

The effect of Age & Sex on some serum electrolytes levels in patients with cardiovascular disease

أرجوان عبد الجبار رضا
كلية الصيدلة / جامعة كربلاء

Abstract :

Serum electrolytes are considered one of the important markers for cardiovascular risk. Electrolyte abnormalities have been demonstrated to have an impact on the risk for Cardiovascular outcomes with onset and time of administration. Electrolyte balance has been regarded as an important factor to cardiovascular stability. Forty five events of myocardial infarction were collected from intensive care unite in AL-Husaini Hospital , they are classified into three age groups, A (30-45) , B (45-60), C(above 60). The aim of the present study is finding the influence of age & sex including the above groups on the levels of serum calcium , phosphorus , potassium and sodium within the maximum normal ranges in those patients, the study discussed the single effect of sex on that levels , results showed there were no any significant difference for sex on them ($p>0.05$) , and for the single age effect , there were significant differences ($p\leq 0.01$), while for calcium and potassium in the third age group (above 60) for both sexes comparing to the other younger age groups . Mainly, the study included the duple effect for age with sex on the studied parameters , and the results showed that there were no significant differences for serum sodium and phosphorus among all age groups ($p>0.05$) , but there were significant differences ($p\leq 0.05$) for calcium levels by the same magnitude in both sexes in the oldest age group(above 60) comparing to the younger age group (30-45)..Significant differences had been seen also ($p\leq 0.05$) for high normal levels for serum potassium in females with the oldest age group (above 60) comparing with the other age groups including the present study.

الخلاصة :

تعد كهارل مصل الدم (الالكتروليتات) من عوامل الخطورة والمؤشرات المهمة قصور القلب الوعائية .. حيث شوهدت مستويات كهارل الدم الواقعة ضمن الحدود العليا للنسب الطبيعية كعوامل خطورة كان لها تأثيرا على نتائج الإصابات القلبية حال حدوثها .. ومن المعروف ان التوازن الكتروليتي عامل مهم لاستقرار تلك الاصابات . جمعت العينات (45 عينة إصابة بالجلطة القلبية) من وحدة العناية المركزة بمستشفى الحسيني بمحافظة كربلاء . صنفت العينات الى ثلاث فئات عمرية , الاولى وتقع ضمن الاعمار (30-45) , الفئة الثانية وتقع اعمارها من (46 - 60) أما الثالثة فتشمل كل الاعمار (فوق الستين عاما) كان الهدف من الدراسة بيان تأثير العمر والجنس بشكل منفرد ومزدوج ضمن تلك الفئات على نسب أيونات الكالسيوم والفوسفور والبوتاسيوم والصوديوم لدى المصابين بتلك الامراض حال ادخالهم وحدة العناية المركزة . فقد ناقشت الدراسة التأثير المنفرد للجنس بالنسبة للفئات بشكل عام على الحدود العليا للنسب الطبيعية للاكتروليتات المدروسة آنفة الذكر واتضح عدم وجود اي فروق معنوية تذكر ضمن مستويات المقارنة ($P> 0.05$) , اما بالنسبة للتأثير المنفرد للعمر على تلك العوامل فقد اظهرت النتائج وجود فروق معنوية ($P\leq 0.01$) لقيم الكالسيوم والبوتاسيوم لدى الفئة العمرية الثالثة لكلا الجنسين مقارنة مع الفئتين الاصغر عمرا. اشتملت الدراسة أساسا التأثير الثنائي للعمر والجنس معا على نسب أيونات الكالسيوم والفوسفور والبوتاسيوم والصوديوم للعينات المدروسة , فاوضحت النتائج انه لا توجد فروق معنوية لقيم الصوديوم والفوسفور بين المجاميع العمرية المقارنة ($P> 0.05$) في حين وجدت فروق معنوية لقيم الكالسيوم عند كلا الجنسين وبنفس المقدار في المجموعة العمرية الاكبر (فوق الستين) مقارنة مع الفئة العمرية الاصغر (30-45) وقد لوحظ ايضا وجود فروق لقيم الحدود العليا للبوتاسيوم لدى الاناث بالفئة العمرية فوق الستين مقارنة مع جميع الفئات العمرية لدى الذكور والاناث ضمن الدراسة المقدمة. ($p\leq 0.05$)

INTRODUCTION :

Electrolytes (electrical conductors) play an important role in many body processes, such as controlling fluid levels, acid/base balance, nerve conduction, blood clotting and muscle contraction (including that of the heart). Electrolyte imbalance can cause serious problems such as dehydration, nausea, vomiting and fever. Over the long term, an electrolyte imbalance can contribute to heart disease, kidney failure, eating disorders and disorders of the endocrine system (glands).

