Study of s-adenosylhomocysteine as marker of Acute Myocardial Infarction in Thi-Qar heart center

Lamees M. Al-Janabi [1]Dheyaa Kadhim Al-Waeli [2]

[1]Department of Biochemistry, College of Medicine, Thi-Qar University, Iraq.

Corresponding Author E-mail: lameeskhalid2004@gmail.com.

[2]Department ofMedicine,College of Medicine, Thi-Qar University, Iraq.

Corresponding Author E-mail:dheyaaalwaeli@yahoo.com

ABSTRACT

In the current study, we investigated the correlation between serum s-adenosylhomocysteine as a new marker for myocardial infarction severity with homocysteine, troponin, vitamin B6 and B 12 on 90 acute myocardial infarction patients and 120 normal persons as control.The data of all patients and controls were measured by using the ELISA technique except troponin was measured by using the VIDIS technique, while the data were analyzed by SPSS software. The results of this study show a significant increase in s-adenosylhomocysteine, troponin, homocysteine, while vitamin B6 and B12 were decreased significantly.The correlation study proved that s-adenosylhomocysteine as a golden marker for AMI patient for male and female-specific with SEAMI while troponin with high correlation in NSEMI.

Keywords: serum, s-adenosylhomocysteine, marker, myocardial infarction, homocysteine, troponin, Vit B6, B 12

How to cite this article: Al-Janabi LM, Al-Waeli DK (2020): Study of s-adenosylhomocystein as marker of acute myocardial infarction in Thi-Qar heart center, Ann Trop Med & Pub Health; 23:S392. DOI: http://doi.org/10.36295/ASRO.2020.2316

INTRODUCTION

Myocardial infarction (MI), which is known as a heart attack happens when blood flow to a part of the heart has been decreased or stopped which leads to damage in the heart muscle. Most myocardial infarctions happen due to coronary artery disease (1).The risk of having a myocardial infarction increases with older age, low physical activity, obesity and high cholesterol level (2). More commonly heart attacks occur in the morning hours, especially between 6 am and afternoon. Myocardial infarctions are less common and are caused by spasms of the coronary artery, which may be due to cocaine, significant emotional stress, and extreme cold, and others (3).The diagnosis of MI can be made by many tests, including electrocardiograms (ECGs), blood tests, and coronary angiography (4). The heart's electrical activity can be recorded by ECG, which confirms a segmented elevation myocardial infarction (STEMI) if ST elevation is present commonly used blood tests include troponin and less often creatine kinase MB used to diagnosis MI (5).Troponin is three regulatory proteins complex (troponin C, troponin I, and troponin T) which is integral to muscle contraction in cardiac muscle and skeletal muscle, but not smooth muscle. Discussions of troponin are often related to its functional properties

and/or to its benefit as a diagnostic marker or therapeutic target for many heart disorders in particular as a highly specific marker for myocardial infarction or heart muscle cell death (13).

METHDOLOGY

For sample collection, this study was achieved by collecting 210 blood samples. The samples included 90 patients (48 male and 42 female) with diagnosed AMI and 120 cases (65 male and 55 female) as control. The patient's group included 90 patients (48 male and 42 female) who were diagnosed with acute myocardial infarction, while the control group included one hundred and twenty healthy cases (65 male and 55 female). For the inclusion criteria, the AMI patients were diagnosis by the physicians of the center. On the other hand, the exclusion criteria included patients with renal, liver failure, congestive heart disease and patients who treat with vitamins B6 and B12.

STATISTIC ANALYSIS

Statistical analysis was performed by using (SPSS) version 20 and all data presented as mean ± SD used ANOVA and T-test. ($P< 0.05$) was considered to be significant statically.

RESULTS AND DISSCASION

Biochemical characteristics.

Table 1: Biochemical characteristics of the study subject, Homocysteine, s-adenosylhomocysteine, troponin, B6 and B12 between patients and controls of G1.

Parameter	Gender	Control		Patient		L.S.D	P. value
		Mean + SD	N	Mean +SD	N		
Age	Male	52.53 ± 9.7[a]	65	55.20 ± 13.1[a]	48	12.3	0.63
	female	55.51 ± 8.6 [a]	55	56.42 ± 6.78 [a]	42	9.52	0.25
Homocysteine µg/dl	Male	1.62 ±1.1[a]	65	1.63 ± 0.51[b]	48	0.17	0.000
	Female	1.04 ± 1.0[a]	55	1.57 ±0.4[b]	42	0.21	0.000
SAH ng/dl	Male	1.32± 0.52[b]	65	19.60 ± 7.0[a]	48	9.20	0.000
	Female	1.40± 0.32[b]	55	9.87 ± 4.38[a]	42	4.29	0.000
Troponin µg/dl	Male	0.20 ± 0.08[a]	65	9.72 ± 4.87[b]	48	0.43	0.000
	Female	0.18 ± 0.06[a]	55	14.54 ±8.21[b]	42	2.49	0.000
Vit. B_6 ng/dl	Male	12.66 ± 1.89[a]	65	4.94± 2.30[b]	48	0.80	0.000
	Female	8.71 ± 1.71[a]	55	4.31± 1.67[b]	42	01.21	0.000
Vit.B_{12} ng/dl	Male	138.3 ± 39.5 [a]	65	94.7 ± 104.0[b]	48	25.9	0.000

