Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

Association between Omentin-1 and Oxidative Stress in Patient with Myocardial Infarction and Possibility of Using Omentin-1 Level as a Marker for Subclinical Atherosclerosis.

Sami A Zbaar[1],SalimJasimKhalaf[2], Moayed Mohammedyonis Al Anzy[3].
[1]Department of Biochemistry College of Medicine Tikrit University.
[2] Department of Biochemistry College of dentist Tikrit university.
[3] Department of Biochemistry College of pharmacyTikrit university.

Corresponding address
Sami A Zbaar
Department of Biochemistry College of Medicine Tikrit University. 100 Dar street Tikrit Iraq.
Dr.samizbar@tu.edu.iq

Abstract

Background and aims: a recently recognized adipokine mediator omentin-1 has important role in the development of atherosclerosis and many other diseases .The aim of this study was to investigate the association between omentin-1, Malondialdehyde and carotid atherosclerosis in patients with first attack of myocardial infarction.
Methods:We enrolled randomly 60 male and female patients with recent attack of myocardial infarction intended to Kirkuk Hospital evaluated their serum level of omentin-1 MDA, cholesterol and carotid intima media thickness values have been estimated .
Result:omentin-1 is inversely association with myocardial infarctionThe study showed that serum concentration of omintin-1has been reduced significantly in myocardial infarction patients (126.15 ±25.68ng /ml) than those of control group (171.56± 34.44 ng/ml), as well as confirmed that there is a significant negative correlation between the serum level of omentin-1 and Malondialdehyde. the present study demonstrated that the omentin-1 concentration in human blood is inverselycorelatedto the carotid intima-media thickness predicting the involvement of omentin-1 in the development of atherosclerosis plague.
Conclusions: the resultsof this study introduced omentin-1 as a cardio protective adipokine, and indicate that reduction in the serumomentin-1 levels could contribute to the stimulate of cardiovascular dysfunction

Keywords: omentin-1, atherosclerosis, Malodialdehyde, carotid intina-media thickness

Introduction

Myocardial infarction has remained the main causes of death around the world , It is caused mainly as result of Atherosclerotic plaquesthat develop in coronary arteries due topermanent inflammation and immunological reactions that are induced by inflammatory mediator and adipokines. the newly 313- amino acid adipokine omentin-1 is a strong anti-inflammatoryagent that commonly produced by vascular cells of visceral adipose tissue.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

omentin-1 level is decreased in associated with body fat , metabolic syndrome and atheroseclerosis.[1]

Omentin-1 involved in regulation of vascular tone and cellular energy hemostasis by its role in activation of 5′-AMP-activated protein kinase as well as stimulated endothelial cell to release nitric oxide synthase. Recent studies have been focused on the pathogenesis of omentin-1 in development vascular inflammation and atherosclerosis. Atherosclerosis is a pathological complicated condition occur in response to multivascular injury [2], initiated by endothelial inflammation and followed by many chemical events characterized by release more amount of intercellular adhesion molecule-1 , vascular adhesion molecule-1 and monocyte adhesion induce formation of fatty streak involving the peroxidation of lipid in endothelial layer[3]. Oxidized LDL stimulates macrophages causing formation of foam cell. In the other hand vascular smooth muscle cell have been known to stimulate the progression of atherosclerotic plaque increasing its stability by the immigration, proliferation, and increase expression of extracellular matrix components[4].

Omentin also has a well-known effects on cardiovascular system by its effects on cardiomyocytes , macrophage , smooth muscle cell and endothelial cell . in agreement with the many experimental conclusions, low circulating omentin-1 levels have been demonstrated in patients with myocardial infarction[5].Also omentin-1 havean important role influencing the synthesis of toll-like receptor-4 . So, omentin-1 have a strong an anti-inflammatory effect on the inflammatory conditions that develop in association with atherosclerosis,in contrast the low levels of omentin-1 may stimulate inflammatory diseases. Omentin-1 inhibits pro-inflammatory molecules that mediated by TNF- alpha release in endothelial cells of blood vessels which palys Important roles in the arterial calcification and development of endothelial dysfunction [6]

In addition omentin-1 inhibits formation of reactive oxygen species like free radicals and superoxide that have a well- known role in initiation of the inflammation of blood vessel and vascular smooth muscle , so omentin-1 considered as protective adipokine in IHD[7] .

