بسم الله الرحمن الرحيم

Sudan University of Science & technology

College of graduate studies

Electrolyte disturbance in Sudanese patients with cancer

اختلال الشوارد الكهربائية في مرضي السرطان السودانيين

A thesis submitted in partial fulfillment of the requirement of M.Sc. degree in Medical LaboratorySciences (Clinical chemistry Department)

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بسم الله الرحمن الرحيم

قال تعالي:

((مَّا يَفْعَلُ اللَّهُ بِعَذَابِكُمْ إِن شَكَرْتُمْ وَآمَنتُمْ ۚ وَكَانَ اللَّهُ شَاكِرًا عَلِيمًا))

صدق الله العظيم

سورة النساء الآية (147)

Dedication

To that who taught to write the first letter of the alphabet, my beloved ..... mother

To the mydear ..... father

To my lovely ..... sisters

To my lovely .....brothers

To all my teachers in all my educational stages

To my ..... friends

To all who love me and I love them

To ..... patients

To all those, I dedicate this work.

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List of abbreviation

ALL	Acute lymphoblastic leukemia
CML	Chronic myeloid leukemia
AML	Acute myeloid leukemia
HPV	Human papilloma virus
Na	Sodium
K	Potassium
Ca	Calcium
Ph	Phosphorous
SD	Standard deviation

Abstract

This study was performed in Khartoum state during the period from January to April 2015. The aim of the study was to assess the effect of cancer on sodium, potassium, Calcium and phosphorous levels as a markers of electrolyte imbalance in Sudanese cancer patients.90 blood samples were collected divided to 50 blood sample from Sudanese cancer patients, and 40 samples from apparently healthy individuals as control group for the comparison . plasma levels of sodium and potassiumwere estimated by iron selective electrod while levels of calcium and phosphorous were estimated by spectrophotometer (Biosystem310). Statistical analysis showed that there is a significant decrease in the sodium level in patients when compared with control group (mean±SD) (132.65±6.6)and(138.75± 2.4) respectively with**P value**=**0.000**. and significant decrease in the potassium level in the breast cancer patients when compared with the control group (mean±SD) (3.3±1) (4.±0.53) respectively with**P value**=**0.039.** While showed no statistical significances in potassium, Calcium , phosphorous level in, myeloid, lymphoid and cervix cancer when compared with control groups were(3.58±.85),(4.2±.67),(3.8±.65)(4.±0.53) **P** values**0.290** ,**0626 ,671** respectively.(8.46 ±1.2) ,(8.63 ±1.17),(8.25 ±.96),(8.45 ±.38)(8.83± .52),

Pvalue**0.699,0.314,0.144**respectively.(3.25±1.1),(3.3±.78),(3.7±.31),(3.5±.33),(4. 34±0.48) **P** values**0.313 , 0.961 , 0.462** respectively.

In this study it was concluded that plasma sodium level decreased in some types of cancer and potassium level is decreased in breast cancer. While level of calcium and phosphorous were not affected in myeloid , lymphoid ,cervical cancer patients.

الخلاصة

أجريت هذه الدراسة في ولاية الخرطوم خلال الفترة من يناير إلي ابريل عام 2015 الهدف من هذه الدراسة هو تقييم تأثير السرطان علي مستويات الصوديوم، البوتاسيوم، الكالسيوم و الفوسفورس في الدم كعلامات خلل الشوارد الكهربائية في مرضى السرطان السودانيين تم جمع 90 عينة دم مقسمة كالأتي 50عينه من مرضى السرطان و 40 عينة كمجموعة قياسية للمقارنة . أعمارهم في كلا المجموعتين في منتصف العمر . تم قياس مستوي الصوديوم والبوتاسيوم بجهاز iron selective electrod بينما تم قياس الكالسيوم والفوسفرس بجهاز الطيف الضوئي .(Biosystem310)
وجد هناك انخفاض كبير في مستوى الصوديوم في مرضي السرطان بالمقارنة مع المجموعة القياسية كانت (6.6 ±132.65)و(2.4±138.7) على التوالي، وأظهرت النتائج الإحصائية فرقا مهما للغاية بين المجموعتين.P = 0.000 ،وانخفاض في مستوى البوتاسيوم في مجموعة سرطان الثدي بالمقارنة مع المجموعة القياسية (3.3±1)(4.±0.5)على التوالي، P = 0.039
لم يظهر أي فرق مهم في مستوي البوتاسيوم او الكالسيوم او الفوسفرس في أي من المجموعات التالية ، السرطان اللمفاوي ,المايلويد وعنق الرحم عندما تم مقارنتهم مع المجموعات القياسية (0.85±3.5)(4.2 ± .67)، (4. ± 0.53) (3.8 ± 0.65)قيمة P0.290 0.626،0.671على التوالي. (8.46 ± 1.2)، (8.63 ± 1.17)، (8.25 ±0.96) (8.83 ± 0.52)،(8.45 ± 0.38)،Pقيمة0.699 0.314، 0.144 على التوالي (3.25 ± 1.1)،(3.3 ± 0.78)،(3.7 ± 0.31)،(3.5 ± 0.33)، (4.34 ± 0.48) قيمة0.313 P ،0.961، 0.462على التوالي .
في هذه الدراسة تما لتوصل إلى أن مستوي الصوديوم انخفض في بعض أنواع السرطان وان مستوي البوتاسيوم انخفض في سرطان الثدي. بينما لم تتأثر مستويات الكالسيوم والفوسفرس في سرطان الليمفاوي ,المايلويد وسرطان عنق الرحم.

