period

The study was carried during period from September 2019 to April

3.1.4 Target population and sample size

The study include(70) seventy patients under chemotherapy .

3.1.5 Inclusion criteria

Cancer patients under chemotherapy .

3.1.6 Exclusion criteria

Cancer patients not under chemotherapy

3.1.7 Ethical consideration

The objectives of the study were explained to all individuals participating in the study ,and was approved by committee of clinical chemistry department, college of medical laboratory science, Sudan university of science and technology.

3.1.8 Data collection

Data collected from hospital files.

3.1.8.1 Blood samples collection

2.5ml of venous blood were collected in heparin containers, then plasma was separated in appendoorff tubes and store at _20 until used.

3.2methods

Serum potassium , sodium ,urea and creatine were measured using Mindray BS200 automated system.

3.2.1measurement of potassium

3.2.1.1principle of the method

The amount of potassium is determined by using sodium tetraphenylboron in specifically prepared mixture to produce a colloidal suspension . the turbidity of which is proporational to concentration of K in range of 2_7 mEq/ l .

3.2.1.2procedure See appendix(1).

3.2.2measurement of sodium

3.2.2.1principle of the method

The Present method is based on reaction of sodium with a selective chromogen producing a chromophore whose absorbance varies directly at the concentration of sodium in test.

3.2.2.2procedure See appendix(2)

3.2.3measurement of urea

3.2.3.1principle of the method

3.2.3.1.1direct method

urea in sample react. With orthphaladhyde in acidic media (boric acid) give pink colour read in 520nm.

3.2.3.1.2urea

in sample react with (DAM) in acidic media (HSO) in high temperature andpresence of activator (TSC),ferric chloride and codamine ions.

3.2.3.2 indirect method

(urea hydrolysis (berthclot reaction)) Urea in sample hydrolysis by urease enzyme to ammonia(NH) and CO, ammonia.

In the presence of glutamate dehydrogenase (GLDH) and reduced nicotinamide adenine dinucleotide (NADH) .the ammonia combines with a.ketoglutarate (a.KG) to produce l-glutamate . the rate decrease in the NADH concentration is directly proportional to the urea concentration in the specimen . it determined by measuring the absorbance at 340 nm.

3.2.3.2 procedure See appendix(3)

3.2.4 measurement of creatinine

3.2.4.1 principle of the method

Creatinine reacts with picric acid in alkaline conditions to form a yellow-orange color complex. The rate of formation of color is proportional to the creatinine quantity in the sample

3.2.4.2 procedure See appendix(4)

3.3 Quality Control

The precision and accuracy of all methods used in this study were checked by commercially prepared control (control serum normal 1 and control serum abnormal 2) sample before application for the measurement of test and control sample .

3.4 Statistical Analysis

Data analysis was done using statistical package of social science (SSPS version 19), the mean and standard deviations of potassium ,sodium ,urea and creatinine were calculated and one sample T test and correlation was used for comparison.

Chapter four

Result

Electrolyte derangement has been documented during cancer chemotherapy leading to the electrolyte imbalance. and disturbance of renal function. A total of 70cancer patients were selected. The age range of the included patient was 10 _ 77 years who received single or combination chemotherapy.

The mean age of patients age was 38. In our study significant difference existed in electrolytes parameters. In our study potassium level after the chemotherapy was 3.43 mg/dl ($p<0.001$) while sodium level after the chemotherapy was 131.77mg/dl ($p<0.001$) . urea level after chemotherapy was 35.30mg/dl ($p<0.001$) . while recorded creatinine levels after chemotherapy was 0.82 mg/dl ($p<0.001$). Sodium, potassium, creatinine and urea levels show insignificant p value.

There was insignificant weak positive correlation between urea levels (mg/dl) and age (year) person correlation ($r=0.203$) and p . value (0.09) . There was insignificant weak positive correlation between creatinine levels (mg/dl) and age (year) person correlation ($r=0.177$) and p . value (0.14) .

There was insignificant weak negative correlation between sodium levels (mg/dl) and age (year) person correlation ($r=- 0.143$) and p . value (0.23) .

There was insignificant weak negative correlation between potassium levels (mg/dl) and age (year) person correlation ($r=-0.219$) and p . value (0.06)

Table (4.2). the mean and Std. deviation of Urea, Creatinine, Sodium and Potassium.