Alterations in electrolyte balance have been claimed to play a role in the pathophysiology of coronary heart disease; however, the relationship between the electrolyte pattern and other clinical variables immediately after an acute vascular event is unclear [1], [2]. Very few conditions will affect phosphorus levels in the blood, so testing for phosphorus alone is not usually very helpful. However, in combination with calcium blood testing, phosphorus testing can be a valuable diagnostic test [1]. Sodium is a vital electrolyte in the fluid that carries nutrients to cell tissue and helps regulate blood pressure. Sodium levels can directly influence potassium and chloride levels in the body. Because of this, sodium levels are a good indicator of overall electrolyte balance.[3] The association between serum sodium level and stroke remained significant after adjustment for diastolic blood pressure and other factors associated with stroke: age, smoking, social class, body mass index, physical activity, heavy drinking, presence of diabetes, blood glucose and pre-existing cardiovascular disease . No association was seen between serum sodium level and risk of cardiovascular disease after adjustment for other risk factors. All-cause and non-cardiovascular mortality were significantly increased at serum sodium levels ≤ 138 mmol/l, probably due to an association between lung cancer and hyponatraemia. These findings suggest that sodium concentration may be related to risk of stroke even at levels of sodium usually regarded as normal.[4] **Potassium** maintains pressure in body fluids and regulates pH balance, kidney function and enzyme (complex proteins found in body cells that act as catalysts) activity. Blood potassium levels become high (hyperkalemia) following a heart attack because excess amounts are released into the blood. Data from a health screening survey with over 18,000 adult participants were used to determine the relations between serum calcium concentration and the cardiovascular risk factors like hypertension, hyperglycaemia and hyperlipidaemia .[5] Though calcium plays an important role in a number of biological processes related to the pathogenesis of atherosclerosis , the relationship of serum calcium and severe stenosis observed on angiography. phosphorus levels with the angiographic severity of coronary artery disease is not known. Results from Multiple regression analysis using age , sex , smoking , diabetes ,hypertension , hyperlipidaemia and family history , showed that serum phosphorus has an independent positive association with most severe stenosis observed on angiography ...[6] The results demonstrated that serum calcium and phosphorus are associated with the prevalence severity of coronary heart disease (CHD), probably through correlation with atherogenic lipids and apolipoprotein .Serum calcium and phosphorus and their ion product were also independent risk factor for CHD.[7] Published studies of the Framingham Heart Study detected the association between serum potassium concentration and risk factors of cardiovascular disease (CVD) in community based- population have reported conflicting results . During 16 years of follow up 313 cardiovascular events occurred , but serum potassium levels did not predict them , there was no statistically significant association between serum potassium concentration and risk of cardiovascular disease after controlling for blood pressure hypertension treatment , diabetes mellitus , smoking , alcohol and caffeine intake and cholesterol levels. According to this study, these observations differ from the findings of the First National Health and Nutrition Examination Survey , Epidemiological Follow up Survey, which did find an increase risk of death due to cardiovascular disease in individuals with high serum potassium levels , however further analysis of the data demonstrated that the increased risk was only in those taking diuretics or abnormal renal failure [8]. American researchers report that the incidence of stroke increase with low potassium levels. The researchers found that participants on diuretics had a 2.5 times increased risk of stroke if their serum level of potassium was below 4.1 meq/L [9],[10].