Chapter one

1. Introduction and Literature Review

1.1 Introduction

Cancers are a large family of diseases that involve abnormal cell growth with the potential to invade or spread to other parts of the body(cancer sheet WHO, 2014). They form a subset of neoplasms. A neoplasm or tumor is a group of cells that have undergone unregulated growth, and will often form a mass or lump, but may be distributed diffusely(Cancer Glossary , American Cancer Society, 2013).

The progression from normal cells to cells that can form a discernible mass to outright cancer involves multiple steps known as malignant progression (Hanahan*etal* ,2011).

In Sudan hospitals in 2000, cancer was thethird leading cause of death after malaria and viral pneumonia, accounting for 5% of all deaths .

In the 18 years to 1984 nasopharyngeal carcinoma and NHL were the most common tumors in Sudanese males. In the last 20 years CML became the predominant cancer, while lymphomas remained the second most common cancer in men. In women, breast, cervical and ovarian cancer remained the three most common cancers over both time periods, but there was also an increase in the incidence of CML among a women(H. M. A. Hamad,2006).

Electrolytes are chemicals in the body that regulate important physiological functions and include sodium, chloride, magnesium, potassium and calcium. When dissolved in water, electrolytes separate into positively and negatively

charged ions. Nerve and muscle function are dependent upon the proper exchange of these ions in and out of the cells

Electrolytes must exist in the body within a narrow concentration range in order to effectively serve a variety of critical functions, The normal range is measured per liter of blood(Tietz*et al* , 2008).

1.2**Literature review**

1.2.1.Cancer

Cancers are a large family of diseases that involve abnormal cell growth with the potential to invade or spread to other parts of the body (cancer sheet WHO, 2014). They form a subset of neoplasms. A neoplasm or tumor is a group of cells that have undergone unregulated growth, and will often form a mass or lump, but may be distributed diffusely (Cancer Glossary , American Cancer Society, 2013).

Six characteristics of cancer have been proposed:

-self-sufficiency in growth signaling

-insensitivity to anti-growth signals

-evasion of apoptosis

-enabling of a limitless replicative potential

-induction and sustainment of angiogenesis

-activation of metastasis and invasion of tissue

The progression from normal cells to cells that can form a discernible mass to outright cancer involves multiple steps known as malignant progression

(Hanahan*etal* ,2011).

1.2.1.1Common types of cancer

1.2.2.2Acute lymphoblastic leukemia (ALL)

is an acute form of leukemia, or cancer of the white blood cells, characterized by the overproductionof cancerous,immature whitebloodcells—knownas lymphoblasts ، inpersons with ALL, lymphoblasts are overproduced in the bone marrow and continuously multiply, causing damage and death by inhibiting the production of normal cells—such as red and white blood cells and platelets—in the bone marrow and by spreading (infiltrating) to other organs. ALL is most common in childhood with a peak incidence at 2–5 years of age, and another peak in old age (Weinblatt, *et al* 2013).

1.2.1.3Breast cancer

is cancer that develops from breast tissue, Signs of breast cancer may include a lump in the breast, a change in breast shape, dimpling of the skin, fluid coming from the nipple, or a red scaly patch of skin ، in those with distant spread of the disease, there may be bone pain, swollen lymph nodes, shortness of breath, or yellow skin(Saunders*et al* ,2009).

Risk factors for developing breast cancer include: female sex, obesity, lack of physicalexercise, drinking alcohol, hormone replacement therapy during menopause, ionizing radiation, early age at first menstruation, having children late or not at all, and older age, About 5–10% of cases are due to genes inherited froma person's parentsincluding BRCA1 and BRCA2 among

others. Breast cancer most commonly develops in cells from the lining of milk ducts and the lobules that supply the ducts with milk. Cancers developing from the ducts are known as ductal carcinomas, while those developing from lobules are known as lobular carcinomas, In addition, there are more than 18 other sub-types of breast cancer. Some cancers develop from pre-invasive lesionssuch as ductal carcinoma in situ(World Cancer ReportWHO, 2014).

1.2.1.4Chronic myeloid leukemia (CML)

is a cancer of the white blood cells. It is a form of leukemia characterized by the increased and unregulated growth of predominantlymphoid cells in the bone marrow and the accumulation of these cells in the blood. CML is a clonal bone marrow stem cell disorder in which a proliferation of
mature granulocytes (neutrophils, eosinophils and basophils) and their precursors is found.It is atypeofmyeloproliferative disease associated with a characteristicchromosomal translocation called the Philadelphia chromosome(Besa*et al*,2013).

1.2.1.5Acute myeloid leukemia (AML)

Acute myeloid leukemiais a cancer of the myeloid line of blood cells, characterized by the rapid growth of abnormal white blood cells that accumulate in the bone marrow and interfere with the production of normal blood cells. AML is the most common acute leukemia affecting adults, and its incidence increases with age (Jemal A, *et al*, 2002).