	Age	Blood urea	creatinine	Sodium	Potassium
NO. sample	70	70	70	70	70
Mean	38	35.30	0.82	131.77	3.43
Std .D	16.85	26.07	0.44	3.1	0.63

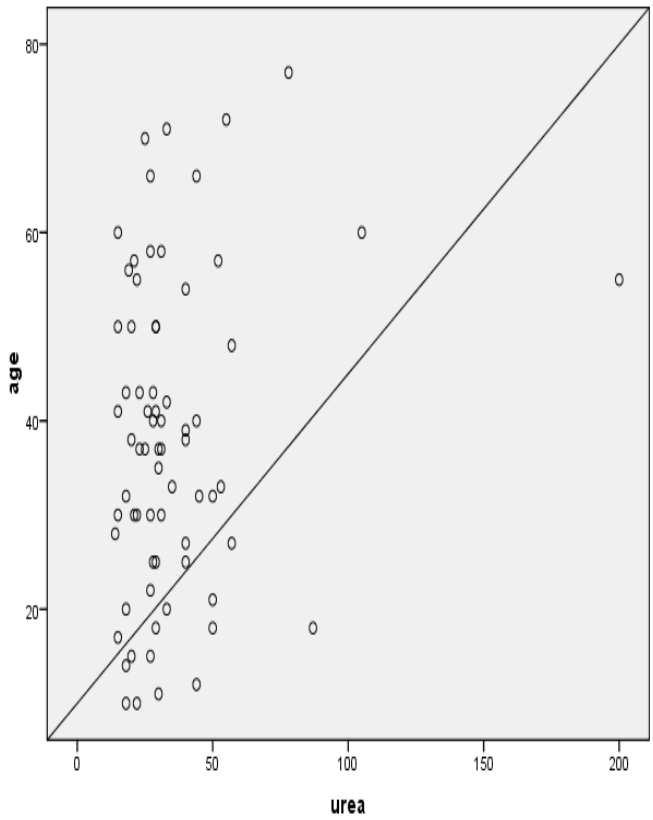

Figure (4.1) represented insignificant correlation between urea levels (mg/dl) and age (year) (r=0.23) (p=0.09) .

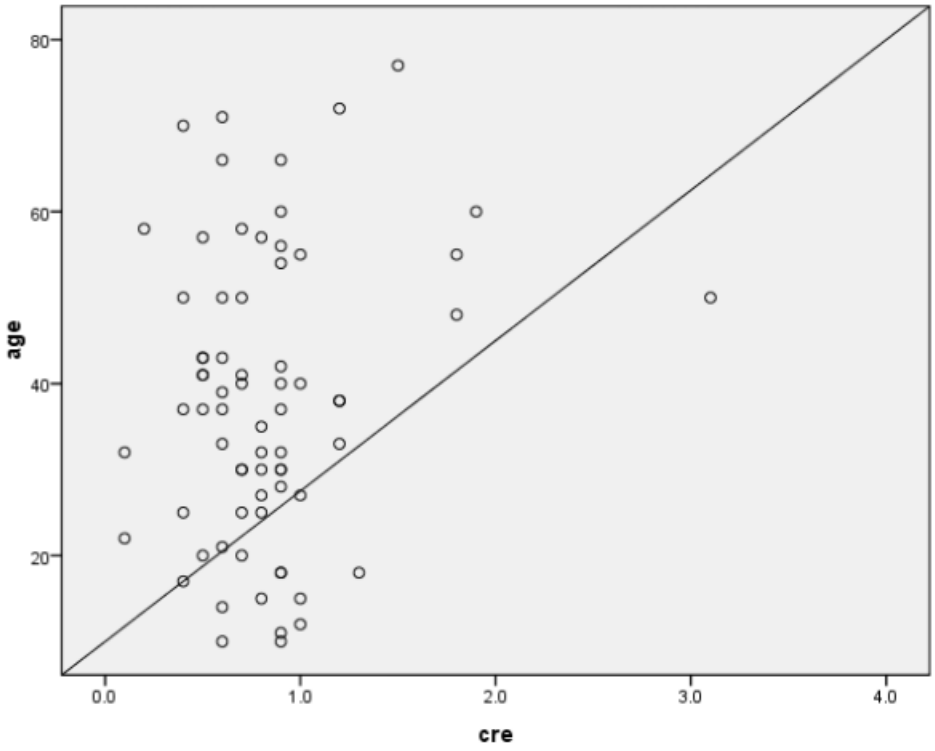

Figure (4.2) represented insignificant correlation between creatinine levels (mg/dl) and age (year)(r= 0.177) (p=0.14) .