Omentin-1 induce a strong vasodilatationsaction bystimulation release of nitric oxide , so there is no any other inhibitor will reduce the vasodilation effect induced by omentin-1 as well as inhibition of pro-inflammatory protein of immune cells; preventing the associations of factors that involve in the pathogenesis of coronary artery disease [9]. In other hand omentin-1

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

stimulatesendothelial type of adenosine monophosphate protein kinase causing regulation of macrophage activity of visceral fat through its action as a strong anti-inflammatory agent [6].

Malodialdehyde isdialdehyde of three carbon atom highly reactive compound , produced by the peroxidation process of polyunsaturated fatty acid . In fact the production of MDA is an indicator of the development of oxidative stress. It is one of the many reactive oxygen species and free radicals that cause toxic oxidative stress in cells forming a covalent modification of protein like advanced lipoxidation end products, which have the same action of the advanced glycation end-products[10]. Several previous studies estimated the serum level of MDA formation to monitor the extent of the lipidperoxidation and as a biomarker to measure the level of oxidative stress in the blood . the using ofother products of peroxidation is inappropriate because most of them are unstable.[11].

CIMT is commonly estimate by measured the B-mode ultrasound in different sites of the carotid arteries. it calculates by measuring the distance between the intima-lumen and adventitia-media . estimation of CIMT could be useful in predicating of ischamic heart diseases [12]. It has been confirmed the relation between the CIMT level and various ischemic heart diseases risk factors, CIMT represent many different stages of atheroseclerotic plague that classified according to arterial wall growth. CIMT become a useful measure formonitoring the initiation and development of recentatheroseclerotic plague predicating the possibility of using CIMT as a tool to evaluate the degree of atherosclerosis and early recognize and diagnosed individuals withhigh risk for ischemic heart disease [13-14].

Aim of the study

This study aimed to investigate and evaluate the relationship between serum levels of omentin-1 and MDA in patient with myocardial infarction and their relation with carotid intima media thickness .

Material &Methods

The study group included 36 male and female pateints with recent attack of myocardial infarction intended to Kirkuk Hospital. from 1st of september to the end of December 2020.and 20 healthy subjects who apparently haven't any chronic diseases.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

patients who have other diseases like metabolic syndrome and renal failure were excluded . Serum levels of omentin-1 and Malodialdehyde were determine for patient and healthy control group, carotid intima media thickness values have been estimated for all patients .

This study was performed according to the Ethical approval has been adopted by college of medicine Tikrit university. All participants signed informed consent before sample collection .

3ml ofblood sample have been collected from all participants, where serum was separated within up to half an hourn of blood collection after being centrifuged for 15 min at 3000 g. The serum was stored in the frige with-20 C , thawed just prior to testing. Serum omintin-1 and MDA serum levels were estimated using enzymelinked immuno-sorbent assay (ELISA Ultra sensitive), kit supplied by BioVendor (USA), an addition to BMI , serum level of cholesterol was colormetrically determine

Statistical Analysis. SPSS 20 software was used to perform data analysis ,P value lees than 0.05 used to determine whether the result was significant or not . The variables represented by mean ± SD. T test was used to evaluate the differences in mean values between groups . the correlations between parameters concentrations were done by correlation analysis.

Results

This study was performed on 60 patients who have MI and 30 healthy participants as a control group. Patients included 41 men and 19 women , ranged from 41 to 79 years old. While control included 19 men and 11 women , ranged from 53 to 71 years old

comparing the patient with the control group indicates presence of an insignificant difference in age and gender.