1.2.1.6Cervical cancer

Cervical cancer is a cancer arising from the cervix, It is due to the abnormal growth of cells that have the ability to invade or spread to other parts of the

body, Early on there are typically no symptoms. Later symptoms may include: abnormal vaginal bleeding, pelvic pain or pain during sexual intercourse ,Bleeding after sex may be not serious; however, may also be due to cervical cancer (Tarney*et al*2014).

Human papillomavirus (HPV) infection appears to be involved in the development of more than 90% of cases , most people who have had HPV infections, however, do not develop cervical cancer(Dunne et al, 2013).

Other risk factors include: smoking, a weak immune system,birth control pills, starting sex at a young age and having many sexual partners, but these are less important, cervical cancer typically develops from precancerous changes over 10 to 20 years, there are a fewtypes of cervical cancer. About 90% aresquamous cell carcinomas, 10% are adenocarcinoma and a small number are other types(National Cancer Institute, 2014).

1.2.2 Electrolyte

Electrolytes are minerals found in bodily fluids that carry an electric and muscles functioning properly. As such, it is important to maintain a precise and constant balance of electrolytes to stay healthy. The kidneys play an important role in ensuring that electrolyte levels remain invariant despite any changes the body may undergo. Having an excess or an insufficiency of electrolytes in the body can be dangerous and in some cases fatal(Tietz*et al* , 2008).

1.2.2.1 Electrolyte Function

One of the major roles of electrolytes is to keepthat fluid levels inside and outside the cell are balanced. The cell can adjust its fluid levels by changing the concentration of electrolytes. For example, an increase in electrolytes within the

cell draws more fluid in whereas a decrease in electrolytes promotes an efflux of fluids. Sustaining this type of osmotic gradient is essential for nerve and muscle function, hydration, and maintaining blood pH levels. Additionally, electrolytes carry electrical impulses across the cell and to neighboring cells in order to promote muscle contractions and nerve impulses.

The most common electrolytes found in the body are calcium, sodium, potassium, phosphate, chloride and magnesium. The serum values and individual functions for these electrolytes are:

1.2.2.2 Calcium

Calciumis the most abundant electrolyte in the body. 99 percent of calcium is stored in the teeth and bones where it helps to make and keep them strong. Moreover, calcium is also critical for muscle contraction, nerve signaling, blood clotting and maintaining normal heart function. Normal serum calcium values range from 8.5 to 10.2 milligrams per deciliter (mg/dL)(Tietz*et al* , 2008).

1.2.2.3 Sodium

Sodiumis the majorcation extracellular fluid. because it represents approximately 90% of ~ 154 mmol of inorganic cation per liter of plasma ,Na is responsible for almost one half osmotic strength of plasma. It has central function in the maintaining the normal distribution of water and osmotic pressure in extracellular fluidcompartments.freely filtered by the glomeruli , seventy to eighty percent of the filtered sodium load is then actively reabsorbed in the proximal tubules ,it regulates the total amount of water in the body and plays a major role in neuronal and nerve signaling. Normal serum sodium values range from 135 to 145 *milliequivalent/liter* (mEq/L)(Tietz*et al* ,

2008).

1.2.2.4 Potassium

Potassiumisthe major intracellularcation. in tissue cell its 150 mmol/L .high intracellular concentration are maintained by the Na,K-ATPase pump ,this pump is a critical factor in maintaining and adjusting the ionic gradients on which never impulses and contractility of muscle depend , average concentration is essential for the proper functioning of the heart, kidneys, muscles, nerves, and digestive system. The normal blood potassium level is 3.5 to 5.0 mEq/L(Tietz*et al* , 2008).

1.2.2.5 Phosphate

Phosphateis majority of the body's phosphate is found in the bones and teeth where it promotes their formation. It also plays an important role in the body's utilization of carbohydrates and fats. Phosphates are also critical to the synthesis of proteins that promote the growth, maintenance, and repair of cells and tissues. Normal values range from 2.4 to 4.1 mg/dL(Tietz*et al* , 2008).

1.2.2.6 Chloride

Chloride is the major anion (negatively charged ions) found outside the cell. Chloride plays a critical role in keeping the proper balance of body fluids and maintaining the body's acid-base balance. The normal chloride values are 96 to 106 mEq/L(Tietz*et al* , 2008).

1.2.2.7 Magnesium

Magnesium is the fourth most abundant mineral in the body. Magnesium is

needed for more than 300 biochemical reactions in the body. It helps maintain normal muscle and nerve function, keeps the heart rhythm steady, supports a healthy immune system, and keeps bones strong. Magnesium also helps regulate blood sugar levels, promotes normal blood pressure, and is also involved in energy metabolism. Normal serum values of magnesium are 1.7 to 2.2 mg/Dl(Tietz*et al* , 2008).

Chapter two

2. Rationale and Objectives

2.1. Rationale.

Epidemiological studies have consistently shown association between the cancer and electrolyte imbalance. Cancer cells secrete some substances change cells functions and hormones that affect electrolytes . This study was conducted to verify the effect of cancer on electrolyte imbalance using sodium,potassium,calcium and phosphorous as a marker for electrolytes disturbance.

