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Raef Elamin. S. Elamin,
Mutaz I. Hassan,
Abedwahab Abdein,
Mosab.O. Khalid,
Mansour.M,
Limia. N. M,
Limia. N. M .Ali
Department of clinical chemistry-Faculty of Medical Laboratory Sciences- Shendi University-Sudan

Mutwakil. E. Awadelkareem,
Department of Medicine-Faculty of Medicine- Shendi University University-Sudan

Rashid Eltayeb,
Haghamad Allzain
Department of Biochemistry-Faculty of Medicine- Shendi University-Sudan

Mohammed. A. Syid
Lab director - Almashafi polyclinic - Alhafouf – KSA

Zeinab .Ali .M. Ahmed
Department of histopathology-Faculty of Medical Laboratory Sciences- Shendi University-Sudan

Elnagar. M. H. Salih
Ex- Lecturer. Community Department- Faculty of nursing sciences. Shendi University University-Sudan

Mohamed. E. Mostafa,
Sidhi Lekshmi J
Amass polyclinic- Ararr- KSA.

Correspondence:
Haghamad Allzain,
Department of Biochemistry-Faculty of Medicine- Shendi University-Sudan

Assessment of serum homocysteine, folic acid and lipid profile levels among acute coronary syndrome and cerebrovascular accident patients in River Nile State-Sudan

Raef Elamin. S. Elamin, Haghamad Allzain, Mutwakil. E.A. Elkareem, Mutaz I. Hassan, Abedwahab Abdein, Mosab.O. Khalid, Nasar Elsirr, Mansour.M, Limia. N. M, Ali, Mohammed.A Said, Zeinab.Ali.M.Ahmed,Elnagar. M. H. Salih, Mohamed. E. Mustafa, Sidhi Lekshmi J, Rashid Eltayeb

Abstract
Background: Homocysteine (Hcy) is a detrimental intermediate amino acid of cellular metabolism in the human body. An increased level of Hcy in the blood is an indicator of a high risk of acute coronary syndrome (ACS) and stroke, hyperhomocysteinemia associated with folic acid deficiency which may due to genetic background, the interaction of diet and other factors, which in turn leads to a high incidence of acute coronary syndrome and CVA by promoting atherosclerosis and endothelial cell injury.

Objective: This study investigated the levels of Hcy, folic acid and lipid profile levels among ACS and CVA patients on River Nile state – Sudan.

Research Design and Methods: Case control study performed in River Nile State. The patients were admitted for follow up in the hospital. (132 samples/patients) were patients with ACS or CVA and (50) were healthy volunteers included during this study, then Hcy, folic acid and lipid profile levels were measured.
Results: This recently established present study included (132) patients previously diagnosed with ACS or CVA as case study group, and (50) apparently healthy individuals as control group. (62.1 %) from case study group were males while (37.9 %) were females, the age of case study group was ranged from (30– 80 years).
This study revealed that there was significantly high Hcy level among ACS and CVA patients with (P. 0.000), also there was significant low level of folic acid with (P. 0.000) while regarding lipid profile there was significant high level of cholesterol (P. 0.005), triglyceride (P. 0.010) with low HDL (P. 0.000) and insignificant LDL (P. 0.400).
Concerning the effect of gender on the studied parameters, this study demonstrated that there was significant increase on homocysteine level in males compared with females (P. 0.000). A significant decreased folic acid levels in males compared with females (P.value 0.02) with insignificant lipid profile levels between both (P. > 0.050). Also this undertaken study adopted a significant increase in homocysteine level (P. 0.000) and a decreased folic acid level (P. 0.020) among adult age group compared with old age group, with insignificant lipid profile between them (P. > 0.05). Regarding the effect of BMI this study prevailed a significantly increased Hcy (P. 0.002). and lipid profile levels (P. < 0.050) among overweight group compared with normal weight group with insignificant folic acid level between them.
Conclusions: Increased Hcy, cholesterol and triglyceride levels with decreased folic acid and HDL and insignificant variation on LDL level among ACS and CVA patients, also Hcy increased and folic acid decreased among adult age group and with whom with (25 -30) BMI, also increased lipid profile among overweight patients while was not affected by age.

Keywords: Homocysteine, folic acid, stroke, ACS, HDL, Cholesterol, LDL, Triglyceride.

Introduction

Acute coronary syndrome (ACS) is a syndrome of decreased blood flow in the coronary arteries such that part of the heart muscle is unable to function properly or dies (Amsterdam, E. A, *et al*. 2014). The most common symptom is chest pain, often radiating to the left shoulder (Gooacre S, et al. 2009). or angle of the jaw, crushing, central and associated with nausea and sweating. Many people with ACS present with symptoms other than chest pain, particularly, women, older patients, and patients with diabetes mellitus (Canto J. G., et al.2000), on the other hand in 2013, the American Health Association (AHA), and American CVA Association (ASA) published an expert consensus document with a new definition of stroke to reflect these advances the major fundamental change compared with older definitions is that the new broader definition of stroke includes any objective evidence of permanent brain, spinal cord or retinal cell death due to a vascular cause based upon pathological or imaging evidence with or without the presence of clinical symptoms **(**Sacco R. L., et al.2013).