The study showed that serum omintin-1 blood levels were reduced significantly ($P<0.01$) in myocardial patients (126.15 ±25.68 ng /ml) than those of control group (171.56± 34.44 ng/ml). also the present study demonstrate that the MDA level was significantly increase in patients (147.5± 35.67ng/ml) compared with control group(120.53± 29.35 ng/ml). Regarding to the role of cholesterol a significant increase blood level of cholesterol was confirmed in patients (227.7±42.18 mg/dl) compared with control group(189. ±22.2 mg/dl)

Table(1): describe the parameters and age in patients group

	N	Minimum	Maximum	Mean	Std. Deviation
omentin-1 patients	60	78.00	176.00	126.1500	25.68177
MDA Patients	60	87.00	200.00	147.5000	35.67532
cholesterol patients	60	132.00	305.00	227.7000	42.18735
CAMT	60	.58	1.35	.9387	.26552
age(years)	60	41	79	61.47	11.978
Valid N	60				

Table(2): show the differences in parameter according to gender

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

	gender	N	Mean	Std. Deviation	Std. Error Mean
omentin-1 patients	**male**	42	123.0952	22.56244	3.48146
	female	18	133.2778	31.37591	7.39537
CAMT	**male**	42	.9560	.27040	.04172
	female	18	.8983	.25666	.06049
MDA Patients	**male**	42	149.7857	35.50921	5.47919
	female	18	142.1667	36.51148	8.60584
cholesterol patients	**male**	42	227.0714	43.69651	6.74252
	female	18	229.1667	39.60578	9.33517
age(years)	**male**	42	60.64	12.127	1.871
	female	18	63.39	12.108	2.854

Table(3): the statistics differences between patients and controls regarding to the parameters

parameters	**Patients N:60**		**Control N:30**		**P value**
	Mean	S.D.	Mean	S.D	
Omentin-1 ng/ml	126.15	25.68	171.56	34.44	sig
MDA ng/ml	147.5	35.67	120.53	29.35	sig
Cholesterol mg/dl	227.7	42.18	189.96	22.2	sig

Regarding to the relation between the omentin-1 serum level and carotid intima-media thickness observed that there was a significant negative correlation between them (figure-1 and table-4). Also the present study demonstrate a significant negative relation between the serum level of omentin-1 and MDA in patients group(figure-3 and table-4).

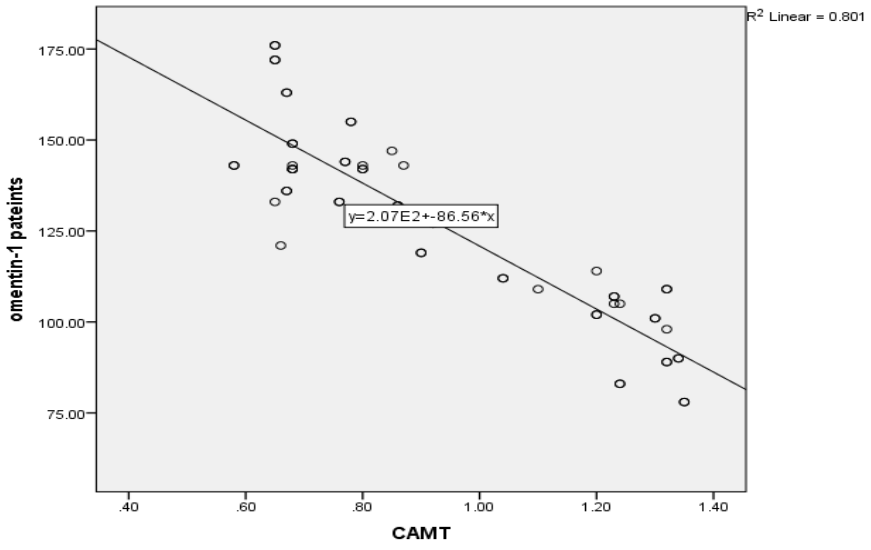
On comparing the serum level of MDA and CIMT this study confirm that there was a significant positive correlation between the CIMT and MDA in patients group(figure-2 and table-4). Also this study demonstrate there was no significant correlation between serum levels of cholesterol and CIMT in patients group (figure-4 and table-4).