2.2 Objectives

2.2.1 General objective

To assess the effect of cancer on electrolyte among Sudanese cancer patients at Khartoum state during Januaryto April 2015

2.2.2 Specific objectives

-To determine level of sodium, potassium, calcium and phosphorusin Sudanese cancer patients.

-To determine the association of specific type of cancer with electrolytes.

Chapter three

3.Material and Methods

3.1 Study approach

A quantitative methods were used to measure sodium, potassium ,calcium and phosphorous in Sudanese cancer patients in Khartoum state, during a period from January to April 2015.

3.2 Study design

Case control study was designed.

3.3 Study population

The study covered 50 individuals randomly selected from whole cancer patients with different age. and 40 apparently healthy people.

3.3.1 Inclusion criteria

The criteria of inclusion of the test group based on a cancer patients from different ages.

3.3.2 Exclusion criteria

The criteria of exclusion of the control group based on renal disease, hypertention and bone diseases.

3.4 Study variables

Dependent variable: plasma sodium , potassium, Calcium and Phosphorous level.

Independent variables: age , type of cancer.

3.5 Sampling

Convenience sampling technique was used.

3.6 Sampling frame

Khartoum state

3.7 Sampling unit

It was restricted to cancer patients.

3.8 Method of data collection and tools

Data were collected using structural interviewing questionnaire, which was designed to collect and maintain all information concerning each case examined.

3.8.1Collection of samples

3 ml of venous blood sample was collected from both cases and controls, using sterile disposable syringe and aseptic standard non traumatic vein puncture technique were applied. Was emptied in a heprnized containers. And then centrifuged at 4000 rpm for10 minutes, then the plasma is separated and transferred in a plain container and processed .

3.9 Method of measuring plasma sodium and potassium

3.9.1 principle of the method:

Iron selective electrode is a transducer (or sensor) that converts the activity of a specific ion dissolved in a solutioninto an electrical potential, which can be measured by a voltmeter or pH meter. The voltage is theoretically dependent on the logarithm of the ionic activity, according to theNernst equation. The sensing part of the electrode is usually made as an ion-specific membrane, along with a reference electrode

3.10 Method of measuring plasma calcium

3.10.1principle of the method:

The measurement of calcium in the sample is based on formation of color complex between calcium and o-cresolphtalein in alkaline medium:

OH

Ca++ + o-Cresolphtalein ~~Colore~~d complex

The intensity of the coluor formed is proportional to the calcium concentration in the sample.

3.11 Method of measuring plasma phosphorous

3.11.1 principle of the method

Inorganic phosphorus react with ammonium molybdate in a acid medium to form a phospholybdate

complex which absorbs light at 600-675 nm .

The absorbance at this wavelength is directly proportional to the amount of inorganic phosphorus

present in the sample .

Inorganic phosphorus + H_2SO_4+ Ammonium molybdatePhosphomolybdate complex

3.12 Data analysis

Data were analyzed by statistical package for social studies(SPSS) software program

3.13. Ethical consideration

An approval was taken from faculty management and verbal consent from individuals under study.

3.14 Instruments

Spectrophotometer device used in this study with following information:

Model =BTS.302

Serial NO. =801560278

3.15 Pretesting

All reagents were tested using control sera.

Chapter four

4.Results

In this study 90 subjects were chosen for determination of plasma sodium,potassium, Phosphorous and calcium. Fifteen of them were withbreastcancer,fifteen were with myeloid leukemia ,ten were with lymphoid leukemia , ten with cervix cancerand The other fourty were apparently healthy subjects represent the control group,during the period from January to April 2015. The results obtained were statistically analyzed,using SPSS T.test. The level of significance was expressed as P value < 0.05 for significant.

Themean values of sodium inallcancer patients was significant low when compared to control(132.65±6.6)(138.75±2.4)mmol /Lrespectively with P=0.000.showed in Table 4.1.

The mean values of potassium in all cancer patients was insignificant when compared to control(3.68±084.)(4.0±0.53)mmol / L respectively with P=0.153.showed in Table 4.1.

The mean values of calcium in cancer all patients was insignificant when compared to control (8.47±.97) (8.83± .52) mg/dlrespectively with P=0.152.showed in Table 4.2.

The mean values of phosphorous in all cancer patients insignificant when compared to control(3.42±0.74)(3.71±.53) mg/dlrespectively with P=0.174.showed in Table 4.1.

The mean values of sodium in breast cancer patients significant low when compared to control (132.55±6)(138.13± 2.4)respectivelywith P=0.001.showed in Table 4.2.

The mean values of potassium in breast cancer patients significant low when compared to control (3.3±1)(4.±0.53) respectivelywith P=0.039.showed in Table 4.2.

The mean values of calcium in breast cancer patients insignificant when compared to control(8.46 ±1.2)(8.83± .52) respectively with P=0.507.showed in Table 4.2.

The mean values of phosphorous in breast cancer patients insignificant when compared to control (3.25±1.1)(4.34±0.48) with P=0.366.showedin Table 4.2.

The mean values of sodium in myeloid leukemia patients significant low when compared to control(132±9.1)(138.13± 2.4respectivelywith P=0.005.showed in Table 4.3.