ACS is the leading cause of premature morbidity and mortality worldwide for both men and women (Williams G. R,et al 1999;R. Clarke, et al 2002) Over the past few decades, many studies have shown a strong correlation between hyperhomocysteinemia and vascular disease (Vollset S. E., et al.2001; Wang X. B., et al.2007), and identified elevated homocysteine (Hcy) levels as a risk factor for coronary artery disease, stroke, and deep vein thrombosis. Therefore, it has been suggested that raised concentrations of Hcy in the blood should be lowered as a therapeutic approach to prevent cardiovascular disease (CVD) (Toole J. F., et al.2004; McNulty H., et al 2008) However, reduction of the concentrations of Hcy in the blood has not consistently been shown to be beneficial (Baker F, et al 2002; Armitage J. etal.2010)**.** Currently, folic acid and B vitamins are used for achieving target Hcy levels, and are clearly effective at reducing concentrations of plasma Hcy. However, their effects on vascular events remain unclear (Bradley A. M., Loscalzo J.2009). Additionally, several large-scale randomized controlled trials have shown that reducing the extent of homocysteinemia with folic acid does not improve cardiovascular outcomes. When combined with B vitamins, folic acid may actually accelerate the risk of CVD, and this has further restricted its application in clinical prevention (Carlsson C. M.2007).

Rational

Acute coronary syndrome (ACS) is one of the most frequent reasons for hospitalization worldwide accounting for (1.4 million) hospitalize patients each year and also according to World Health Organization (WHO) (15 million) people suffer from CVA worldwide each year of these (5 million) die and (5 million) are permanently disabled.

Several factors have been considered as possibly related to a high mortality rate, namely, the onset of ACS and stroke and association with a higher number of cardiovascular risk factors and higher co-morbidity longer delay prior to receiving healthcare and lesser efforts both in terms of diagnosis and therapy received, most published studies especially in Africa concern about classical risk factors for ACS and CVA like hypertension, dyslipidemia but in our study we will focus on homocysteine level because hyperhomocysteinemia lead to endothelial cell damage, reduction in flexibility of vessels, alter the process of hemostasis and enhance atherosclerosis which promote ACS and CVA while good status of folic acid level can lower the Hcy because its act as coenzyme to convert it to methionine, for that reason we measure it in association with lipid profile on patients mentioned above.

This study was conducted on Sudanese patients with ACS and CVA whom live in River Nile State to establish the relationship between Hcy, folic acid and lipid profile levels with diseases mentioned above. There is very limited literature about the same topic, particularly in River Nile State. This study will help in bridging between the future research and potential preventive and therapeutic interventions against such diseases.

Objectives

The main objective of the current study was to assess the level of serum homocysteine, folic acid and lipid profile among Sudanese patients with acute coronary syndrome and CVA, while the specific objectives were:

1. To study the relation between studied parameters and gender among case group.
2. To find out an association between studied parameters and different patients age groups.
3. To measure the effect of body mass index on Serum Hcy, folic acid and lipid profile levels.
4. To measure Hcy, folic acid and lipid profile levels among different classes of ACS and CVA.
5. To correlate between folic acid & Hcy among ACS and CVA patients.
6. To correlate between folic acid & Hcy according to gender.
7. To correlate between lipid profile & Hcy among ACS and CVA patients.

Subjects and Methods

- The study was conducted in River Nile State (Shendi, Atbara and Eldamar towns) which located (195) km, (333) km and (319) km respectively from capital of Sudan Khartoum.
- Samples were collected from different sites in River Nile State; from cardiac centeron El–mek Nimir University Hospital in Shendil, Atbara Medical Insurance Complex in Atbara, from Eldamar Teaching Hospital, and Quality lab in Eldamar.

Study design

- Prospective, case control hospital and laboratory – based study done on blood samples from patient's ACS or CVA in River Nile State.

Study population & Sample size

- One hundred and eighty two (182) random samples were collected from different centers in River Nile State from different centers as mention above; (132) samples from patients with ACS or CVA, and (50) samples from healthy individuals as control group. All patients had an ACS or CVA confirmed by ECG and cardiac enzymes for ACS and CT scan or/and MRI for CVA patients.

Study duration

- The study had been done in the period from December 2015 to December 2019.

Inclusion criteria

- Case group: Sudanese peoples with ACS or stroke.
- Control group: Sudanese healthy volunteers**.**
- All pateints with (ACS) were confirmed diagnosis by clinical symptoms, (ECG) and cardiac enzymes while (CVA) patients confirmed by clinical symptoms with (CT) scan and/or (MRI).

Exclusion criteria

- For case group any patient with ACS or stroke combined with other disease which had effect on parameters under study for example (Renal disease, liver disease, anemia, DM, pregnancy), and patient had given multivitamin drugs, drugs can affect the level of lipids. All the mentioned above were excluded from control group.