	Female	135.6 ± 65.6[a]	55	109.9 ± 73.5[b]	42	21.3	0.000

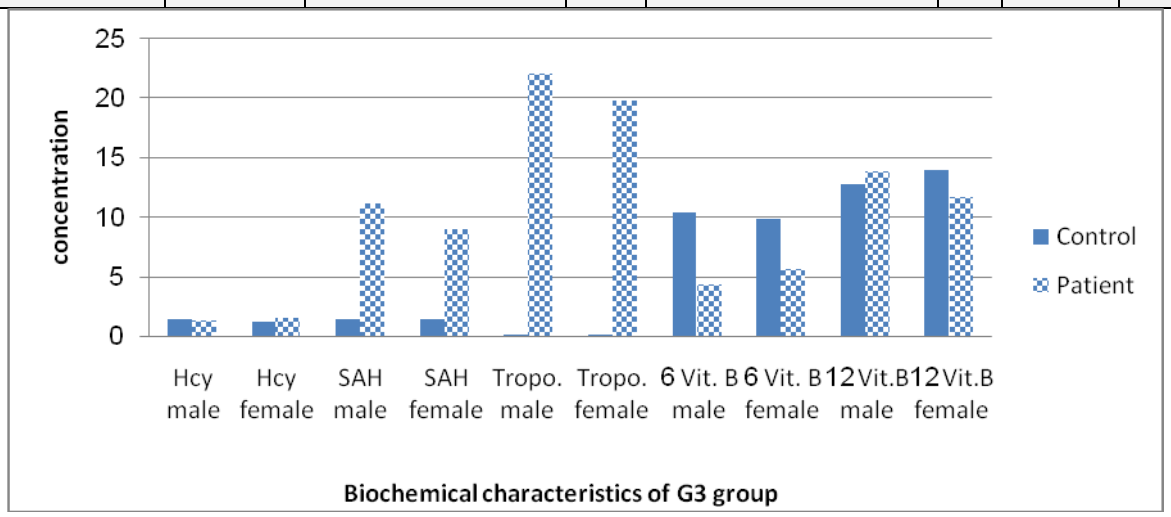

Figure (1): Biochemical characteristics of study subject, Homocysteine, adenosylhomocysteine, troponin, B_6 and B_{12} between patients and controls at patients.

Ages Distribution which is presented in (table 1), shows no significant differences in the age of the patients when compared with those of the control group (P <0.005).

Homocysteine

The results of our study which was presented in table 1 show a significant increase (P< 0.05) in homocysteine levels of MI male and female patients. We suggest this elevation in homocysteine level may be due to the decreasing level of vitamin B6 that inhibit cystathionine beta-synthase enzyme and retarding homocysteine from converting to cystathionine and then to the cysteine and excretion in urine. Hao L et al 2007, A Bayır K et al 2011 and Yan M et al 2017, reported that the elevation in homocysteine level is may be due to the reduction of folic acid and vitamin B12 are two vital regulators in Hcy metabolic process [1,2,3]. Other researchers reported that the elevation in homocysteine levels is may be due to serum vitamin A is a causal factor for homocysteine elevation in acute myocardial infarction [4, 5]. In other studies; MujibulHaq AM1et al 2011, suggested that the elevation of homocysteine may be due to an increase in lipoprotein (Lp a) in a patient with AMI [6].

S-adenosylhomocysteine

Our data in the table (1) have also shown that a significant increase (P< 0.05) in s-adenosylhomocystine levels of MI male and female patients as compared with control. We suggest this elevation in s-adenosylhomocystine level is may be due to the increasing level of homocysteine that which in equilibrium with adenosylhomocystine (the more stable form) or may due to converting methionine (that come from diet or from homocysteine feedback by the activity of vitamin B12) into adenosylhomocystine. Yunjun Xiao et al 2013 reported that the elevation of s-adenosylhomocystinemay be due to decrease the concentration of serum folate [7] and in another study; reported that elevation of s-adenosylhomocystine may due to low dietary choline lowers methionine formation and causes a marked increase in S-adenosylmethionine utilization in the liver [8].

Troponin

As in the previous two sections, the troponin level in our study, which was presented in (table 1) shows a significant increase (P< 0.05) of MI male and female patients in comparison with control groups. We suggest this elevation in troponin level may due to necrosis of the cardiac cell which prevents troponin from attaching tropomyosin and does not lie within the groove between actin filaments in muscle tissue, so it releases in the bloodstream. Antman et al 1996 and

M Lickaet al 2002, suggested that the elevation in troponin levels in AMI patients may be due to the damaged area in the heart muscle [9, 10].