The mean values of potassium in myeloid leukemia patients insignificantwhen compared to control(3.58±.85)(4.±0.53) with P=0.290.showed in Table 4.3.

The mean values of calcium in myeloid leukemia patients in significant low when compared to control(8.63 ±1.17) (8.83± .52) with P=0.699.showed in Table 4.3.

The mean values of phosphorous in myeloid leukemia cancer patients insignificant when compared to control (3.3±.78)(4.34±0.48 respectively with P=0.313. showed in Table 4.3.

The mean values of sodium in lymphoid leukemia patients significant low when compared to control (133±3.5)(138.13± 2.4) respectively with P=0.001.showed in Table 4.4.

The mean values of potassium in lymphoid leukemia patients insignificant when compared to control (4.2±.67)(4.±0.53) respectively withP=0.626.showed in Table 4.4

The mean values of calcium in lymphoid leukemia patients insignificant when compared to control (8.25 ±.96)(8.83± .52) respectively with P=0.314.showed in Table 4.4.

The mean values of phosphorous in lymphoid leukemia patients insignificant when compared to control (3.7±.31)(4.34±0.48) with P=0.961.showed in Table 4.4.

The mean values of sodium in cervix cancer patients significant low when compared to control (133±8.1)(138.13± 2.4)with P=0.01.showed in Table 4.5.

The mean values of potassium in cervix cancer patients insignificant when compared to control (3.8±.65) (4.±0.53) with P=0.671.showed in Table 4.5.

The mean values of calcium in cervix cancer patients insignificant when compared to control(8.45 ±.38)(8.83± .52) respectively with P=0.144.showed in Table 4.5.

The mean values of phosphorous in cervix cancer patients insignificant when compared to control (3.5±.33)(4.34±0.48) respectively with P=0.462.showed in Table 4.5.

Table 4.1a descriptive summary of the mean and SDof serum sodium, potassium ,calcium and Phosphorousconcentrations between cancers and control group.

	Patients No: 50	Control No: 40	p. value
Age	33	35	
Sodium	(132.65±6.6)	(138.75±2.4)	0.000
Potassium	(3.68±084.)	(4.0±0.53)	0.153
calcium	(8.47±.97)	(8.83±.52)	0.152
Phosphorous	(3.42±0.7	(3.71±.53)	0.174

Independent sample t.test ,significant<0.05.

Table 4.2 a descriptive summary of the mean and SDof serum sodium, potassium ,calcium and Phosphorousconcentrations between breast cancer and control group.

	Patients No: 15	Control No: 40	P.value
Age	34	35	
Sodium	(132.55±6)	(138.75±2.4)	0.001
Potassium	(3.3±1)	(4.0±0.53)	0.039
calcium	(8.46±1.2)	(8.83±.52)	0.507
Phosphorous	(3.25±1.1)	(3.71±.53)	0.366

Independent sample t.test ,significant<0.05.

Table 4.3 a descriptive summary of the mean and SDofsodium, potassium ,calcium and Phosphorousconcentrations between myeloid cancers and control group.

	Patients No: 15	Control No: 40	P.value
Age	33	35	
Sodium	(132±9.1)	(138.75±2.4)	0.005
Potassium	(3.58±.85)	(4.0±0.53)	0.290
calcium	(8.63±1.17)	(8.83±.52)	0.699
Phosphorous	(3.3±.78)	(3.71±.53)	0.313

Independent sample t.test ,significant<0.05.

Table 4.4a descriptive summary of the mean and SDofserum sodium, potassium ,calcium and Phosphorousconcentrations between lymphoid cancers and control group.

	Patients No: 10	Control No: 40	p. value
Age	30	35	
Sodium	(133±3.5)	(138.75±2.4)	0.001
Potassium	(4.2±.67)	(4.0±0.53)	0.626
calcium	(8.25±.96)	(8.83±.52)	0.314
Phosphorous	(3.7±.31)	(3.71±.53)	0.961

Independent sample t.test ,significant<0.05.

Table 4.5a descriptive summary of the mean and SDofserum sodium, potassium ,calcium and Phosphorousconcentrations between cervix cancers and control group.

	Patients No: 10	Control No: 40	P.value
Age	35	35	
Sodium	(133±8.1)	(138.75±2.4)	0.01
Potassium	(3.8±.65)	(4.0±0.53)	0.671
calcium	(8.45±.38)	(8.83±.52)	0.144
Phosphorous	(3.5±.33)	(3.71±.53)	0.462

Independent sample t.test ,significant<0.05.

Chapter five

5.Discussion

In the present study, a correlations existed among cancers patients(breast, myeloid ,lymphoid and cervix cancers). The associations between cancers and Electrolyte were investigated using plasma sodium , potassium, calcium and phosphorous as marker for Electrolyte abnormality.

We found that there wasa significant decrease in the sodium level in all types of cancers when compared with control (mean±SD)**(132.65±6.6)**(138.75±2.4)***P*.value 0.000** this finding confirmed by Doshi et al ,2012 in USA they found low level of sodium in all type of cancer (mean) from 130- 134 mmol/l ,

Also confirmed by abuZeinahGF ,*et al,* they found a mild hyponatraemia is a common electrolyte disturbance among patients with cancer (mean) 130-135mmol/l.

also confirmed by Hampshire *et al*, 2009 in UK they found hyponatremia in hematological malignancy mean 130mmol/l .