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

Table (4) correlation of parameters in patients group

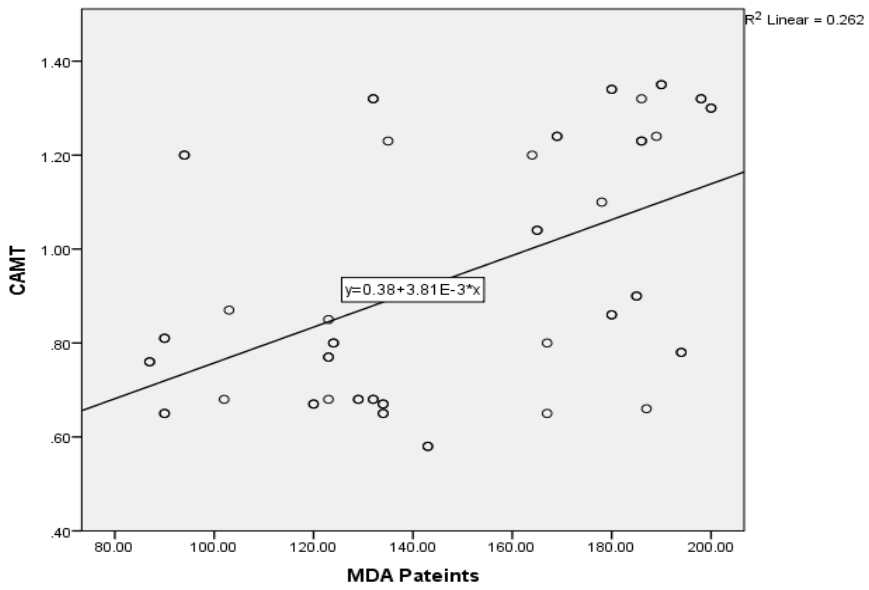
		omentin-1 pateints	Carotid intima media thickness	MDA Pateints	cholesterol pateints
omentin-1 pateints	Pearson Correlation	1	-.895**	-.518**	.234
	Sig. (2-tailed)		.000	.000	.072
	N	60	60	60	60
Carotid intima media thickness	Pearson Correlation	-.895**	1	.512**	-.241
	Sig. (2-tailed)	.000		.000	.064
	N	60	60	60	60
MDA Pateints	Pearson Correlation	-.518**	.512**	1	.102
	Sig. (2-tailed)	.000	.000		.438
	N	60	60	60	60
cholesterol pateints	Pearson Correlation	.234	-.241	.102	1
	Sig. (2-tailed)	.072	.064	.438	
	N	60	60	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