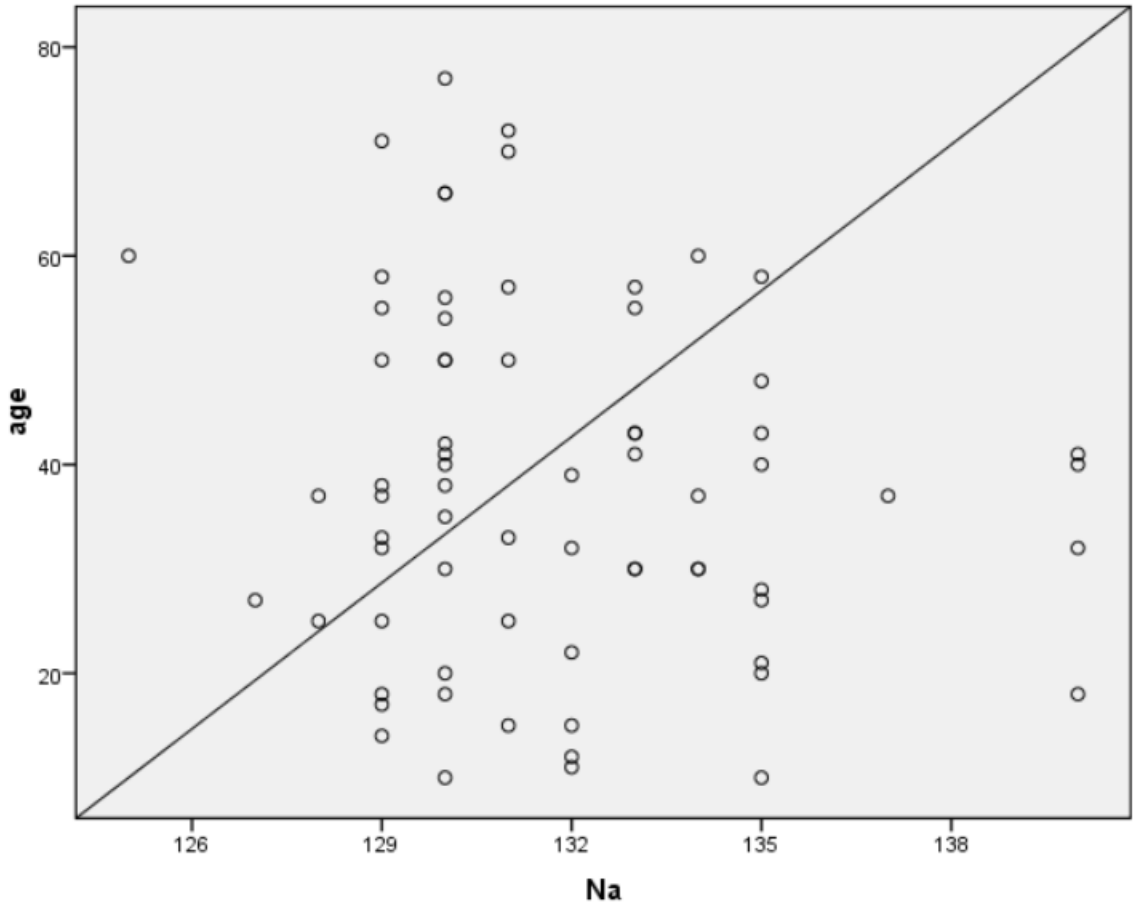

Figure (4.3) represented significant// 49

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9represented insignificant correlation between sodium levels (mg/dl) and age (year) (r=-0 .143) (p=0.23) .

