Evaluation of Abdominal Obesity Using Ultrasound and Its Correlation with Intima Media Thickness in Carotid Arteries

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ABSTRACT

Background: Recognition of contributing factors of atherosclerosis is important to reduce the burden of disease. The purpose in this study was to determine the correlation of abdominal wall fat, visceral fat and preperitoneal fat with Intimal Media Thickness (IMT) in carotid artery. Methods: In this observational cross-sectional comparative study, 258 consecutive patients under carotid ultrasonography were enrolled and the correlation of abdominal wall fat, visceral fat and preperitoneal fat with Intimal Media Thickness of carotid arteries was determined in them. Results: The results in this study demonstrated that age (r=0.427, P=0.0001), BMI (r=0.784, P=0.0001), abdominal wall fat (r=0.566, P=0.0001), visceral fat (r=0.766, P=0.0001), and preperitoneal fat (r=0.547, P=0.0001) had direct significant correlation with Intimal Media Thickness (P < 0.05) of carotid artery. The strongest relationship is seen between visceral fat and intimal medial thickness. Conclusion: Totally, according to the obtained results, it may be concluded that there is significant correlation between abdominal wall fat, visceral fat and preperitoneal fat with Intimal Medial Thickness of carotid artery. The correlation of visceral fat with intimal medial thickness and carotid atherosclerosis is stronger than abdominal wall and preperitoneal fat.

Key Words: Abdominal Wall Fat, Visceral Fat, Preperitoneal Fat, Intimal Medial Thickness.

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INTRODUCTION

Carotid artery stenosis is a common asymptomatic vascular disease increasing with age [1]. It may result in increased probability of ischemic cerebral stroke and regarding to asymptomatic status in many patients, routine monitoring in high-risk subjects is recommended [2]. It is also accompanied with some other vascular disorders such as aortic aneurysm [3]. It is more common in patients with background diseases such as diabetes mellitus and hypertension [4]. Prompt diagnosis and treatment of carotid artery stenosis is important and for this matter CT-angiography [5] and Doppler ultrasonography [2] beside magnetic resonance imaging may be useful [6, 7]. The sensitivity and specificity of Doppler ultrasound is 92.9% and 81.9% for diagnosing carotid atherosclerotic disease respectively [8]. Beside different clinical and laboratory risk factors such as male gender, smoking, hypertension, dyslipidemia, and obesity for atherosclerosis [9-13] special consideration to imaging techniques is seen. Intima media thickness (IMT) of carotid arteries is an important factor in this era that is a predictive factor for cardiovascular disorders [14]. Hence it may be rational that central obesity be related to increased IMT as well as increased abdominal wall, propritoneal, and visceral fat as atherosclerosis risk factors [15-20]. However further studies should be carried out and for this matter the purpose in this study was to determine the correlation of abdominal wall fat , visceral fat and preperitoneal fat with Intimal Medial Thickness (IMT) in carotid artery.

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MATERIALS AND METHODS

In this observational cross-sectional comparative study, 258 consecutive patients under carotid ultrasonography attending to training hospital in Tehran, Iran in 2017 were enrolled. The exclusion criteria were presence of positive history of diabetes mellitus, hypertension, and smoking. The study was approved by university ethics committee and written consent was given to each individual participated.

An ultrasonographic evaluation using a 7.5 MHz linear transducer with TOSHIBA, A500A, Tokyo, Japan equipment was performed to evaluate IMT.patients were placed in a supine position and bilateral carotid arteries were scanned.we measured the thickness of IMT on the far wall of the common carotid artery about 10mm proximal to the bifurcation,the image was maximized for visualizing the lumen diameter and measuring the distance between the first and the second echogenic line.the greater value was used for the analysis. (figure1)

For measurement of properitoneal fat thickness, the transducer was held prependicullar to the skin at the epigastrium and vertical scan was performed.maximum thickness of preperitoneal fat at the anterior surface of liver was measured.

Then the transducer was placed 1cm above umblical scar and subcutaneous fat thickness was defined as the measurement from the skin-fat interface to the linea alba and visceral fat thickness was defined as the thickness from the linea alba to the anterior wall of aorta. (figure2)

Data were recorded in a checklist and the correlation of abdominal wall fat and visceral fat and preperitoneal fat with Intima Media Thickness was determined in them. Data analysis was performed among 258 subjects by SPSS (version 24.0) software [Statistical Procedures for Social Sciences; Chicago, Illinois, USA]. Kolmogorov-Smirnov and Pearson regression tests were used and were considered statistically significant at P values less than 0.05.

RESULTS

The mean age was 57.1 ± 14.8 years. Among them 46.1% were male and 53.9% were female. Mean IMT, BMI, and fat levels in the patients are demonstrated in Table 1. The results in Table 2 revealed that age (r=0.427, P=0.0001), BMI (r=0.784, P=0.0001), abdominal wall fat (r=0.566, P=0.0001), visceral fat (r=0.766, P=0.0001), and preperitoneal fat (r=0.547, P=0.0001) had direct statistically significant correlation with Intima Media Thickness (P < 0.05).