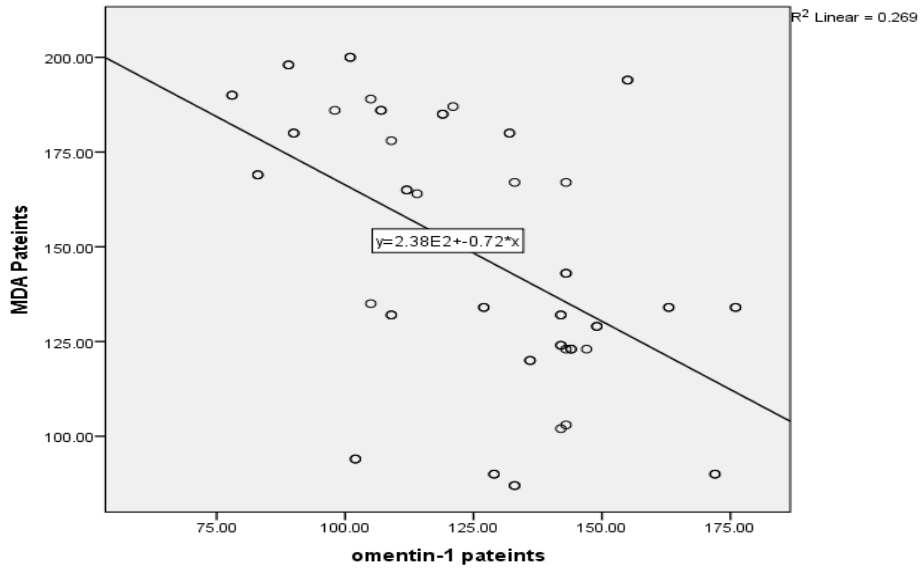


Figure(1): Correlation between omentin-1 and Carotid intima-media thickness(CIMT) in patients with myocardial infarction

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

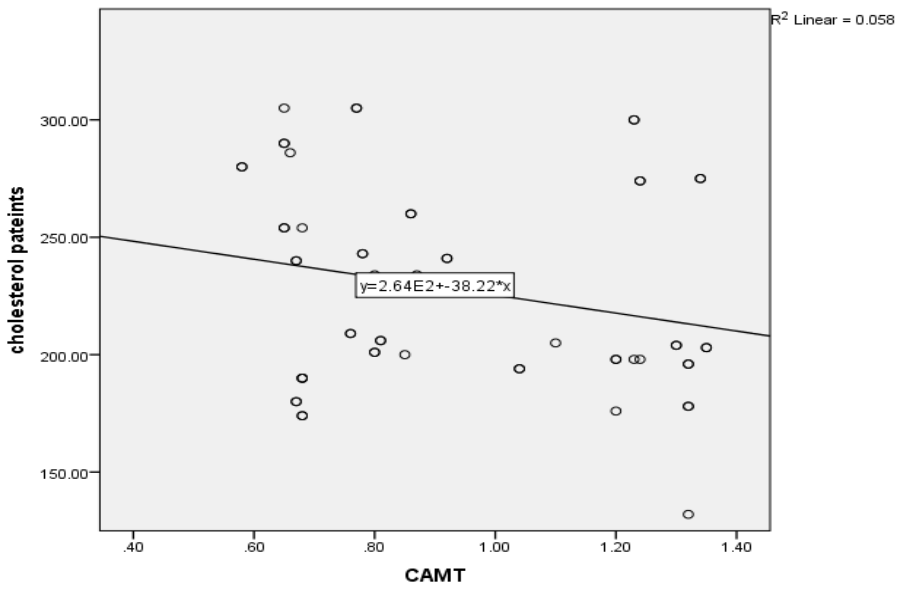


Figure(2): Correlation between Malondialdehyde and Carotid intima-media thickness in patients with myocardial infarction



Figure(3):Correlation between serum levels of omentin-1 and Malondialdehyde in patients with myocardial infarction

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.



Figure(4): Correlation between serum cholesterol and Carotid intima-media thickness (CIMT) in patients with myocardial infarction

Discussion

The present study demonstrates that there is a highly significant reductionof omentin-1 serum levels in patients who suffer from acute myocardial infarction comparing with normal healthy subjects . In agreement with our finding, many clinical studies of patients have recent attack of acute myocardial infarction reported that the serum omentin-1 levels were negatively related to severity of Ischemic heart diseases [1,3,8] , many researchers investigations have been confirmed that omentin-1 has an extreme vasodilator effect on blood vessels stimulate by endothelium-derived nitric oxide which is consider a potent vasodilator. omentin-1 improves vascular endothelial functions by activation of Nitric oxide synthase phospheration and AMPK which suppressed p38- mediated e-selectin induction.[2]. In contrast with our study,J. Menzel et a , Saely et al. approved that there is a positive relation between serum omentin-1 levels and higher risk of myocardial infarction attack in coronary artery disease patients[15,16] , this conflict occur may be due to associations between omentin-1 , adiponectin and other adipokines that confirmed by many cross-sectional analyses providing additional evidence regarding the effect of these factors on the serum level of omentin-1[17].

