Assessment of Electrolyte Level (Na and K) in Acute Myocardial Infarction Patients in Khartoum State (Sudan)

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Abstract:
Background :
Acute myocardial infarction (AMI) is one of the leading causes of morbidity and mortality across the world. Electrolyte disturbance after acute myocardial infarction are more conmen.
Objective:
This study was carried out to measure serum levels of sodium and potassium in patients with acute myocardial infarction (AMI).
Materials and Methods
Sixty blood samples were collected from patients in period between April to July 2017, chosen from Sudan Heart Center, in Khartoum (Sudan) and sixty normal individual serve as control. Serum sodium and potassium were measured by using ion selective electrode (Easylyte),
Results:
The study showed that, 66% of patients were males while 34% of patients were females. Also the study found 30% of patients with AMI were hypertensive, while 33% of patients were diabetic and 26% of patients were smoker. The result showed that, patients with acute myocardial infarction (AMI) had significantly lower in means of serum potassium (3.76±0.54 vs. 3.92±0.36 mmol/l) P<0.05 , while there was significant increase in the mean of serum sodium in patients with acute myocardial infarction (AMI) compared to control group (138.28±3.71 vs 136.02±2.39 mmol/l) p value <0.05 .
Also there was significant decrease in mean of potassium level in females patients compared to males patients (3.57±0.65 vs 3.86±0.45 mmol/l), while there was significant increase in mean of sodium level in females patients compared to males patients(139.08±4.76 vs 137.86±3.01 mmol/l) p value <0.05. There was significantly negative correlation between serum potassium and sodium levels in patients with acute myocardial infarction (AMI) (r=-0.289, p. value = 0.015).
Conclusion: *There was significant decrease in serum potassium level while there was significant increase in serum sodium level in patients with acute myocardial infarction (AMI).*

I. Introduction:

Myocardial infarction (MI) is a dreadful complication of cardiovascular disease causing million per year. Acute myocardial infarction (AMI) is one of the most common diagnoses made in hospitalized patients in industrialized countries [1]. It is a growing cause of death worldwide. Sudden cardiac deaths occur worldwide at rates of around 3 million per year. Serum sodium and potassium are considered to be major determinants of electrophysiological properties of myocardial membrane. Electrolyte imbalances after an episode of acute MI are common [2]. Clinical importance of these imbalances in ST elevation Myocardial Infarction (STEMI) increasing mortality worldwide. The total body potassium levels in body is 3500 mmol, out of which 98 % is intracellular. Its main regulation is by the renal excretion and shift between the intracellular and extracellular compartments.[3,4] Mainly the sodium potassium ATPase pump is responsible for preserving the intracellular potassium. Aldosterone and vasopressin stimulate the potassium secretion by up regulating the luminal Na K ATPase pump and opening the luminal Na and K channels[5]. The sarcolemma, which in the resting state is largely impermeable to Na, has a Na\ K ATPase pump that extrudes Na from the cell; this pump plays a critical

role in establishing the resting potential. Thus, intracellular [K] is relatively high and [Na] is far lower, while, conversely, extracellular [Na] is high and [K] is low. There are four phases of the action potential dependent on Na and K[6] .Several electrolyte changes have been reported to follow AMI. These electrolyte levels, being modifiable hold an important role in altering the prognosis of such myocardial infarction (MI) patients.[7] The T wave changes commonly found in the ECG of MI patients are attributed to changes in potassium levels. Potassium homeostasis is critical to prevent the adverse events in patients with cardiovascular disease. The prevalence and role of hypokalemia , in myocardial ischemia and MI in particular, has been under investigation for a long time. [8] Hypokalemia was even found to be associated with larger infarcts [9]. It is important to find the relation between mean post admission potassium levels and the clinical outcomes, as these potassium levels are potentially modifiable during hospitalization. Recent guidelines suggest that K levels should be monitored and routinely replaced in patients with heart failure and MI, even if initial K appears normal[10].