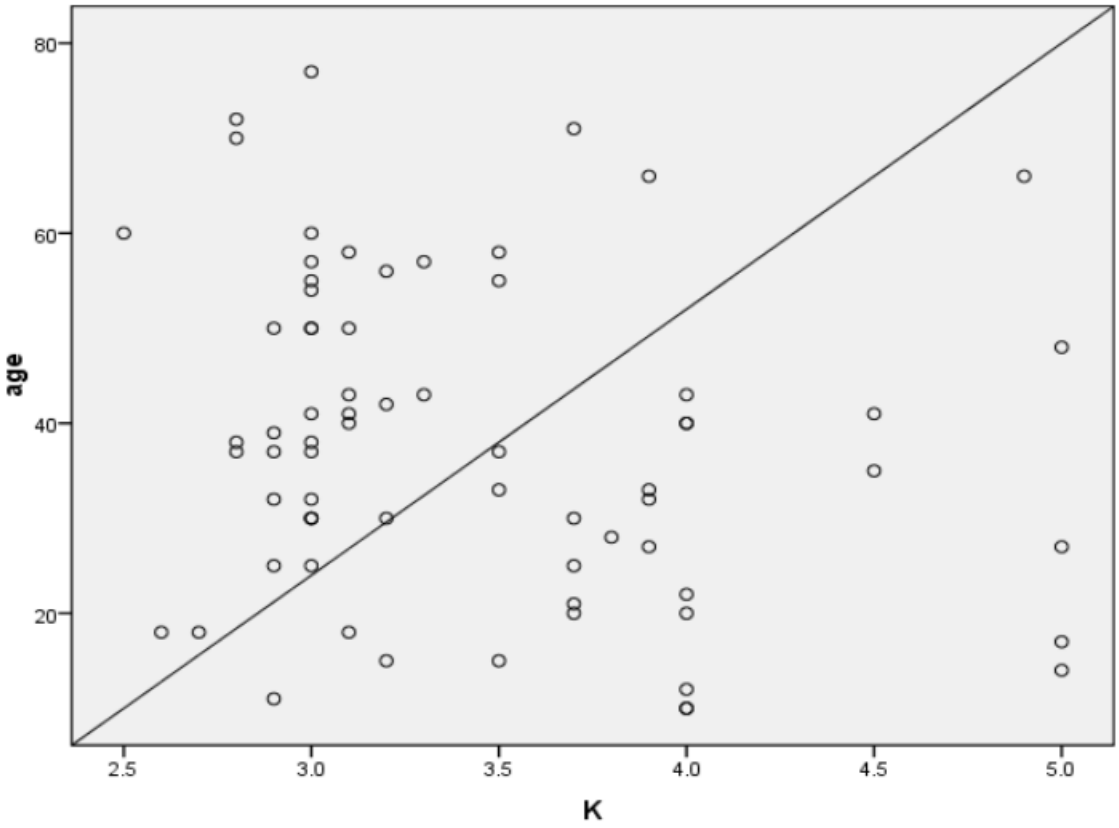

Figure (4.4) represented significant correlation between potassium levels (mg/dl) and age (year)(r=-0.219) p=(0.06) .

Chapter five

5.Discussion,Conclusion and Recommendation

5.1 Discussion

Chemotherapy drugs kill or disable cancer cell, it help lower the risk of cancer. Our results are in accordance with earlier studies which showed the levels of electrolytes are changed after chemotherapy

In the study under discussion there is a drop of sodium level below normal level and the mean recorded sodium level is 131.77mg/dl with insignificant p value(0.00) . In our study almost all the patients had normal potassium, urea and creatinine levels after the start of chemotherapy regime. The overall findings in the studies mentioned above. Similar observation has been recorded in (kumari *et al*. 2015), (lauray-Vacher *et al*. 2016).

In the present study in case of chemotherapy effect on renal function and electrolyte the level of sodium, potassium level show in significant p. value (<0.001) similar finding has been recorded in (kumari *et al*. 2015), (lauray-Vacher *et al*. 2016).

In this study significant negative correlation between serum sodium and age of the patient (R=-0.143), p .value (0.23), significant negative correlation between serum potassium and age of the patient (R=-0.219), p. value (0.06), significant positive correlation between serum urea and age of the patient (R=0.203), p. value (0.09), significant positive correlation between serum creatinine and age of the patient (R=0.177), p .value (0.14).

5.2 conclusion

The study has concluded that there are variations in electrolytes parameters in patients receiving chemotherapy. Our study showed that patients during

chemotherapy develop electrolyte imbalances mainly in sodium and potassium.

5.3. Recommendation

Other study recommended to investigate the renal profile &electrolyte in patients under chemotherapy , including large number of participant , conducted as prospective study , include other electrolyte (phosphate , calcium , magnesium and other trace elements) and include other variable as BMI ,treatment type (single /combination drug) and diet habits .Based on these observations recommended to all patients under chemotherapy electrolyte should be investigated. and focus on electrolyte imbalance , so that the appropriate chemotherapeutic plan can be devised to manage the

patients accordingly. This may help to decrease mortality and morbidity in future.

References

Allolio B, Annane D, Ball S, *et al*.(2014), Clinical practice guideline on diagnosis and treatment of hyponatraemia. *Intensive Care Med*.; 40: 320-331.

Anderson .R.G (1986). Hospital acquired hyponatraemia. *Kidney In* 29:1237-35.