Vitamin B_6

The results of our study which was presented in table 1 clearly shown a significant decrease (P< 0.05) in vitamin B6 levels of MI male and female patients. We suggest this decreasing in vitamin B6 level is may be due to bad feeding with vitamin B6 poor meals to avoid clinical disease such as diabetic Mellitus, hypertension, obesity and others or may due to inflammation that lead for decreasing number of vitamin B6 receptor or treated with some type of medications that cause of pyridoxine deficiency. Ulvik A. et al 2016, reported that the decreasing in vitamin B6 level is may be due to inflammation that causes decreases plasma pyridoxal 5'-phosphate (PLP) [11] or the decreasing in vitamin B6 level may due to intake anti-tuberculosis drug and levodopa medication have been reported to produce of pyridoxine deficiency [12].

Vitamin B_{12}

The results of our study which were presented in table 1 show a significant decrease (P< 0.05) in vitamin B12 levels of MI male and female patients. The results of our study were agreeing with Ma. Y. et al 2017and Xiao Y. et al 2013[3, 7]

2: Biochemical characteristics of the study subject, comparison of FBS, lipid profile and BMI between control group and patient.

Table (2): Biochemical characteristics of the study subject, comparison of FBS, lipid profile and BMI between control group and patient.

Parameter	Gender	Control		Patient		L.S.D	P. value
		Mean + SD	N	Mean +SD	N		
Fasting blood sugar (mg/dl)	**Male**	78.2 ± 6.5[b]	65	152.1 ± 34.2[a]	48	12.1	0.021
	Female	75.5 ± 4.2[a]	55	133 ± 38.4[a]	42	16.5	0.006
Total cholesterol (mg/dl)	**Male**	165.2 ± 45.5[b]	65	207.2 ± 62.2[a]	48	22.6	0.000
	Female	168.3 ± 40.8[b]	55	234.5 ± 53.4[a]	42	30.6	0.000
Triglyceride mg/dl	**Male**	98.6 ± 15.4[b]	65	216.5 ± 59.9[a]	48	35.4	0.000
	Female	90.5 ± 13.6[a]	55	223.4 ± 60.6[a]	42	29.8	0.000
HDL-Cholesterol mg/dl	**Male**	47.1 ± 6.6b	65	64.2 ± 17.13[a]	48	5.3	0.000
	Female	52.1 ± 5.62[a]	55	60.8 ± 20.4[b]	42	7.8	0.000
VLDL-Cholesterolmg/dl	**Male**	36.5 ± 5.4[b]	65	42.9 ±16.87[a]	48	5.62	0.000
	Female	35.2 ± 3.5[a]	55	45.3 ± 19.2[a]	42	6.44	0.015

LDL-Cholesterolmg/dl	**Male**	72.1 ± 6.5[b]	65	84.6 ± 27.6[a]	48	8.6	0.000
	Female	69.4 ±7.8[a]	55	92.3 ± 25.7[a]	42	12.8	0.000
BMI kg/m2	**Male**	28.3 ± 2.5[b]	65	32.3 ± 7.8[a]	48	2.6	0.000
	Female	25.2 ± 7.7[b]	55	35.2 ± 6.9[a]	42	4.4	0.000