Sample collection

- Five (5 ml) of blood were collected by clean venipuncture using sterile disposable syringes, and immediately blood entered a plain (No anticoagulant) container which left to clot and after clot retraction, serum was separated by centrifugation and kept in a deep freezer.

Methodology and test procedure

- Serum Free and esterified cholesterol,cholesterol HDL, cholesterol LDL, triglycerides and Homocysteine were measured by standard methods,employing standard reagent from BioSystem, using BioSystem A15 automated analyzer
- Calibration for each test and control done before the run to ensure that control reading within the accepted value to provide the accuracy for test results.
  Serum folic acid was measured by competitive chemiluminescence immunoassay, using Maglumi 800 analyzer.

Tools of data collection

- The primary data was collected by using questionnaires and laboratory results.

Data analysis and presentation

- All data was analyzed using statistical package for the social sciences (SPSS) version (20). The mean was obtained and independent samples T- test and ANOVA test.All results presented in form of figures and tables. *P* value was obtained to assess the significant of the results. *P*-values <0.05 was considered as statistically significant. Also person correlation done to show the correlation between some parameters and R ratio was reported to decide about the strength of correlation.

Ethical consideration

- The study was approved by research ethics committee of the Faculty of Graduates Studies and Scientific Research in Shendi University in Sudan.
- This research was performed after the consent of all the people involved in it, and was taking into account the trust and strict confidentiality with respect to patients and information about them, and was scheduled, based on reliable information and reliable source. This study was identical for all human rights. During data collection from patients or relatives, verbal consent was obtained, and names and personal data were completely secured and transferred to codes to keep patients' identities private.

Results

This study involved (132) patients with acute coronary syndrome and/or cerebrovascular accident; median age was (55years); ranged from (30– 80 years), (62.1%) male and (37.9%) female, (56.8%) of them with normal BMI while (43.2%) over wight and (50) volunteers as healthy control group

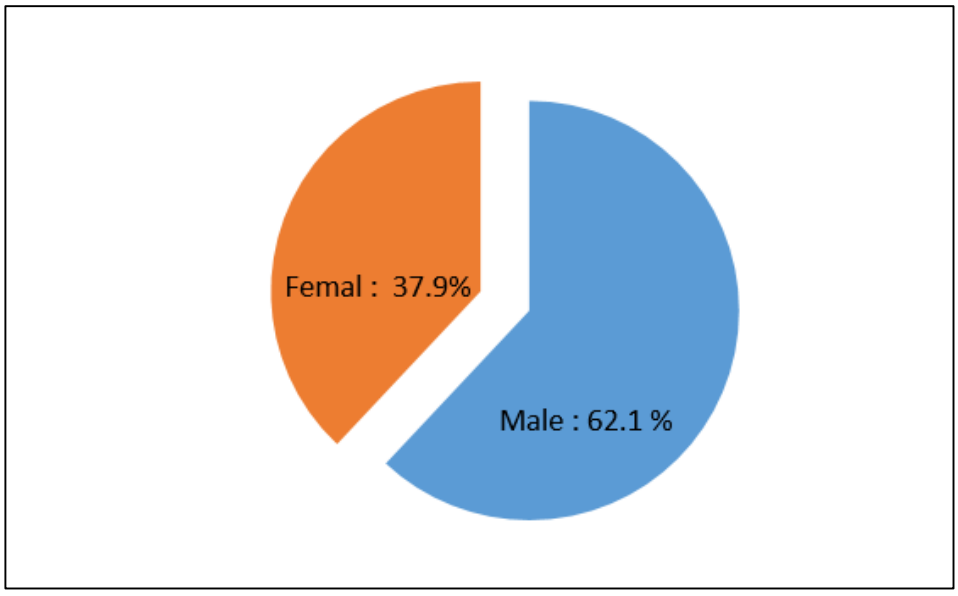

Fig. 1: Gender distribution of patients with acute coronary syndrome and CVA.