II. Materials and Methods:-

Study Population: The study was carried out at College of Medical laboratory Sciences and the subjects were recruited from Sudan Heart Center, in Khartoum (Sudan) from April to July 2017. A total of 120 individual were enrolled in this study; divided into two groups, 60 patients with myocardial infarction and 60 healthy individual serve as control. The study was approved by hospital's ethics committee. Informed consent was obtained from patients before blood sampling.

Inclusion criteria:-
Patients with myocardial infarction (Confirm cases of MI diagnosed clinically by Physician based on Clinical examination and ECG changes) and healthy individual serve as control group were included in this study.

Exclusion criteria
MI Patients on diuretics, Patients with renal insufficiency, hyperglycemic MI patients, Known cases of liver failure, chronic vomiting, diarrhea patients, malignancy, adrenal insufficiency ,   Known cases of hypothyroidism, as well as the patients refuse to participate in the study were excluded.

Blood sample and Analysis:-
About 2ml of venous blood was collected from the antecubital vein by taking aseptic precautions. Care was taken to prevent venous stasis during the sample collection. The blood was allowed to clot and the serum was separated by centrifugation. The estimation of the parameters was carried out within 4-6 hrs. The samples were analyzed for serum sodium and potassium by Electrolyte analyzer (**easylyte**). The internal control sera of two different levels were used to calibrate the instruments.
Data was analyzed using SPSS computer program, the mean and standard deviation were obtained and the independent 't.test' used for comparison (p value of ≤ 0.05) was considered significant.

III. Results:

The mean age of AMI patients was 57.4 ± 5.2 years, while in control group was 57.2 ± 4.9 years   with p value 0.89.
66% of patients were males, while 34% of patients were females as in figure (1):
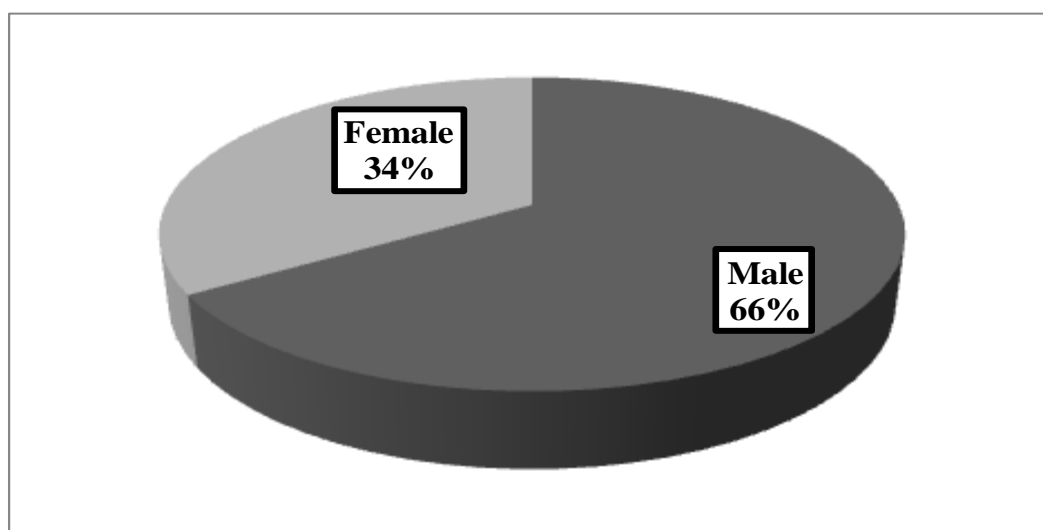

Figure (1) distribution of patients according to gender

30% of patients with AMI were hypertensive, while 33% of patients were diabetic and 26% were smoker as in table (1)

Table (1) General characteristic of patients with AMI

Patients	Number	Frequency
Hypertensive	18	30%
Diabetic	20	33%
Smoker	16	26%

In comparison with the controls, patients with AMI had significantly lower in means of serum potassium (3.76±0.54 vs 3.92±0.36 mmol/l) P<0.05, while there was significant increase in the mean of serum sodium in patients with AMI compared to control group (138.28±3.71 vs 136.02±2.39 mmol/l) p value <0.05 as in table (2).

Table (2) means comparisons of serum sodium and potassium levels in patients with AMI compared to control group.