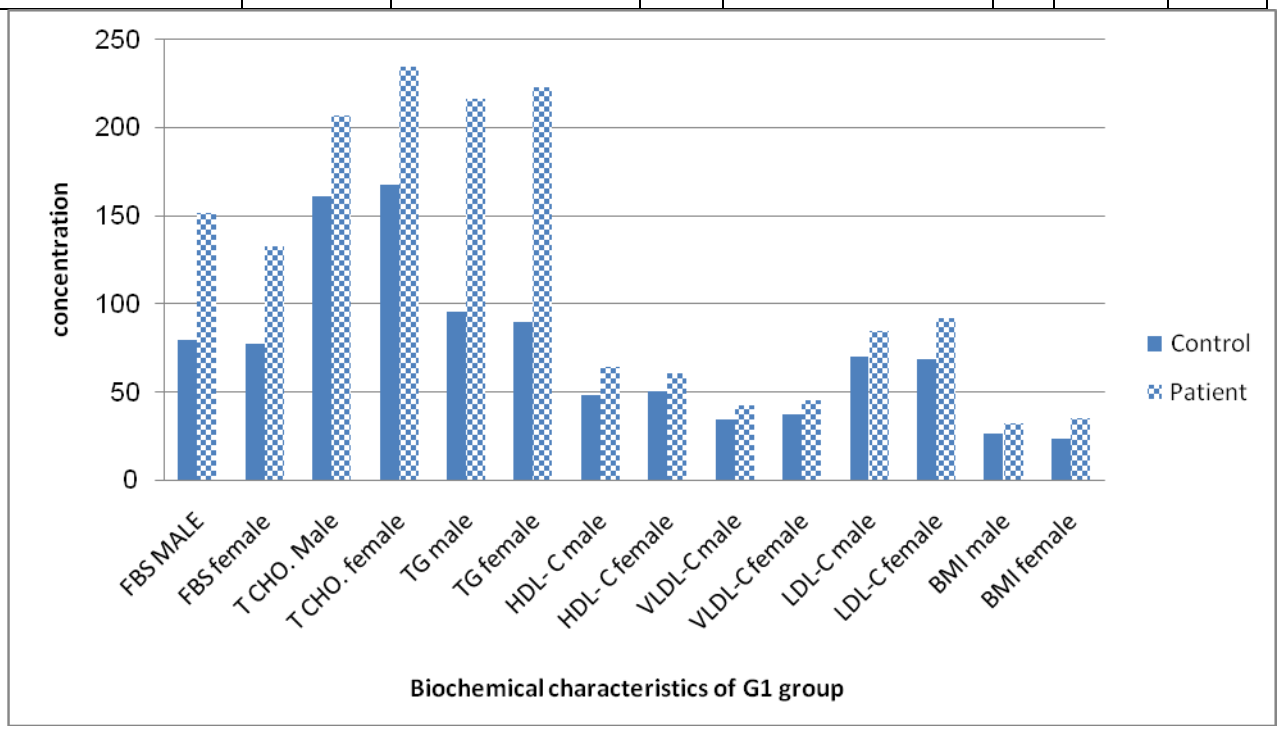

Figure (2): Biochemical characteristics of the study subject, comparison of FBS, lipid profile and BMI between control group and patient.

Fasting blood sugar

The results of our study which were presented in table 2 show a significant increase (P< 0.05) in fasting blood sugar levels of MI male and female patients. The results of our study agree with the results of Yan M *et al* 2017, Adam M. Zawada*et al* 2014[3, 13].

Total cholesterol

The results of our study which were presented in table 2 show also a significant increase (P< 0.05) in total cholesterol levels of MI male and female patients. The agreement with the results of our study is with the results of Yan M et al 2017, Adam M. Zawada et al 2014 and Xiao Y. et al 2013 [3,13,7].

Fasting triglyceride

As in the previous two sections, the fasting triglyceride level in our study, which was presented in (table 2) shows a significant increase (P< 0.05) of MI male and female patients. The results of our study are in agreement with the results of Yan M et al 2017, Adam M. Zawadaet al 2014 and Xiao Y. et al 2013 [3,13,7].

HDL-Cholesterol

The results of our study which were presented in table 2 clearly shown a significant increase (P< 0.05) in HDL-Cholesterol levels of MI male and female patients. The results of our study are in agreement with the results of Yan M et al 2017, Adam M. Zawadaet al 2014 and John H. Page et al 2009 [3, 7,13].

VLDL-Cholesterol

The results of our study which were presented in table 2 clearly shown a significant increase (P< 0.05) in VLDL-Cholesterol levels of MI male and female patients

LDL-Cholesterol

The results of our study which were presented in table 2 clearly shown a significant increase (P< 0.05) in LDL-Cholesterol levels of MI male and female patients. The results of our study are lining with the results of Yan M *et al* 2017, and Adam M. Zawada*et al* 2014 [3,13].

Body mass index

The results of our study which were presented in table 2 show also a significant increase (P< 0.05) in the Body mass index for MI male and female patients.

3: Biochemical characteristics of ST- segmented elevation (STEMI) and NST- non segmented elevation (NSTEMI) for MI patients

Table 3: Biochemical characteristics of the study subject, comparison between ST- segmented elevation (STEMI), NST-nonsegmented elevation (NSTEMI) patients and control group.

Parameter	Type Of MI	Control		Patient		L.S.D	P. value
		Mean + SD	No.	Mean + SD	No.		
Homocysteine µg/dl	**ST-MI**	1.38 ± 1.05^{b}	120	1.63 ± 0.84^{a}	53	0.21	0.003
	NST-MI	1.38 ± 1.05^{b}	120	1.57 ± 0.73^{a}	37	0.35	0.000
S-adenosyl-homocysteineng/ dl	**ST-MI**	1.28± 0.42^{b}	120	19.64 ±7.4^{a}	53	3.95	0.000
	NST-MI	1.28± 0.42^{b}	120	9.87 ± 5.1^{a}	37	0.74	0.000
Troponin µg/dl	**ST-MI**	0.19 ± 0.00^{b}	120	9.75 ± 5.6^{a}	53	0.90	0.000
	NST-MI	0.19 ± 0.00^{b}	120	14.11 ± 4.3^{a}	37	4.76	0.000
Vit. B_6 ng/dl	**ST-MI**	13.05 ± 1.9^{a}	120	4.81 ± 0.93^{b}	53	1.39	0.000
	NST-MI	13.05 ± 1.9^{a}	120	4.62 ± 1.62^{b}	37	1.82	0.000
Vit.B_{12} ng/dl	**ST-MI**	135.85 ± 50.3^{b}	120	88.2 ± 91.8^{a}	53	22.1	0.000
	NST-MI	135.85 ± 50.3^{b}	120	91.4 ± 95.1^{a}	37	27.3	0.000
Fasting blood sugar (mg/dl)	**ST-MI**	78.3 ± 4.3^{a}	120	150.4 ± 22.4^{a}	53	12.1	0.000
	NST-MI	78.3 ± 4.3^{a}	120	142.5 ± 47.3^{a}	37	16.5	0.000
Total cholesterol (mg/dl)	**ST-MI**	168.2 ± 43.7^{b}	120	206.2 ± 67.2^{a}	53	28.6	0.000
	NST-MI	168.2 ± 43.7^{b}	120	199.5 ± 89.4^{a}	37	30.6	0.016