MATERIALS & METHODS

The study was conducted in (Kerbala) governorate, Al-Husaini Hospital . A total of 45 patients (26 females), (19males) , were studied and they admitted to the coronary care unit as of JUNE 2007, they were classified into 3 age subgroups , group A from (30-45) , group B from (46-60) , group C (above 60) .Those groups had been underwent some serum electrolytes and minerals tests such as Ca^{+2} , $\text{H}_2\text{PO}_4^{-1}$, K^{+1} , Na^{+1} . The output results for serum Na^{+1} and K^{+1} were done by

using flame photometry FP 20....Seac. ITALY , where the outputs for serum calcium and phosphorus were done by using colorimetric method by manual kit from **RANDOX** laboratories,UK . 2ml for each 45 blood samples were collected intravenously in plane tubes , serum was separated by centrifugation of blood samples .Serum calcium was estimated through depending on the reaction of Ca^{+2} ions with orthocresolphthalein complexone in an alkaline medium without deproteinization , the complex formed was measured at 570 nm .Serum phosphorus determination was dependent on the reaction of inorganic phosphate in serum with molybdic acid complex : which is reduced by ammonium Fe^{+2} sulphate to molybdenum blue , which is measured at 690 nm. The normal range of the parameters which is based on this study was as follows :

- Calcium 2.1 – 2.6 mmol/L
- Phosphorus 0.8-1.6 mmol/L
- Potassium 3.5-5.5 meq/L
- Sodium 135-150 meq/L

Statistical analysis system – SAS(2001) was used to analyze the experimental data , means differences were compared by using least significance differences (LSD).

Results

Regarding the single effect of age on the serum electrolytes included in this study , results showed that there was a significant difference for potassium and calcium in both sexes through comparing the oldest age group with the youngest one , $p \leq 0.01$, Table -1-.

Table -1- Age effecting on some serum electrolytes in patients with cardiovascular disease

Age	Calcium Ca^{+2}	Phosphorus $H_2PO_4^-$	Potassium K^{+1}	Sodium Na^{+1}
30 - 45	0.045±*2.30 b	0.037±1.43 a	0.251±3.99 b	0.874±138.58 a
60 – 46	0.033±2.41 ab	0.064±1.37 a	0.197±4.18 ab	0.728±139.69 a
Above 60	0.033±2.52 a	0.069±1.48 a	0.306±4.75 a	1.277±140.18 a
LSD	0.1181	0.2021	0.6568	2.819

* Means ± SE..... $P \leq 0.01$

Means with *similar* letters , within same column are not significant differences but the *different* letters(including singles and binary) letters within same column , are significant ($p \leq 0.01$) .

While the single effect for sex on the studied electrolytes, the results showed that there were no any significant differences for sex on that parameters , $p > 0.05$ Table-2- .

Table -2- Sex effecting on some serum electrolytes in patients with cardiovascular disease

sex	Calcium Ca^{+2}	Phosphorus $H_2PO_4^-$	Potassium K^+	Sodium Na^+
Male	0.034±2.4157 a	0.043±1.463 a	0.232±4.321 a	0.831±139.421 a
Female	0.034±2.4148 a	0.056±1.3851 a	0.183±4.237 a	0.684±139.593 a
LSD	0.0929	0.158	0.516	2.2159

Means with *similar* letters within same column are not significant differences but the *different* letters are significant ($p \leq 0.05$).

Representing the several levels of important serum electrolytes in patients admitted due to the cardiovascular disease , the effect of interference between age subgroups with sex on the obtained parameters in this study, showed the following results (Table- 3-):

Regarding serum potassium measurement females with third age group showed the highest level compared to the other female age groups , second and third male age groups (3.51 ± 0.02 , 4.29 ± 0.24 , 3.98 ± 0.33 , 4.34 ± 0.4) respectively , that means, the lowest level had seen in female at first age group (3.512 ± 0.02) , ($P \leq 0.05$) , although there was a little difference in mean serum potassium between the different groups , there was a significant difference when comparing the groups above each other .