Omentin-1 inhibits vascular endothelial growth factors stimulating endothelial cell migration and angiogenesis in microvascular endothelial cells. Therefore, a potent vasodilation effect of omentin-1 inhibit norepinephrine effect causing prolonged cardiac vasodilatations. also, omentin-1 decrease vascular endothelial abnormalty through modulation the inflammatory comditionbyinhibition vascular endothelial growth factors, c-reactive proteins , NF-kB, and TNF in regard with outline of the present study which reveals that there is a highly significant

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

reduction of omentin-1 serum levle in patients with acute myocardial infarction [8,11]. Other role ofomentin-1 introduce by inhibition of reactive oxygen species and free radicals formation preventing development of ischemic heart diseases. This suggests the antiangiogenic effect of omentin-1 making it a potent protective agent involvein the development of atheroseclerosisand play important role in preventing ischemic heart disease [18].

The recently recognized role of omintin-1 as anti-inflammatory agent, play important role to decrease and prevent development of atherosclerosis plague in effected coronary artery, inversely relation that was found between Omentin-1and inflammatory cytokines like IL-6 , TNF-α and C-reactive protein indicating the anti-inflammatory role of omentin-1 has been suggested as a potential mechanism of anti-atherogenic effect[19] . This study show there is a significantly increased in MDA serum levels in patients of MI than those of control group this totally agree with many researches that have been suggested that The MDA serum level are significantly increased in AMI indicating the role of oxidative stress as a risk factor of AMI[18].

The study also confirm that there is a significant negative relation between the plasma concentration of MDA and omentin-1 in agreement with many studies have shown that omentin-1 has a negative correlation with the serum level of oxidative stress and demonstrate the protective effect of omintin-1 to prevent the damage caused by oxidative stress [20], may be the protective atherogenic effects of Ominten-1 induce by reducing reactive oxygen species , like superoxide and free radical and inducing nitric oxide synthesis by activation of AMPK , nitric oxide synthase phosphorylation and decrease vascular endothelial growth factor expression [21] .all these effects that bring out by the presence of Ominten-1 make it has a highly protective role against Myocardial infarction[6,15.18]

The present study demonstrated that serum concentration of omentin-1 isnegatively related to CIMT in MI patients suggested the anti atherogenic effect of omentin-1 in agreement with the findings of Rundek T, et al. who suggested the association between serum levels of omentin-1and endothelium vasodilation. As well as , Lena Tschiderer,et al they were discovered that the blood omentin-1 levels were inversely correlated with CIMT, suggesting the important role of omentin-1 serum concentration as a good marker for early detection of atherosclerosis as indicator for ischemic heart diseases also confirmed that a reduction in omentin-1 level could contribute to induction of ischemic heart attacks[23,24] . Omentin inhibits the production of alkaline phosphatase by selectively stimulation the Akt,, and inhibits the conversion of smooth muscle cells in coronary artery into osteoblasts, by which inhibiting arterial vascular calcification. omentin also has a protective effect on cardiomyocytes. omentin was shown to reduce myocardial infarct size and cardiomyocyte apoptosis by enhancing AMPK and Aktphosphorylation to protect the myocardium from ischemic attack[25].

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

Conclusion

These data identify omentin-1 may serve as biomarker for the early detection of ischemic heart attack , and indicate that the reduction in the srum level of omentin-1 may be causing the induction of ischemic heart attack.

1. Serum concentration of omentin-1 was reduced significantly in MI patients while serum MDA was elevated.
2. There is a significantly negative relation between serum concentration of Ominten-1 and MDA in pateins with myocardial infarction.
3. The current study confirmed that the serum of omentin-1 level is inversely related to carotid intima media thickness in patient with MI .