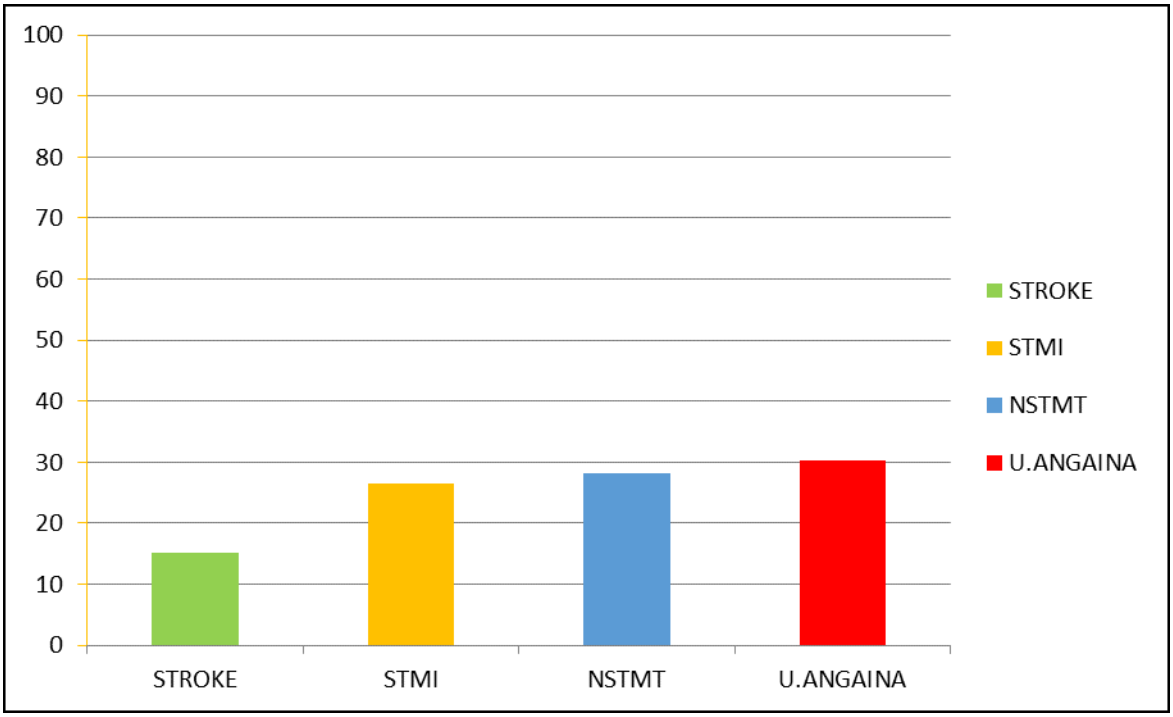

Fig. 2: Distribution types of acute coronary syndrome and CVA.

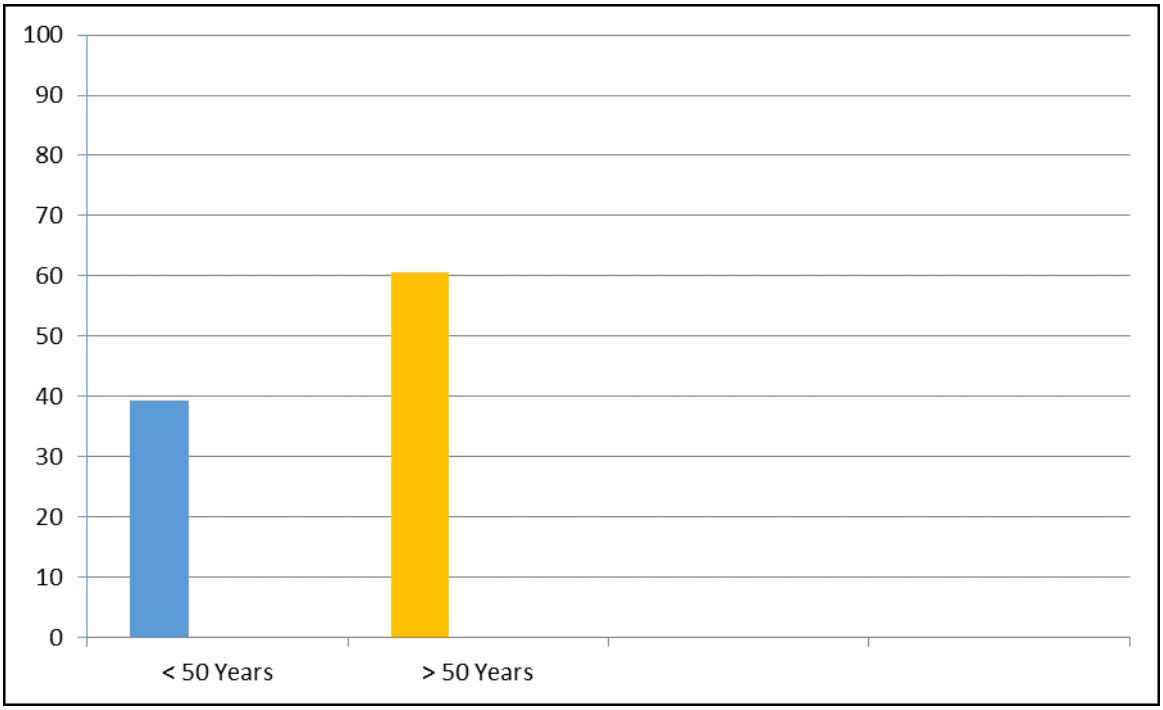

Fig. 3: Frequency of acute coronary syndrome and CVA according to age group.

Table 1: Mean and Std.Deviation of homocysteine (µmol/L) among patients and control group:

	Number	Mean	Std. Deviation	*P*. value
Test	132	24.9	9.9	0.000
Control	50	5.7	2.0	

Table (1): presented that, homocysteine level was significantly increased in the case group compared with control group, (*P*. value 0.000).

