ORIGINAL RESEARCH PAPER

Clinical Biochemistry

LEVEL OF SERUM SODIUM AND SERUM POTASSIUM IN ACUTE MYOCARDIAL INFARCTION

KEY WORDS: Myocardial Infarction, CVD, Electrolytes, Hypokalemia, Hyponatremia.

Shivam Agarwal Department of Medical Laboratory Technology, School of Health Sciences, CSJMU Kanpur

Dr. Praveen Katiyar Assistant Professor School of Health Sciences, CSJMU Kanpur

Dr. Awadhesh Kumar Sharma Associate Professor LPS Institute of Cardiology, & GSVM Medical College Kanpur.

ABSTRACT

Myocardial Infarction (MI), commonly known as heart attack, is one of the most frequent and non-communicable or chronic diseases that cannot be passed from one person to another person. Myocardial infarction is a dire complication of CVD causing, an increasing number of mortalities worldwide. Myocardial infarction is a serious medical emergency that occurs due to blood flow stopping at the tone of the cardiac arteries which supply blood to the heart causing damage to the myocardial thus increasing myocardial metabolic demand, and decreasing the delivery of oxygen and nutrients to the myocardium via the coronary circulation. Electrolytes such as potassium (K) and sodium (Na) are considered to be major determinates of electrophysiological properties of the myocardium membrane and their imbalance in concentration after MI is common. Serum sodium (Na) and potassium (K) imbalances are fairly common in acute phase of MI patients. Hyponatremia is defined as serum sodium level decreases their normal range <136mmol/L. Hyponatremia is electrolyte abnormality that has been associated with poor outcomes in AMI. Hyponatremia was present on admission in 20.9% of the patients and 60.7% had hyponatremia during the first seven days of hospitalization. Hypokalemia is defined as serum potassium level decreases their normal range < 3.5 mmol/L.

INTRODUCTION

Cardiovascular disease (CVD) is a global public health associated problem contributing to 30% of global mortality and 10% of the global disease burden. Myocardial Infarction (MI) is one of the leading causes of mortality and morbidity across the world. According to the WHO the prevalence of Myocardial Infarction is more in middle income world and it is well known that males are more commonly affected then females.[1]

In India the prevalence ischemic heart diseases among adult were estimated at 97.5 per 1000 population in the urban and 27.1 per 1000 in rural.[2] The burden of Myocardial Infraction is increasing in both low income and middle- and- high income countries because of ageing populations, but the burden is highly increase in low-middle income countries because due to much larger population sizes and widespread exposure to increasing levels of risk factor such as unhealthy diet, obesity, tobacco, physical inactivity, diabetes etc.[3]

Several metabolic changes occur in myocardial infarction, which include increased plasma concentration catecholamines, glucose, free fatty acids, cortisol and cyclic-AMP. There is also decreased triglycerides and initial decrease insulin concentration, followed by an early return to normal value.[4]

Myocardial Infraction

Myocardial Infraction (MI), also known as Heart attack, is one of the most frequent noncommunicable and chronic diseases that cannot passed from one person to another. It worsens with time, affecting the heart's flow rate. It is serious medical emergency that occur due to the blockage of coronary arteries which supply blood to the heart. Due to which, lacks of oxygen to myocardium (hypoxia) causes characteristics chest pain and death of myocardial tissues.[5]

The term AMI (Acute Myocardium Infarction) is defined as a disturbance between myocardial oxygen supply and requirement which result in injury to myocytes and following death of myocytes. The interference of blood supply to heart leads to the gross necrosis of myocardium. Total loss of coronary blood flow results in a clinical syndrome called as associated with ST segment elevation AMI (STE AMI). Partial loss of coronary perfusion is generally scanty severe and known as non-ST-elevation myocardial infarction (NST AMI). The damage of myocardium is permanent because cardiac muscle cannot regenerate and dead tissue is replaced with nonfunctional fibrous tissue.[6]

The WHO European Myocardial Infarction Register criteria were based on clinical history, electrocardiogram results, and enzyme measurements.

- The ECG shows clear abnormal Q waves and ST segment elevation or depression.
- A history of conventional or atypical angina pectoris, as well as ambiguous ECG abnormalities and increased enzymes.
- Fatal cases with naked eye indications of recent heart attack or recent coronary arteries blockage at necropsy, whether abrupt or not (hemorrhage into an atheromatous plaque or embolism, antemortem thrombus).[7]

Symptoms

Cheat Pain, Jaw pain, Sweating, Dizziness, Fatigue, Light-headedness, Cold sweat, Heartburn, Shortness of breath, Shoulder discomfort, Anxiety, Chest pressure.