ANTHONY J. VIERA, MD, MPH, *et al*. (2010), University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, North Carolina(2. Lippi G, Favaloro EJ, Montagnana M, Guidi GC. Prevalence of Hypokalemia: the experience of a large academic hospital. *Intern Med J*. 40(4):315-316.

ANTHONYJ.VIERA, MD, MPH, *et al*. (2015),University of North Carolina at Chaple Hill , North Carolina volume (92);number.(Shemer J, Modan M, Ezra D, Cabili S. Incidence of Hyperkalemia in patients. *Isr J Med Sci*. 1938;19 (7):659- 661. And

Bellows .L, Moore .R.(2013).Potassium and the diet, *Food and Nutrition series*. Fact sheet No9.335

Bishop M L . Fody E P. Schoeff L E . (2010). Clinical chemistry techniques , principles , correlation , 6 th , Lippincott Williams and wikins , London: p 373-377.

Bowman BT,(2017). Electrolyte Disorders Associated with Cancer. *J. Onco-Nephrology*.; 1(1): 30-35.

Carvalho F, Louro F, Zakout R.(2015). Adrenal Insufficiency in Metastatic Lung Cancer. *World Journal of Oncology*. 6(3): 375-377.

Colorado State University (2013) , U.S. Department of Agriculture and Colorado counties cooperating.

D. C. (2005)Mikulecky Faculty Mentoring Program Virginia Commonwealth Univ. Evans KJ , Greenberg A. Hyprekalemia : a review . *J Intensive Care Med*;20 (5):272-290.

G Giebisch, R Krapf , C Wagner(2007) : Higgins C.Urea and the clinical value measuring blood urea concentration. *kidney international* 72, 397-410.

Ganong WF(2015). Review of medical physiology, 18th edn. Connecticut. Moritz ML, Ayus JC. Maintenance intravenous fluids in acutely ill patients. *New England Journal of Medicine*. 373(14):1350- 1360. DOI: 10.1056/NEJMra1412877 .

Kitai Y, Matsubara T, Yanagita M(2015). Onco-nephrology: current concepts and future perspectives. *Japanese journal of clinical oncology*.; 45(7): 617-628.

Kumar RV, Bhasker S(2015). Health-care related supportive-care factors may be responsible for poorer survival of cancer patients in developing countries. *Journal of Cancer Policy*. 5: 31-47.

Lameire N(2014). Nephrotoxicity of recent anti-cancer agents. *Clinical kidney journal*. 7(1):11-22..

Lameire N(2014). Nephrotoxicity of recent anti-cancer agents. *Clinical kidney journal*. 7(1):11-22.

Lameire N, Van Biesen W, Vanholder R(2010). Electrolyte disturbances and acute kidney injury in patients with cancer. *In Seminars in nephrology*. 30(6): 534-547.

Liamis G, Rodenburg EM, Hofman A, *et al*(2013). Electrolyte disorders in community subjects: prevalence and risk factors. *Am J Med*.;126(3):256-263.).

Moritz ML, Ayus JC.(2015). Maintenance intravenous fluids in acutely ill patients. *New England Journal of Medicine*. 373(14):1350-1360.

Lameire N, Van Biesen W, Vanholder R.(2010). Electrolyte disturbances and acute kidney injury in patients with cancer. *In Seminars in nephrology*. 30(6): 534-547.

Carvalho F, Louro F, Zakout R.(2015). Adrenal Insufficiency in Metastatic

Lung Cancer. *World Journal of Oncology*. 6(3): 375-377.

Kitai Y, Matsubara T, Yanagita M.(2015). Onco-nephrology: current concepts and future perspectives. *Japanese journal of clinical oncology*. 45(7): 617-628.

Nicola Longo(2011) , Genet C and C Semin Disorders of creatine transport and metabolism. *A M J Med* ,

Nriagu J, Darroudi F, Shomar B. (2016). Health effects of desalinated water: Role of electrolyte disturbance in cancer development. *Enviro Res*.150:191-204.

Kumar RV, Bhasker S(2015) . Health-care related supportive-care factors may be responsible for poorer survival of cancer patients in developing countries. *J. Cancer Policy*. 5: 31-47.

Nriagu J, Darroudi F, Shomar B. (2016). Health effects of desalinated water: Role of electrolyte disturbance in cancer development. *Environmental Research*. 150:191-204. Prentice Hall international Inc. 1997.

Paice B ,Gray J M , McBride D ,*et al*(1983).Hyprekalemia in patients in hospital. *Br Med J (Clin Res Ed)*. 339(7): 451-458.