Table 2: Mean and Std.Deviation of folic acid (ng/ml) among patients and control group:

	Number	Mean	Std.Deviation	*P*. value
Test	132	1.1	0.88	0.000
Control	50	9.1	4.9	

Table (2): revealed that, folic acid level was significantly decreased in the case group compared with control group, (*P*. value 0.000).

Table 3: Mean and Std.Deviation of serum cholesterol (mg/dl) among patients and control group:

	Number	Mean	Std. Deviation	*P*. value
Test	132	138.0	32.5	0.005
Control	50	124.2	18.0	

Table 3: prevailed that: cholesterol level was significantly increased in the case group compared with control group, (*P*. value 0.005).

Table 4: Mean and Std. Deviation of serum triglyceride (mg/dl) among patients and control group:

	Number	Mean	Std. Deviation	*P*. value
Test	132	140.0	36.8	0.016
Control	50	126.7	20.3	

Table 4: adopted that: triglyceride level was significantly increased in the case group compared with the control group, (*P*. value 0.016).

Table 5: Mean and Std.Deviation of HDL (mg/dl) among patients and control group:

	Number	Mean	Std. Deviation	*P*. value
Test	132	33.1	6.4	0.000
Control	50	40.6	6.1	

Table 5: elucidated that, HDL level was significantly decreased in the case group compared with the control group, (*P*. value 0.000).

Table 6: Mean and Std. Deviation of LDL (mg/dl) among patients and control group:

	Number	Mean	Std. Deviation	*P*. value
Test	132	80.5	22.09	0.430
Control	50	77.9	11.4	

Table 6: denoted that: there was an insignificant differences in LDL level between case and control group, (*P*. value 0.430).

Table 7: Mean of homocysteine, folic acid, cholesterol, triglyceride, HDL and LDL according to gender:

	Number	Homocysteine	Folic acid	cholesterol	Triglyceride	HDL	LDL
Male	81	28.0	1.0	142	144	33.2	82.7
Female	51	20.0	1.3	131.6	133.5	33.07	77.0
***P*. value**		0.000	0.020	0.720	0.100	0.900	0.150

Table 7: showed that, there was significant increase in homocysteine (*P*. value 0.000) and decrease in folic acid (P. value 0.020) levels in males compared with females, but on the other hand there was an insignificant differences in lipid profile levels between them (*P*. value > 0.050).

Table 8: Mean of homocysteine, folic acid, cholesterol, triglyceride, HDL and LDL according to age group:

	Number	Homocysteine	Folic acid	cholesterol	Triglyceride	HDL	LDL
<50 years	52	28.8	0.9	137.9	134.2	32.5	81.4
>50 years	80	22.3	1.3	138.1	143.9	33.5	79.9
***P*. value**		0.000	0.020	0.9	0.100	0.300	0.700

Table 8: identified that, there was a significant increase in homocysteine level (P. value 0.000) with a decreased folic acid level (P. value 0.020) among adult age group compared with old age group while there was an insignificant differences in lipid profile between them (P.value > 0.050).

Table 9: Mean of homocysteine, folic acid, cholesterol, triglyceride, HDL and LDL according to (BMI):

	Number	Homocysteine	Folic acid	cholesterol	Triglyceride	HDL	LDL
< 25	75	22.5	1.1	127.1	135	32.0	72.6
25-30	57	28.0	1.2	152.3	146.8	34.5	90.8
P. value		0.002	0.500	0.000	0.060	0.020	0.000

Table 4,9: indicated that, there was a significant increase in homocysteine (P. value 0.002) and lipid profile levels (P.value < 0.050) except triglyceride (P.value 0.060) among overweight group compared with normal weight group but at the same time there was an insignificant variation in folic acid levels between them (P. value 0.500).

Table 10: Mean of homocysteine, folic acid, cholesterol, triglyceride, HDL and LDL according to types of diseases:

		Number	Homocysteine	Folic acid	cholesterol	Triglyceride	HDL	LDL
STEMI		35	26.5	0.94	119.9	116.8	32.6	69.5
NSTEMI		37	20.5	1.2	136.5	143.6	33.7	82.1
U. angina		40	25.5	0.97	154.6	153.3	33.5	87.9
CVA		20	29.1	1.7	139.3	147.9	32.3	82.0
P.value			0.007	0.004	0.00	0.00	0.8	0.00

Table 10: provided that, there were a significant variation on homocysteine, folic acid, cholesterol, triglyceride and LDL levels (*P*.value > 0.05) with an insignificant HDL level (*P*. value 0.8) according to types of disease.

Table 4.11: Mean of homocysteine, folic acid, cholesterol, triglyceride, HDL and LDL according to duration of diseases:

	Number	Homocysteine	Folic acid	cholesterol	Triglyceride	HDL	LDL
<1 month	51	34.2	0.96	138.8	134.1	34.0	82.5
1 – 6 months	29	23.1	1.4	140.1	142.1	31.6	78.8
> 6 months	52	16.8	1.1	136.1	144.8	33.1	79.4
***P*. value**		0.000	0.040	0.800	0.300	0.280	0.690

Table 11: referred to that, there was a significant variation on homocysteine and folic acid levels (*P*. value < 0.05) with insignificant lipid profile levels (*P*. value > 0.05) according to duration of disease.