Risk Factor

Life style: - Smoking (including secondhand smoke), Junk food, Alcohol, Job stress, No Physical activity, Socioeconomic status, Air pollution, Family history and obesity etc.

Genetics: - The following genes have an association with heart attack: SORT1, MIA3, PCSK9, 2B, COL4A1, MRAS, WDR12, MIA3, ABO, ADAMTS7, SMG6, SNF8, SLC5A3.

Others: - Combined oral contraceptive pills, Use of non-steroidal anti-inflammatory drugs (NSAISs), Endometriosis, Acute and chronic infection, Late consequence of Kawasaki disease.

Etiology of MI

1) Myocardial ischemia
2) Non-atherosclerotic causes—arteritis, coronary ostial stenosis, coronary vasospasm, embolism, thrombotic

diseases, trauma and outside compression.

3) Acute Plaque rupture:-

1. Superimposed coronary thrombosis
2. Intramural hemorrhage

Serum Electrolytes

Electrolyte is the medical term for salt that is present in blood and others body fluid like CSF, Amniotic fluid, abdominal fluid and balance of these is essential for normal function of cells and organs. There are many several common electrolytes found in blood and body fluid. The balance is significantly important for nerve impulses, muscle function, hydration and pH level. Serum Sodium and Serum Potassium are considered to be the major determinants of electrophysiological properties of myocardial membrane.[8] Electrolytes play an important role in cellular function, Active transport (Sodium-potassium pump, calcium pump and Potassium hydrogen pump), intermediary metabolism, enzyme activities and electrical gradients.[9]

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.[10]

Sodium is the most abundant extracellular cation and positively charged electrolytes which helps to maintain fluid levels in the body and facilitates neuromuscular functioning. Serum Sodium disturbance has been also recorded in early phase of Acute Myocardial Infarction in some studies. Normal plasma or serum sodium concentration is 133-146mmol/L. Hyponatremia is decreased sodium level <133 mmol/L in blood with hospitalized patients of AMI. In acute myocardial infraction, non-osmotic release of vasopressin may occur due to the acute development of left ventricular dysfunction; in response to major stress, nausea and pain the most common mechanisms of hyponatremia in adults; or in response to the administration of analgesics and diuretics. Which leads to low sodium level in blood. Hyponatremia may be further disturbed in acute myocardial infarction by the complementary activation of the renin angiotensin system and increased catechocholamine production.[11] Hyponatremia was present on admission in 20.9% of the patients and 60.7% had hyponatremia during the first seven days of hospitalization.

Potassium is the most abundant intracellular cation and positively charged electrolytes. Serum potassium levels are tightly controlled in humans. Serum potassium disturbance has been also recorded in early phase of Acute Myocardial Infarction in some studies. Normal serum or plasma concentration is 3.5 to 5.0 mmol/L through sophisticated at the cellular, molecular and organ level.[12] Potassium is very important for regulating heartbeat and muscle function. Heart requires potassium for depolarization and contraction. Changes in extracellular and intracellular serum potassium levels modify the electrophysiological properties of the resting membrane potential of the myocardium and subsequently contribute to the occurrence of ventricular arrhythmia.[14] Hypokalemia is a condition in which the serum potassium level is < 3.5 mmol/L and occurs as a determent of excessive morbidity in such patients. Hypokalemia may affect the resting membrane potential of the myocardium, repolarization and relative refractory time, and conduction velocity.[15] Several studies have shown association between hypokalemia with increased occurrence of cardiac arrhythmias in Acute Myocardial Infarction patients.[15] Hypokalemia prolongs ventricular repolarization, often with prominent U waves. This hypokalemia is mostly due to the stress induced catecholamine response that role as hormones, in such of AMI causing increased potassium uptake into cells.[16]

DISCUSSION

Serum sodium (Na) and potassium (K) imbalances are fairly common in acute phase of MI patients. Hyponatremia is defined as serum sodium level decreases their normal range <136mmol/L. Fall in sodium level on day of admission in acute myocardial infarction was observed in various study. Hyponatremia is a common electrolyte abnormality which associated with poor outcomes in acute myocardial infarction (AMI) and several others condition. Hyponatremia is an indicator of heart attack. Serum sodium level is prognostic indicator i.e., increase in sodium level after initial fall of serum on day of MI was indicative of clinical improvement.[16]

Hypokalemia is defined as serum potassium level decreases their normal range < 3.5 mmol/L. Hypokalemia prolongs ventricular repolarization, frequently with important U waves. The occurrence of ventricular fibrillation has been exact expected five-fold higher in cases induced catecholamine response that function as hormones, in such patients causing increased potassium uptake into cells. Therefore, estimation of sodium and potassium levels in AMI patients can help assess their prognosis.