Recommendations.

1- Depending of concentration of serum omentin-1 in management and treatment of MI patients .
2- More studies are required in evaluation the role of omentin-1 as risk factor for ischemic heart disease.
3- The strong negative relation between the MDA and Ominten-1 serum levels suggestive more study required

References

1- Masami Nishimura, Tomoaki Morioka, Mariko Hayashi, Yoshinori Kakutani,Yuko Yamazaki, MasafumiKurajoh , Plasma omentin levels are inversely associated with atherosclerosis in type 2 diabetes patients with increased plasma adiponectin levels: a cross-sectional study. 2019.*Cardiovascular Diabetology* volume 18, Article number: 167

2- Chen H, Montagnani M, Funahashi T, Shimomura I, Quon M J . Adiponectin stimulates production of nitric oxide in vascular endothelial cells. *J BiolChem* 2003; **278**: 45021–45026.

3- F.-J. Shang, J.-P. Wang, X.-T. Liu et al., “Serum omentin-1 levels are inversely associated with the presence and severity of coronary artery disease in patients with metabolic syndrome,” Biomarkers, vol. 16, no. 8, pp. 657–662, 2011

4- H. Yamawaki, J. Kuramoto, S. Kameshima, T. Usui, M. Okada, and Y. Hara, “Omentin, a novel adipocytokine inhibits TNFinduced vascular inflammation in human endothelial cells,” Biochemical and Biophysical Research Communications, vol. 408, no. 2, pp. 339–343, 2011.

5- Atif E Abd-Elbaky1 , Dina M Abo-ElMatty2 , Noha M Mesbah2 and Sherine M Ibrahim3,Associations of Serum Omentin and Apelin Concentrations with Obesity,

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

Diabetes Mellitus Type 2 and Cardiovascular Diseases in Egyptian Population. EndocrinolMetabSynd 2015, 4:2

6- FatemeZabetian-Targhi , KhadijehMirzaei , Seyed Ali Keshavarz , Arash Hossein-Nezhad. Modulatory Role of Omentin-1 in Inflammation: Cytokines and Dietary Intake. J Am CollNutr . Nov-Dec 2016;35(8):670-678

7- W.-H. Feng, X.-W. Yuan, G.-Y. Tong et al., "Correlated increase of omentin-1 and adiponectin by exenatide, avandamet and dietary change in diet-induced obese rats," Folia Biologica, vol. 59, no. 6, pp. 217–224, 2013

8- Yu Du, Qingwei Ji, Lun Cai1, Fangjiong Huang, Yongqiang Lai, Yue Liu, et al., Association between omentin-1 expression in human epicardial adipose tissue and coronary atherosclerosis. CardiovascDiabetol (2016) 15:90.

9- H. J. Yoo, S. Y. Hwang, H. C. Hong et al., "Association of circulating omentin-1 level with arterial stiffness and carotid plaque in type 2 diabetes," Cardiovascular Diabetology, vol. 10, article 103, 2011.

10- RouthuKathyaini, Sowmya G. DawoodSulema, A Study on Malondialdehyde as an Oxidative Stress Marker in Patients with Myocardial Infarction at a Tertiary Care Centre. National Journal of Laboratory Medicine. 2017 Oct, Vol-6(4): BO13-BO1

11- Yu Yin ,Wei Han, Ying Cao. Association between activities of SOD, MDA and Na^{+}-K^{+}-ATPase in peripheral blood of patients with acute myocardial infarction and the complication of varying degrees of arrhythmia.Hellenic Journal of CardiologyVolume 60, Issue 6, November–December 2019, Pages 366-371.

12- Franceschini N, Giambartolomei C, de Vries PS, et al. GWAS and colocalization analyses implicate carotid intima-media thickness and carotid plaque loci in cardiovascular outcomes. Nat Commun. 2018;9:5141.