Table 12: Relation between homocysteine and folic acid in CVA Patients:

		Homocysteine
Folic acid	Pearson Correlation	-0.372
	Sig. (2-tailed)	0.106

Table 12: depicted that, there was weak negative correlation (R -0.3) between homocysteine and folic acid among CVA patients.

Table 13: Relation between homocysteine and folic acid in different types of acute coronary syndrome Patients:

In case of STEMI		**Homocysteine**
Folic acid	Pearson Correlation	-0.542"
	Sig. (2-tailed)	0.001
In case of NSTEMI		
Folic acid	Pearson Correlation	-0.087-
	Sig. (2-tailed)	0.608
In case of Unstable angina		
Folic acid	Pearson Correlation	0.000
	Sig. (2-tailed)	0.997

Table 13: illustrated that, there was a week negative correlation between homocysteine and folic acid among (STEMI) (R -0.5) and (NSTEMI) (R -0.08) patients but at the same time with no correlation among unstable angina patients (R 0.00).

Table 14: Relation between homocysteine and lipid profile in acute coronary syndrome Patients:

		Homocysteine
Cholesterol	Pearson Correlation	0.146
	Sig. (2-tailed)	0.125
Triglycerides	Pearson Correlation	-0.044-
	Sig. (2-tailed)	0.648
HDL	Pearson Correlation	0.237
	Sig. (2-tailed)	0.012
LDL	Pearson Correlation	0.213
	Sig. (2-tailed)	0.024

Table 14: summarized that, there was a week positive correlation between homocysteine with cholesterol (R 0.1), LDL (R 0.2) and HDL (R 0.2), also a week negative correlation between homocysteine and triglyceride (R -0.04) among (ACS) patients.

Table 15: Relation between homocysteine and lipid profile in CVA Patients:

		Homocysteine
Cholesterol	Pearson Correlation	-0.300
	Sig. (2-tailed)	0.199
Triglycerides	Pearson Correlation	-0.437
	Sig. (2-tailed)	0.054
HDL	Pearson Correlation	-0.281
	Sig. (2-tailed)	0.229
LDL	Pearson Correlation	-0.192
	Sig. (2-tailed)	0.117

Table 15: predicted that, there was a week negative correlation between homocysteine and lipid profile among CVA patients (R range (-0.1--0.4).

Table 16: Relation between homocysteine and folic acid among male patients with acute coronary syndrome and/or CVA:

		Homocysteine
Folic acid	Pearson Correlation	-0.192
	Sig. (2-tailed)	0.084

Table (16): demonstrated that, there was a very week negative correlation between homocysteine and folic acid among male patients (R -0.1).

Table 17: Relation between homocysteine and folic acid in female patients with acute coronary syndrome and/or CVA:

		Homocysteine
Folic acid	Pearson Correlation	-0.090
	Sig. (2-tailed)	0.533

Table 17: estimated that, there was very week negative correlation between homocysteine and folic acid among female patients (R -0.09).

Discussion

Homocysteine (Hcy) is a detrimental intermediate of cellular metabolism in the human body. An increased level of Hcy in the blood is an indicator of a high risk of ACS and CVA.

HHcy associated with folic acid deficiency which may be due to genetic background, interaction of diet and other factors, which in turn leads to a high incidence of ACS and CVA by promoting atherosclerosis and endothelial cell injury.

In this present performed study which includes (132) patients previously diagnosed with ACS or CVA as case study group, and (50) apparently healthy individuals as control group. (62.1 %) from case group were male while (37.9 %) were female. the age of case group ranged from (30– 80 years) which (56.8 %)with normal body mass index (< 25) and (43.2 %) overweight (25-30) body mass index, while about the distribution of the patients according to types of ACS and CVA, the distribution revealed that (30.3 %) were with unstable angina, (28 %) with NSTEMI, (26.5 %) with STEMI and (15.2 %) for CVA patients.

In this current established study it was found that, there was significantly high homocysteine level among ACS and CVA patients with (*P*. value 0.00), these findings were in accordance with studies among ACS patients performed by (Torjorn, O etal. 2000 **;** Yayehd, K. et al. 2012 ; Arun B, et al. 2018 ; Ohar N, et al. 1995. **;** and Wang G, et al.2014) All the findings of the above published studies reported that Hcy level was in an increasing manner among ACS patients, also the aforementioned results were observed to be in harmony with the findings of this recent established study on CVA patients which at the same time was consistent with other studies conducted by (Nahid A, et al. 2013 ; Hafsatu M S, et al. 2019 ; Narang A P S, etal 2009 ; and Jothi D.N, et al. 2017)whom reported that high Hcy level was revealed among CVA patient's. Increased Hcy level may be probably due to decreased folic acid level which was the main cofactor in homocysteine metabolism.