Susan G.Komen 1-877-465-6636 komen.org.

University of Maryland Medical Center(2017).”creatine “ .*N.P.* n . p. Web.

BioMed-Sodium

Colorimetric, Endpoint

REF: SOD100100 (2 × 50 ml)
SOD100040 (2 x 20 ml)

INTENDED FOR USE:
For the quantitative determination of **Sodium** in serum.

PRINCIPLE:
The Present method is based on reaction of sodium with a selective chromogen producing a chromophore whose absorbance varies directly at the concentration of sodium in test.

SPECIMEN COLLECTION:
Freshly drawn non hemolysed serum is the specimen of choice.
Serum Sodium is stable for atleast 24 hours at room temperature and two weeks at 2-8°C.
Serum or heparinised plasma, CSF & Urine. Urine diluted 1+1 with distilled water can be used for chloride estimation. Chloride in serum is stable for 7 days at 2-8°C.

REAGENT COMPOSITIONS :

R1 Standard	Sodium	150 mEq/l
R2 Color Reagent	Color reagent	

PACKAGE: Collection and storage.
Store all reagents at +2-8°C the reagents are stable until the expiration date as indicated on the label.

PRECAUTIONS & WARNING :
Avoid pipette with mouth.
The preparation, according to current regulation, is classified as not dangerous.
The total concentration of non active components (preservatives, detergents, stabilizers) is below the minimum required for citation.
Anyway handle with care, avoid ingestion, avoid contact with eyes, skin and mucous membranes. The samples must be handle as potentially infected from HIV or Hepatitis.

REAGENT PREPARATION & STABILITY :
Liquid reagents must be at room temperature (+15-25°C) before using.

REQUIRED MATERIALS NOT PROVIDED:
General Laboratory Equipment and instrumentations.

PROCEDURE:

Wavelength:	623nm (620-640)
Optical path:	1 cm light path
Temperature:	+25/30/37°C.
Reading:	Against reagent blank
Assay type:	End Point

Pipetting in tubes:

	BLANK	STANDARD	SAMPLE
Reagent (R2)	1ml	1ml	1ml
Distilled water	10 µL		
Standard		10 µL	
Sample			10 µL

Mix, incubate for 5 min at room temperature (+15-25°C.) Read the absorbance of standard and sample tubes.
Volumes can be proportionally modified.
This methodology describes the manual procedure to use the kit.
For automated procedure, ask for specific application.

CALCULATION:

$$\text{Sodium mEq/l} = \frac{\text{(A) Sample}}{\text{(A) Standard}} \times 150$$

EXPECTED VALUE:
Serum: 135 - 155 mEq/l

The above mentioned values are to be considered as a reference. It is strongly recommended that each laboratory establish its own normal range according to its geographic area, according to IFCC protocol.

WASTE DISPOSAL:
The disposal of the product must be in accordance with local regulation concerning waste disposal.

QUALITY CONTROL:
It is recommended to execute the quality control at every kit utilization to verify that values are with in the reference range indicated by the methodology.

INTERFERENCE:
Turbid or Icteric serum produce falsely elevated results.

Linearity :
The assay is linear up to Sodium 200 mEq/l

REFERENCES:

1- Tietz, N.W., Fundamentals of Clinical Chemistry, W.B.Saunders Co., Phila, P.A.p.874.
2- Henry R.F., et, al, Clinical Chemistry Principles and Technics. 2nd Ed, Harper and Row, Harper and 3- Row, Hargersein, M.D.(1974).
4- Maruna RFL., Clin Chem. Acta. 2:581, (1958).
5- Trinder, P:Analyst, 76:596, (1951) .

	Consult Instructions for Use
	Caution, Consult accompanying Documents
IVD	In Vitro Diagnostic Medical Device
	Temperature Limitation
	Manufacturer
EC REP	Authorized Representative in the European Community
REF	Catalogue Number
LOT	Batch Code
	Use by

EGY- CHEM for lab technology
Badr City, Industrial Area Piece 170
250 Fadan In East of Elrubaki, EGYPT
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Factory Tel: +202 23108170 / +202 23108171
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EC REP
MDSS GmbH
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List of abbreviation

A urea cycle disorder	AUCD
Arginine glycine amido transferase	AGAT
Bicarbonate	Na2Co3
Calcium	Ca2
Chloride	Cl
Guanidine aceto methyl transferase	GAMT
Magnesium	Mg2
Potassium	K
Sodium	Na
Sulphate	So4
Total body water	TBW