Table No. 01 Previous Researcher Find Disturbance In Serum Electrolyte Level In Acute Myocardial Infarction Patients.

Title	Publication Detail	Year	Result
Study of Serum Sodium and Potassium in Acute Myocardial Infarction	WaliM V, Yatiraj S. Study of serum sodium and potassium in acute myocardial infarction. J Clin Diagn Res. 2014 Nov;8(11):CC07-9. doi: 10.7860/JCDR/2014/10417.5083. Epub 2014 Nov 20. PMID: 25584210; PMCID: PMC4290227.	2014	Hypokalemia Hyponatremia
Electrolyte Level Changes in Acute Myocardial Infarction Patients as Compared to Healthy Individuals in Khan Younis Governorate, Gaza Strip	Lamia Fasail Abu Marzoq, Wafaa Hamad Jaber, Dina K. Halaid Azzam. Electrolyte Level Changes in Acute Myocardial Infarction Patients as Compared to Healthy Individuals in Khan Younis Governorate, Gaza Strip. Advances in Biochemistry. Vol. 4, No. 2, 2016 pp. 9-15. doi: 10.11648/j.ab.20160402.11	2016	Hypokalemia Hyponatremia
A Clinical Study Of Serum Electrolytes (na, K, Cl) And Serum Magnesium Levels In Patients Of Acute Myocardial Infarction	Parmar KB, Sharma RN, Shah J. A clinical study of serum electrolytes (NA, K, CL) and serum magnesium levels in patients of acute myocardial infarction. J. Evid. Based Med. Healthc. 2017; 4(61), 3691-3695. DOI: 10.18410/jebmh/2017/736	2017	Hypokalemia Hyponatremia
Electrolyte dysfunction in myocardial infarction patients	S., Hariprasad; M., Basavaraj. Electrolyte dysfunction in myocardial infarction patients. International Journal of Advances in Medicine, [S.l.], v. 5, n. 5, p. 1172-1176, sep. 2018. ISSN 2349-3933.	Oct 2018	Hypokalemia Hyponatremia
Serum potassium levels and mortality of	The European Society of Cardiology 2018 Article reuse guidelines: sagepub.com/journals-	2019	Hyponatremia

patients with acute myocardial infarction: A systematic review and meta-analysis of cohort studies	permissions DOI: 10.1177/2047487318780466 journals.sagepub.com/home/ejpc	2019	Hyponatremia
The association of hyponatremia and clinical outcomes in patients with acute myocardial infarction: a cross-sectional study	Cordova Sanchez A, Bhuta K, Shmorgon G, Angeloni N, Murphy R, Chaudhuri D. The association of hyponatremia and clinical outcomes in patients with acute myocardial infarction: a cross-sectional study. BMC Cardiovasc Disord. 2022 Jun 18;22(1):276. doi: 10.1186/s12872-022-02700-y. PMID: 35717160; PMCID: PMC9206366.	JUNE 18 2022	Hyponatremia
Serum potassium level, variability and in-hospital mortality in acute myocardial infarction	Zhang X, Wang M, Zhu Z, Qu H, Gu J, Ni T, Wang Y, Wang X, Zhang R, Li Q. Serum potassium level, variability and in-hospital mortality in acute myocardial infarction. Eur J Clin Invest. 2022 Jul;52(7):e13772. doi: 10.1111/eci.13772. Epub 2022 Mar 22. PMID: 35294777.	March 16 2022	Hyponatremia

CONCLUSION

Hypokalemia and Hyponatremia are indicators of AMI. Serum sodium and potassium levels were significantly lower at baseline and gradually becomes near normal on 4th day in the AMI patients, so estimation of these can help to assess prognosis. Serum sodium and potassium levels are prognostic indicators, i.e., rise in sodium levels after initial fall was indicative of clinical improvement. Therefore, estimation of sodium and potassium level in acute MI patients can help assess their prognosis.

Recommendations

- Estimation of Serum sodium and potassium is good for diagnosis and prognosis of acute myocardial infarction.
- Taking the sample as soon as the patients enters the hospital before any admission.
- Estimation of serum Sodium and potassium level in patients with AMI should be done as early as possible on arrival of the patients in emergency department.

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