Concerning to folic acid level, this present carried out study revealed that there was significant low level of folic acid with (*P*. value 0.00) in patients with ACS but these findings were in similarity with the results of a study done by (Hanguan G, et al. 2009). And in disagreement with (Mabrouka O, et al. 2010) whom elucidated that there was significant increase in folic acid level among ACS patients.

On the other hand another studyfindings done by (Nevbhar T, et al. 1999) demonstrated that there was an insignificant variation in folic acid level among ACS patients, which was not in agreement with this current study. Also same findings had been shown on CVA patients and these results were in agreement with the study performed by (Nahid A, et al. 2013 and Jothi D.N, et al.2017).The deficient cause of low folic acid level in this present conducted study may be attributed to nutritional factors, such as insufficient intake of folic acid as well as genetic factors and the defects of dihdrofolate reductase gene may be considered as prime suspect also.

Regarding to lipid profile, this recent developed study, revealed that there was a significant high level of cholesterol (*P*.value 0.005), triglyceride (*P*.value 0.01) with low HDL *(P*.value 0.00) and insignificant (LDL) level (P.value 0.4) among ACS and CVA patients at the same time these findings were partially matching the results of studies done by (Arun B. et al 2018, Dilshad P. et al. 2019 and Abdulla A and Mohamed S. 2014), whom indicated a significant increased level of cholesterol, triglyceride and LDL and a decreased level of HDL among ACS patients. Also the findings of this present performed study were in disagreement with the outcomes of the study conducted among CVA patients by (Dey S.K, et al. 2010) whom depicted a significant high LDL with normal other lipids among CVA patients, also the results of the current established study was not in accordance with the findings of the studies done by (Joshua Z, et al. 2009 and Shashidhar K, et al. 2011) whom predicted an insignificant lipid profile. The increased cholesterol and triglyceride levels may be probably due to an increase in fats and carbohydrates on the diet with irregular exercise.

Concerning to the effect of gender on the studied parameters, this present study showed that there was significant increase on Hcy level on males compared with females with (*P*.value 0.00), but this finding was in agreement with the result of study handled by (Torjorn, O et al. 2000), but at the same time it was in disagreement with study done by (Narang A P S, et al 2009) whom arrived at an insignificant difference in Hcy level between males and females, the increased Hcy level in males may be contributed due to muscle mass that will be in need to creatine which will be synthesized from guanidine acetate by the enzyme guanidine acetate methyl transferase and the reaction will need more methyl groups for its generation to be accompanied with Hcy synthesis.

Also this up-to-date analytical study showed that there was significantly relatively decrease level of folic acid among males rather than females (*P*.value 0.02) and these findings were matched with the outcomes of the study results done by (Kuan J.U, et al. 2005 and Siew-choo C, et al. 2011) whom reported that high folic acid on females rather than males but was in contrast with the findings of the study carried out by (Martina H, et al. 2006) who reported that there was insignificant variation in folic acid level between males and females, on the other hand the same study showed that there was insignificant variation between males and females on cholesterol level (*P*.value 0.7), Triglyceride (*P*.value 0.1), HDL (*P*.value 0.9) and LDL (*P*.value 0.1) and these findings were contradicting the results of the study done by (Abdulla A and Mohamed S. 2014) whom reported that: a significant increased cholesterol, triglyceride and LDL with decreased HDL in males compared to females.

The findings of this present study, were trying to look for the effect of age on the studied parameters showing that Hcy level was significantly increased in adult age (<50 years) when compared to older ages (>50 years) with (*P*.value 0.00) and this finding was similar to the results of

the study done by (Torjorn, O etal. 2000) on ACS patients and was in disagreement with the results of the study performed by (Ohar N. etal. 1995) and (Nevbhar T, et al. 1999) whom described in a report: that Hcy level was increasing with age. On the other hand the study showed that folic acid level was increased in older ages compared to adult age with (*P*.value 0.02), so these findings were in disagreement with the findings of the study conducted by (Martina H, et al. 2006) whom reported the decrease of folic acid with age. While there was insignificant variation between age group regarding lipid profile level, and these findings were not in agreement with the results of the study carried out by (Hala M B, et al. 2009) whom reported that there was a significant increase in cholesterol and decrease in triglyceride levels in older age compared to adult age, (Benjamin D, et al, 2006) whom presented an increased lipid profile with increasing age, also this current study outcomes were in disagreement with the results obtained by (Orit B H, et al 2012) whom demonstrated in a report that cholesterol, LDL and HDL showed a decrease in adolescence compared to adults.

Additionally this present study indicates that regarding the effect of the body mass index on studied parameters that's there was a significant high Hcy level on overweight group with (BMI 25-30) compared to normal weight (BMI< 25) with (*P*.value 0.002) and these findings were consistent with a study report done by (Martina H, et al.2006) whom reported that Hcy level was increased with increasing BMI, while insignificant variation on folic acid level between two groups regarding BMI with (*P*.value 0.5) and these findings were in disagreement with a study results done by (Martina H, et al. 2006) whom reported that folic acid level decreased with increasing BMI. In contrast this recent study showed an increase in lipid profile parameters levels on overweight group compared to normal weight group, at the same time these findings were in agreement with a study results done by (Zhou B F, et al. 2002) whom reported that there was an increase in a degree of dyslipidemia with increasing BMI and partial degree with a study results provided by (Gupta R, et al. 2007) whom reported that increased (LDL) and triglyceride levels occurred with increasing BMI.