Another study done by Jorge J. Castilo, Marc vincent, Eric Justice, confirmed Hyponatremia in Cancer Patients

We found a significant decrease in the potassium level in the breast cancerwhen compared with control group (mean±SD)**(3.3±1)**(4.0±0.53)***P*.value 0.039** respectively we disagree with anyone except some studies regarded side affect of drugs.

While showed no statistical significances in potassium, calcium and phosphorous levels in all types of cancer when compared with control group(3.68±0.84),(8.47±0.97),(3.42±0.7) ***P*.value 0.153, 0.152, 0.174** respectively , rather than potassium in breast cancer.

Conclusion and Recommendations

Conclusion

The findings of the study concluded thathyponatremia is most common disturbance in allcancer patients, and low level of potassium in breast cancer ,while there is no significant of calcium and phosphorous in myeloid ,lymphoid ,cervical cancer

Recommendations

- Further explorations of the effect of cancer on other parameters.

-More studies to determine the specific cause of hyponatremia and how to manage it. -Thecomparisonof the result with more data collected from patients such as stage of cancer, duration, dose and type of treatment and must be studied.

- Further studies should be done with larger sampleand separate type of cancer to determine the exactly association of type of cancer and electrolyte should be carefully analyzed and interpreted.

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APPINDIX

بسم الله الرحمن الرحيم

Sudan University of Science & technology

College of graduate studies

Questionnaire

Electrolyte disturbance in Sudanese patients with cancer

اختلال الشوارد الكهربائية في مرضي السرطان السودانيين

A thesis submitted in partial fulfillment of the requirement of M.Sc. degree in Medical LaboratorySciences (Clinical chemistry Department)

Name……NO( )

Age ( )

Sex: male ( ) Female ( )

Type of cancer ( )

History of any disease……

…….

…….

History of any drugs

…….....

……

……

PHOSPHORUS

PHOSPHOMOLYBDATE/UV

PHOSPHORUS

COD 12508 3 x 24 mL + 2 x 15 mL

STORE AT 15-30ºC

Reagents for measurement of phosphorus concentration

Only for in vitro use in the clinical laboratory

PRINCIPLE OF THE METHOD

Inorganic phosphorus in the sample reacts with molybdate in acid medium forming a

phosphomolybdate complex that can be measured by spectrophotometry1,2.

CONTENTS AND COMPOSITION

A. Reagent: 3 x 24 mL.Sulfuric acid 0.36 mol/L, sodium chloride 154 mmol/L.

DANGER: H314: Causes severe skin burns and eye damage. P280: Wear protective

gloves/protective clothing/eye protection/face protection. P303+P361+P353: IF ON SKIN (or

hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

B. Reagent: 2 x 15 mL. Sulfuric acid 0.36 mol/L, sodium chloride 154 mmol/L, ammonium

molybdate 3.5 mmol/L.

DANGER: H314: Causes severe skin burns and eye damage. P280: Wear protective

gloves/protective clothing/eye protection/face protection. P303+P361+P353: IF ON SKIN (or
hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
For further warnings and precautions, see the product safety data sheet (SDS).

STORAGE

Store at 15-30ºC.
Reagents are stable until the expiry date shown on the label when stored tightly closed and if
contaminations are prevented during their use.
Indications of deterioration:
− Reagents: Presence of particulate material, turbidity, absorbance of the blank over the limit
indicated in "Assay parameters".

AUXILIARY REAGENTS

Biochemistry Calibrator (BioSystems cod. 18011) or Biochemistry Calibrator Human
(BioSystems cod. 18044).

REAGENT PREPARATION

Reagents are ready to use.
Reagents open and kept in the refrigerated compartment of the analyzer are stable 2 months.

SAMPLES

Serum, heparinized plasma or urine collected by standard procedures.
Phosphorus in serum or plasma is stable for 7 days at 2-8ºC.
Collect 24-hour urine in a bottle containing 10 mL of 10% (v/v) hydrochloric acid. Stable for 10

days at 2-8ºC. Centrifuge or filter the sample and dilute 1/10 with distilled water before
measurement.

REFERENCE VALUES

Serum3:

Adults: 2.5-4.5 mg/dL = 0.81-1.45 mmol/L

Children: 4.0-7.0 mg/dL = 1.29-2.26 mmol/L

Urine3: 0.4-1.3 g/24-h = 12.9-42 mmol/24-h

Concentrations in plasma are about 0.25 mg/dL(0.08 mmol/L) lower than in serum. These
ranges are given for orientation only; each laboratory should establish its own reference ranges.

CALIBRATION

It is recommended to do a reagent blank every day and a calibration at least every 2 months,
after reagent lot change or as required by quality control procedures.

ASSAY PARAMETERS

A25	A15	
GENERAL	Test name	PHOSPHORUS PHOSPHORUS
	Analysis mode	bireagent differential
		bireagent differential
	Sample type	SER/URI SER/URI
	Units	mg/dL mg/dL
	Reaction type	increasing increasing
	Decimals	2 2

No. of replicates 1 1

Test name in patient report - -

PROCEDURE Reading monoch.monoch.