Triglyceride mg/dl	**ST-MI**	95.5 ± 12.4[b]	120	197.6 ± 70.6[a]	53	35.4	0.000
	NST-MI	95.5 ± 12.4[b]	120	189.1 ± 67.4[a]	37	29.8	0.000
HDL-Cholesterol mg/dl	**ST-MI**	48.4 ± 5.5[b]	120	57.8 ± 21.1[a]	53	5.3	0.000
	NST-MI	48.4 ± 5.5[b]	120	62.3 ± 18.5[b]	37	7.7	0.000
VLDL-Cholesterolmg/dl	**ST-MI**	38.2 ± 5.1[b]	120	45.2 ±19.6[a]	53	5.62	0.000
	NST-MI	38.2 ± 5.1[b]	120	45.2 ±19.6[a]	37	6.44	0.000
LDL-Cholesterolmg/dl	**ST-MI**	70.1 ± 7.5[b]	120	88.6 ± 27.6[a]	53	22.1	0.000
	NST-MI	70.1 ± 7.5[a]	120	92.3 ± 25.7[a]	37	24.3	0.000

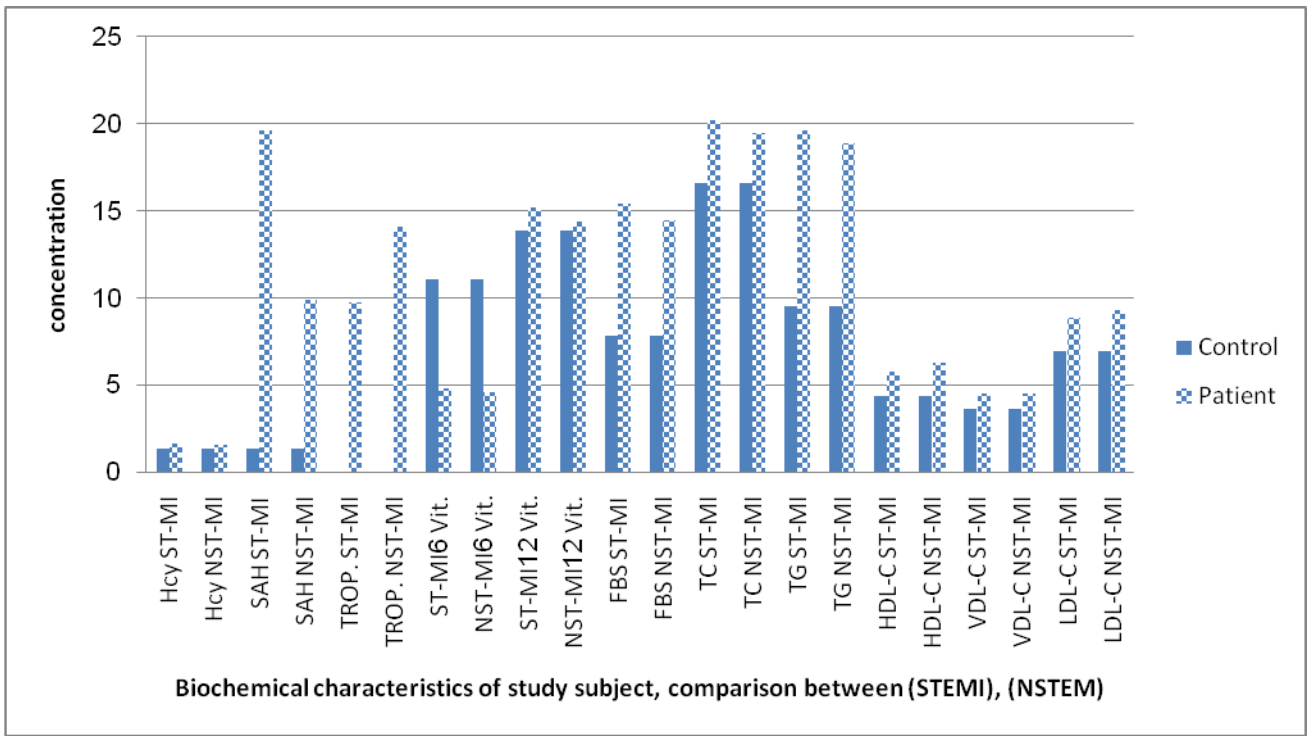

Figure (3): Biochemical characteristics of the study subject, comparison between ST- segmented elevation (STEMI), NST- nonsegmented elevation (NSTEMI) patients and control group.