As demonstrated by this Hcy study about the effects of types of disease on the given studied parameters the study elucidated that there was significant variation on Hcy and folic acid level regarding types of disease with (*P*. value 0.00) with significant variation on cholesterol, triglyceride and LDL levels inspite of insignificant variation on HDL level and these findings were partially agreed with a study done by (Abdulla A and Mohamed S. 2014) whom reported that there was no difference identified between UA and MI patients regarding lipid profile, but this current study showed that there was a partial agreement with the study done by (Abdullah M. 2014) whom reported that there was an insignificant variation on cholesterol and triglyceride with significant difference prevailed on LDL and HDL according to ACS types.

Besides, this recently developed study showed that regarding the effect of disease duration on study parameters that there was significant variation on homocysteine level (*P*.value 0.00) which has an inverse level with disease duration.

At the same there was a significant variation on folic acid level according to duration of disease with (*P*.value 0.04), on the other hand there was insignificant variation in lipid profile levels according to duration of disease and these findings were dissimilar to the results of the study findings done by (Torjorn, O *et al.* 2000) whom prevailed that an increase in homocysteine level with those patients whom have history of MI compared to those without history, also this up-to-date study was in disagreement with the study performed by (Joan M, et al. 2006) whom declared that there was an increase in homocysteine level with increased duration of coronary artery calcification.

Regarding the association between Hcy and folic acid between different types of disease, this recently conducted study denoted that there was weak correlation between Hcy and folic acid among stroked patients r (-0.3) furthermore these findings were in agreement with study established by (Jothi D.N, et al.2017)**.**

Also this study identified insignificant correlation between Hcy and folic acid among unstable angina patients r (0.00). On the other hand this newly carried out study pointed out that there was significant week negative correlation between Hcy and folic acid level among (STEMI) r (-0.5) and (NSTMI) r (- 0.1) also these findings were in partial agreement with the study results done by (Nevbhar T, et al.1999) [whom] illustrated that there was no correlation between Hcy and folic acid among ACS patients.

Regarding the association between Hcy and lipid profile among ACS patients, this study showed weak positive correlation between Hcy with cholesterol, HDL and LDL r (0.1, 0.2, 0.2) respectively and week negative correlation with triglyceride r (-0.4), these findings were partially agreed with study results done by (Ohar N. et al 1995) whom revealed that there was positive correlation between Hcy and cholesterol level.

Regarding this present study there was a negative correlation between Hcy and lipid profile among stroked patients, which indicated at the same time a significant week correlation between Hcy with cholesterol, triglyceride, HDL and (LDL) r (-0.3,-0.4,-0.2,-0.19) respectively and these findings were in disagreement with study results done by (Narang A P S, et al.2009) whom reported that there was no significant correlation between Hcy and lipid profile among CVA patients.

Concerning to the association between Hcy and folic acid among males and females diagnosed with ACS and CVA, this current study revealed that there was a week correlation between Hcy and folic acid among males and females r (-0.1,-.09) respectively and these findings were in agreement with a study results performed by (Ubbink JP, et al. 1993) whom reported a decrease in folic acid among HHcy males.

Conclusion

This study concluded that

- Increased homocysteine, cholesterol and triglyceride levels with decreased folic acid and HDL and insignificant variation on LDL level among ACS and CVA patients comparing with control group.
- Homocysteine increased and folic acid decreased among adult age group and also increase lipid profile among overweight patients while it's not affected by age.
- Homocysteine level increased among CVA patients more than ACS patients while lowest level for folic acid was reporting among STMI patients.

- Homocysteine level increased with decreasing duration of illness, also lowest concentration of folic acid regarding duration of disease was reported in group < 1 month while lipid profile were not significantly affected by duration of disease.
- Weak negative correlation between homocysteine and folic acid among CVA, STMI and NSTMI patients with no correlation found among patients with unstable angina.
- Weak positive correlation between homocysteine and cholesterol, HDL and LDL with negative week correlation between homocysteine and triglycerides among ACS patients, while there was weak negative correlation between homocysteine and lipid profile among CVA patients.
- Weak negative correlation between homocysteine and folic acid among males and females patients.

Recommendations

On the basis of the obtained results, it is recommended that

1. Assessment of homocysteine and folic acid levels regularly among ACS and CVA patients especially on whom do not have classic risk factors to avoid hyperhomocysteinemic effect on blood vessels.
2. Availability of homocysteine reagent with low cost which help the physicians and patients to assess it.
3. Conducting more studies in the same area of this study includes another cofactors regulate homocysteine level like B_{12} and molecular studies of the genes involve in folic acid metabolism.

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