Parameters (mmol/l)	Case (Mean ±SD)	Control (Mean ±SD)	*P-value*
Potassium (K+)	3.76±0.54	3.92±0.36	0.042
Sodium (Na+)	138.28±3.71	136.02±2.39	0.000

Results expressed as Mean ±SD and significant differences considered as p-value ≤0.05.

Table (3) mean comparisons of serum potassium and sodium levels according to gender

Parameters (mmol/l)	Male (Mean ±SD)	Female (Mean ±SD)	*P-value*
Potassium (K+)	3.86±0.45	3.57±0.65	0.033
Sodium (Na+)	137.86±3.01	139.08±4.76	0.019

Results expressed as Mean ±SD and significant differences considered as p-value ≤0.05.

In comparison between mean of sodium and potassium levels according to gender, there was significant decrease in mean of potassium level in females patients compared to males patients (3.57±0.65 vs 3.86±0.45 mmol /l), while there was significant increase in serum sodium level in females patients compared to control group (139.08±4.76 vs 137.86±3.01 mmol/l) p value <0.05.

There was significantly negative correlation between serum potassium and sodium levels in patients with AMI (r=-0.289, p. value = 0.015) as in figure (2)
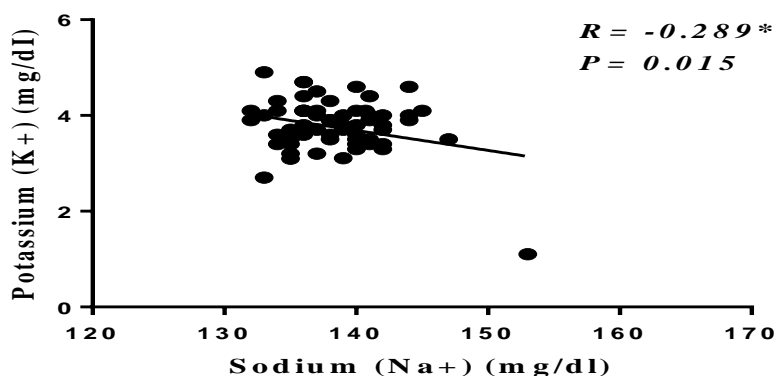

Figure (2) correlation between sodium and potassium levels

IV. Discussion:-

Acute myocardial infarction (AMI) is one of the leading causes of morbidity and mortality across the world.[11]

From the finding of this study it appears that, serum level of potassium was significantly decrease in patients with AMI group compared to control group (p, value=0.000). This result agreed with study carried by many authors (12, 13, 14, 15), which showed that; There was statistically decrease in serum potassium level in case group compared to normal healthy control group (p, value =0.00).Also this result agreed with another result which showed that; there was association between hypokalemia with increased occurrence of cardiac arrhythmias in AMI patients, potassium deficiencies play an important role in the development of cardiac arrhythmias. Also this result agreed with another result which finding confirmed that, decrease in potassium level was influenced by the catecholamine levels which are elevated in early acute myocardial infarction. [16]

Also this result similar to another result which found   Hypokalemia was evident in a large number of patients in the early phase of AMI, mostly due to the catecholamine response in such patients. It has been associated with ventricular arrhythmias and increased mortality in post AMI patients [17].

Result of this study showed that, there was significant increase in serum sodium level in patients with AMI compared to control group (p, value=

0.00). This result disagreed with result carried by (Pitts and Duogan ; 1950) which found significant decrease in sodium level in AMI patients due to hypoxia and ischaemia, which increase the permeability of sarcolemma to sodium. [17] Also the result disagreed with another result which found significant decreased in serum sodium level in AMI patients, this decrease of sodium level due to a larger volume of water was excreted than would be expected from the measured amount of sodium chloride lost at the same time. I t was suggested that the edema of heart failure was initiated primarily by retention of water rather than retention of salt.[16]

Another result found, Hyponatremia was a fairly common finding among acute MI patients, probably attributed to the non-osmotic secretion of vasopressin. [5] Also the result disagreed with another result which showed that, with decreased glomerular filtration in congestive heart failure there is a great reduction in tubular sodium load. This apparently results in increased reabsorption of sodium in the obligatory phase, either because of the decreased sodium load or because of malfunction of the tubular apparatus. [17]