Homocysteine

The results of our study which were presented in the table3 show a significant increase (P< 0.05) in the Homocysteine levels of the STEMI patients and for the NSTEMI. We suggest that this elevation in homocysteine level may be due to the decreasing level of vitamin B6 that inhibit cystathionine beta-synthase enzyme and retarding homocysteine from converting to cystathionine and then to the cysteine and excretion in urine.

S-adenosylhomocysteine

The results of our study which were presented in table 3 show also a significant increase (P< 0.05) in s-adenosylhomocysteine levels of the STEMI patients and for the NSTEMI. We suggest that this elevation in s-

adenosylhomocysteine level is may be due to the increasing level of homocysteine that which in equilibrium with adenosylhomocysteine (the more stable form) or may due to converting methionine (that come from diet or from homocysteine feedback by the activity of vitamin B12) into adenosylhomocysteine.

Troponin

The results of the troponin levels in our study, which were presented in (table 3) show a significant increase (P< 0.05) of the STEMI patients and for the NSTEMI. We suggest that this elevation in troponin level may due to necrosis of the cardiac cell which prevents troponin from attaching tropomyosin and does not lie within the groove between actin filaments in muscle tissue, so it releases in the bloodstream.

Vitamin B_6

The results of our study which were presented in table 3 clearly shown a significant decrease (P< 0.05) in vitamin B6 levels of the STEMI patients and for the NSTEMI. We suggest this decreasing in vitamin B6 level is may be due to bad feeding with vitamin B6 poor meals to avoid clinical disease such as diabetic Mellitus, hypertension, obesity and others or may due to inflammation that lead for decreasing number of vitamin B6 receptor or treated with some types of medications that cause of pyridoxine deficiency.

Vitamin B_{12}

The results of our study which were presented in table 3 show a significant decrease (P< 0.05) in vitamin B12 levels of the STEMI patients and a significant decrease for the NSTEMI.

Fasting blood sugar

The results of our study which were presented in table 3 show a significant increase (P< 0.05) in fasting blood sugar levels of the STEMI patients and for the NSTEMI.

Total cholesterol

The results of our study which were presented in the table 3 show also a significant increase (P< 0.05) in total cholesterol levels of the STEMI patients and for the NSTEMI.

Fasting triglyceride

As in the previous two sections, the fasting triglyceride level in our study, which was presented in (table 3) shows a significant increase (P< 0.05) of the STEMI patients and the NSTEMI.

HDL-Cholesterol

The results of our study which were presented in table 3 clearly shown a significant increase (P< 0.05) in HDL-Cholesterol levels of the STEMI patients and for the NSTEMI.

VLDL-Cholesterol

The results of our study which were presented in Table 3 showed a significant increase (P< 0.05) in VLDL-Cholesterol levels of the STEMI patients and for the NSTEMI.

LDL-Cholesterol

The results of our study which were presented in the table 3 that showed a significant increase (P< 0.05) in LDL-Cholesterol levels of the STEMI patients and for the NSTEMI.

4. Correlation between the severity of MI disease and the studied parameters

From the results of our study, listed in the table (1) which showed that s-adenosylhomocysteine is a good protein marker for MI detection, we can measure the severity of the AMI is proportion to the SAH levels. The correlation was made between s-adenosylhomocysteine and the studied parameters by SPSS (P< 0.05) as a significant correlation.

Correlation between S-adenosylhomocysteine and vitamin B_6

Our data in this study showed that a significant negative correlation between S-adenosylhomocysteine and vitamin B_6 levels, (r= -0.61) and (P <0.05), as shown in the figure (4) and table (1).