Volumes Sample 3 3

Reagent 1 210 210

Reagent 2 90 90

Washing 1.2 1.2

Predilution factor - -

Postdilution factor 2 2

Filters Main 340 340

Reference - -

Times Reading 1 60 s 72 s

Reading 2 300 s 312 s

Reagent 2 75 s 96 s

CALIBRATION Calibration type multiple multiple

Calibrator replicates 3 3

Blank replicates 3 3

Calibration curve - -

OPTIONS Blank absorbance limit 0.500 0.500

Kinetic blank limit - -

Linearity limit 20 20

QUALITY CONTROL

It is recommended to use the Biochemistry Control Serum level I (cod. 18005, 18009 and

18042), level II (cod. 18007, 18010 and 18043) and the Biochemistry Control Urine (cod. 18054)

to verify the performance of the measurement procedure.

Each laboratory should establish its own internal Quality Control scheme and procedures for
corrective action if controls do not recover within the acceptable tolerances.

METROLOGICAL CHARACTERISTICS

The following data were obtained using an A25 analyser. Results are similar with A15. Details
on evaluation data are available on request.

− Detection limit: 0.13 mg/dL = 0.04 mmol/L.

− Linearity limit: 20 mg/dL = 6.46 mmol/L.

− Repeatibility (within run):

Mean concentration CV n

3.80 mg/dL = 1.23 mmol/L 1.9 % 20

9.18 mg/dL = 2.96 mmol/L 1.2 % 20

− Reproducibility (run to run):

Mean concentration CV n

3.80 mg/dL = 1.23 mmol/L 2.5 % 25

9.18 mg/dL = 2.96 mmol/L 2.3 % 25

− Trueness: Results obtained with this procedure did not show systematic differences when
compared with a reference procedure. Details of the comparison experiments are available on
request.

− Interferences: hemoglobin (10 g/L), lipemia (triglycerides 10 g/L) and bilirubin (20 mg/dL) do
not interfere. Other drugs and substances may interfere4.

DIAGNOSTIC CHARACTERISTICS

Approximately 80% of the phosphorus in the human body is found in the calcium phosphate
salts, which make up the inorganic substance of bone. The remainder is involved in the
esterification of carbohydrate metabolism intermediaries and is also found as a component of
phospholipids, phosphoproteins, nucleic acids and nucleotides.

Hypophosphatemia can be caused by shift of phosphate from extracellular to intracellular
spaces, increased renal loss (renal tubular defects, hyperparathyroidism) or gastrointestinal loss
(diarrhea, vomiting), and decreased intestinal absorption3,5.

Hyperphosphatemia is usually secondary to inhability of the kidneys to excrete phosphate due to
renal failure or hypoparathyroidism3,5.

Clinical diagnosis should not be made on the findings of a single test result, but should integrate
both clinical and laboratory data.

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CALCIUM-CRESOLPHTHALEIN

O-CRESOLPHTHALEIN COMPLEXONE

CALCIUMCRESOLPHTHALEIN

COD 11811

1 x 200 mL

COD 11812

1 x 500 mL

STORE AT 15-30ºC

Reagents for measurement of calcium concentration

Only for in vitro use in the clinical laboratory

PRINCIPLE OF THE METHOD

Calcium in the sample reacts with o-cresolphthaleincomplexone (o-CPC) forming a coloured

complex that can be measured by spectrophotometry1.

CONTENTS

	COD 11811	COD 11812
A. Reagent	1 x 160 mL	1 x 400 mL
B. Reagent	1 x 40 mL	2 x 50 mL
S. Standard	1 x 5 mL	1 x 5 mL

COMPOSITION

A. Reagent. Ethanolamine 900 mmol/L.

B. Reagent. o-CresolphthaleinComplexone 0.3 mmol/L, 8-hydroxyquinoline 28 mmol/L,

hydrochloric acid 100 mmol/L.

DANGER: H314: Causes severe skin burns and eye damage. P280: Wear protective

gloves/protective clothing/eye protection/face protection. P303+P361+P353: IF ON SKIN (or

hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

S. Calcium/Magnesium Standard. Calcium 10 mg/dL(2.5 mmol/L), magnesium 2 mg/dL.

Aqueous primary standard.

For further warnings and precautions, see the product safety data sheet (SDS).

STORAGE

Store at 15-30ºC.

Reagents and Standard are stable until the expiry date shown on the label when stored tightly

closed and if contaminations are prevented during their use.

Indications of deterioration:

− Reagents: Presence of particulate material, turbidity, absorbance of the blank over 0.500 at 560

nm.

− Standard: Presence of particulate material, turbidity.

REAGENT PREPARATION

Standard is provided ready to use.

Working Reagent (Note 1):

• Cod. 11811: Pour the contents of the Reagent B into the Reagent A bottle. Mix gently. Other

volumes can be prepared in the proportion: 4 mL Reagent A + 1 mL Reagent B. Stable for 2

days at 2-8ºC.