References:-

[1]. **Jeldsen, K. K.** Hypokalemia and sudden cardiac death. Exp Clin Cardiol 2010; 15 (4):96-99

[2]. **Harish, R**. Department of Biochemistry, SDUMC, Kolar for the technical and statistical assistance.2012;2(4): 167

[3]. **Tada, Y., Nakamura, T., Funayama, H., Sugawara, Y., Ako, J., Ishikawa, S., Momomura, S**. Early development of hyponatremia implicates short and long term outcomes in ST elevation acute myocardial infarction. Circ J. 2011; 75:19271933.

[4]. **Mac Donald ,J. E., Struthers, A., D**. What is the optimal serum potassium level in cardiovascular patients. J Amc Cardio 2004;43(2):155-161.

[5]. **Fauci, A.S., Braunwald, E., Isselbacker, K.J., Wilson J.D., Martin, J.B., Kasper, D.L**. ST elevation mycardian infraction. In Harrisons th principles of internal medicine, 17 ed. USA: McGraw Hill Companies. Serum potassium levels and mortality in acutemyocardial.2012:15327.

[6]. **Goyal, A., Spertus, J. A., Gosch. K., Venkitachalam, L., Jones, P. G., Berghe, G. V. D**. Serum potassium levels and mortality in acutemyocardial in Jan farction. JAMA 2012; 307(2):157-164.

[7]. **Xianghua, F., Peng, Q., Yanbo, W., Shigiang, L., Weize, F., Yunfa, J.** The relationship between hypokalemia at the early stage of acute myocardial i nfarction and malignant   ventricular arrhythmia. Heart Rec .2010;96:196.

[8]. **Reuter, H ., Henderson, S.A., Han,T.** The Na^+-Ca^{2+} exchanger is essential for the action of cardiac glycosides Circ Res 2002,90 : 305-308

[9]. **Madias, J. E., Shah, B., Chintalapally, G., Chalavarya, G., Madias, N.E**. Admission serum potassium in patients with acute myocardial infarction: its correlates and value as a determinant of in hospital outcome. Chest 2000;118:904-913.

[10]. **Reuter, H., Henderson, S.A ., Han,T**. The Na^+-Ca^{2+} exchanger is essential for the action of cardiac glycosides Circ Res 2002,90 : 305-308

[11]. **Arnon, A., Hamlyn, J.M., Blaustein, M.P.** Ouabain augments Ca(2+) transients in arterial smooth muscle without raising cytosolic Na(+) Am J Physiol. 2000; 279 :679-691.

[12]. **Cohn, J. N., Kowey, P. R., Whelton, P. K., Prisant, L. M.** New Guidelines for Potassium replacement in Clinical Practice, A Contemporary Review by the National Council on Potassium in clinical practice. Arch Int Med 2000;160:16.

[13]. **Vamne, A., Pathak,S., Chandra, R .T., Choudhary,R**. Electrolyte changes in patients of acute myocardial infarction. International journal of advanced biological research .2015;.5(1) : 78-80 .

[14]. **Singla,I., Zahid, M., Good ,C.B.,Macioce ,A., Sonel. A.F**. Effect of hyponatermia on outcome of patients in non ST elevation acute coronary syndrome.AMJ Cardiol.2007; 100: 406-408.

[15]. **Abu Marzoq, L.F., Jaber, W.H., Halaid Azzam , D.K**. Electrolyte Level Changes in Acute Myocardial Infarction Patients as Compared to Healthy Individuals in Khan Younis Governorate, Gaza Strip ; Advances in Biochemistry. 2016; 4(2): 9-15

[16]. **Thygesen, K., Alpert, J.S., White, H.D., Jaffe, A.S., Apple, F.S., Galvani ,M** . Universal definition of myocardial infarction . *Eur Heart J.* 2007 ; 28(20):2525–38.

[17]. **Pitts, R. F and Duogan , J. J.** Studies on diuretics . The relationship between glomerular filtration rate, proximal tubular reabsorption of sodium, and diuretic efficacy of mercurials. J. Clin. Investigation 1950; 29: 372-379.