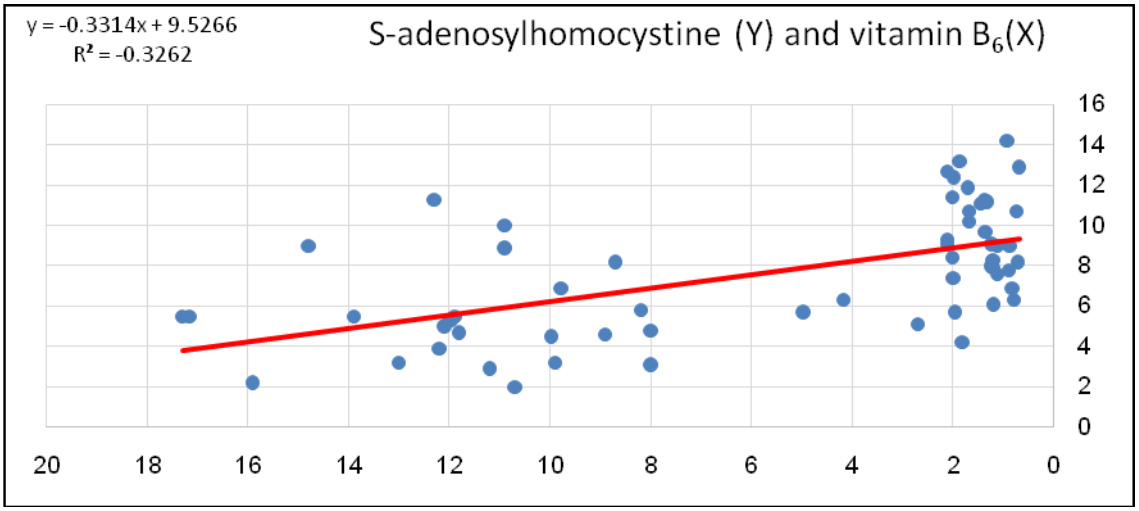

Figure 4: Diagram of Correlation between S-adenosylhomocysteine and vitamin B_6.

Correlation between S-adenosylhomocysteine and vitamin B_{12}

Our study showed that a significant negative correlation between S-adenosylhomocystine and vitamin B_{12} levels, (r= -0.36) and (P <0.05), as shown in figure (5) and table (1).

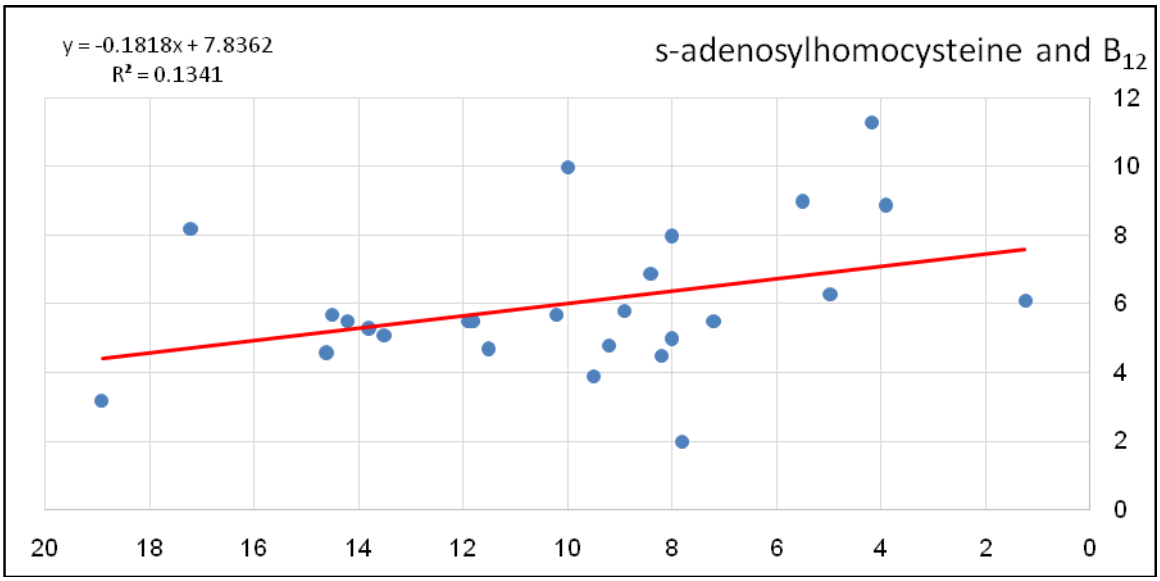

Figure 5: Diagram of Correlation between S-adenosylhomocysteine and vitamin B_{12}.

We suggest that this negative relationship between s-adenosylhomocysteine and vitamin B6 and B12, is maybe due to a bad feeding with vitamin B6 and B12, due to inflammation which leads to decrease the number of vitamin B6 and B12 receptors or due to treated with some type of medications that cause of vitamin B6 deficiency such as tuberculosis and levodopa antibiotic group. The decrease in vitamin B6 levels leads to increase homocysteine levels because vitamin B6 is cofactor to the enzyme cystathionine beta-synthase which converts homocysteine into cystathionine.

Correlation between S-adenosylhomocysteine and homocysteine

The results of our study that listed in the table (1), showed that a significant positive correlation between S-adenosylhomocysteine and homocysteine levels, (r= 0.10) and (P <0.000), as shown in the figure (6).