• Cod. 11812: Transfer 100 mL of Reagent B into a Reagent A bottle. Mix gently. Other volumes

can be prepared in the proportion: 4 mL Reagent A + 1 mL Reagent B. Stable for 2 days at 2-
8ºC.

ADDITIONAL EQUIPMENT

− Analyzer, spectrophotometer or photometer able to read at 560 ± 20 nm.

SAMPLES

Serum, heparinized plasma or urine collected by standard procedures (Note 1). Calcium in serum or plasma is stable for 10 days at 2-8ºC. Anticoagulants other than heparin
should not be used.

Collect a 24-hour urine specimen in a bottle containing 10 mL of 50 % (v/v) nitric acid. Stable for
10 days at 2-8ºC. Centrifuge or filter and dilute ½ with distilled water before testing.

PROCEDURE

1. Pipette into labelled test tubes: (Notes 1,2)

Blank Standard Sample

Calcium Standard (S) ¾ 13 ?L ¾

Sample ¾ ¾ 13 ?L

Working Reagent 1.0 mL 1.0 mL 1.0 mL

2. Mix thoroughly and let stand the tubes for 4 minutes at room temperature.

3. Read the absorbance (A) of the Standard and the Sample at 560 nm against the Blank. The
colour is stable for at least 1 hour.

CALCULATIONS

The calcium concentration in the sample is calculated using the following general formula:

If the Calcium Standard provided has been used to calibrate (Note 3):

Serum and plasma Urine

x 10 = mg/dL calcium x 20 = mg/dL calcium

x 2.5 = mmol/L calcium x 5 = mmol/L calcium

REFERENCE VALUES

Serum and plasma2: 8.6-10.3 mg/dL = 2.15-2.58 mmol/L

Urine2: 100-300 mg/24-h = 2.5-7.5 mmol/24-h

These ranges are given for orientation only; each laboratory should establish its own reference

ranges.

QUALITY CONTROL

It is recommended to use the Biochemistry Control Serum level I (cod. 18005, 18009 and 18042),

level II (cod. 18007, 18010 and 18043) and the Biochemistry Control Urine (cod. 18054) to verify

the performance of the measurement procedure.

Each laboratory should establish its own internal Quality Control scheme and procedures for

corrective action if controls do not recover within the acceptable tolerances.

METROLOGICAL CHARACTERISTICS

− Detection limit: 0.26 mg/dL calcium = 0.06 mmol/L calcium.

− Linearity limit: 20 mg/dL calcium = 5 mmol/L calcium. For higher values dilute sample 1/2 with

distilled water and repeat measurement.

− Repeatibility (within run):

Mean calcium concentration CV n

9.58 mg/dL = 2.40 mmol/L 1.7 % 20

13.6 mg/dL = 3.40 mmol/L 1.4 % 20

− Reproducibility (run to run):

Mean calcium concentration CV n

9.58 mg/dL = 2.40 mmol/L 2.2 % 25

13.6 mg/dL = 3.40 mmol/L 1.6 % 25

− Trueness: Results obtained with this reagent did not show systematic differences when compared with reference reagents (Note 3). Details of the comparison experiments are available on request.

− Interferences: Bilirubin (< 20 mg/dL), hemolysis (hemoglobin < 10 g/L) and lipemia (triglycerydes< 30 g/L) do not interfere. Other drugs and substances may interfere3.

These metrological characteristics have been obtained using an analyzer. Results may vary if a different instrument or a manual procedure are used.

DIAGNOSTIC CHARACTERISTICS

Calcium is the most prevalent cation found in the body, distributed in bone (99%), soft tissues and extracellular fluid. Its concentration in plasma is regulated by parathyroid hormone, vitamin D and calcitonin.

Calcium ion is important in the transmission of nerve impulses, in the maintenance of normal muscle contractility, as a cofactor in certain enzyme reactions, and in the coagulation of the

blood.

Hypercalcemia can be due to vitamin D intoxication, enhanced renal retention, osteoporosis,
sarcosidosis, thyrotoxicosis, hyperparathyroidsm, multiple mieloma, idiopathic hypercalcemia of
infancy, and carcinoma metastasic to bone2,4.

Elevated calcium concentration in urine is found in nephrolithiasis and metabolic acidosis2,4.

Hypocalcemia may be caused by primary and secondary hypoparathyroidism, pseudohypoparathyroidism, vitamin D deficiency, malnutrition and intestinal malabsorption2,4.

Clinical diagnosis should not be made on the findings of a single test result, but should integrate
both clinical and laboratory data.

NOTES

1. Contamination of glassware with calcium will affect the test. Use acid-washed glassware or
plastic tubes.
2. These reagents may be used in several automatic analysers. Instructions for many of them are
available on request.
3. Calibration with the provided aqueous standard may cause a matrix related bias, specially in
some analyzers. In these cases, it is recommended to calibrate using a serum based standard
(Biochemistry Calibrator, cod. 18011 and 18044).

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4. Friedman and Young. Effects of disease on clinical laboratory tests, 4th ed. AACC Press, 2001.

$$\frac{A\ \text{Sample}}{A\ \text{Standard}} \times C\ \text{Standard} \times \text{Sample dilution factor} = C\ \text{Sample}$$