Table -3- Influence of age and sex on some electrolytes in patients with cardiovascular disease

Sex	Age	Calcium Ca^{+2}	Phosphorus $H_2PO_4^-$	Potassium K^+	Sodium Na^+
Male	30-45	B $2.300 \pm 0.07^*$	A 1.425 ± 0.075	**AB 4.95 ± 0.48	A 139.0 ± 1.77
	45-60	AB 2.375 ± 0.041	A 1.412 ± 0.093	BC 3.987 ± 0.33	A 138.75 ± -0.94
	Above 60	A 2.528 ± 0.047	A 1.5429 ± 0.020	BC 4.342 ± 0.40	A 140.429 ± 1.81
Female	30-45	B 2.312 ± 0.061	A 1.437 ± 0.046	C 3.512 ± 0.02	A 138.375 ± 1.05
	45-60	AB 2.44 ± 0.046	A 1.360 ± 0.08	BC 4.293 ± 0.24	A 140.20 ± 0.996
	Above 60	A 2.525 ± 0.047	A 1.375 ± 0.19	A 5.475 ± 0.025	A 139.75 ± 1.842
LSD		0.175	0.300	0.974	4.185

* Means \pm SE

** Means with *similar* letters , within same column are not significant differences but the *different* letters(including singles and binary) letters within same column , are significant ($p \leq 0.05$) .

In(Table -3-) the results showed also the means of serum phosphorus which they were within high normal levels range from (1.36 ± 0.08 ___ 1.5429 ± 0.02) , the last was found in male age group above 60 years.

There was a little difference in mean serum phosphorus among all age group for both sexes but without significant differences through comparing each other .(Table -3-) .

Considering the serum sodium and phosphorus levels , there were no significantly differences for both sexes among the all age groups . The mean of serum calcium was higher for both males and females (2.52 ± 0.047) in the third age group (above 60) , whereas it was lower for both sexes at the first age group(2.3 ± 0.06) , the results showed that there were no any significant differences between first and second age group , also between second and third one . In general , the study showed that there was no significant difference between sexes in all subgroups of high normal proportion levels of serum electrolytes in cardiovascular disease patients but the number of males and females would be considered for each electrolyte , also the difference in sex distribution between the different groups was not significant ($p > 0.05$) , it was concluded that sex is not effecting on the studied properties, age had not effect on the studied parameters in both sexes

except for serum calcium where there was a significantly difference between the first age group (30-45) and the third one (above 60), $p \leq 0.01$.

Discussion

The results obtained from the present study showed that age had an important effect on the levels of serum calcium in both males and females by the same magnitude. The maximum age group (above 60), had an increase for the incidence of cardiovascular disease (CVD), which was associated with moderate higher serum mean calcium value (2.52 ± 0.047). The obtained results agreed with what health screening survey demonstrated, which showed that calcium plays an important role in a number of biological processes related to the pathogenesis of atherosclerosis and heart disease. Changes in calcium metabolism seemed to be related to metabolic syndrome of hypertension, impaired glucose tolerance and hyperlipidaemia [6]. The obtained results from present study differ what the above survey explained including age as an risk factor, the results demonstrated that there was a significant difference including (age group above 60) compared to other subgroups, whereas in the previous survey it was found that serum calcium was an independent risk for CHD [8]. It has been known for many years that dystrophic calcification may affect cardiac myocytes. That is, necrotic cardiac myocytes may be come calcified, especially in patients who have a high serum calcium level or who are in uremia. Calcification of vascular structures as noted in several studies could be of considerable significantly difference in the incidence of acute myocardial infarction (MI) associated myocardial calcification when they studied in relating to gender. There is a reason to believe that calcium influx into heart muscle during acute myocardial infarction can aggravate myocyte injury. Furthermore, the degree of such influx might correlate with the occurrence of microscopic myocyte calcification observed at autopsy. [11] Considering the proportions of serum phosphorus in those patients, there was no any significant difference had been seen in both sexes for all age groups, but the results within the high normal levels were in the mean range from (1.36 ± 0.08 _ 1.54 ± 0.020). Considering serum potassium, the obtained levels from the present study had reported conflicting results, that is agree with the findings of the First National Health and Nutrition Examination Survey Epidemiological Follow up Survey which did find an increase cardiovascular events in individuals with high serum potassium within the normal range [9], and that is also agree with the data of Cohort Study which confirmed an association of modest hyperkalemia with increased cardiovascular events but in patients which they had treated by diuretics, the present studied results disagreed and differed from another observations which had been found an association of mild hypokalemia with increased cardiovascular risk among these patients, it could be concluded from the results of this study relating to serum K^+ that old females (above 60) had more risk to CHD than males who they were on diuretics with, this subject seemed to be newly adapted by the scientific researchers and cannot be well determined in community-based populations. [8] The present results showed the lowest level of serum K^+ was found in females at the first age group (3.512 ± 0.02) and it was lower than 4.1 meq/L (the level at which considered the dependent significant risk for CVD) in contrast to what Framingham Heart Study detected, which there was no statistically significant association between serum potassium concentration and risk of cardiovascular disease after controlling for blood pressure, hypertension treatment, diabetes mellitus, smoking as mentioned previously in the introduction, which they treated by diuretics without using potassium sparing supplements. [9] Regarding serum sodium levels in this study, there was No association was seen between serum sodium level and the incidence of cardiovascular heart disease after adjustment for other risk factors and that agreed with the outcomes of a study which showed the inverse relationship between sodium and stroke up to 144 mmol/l which was seen in a) males with and without pre-existing CVD or stroke b) normotensives c) untreated hypertensives. These findings suggest that sodium concentration may be related to risk of stroke even at levels of sodium usually regarded as normal. [4]