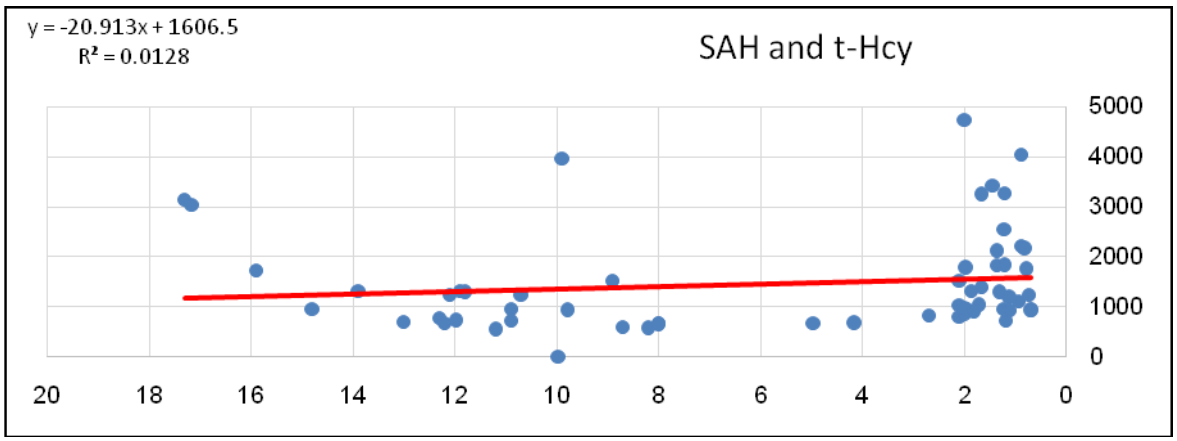

Figure 6: Diagram of Correlation between S-adenosylhomocysteine and t-Hcy.

We suggest that the parallel relationship between s-adenosylhomocystine and homocysteine is due to the equilibrium reaction between them. The result of our study that correlated in agreement with Adem M. Zawada et al 2014 [13].

Discussion

Myocardial infarction is better diagnosed by S-adenosylhomocysteine than homocysteine and troponin during all time of the heart attack, there is strong correlation between s-adenosylhomocystine levels with homocysteine, vitamin B6, fasting blood sugar, fasting cholesterol, fasting tri-glyceride, high-density lipoprotein, low-density lipoprotein, very low-density lipoprotein levels, cigarette smoking, and body mass index.

Vitamin B6 has been played an important role in the accumulation of s-adenosylhomocystine more than vitamin B12. Also elevation of troponin levels associated more with NSTEMI patients compared to STEMI patients.

Reference

1. Hao, L., Ma, J., Zhu, J., Stampfer, M. J., Tian, Y., Willett, W. C., & Li, Z. (2007). High Prevalence of Hyperhomocysteinemia in Chinese Adults Is Associated with Low Folate, Vitamin B-12, and Vitamin B-6 Status. The Journal of Nutrition, 137(2), 407–413.
2. Bayır, A., Karabulut, K. U., &Ak, A. (2011). Levels of serum B12, folic acid and homocysteine in thromboembolic diseases on admission to the Emergency Department. Critical Care, 15(Suppl 1), P14.
3. Yan M Peng, D., Liu, C., Huang, C., & Luo, J. (2017). Serum high concentrations of homocysteine and low levels of folic acid and vitamin B12 are significantly correlated with the categories of coronary artery diseases. BMC Cardiovascular Disorders, 17(1)
4. Paolo E Puddu August 28, 2018. Serum vitamin A, total homocysteine and acute myocardial infarction: is there a causal association? European Journal of Preventive Cardiology. org/10.1177/2047487318796581.
5. Thomas Olsen. , Vinknes, K. J., Svingen GFT, et al (2018). The risk association of plasma total homocysteine with acute myocardial infarction is modified by serum vitamin A. European Journal of Preventive Cardiology, 25:1612-1620.

6. MujibulHaq AM1, M Giasuddin AS, Huque MM. J Coll Physicians Surg Pak. 2011 May; 21(5):266-70. doi: 05.2011/JCPSP.266270.
7. Xiao, Y., Zhang, Y., Wang, M., Li, X., Xia, M., & Ling, W. (2013). Dietary protein and plasma total homocysteine, cysteine concentrations in coronary angiographic subjects. Nutrition Journal, 12(1). 144-154.
8. Rima obeid (2013). The Metabolic Burden of Methyl Donor Deficiency with Focus on the BetaineHomocysteineMethyltransferase Pathway. Nutrients, 5(9), 3481–3495.
9. Antman, E. M., Tanasijevic, M. J., Thompson, B., et al (1996). Cardiac-Specific Troponin I Levels to Predict the Risk of Mortality in Patients with Acute Coronary Syndromes. New England Journal of Medicine, 335(18), 1342–1349 .
10. Licka, M. (2002). Troponin T concentrations 72 hours after myocardial infarction as a serological estimate of infarct size. Heart, 87(6), 520–524.
11. Ulvik, A., Pedersen, E. R., Svingen, G. F., McCann, A., Midttun, Ø.Nygård, O., &Ueland, P. M. (2016). Vitamin B-6 catabolism and long-term mortality risk in patients with coronary artery disease. The American Journal of Clinical Nutrition, 103(6), 1417–1425.
12. Martin A crook. 2013, edition 7,chapter 17 (water soluble vitamins) , page 224
13. Zawada, A. M., Rogacev, K. S., Hummel, B., et al (2014). S-adenosylhomocysteine is associated with subclinical atherosclerosis and renal function in a cardiovascular low-risk population. Atherosclerosis, 234(1), 17–22.