13- Vishnu A, Choo J, Kadota A, et al. Comparison of carotid plaque burden among healthy middle-aged men living in the US, Japan, and South Korea. Int J Cardiol. 2018;266:245-249.

14- Jones DL, Rodriguez VJ, Alcaide ML, et al. Subclinical atherosclerosis among young and middle-aged adults using carotid intima-media thickness measurements. South Med J. 2017;110:733-737.

15- JulianeMenzel ,Romina di Giuseppe , Ronald Biemann , Clemens Wittenbecher , KrasimiraAleksandrova g, , Tobias Pischon. et al. Omentin-1 and risk of myocardial infarction and stroke: Results from the EPIC-Potsdam cohort study. Atherosclerosis (2016) 1-7

16- C.H. Saely, A. Leiherer, A. Muendlein, et al., High plasma omentin predicts cardiovascular events independently from the presence and extent of angiographically determined atherosclerosis, j.atherosclerosis.2015.10.100.

17- R.Z. Yang, M.J. Lee, H. Hu, et al., Identification of omentin as a novel depotspecificadipokine in human adipose tissue: possible role in modulating insulin action, Am. J. Physiol. Endocrinol. Metab. 290 (2006) E1253eE1261

18- Mahesh BasavarajMadole 1, Narendra PrabhakarBachewar 2, Chandrashekhar M Aiyar. Study of oxidants and antioxidants in patients of acute myocardial infarction.Adv Biomed Res . 2015 Oct 29;4:241

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3100 – 3111
Received 15 April 2021; Accepted 05 May 2021.

19- Fateme Z-Targhi, KhadijehMirzaei, Seyed Ali Keshavarz and Arash H-Nezhad. Modulatory Role of Omentin-1 in Inflammation: Cytokines and Dietary IntakeJournal of the American College of Nutrition.2016. 35(8):1-9
20- NahidehTahmasebpour, Mohammad Ali, HosseinpourFeizi, NasrinZiamajidi, NaserPouladi, VahidMontazeri, Maryam Farhadian, RoghayehAbbasalipourkabir.Association of Omentin-1 with Oxidative Stress and Clinical Significances in Patients with Breast Cancer. Adv Pharm Bull. 2020 Jan; 10(1): 106–113.
21- FatmaBehiceSerinkanCinemre, HakanCinemre, NurtenBahtiyar, BehlülKahyaoğlu, Mustafa Tarık Ağaç, HarikaShundo, Leyla Sevinç&BirsenAydemir. Apelin, Omentin-1, and Vaspin in patients with essential hypertension: association of adipokines with trace elements, inflammatory cytokines, and oxidative damage markers.Irish Journal of Medical Science 2021 volume 190, pages 97–106
22- Masami Nishimura, Tomoaki Morioka, Mariko Hayashi, Yoshinori Kakutani, Yuko Yamazaki, MasafumiKurajoh.et al.Plasma omentin levels are inversely associated with atherosclerosis in type 2 diabetes patients with increased plasma adiponectin levels: a cross-sectional study. Cardiovascular Diabetology(2019) volume 18, Article number: 167
23- . Rundek T, Gardener H, Della-Morte D, et al. The relationship between carotid intima-media thickness and carotid plaque in the Northern Manhattan Study. Atherosclerosis. 2015;241:364-370.
24- . Lena Tschiderer, GerhardKlingenschmid, Lisa Seekircher, and Peter Willeit. Carotid intima-media thickness predicts carotid plaque development: Meta-analysis of seven studies involving 9341 participants. Eur J Clin Invest. 2020 Apr; 50(4): e13217.
25- .Yıldız S S, Sahin I, Cetinkal G, et al. Usefulness of Serum Omentin-1 Levels for the Predictions of Adverse Cardiac Events in Patients with Hypertrophic Cardiomyopathy. Medical Principles & Practice. 2018.