Conclusion

The study showed that there were no significant differences for the influence of age and sex on the levels of serum sodium and phosphorus even with high normal values among all age groups for both males and females with cardiovascular disease, but there were significant differences for serum calcium and potassium in the oldest age group, significant difference had been seen for high normal level of serum potassium in the oldest females.

References

- 1- Solini A. , Zamboni P. ; Acute vascular events and electrolytes variations in elderly patient ; **Hormone and metabolic research** 2006 , vol.83 ; n^o 3 , p. 197-202.
- 2- Tonelli M. , Sacks F. , Pfeffer M. , Gao Z. , Curhan G. ; Relation between serum phosphate level and cardiovascular event rate in people with coronary disease ; **Circulation Journal** , 2005 ;112:2627-2633 .
- 3- Schmidt , Tracy RN. ; Assessing a sodium fluid imbalance , **Nursing** 2000, volume 30 , number 1 , p. 18.
- 4- Wannamethee G. , Whincup PH. , Shaper AG. , Lever AF. , Serum sodium concentration and risk of stroke in middle – aged males, **J Hypertens** . August 1994 ; 12(8): P.971-9.
- 5- Lind L. , Jakobsson S. , Relation of serum calcium concentration to metabolic risk factors for cardiovascular disease , **BMJ**.1988 October 15; V. 297 (6654) : p.960 -963 .
- 6- Rajiv N. , Deborah R. ; Serum calcium , phosphorus and albumin levels in relation to the angiographic severity of coronary artery disease ; **International Journal of Cardiology** , volume 60 , issue 1 , 27 June 1997, P.73-79 .
- 7- Mehdi R. , Asadollah K. ; Serum calcium and phosphorus associate with the occurrence and severity of angiographically documented CHD , possibly through correlation with atherogenic apolipoprotein ; **Journal of Clinical Chemistry and Laboratory Medicine** . 2006 January ; V.44: p. 43-50.
- 8- Walsh CR. , Larson MG. , Leip EP. , Vasan.RS , Daniel L. , Serum potassium and risk of cardiovascular disease : the Framingham Heart Study; **Arch Int Med** , 2002 , vol.162, p. 1007-1012.
- 9- Cohen HW. , Madhavan SH. , Alderman MH. ; High and low serum potassium associated with cardiovascular events in diuretic- treated patients ; **Journal of hypertention** 2001 , vol .19 ; n^o 7 , p. 1315-1323.
- 10- Green DM. , Serum potassium level and dietary potassium intake as risk factors for stroke . **Neurology** , Vol. 59, August 2002 , p. 314-320.
- 11- Gore I. , Arons W. : Calcification of the myocardium , a pathological study of 30 cases . **Arch Pathol** 1949 ; V48 : P.1-12 .