Table 1- Mean IMT, BMI, and fat levels in patients

	BMI	Visceral Fat	Abdomminal Wall Fat	PP Fat	IMT
Mean	29.86	64.43	20.63	15.97	.6981
Std.Error of Mean	.362	1.192	.436	.351	.01562
Median	29.00	65.00	20.00	15.00	.7000
Std.Deviation	5.808	19.142	7.006	5.637	.25094
Variance	33.737	366.418	49.083	31.772	.063

Table 2- Correlation between IMT with BMI and fat levels in patients

		Age	BMI	Visceral Fat	Abdomminal Wall Fat	PP Fat	IMT
Age	Pearson Correlation	1	.254**	.338**	.099	.113	.427**
	Sig. (2-tailed)		.000	.000	.112	.070	.000
	N	258	258	258	258	258	258
BMI	Pearson Correlation	.254**	1	.812**	.722**	.622**	.784**
	nSig. (2-tailed)	.000		.000	.000	.000	.000
	N	258	258	258	258	258	258
Visceral Fat	Pearson Correlation	.338**	.812**	1	.665**	.589**	.776**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	258	258	258	258	258	258
Abdomminal Wall Fat	Pearson Correlation	.099	.722**	.665**	1	.754**	.566**
	Sig. (2-tailed)	.112	.000	.000		.000	.000
	N	258	258	258	258	258	258
PP Fat	Pearson Correlation	.113	.622**	.589**	.754**	1	.547**
	Sig. (2-tailed)	.070	.000	.000	.000		.000
	N	258	258	258	258	258	258
IMT	Pearson Correlation	.427**	.784**	.776**	.556**	.547**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	258	258	258	258	258	258

** Correlation is significant 0.01 level (2-tailed)

Table 3- Association between IMT, BMI, and fat levels with gender

Gender	Mean	Std. Deviation
BMI		
Male	31.11	5.630
Female	28.88	5.765
Visceral Fat		
Male	68.40	18.220
Female	61.04	19.321
Abdomminal Wall Fat		
Male	21.69	6.838
Female	19.72	7.044
PP Fat		
Male	16.65	5.565
Female	15.39	5.652
IMT		
Male	.7781	.26361
Female	.6297	.21823

The IMT, BMI, and fat levels were significantly higher in males rather than female patients (Table 3).

Table 4- Correlation of IMT, BMI and fat levels in men and women

Gender			Age	BMI	Visceral Fat	Abdomminal Wall Fat	PP Fat	IMT
Male	Age	Pearson Correlation	1	.092	.103	-.o98	-.090	.326**
		Sig. (2-tailed)		.319	.265	.289	.330	.000
		N	119	119	119	119	119	119
	BMI	Pearson Correlation	.092	1	.824**	.741**	.624**	.768**
		nSig. (2-tailed)	.319		.000	.000	.000	.000
		N	119	119	119	119	119	119
	Visceral Fat	Pearson Correlation	.103	.824**	1	.679**	.612**	.777**
		Sig. (2-tailed)	.265	.000		.000	.000	.000
		N	119	119	119	119	119	119
	Abdomminal Wall Fat	Pearson Correlation	-.098	.741**	.679**	1	.784**	.599**
		Sig. (2-tailed)	.289	.000	.000		.000	.000
		N	119	119	119	119	119	119
	PP Fat	Pearson Correlation	-.090	.624**	.612**	.784**	1	.562**
		Sig. (2-tailed)	.330	.000	.000	.000		.000
		N	119	119	119	119	119	119
	IMT	Pearson Correlation	.326**	.768**	.777**	.599**	.562**	1
		Sig. (2-tailed)	.000	.000	.000	.000	.000	
		N	119	119	119	119	119	119
Female	Age	Pearson Correlation	1	.364**	.507**	.240**	.266**	.521**
		Sig. (2-tailed)		.000	.000	.004	.002	.000
		N	139	139	139	139	139	139
	BMI	Pearson Correlation	.364**	1	.790**	.694**	.609**	.790**
		Sig. (2-tailed)	.000		.000	.000	.000	.000
		N	139	139	139	139	139	139
	Visceral Fat	Pearson Correlation	.507	.790**	1	.639**	.558**	.770**
		Sig. (2-tailed)	.000	.000		.000	.000	.000
		N	139	139	139	139	139	139
	Abdomminal Wall Fat	Pearson Correlation	.240**	.694**	.639**	1	.723**	.516**
		Sig. (2-tailed)	.004	.000	.000		.000	.000
		N	139	139	139	139	139	139
	PP Fat	Pearson Correlation	.266**	.609**	.558**	.723**	1	.526**
		Sig. (2-tailed)	.002	.000	.000	.000		.000
		N	139	139	139	139	119	139
	IMT	Pearson Correlation	.521**	.790**	.770**	.516**	.526**	1
		Sig. (2-tailed)	.000	.000	.000	.000	.000	
		N	139	139	139	139	139	119

As shown in Table 4, the correlation of IMT with BMI and fat levels was significant (direct linear) in both men and women with same effects in two genders (P=0.0001).and the correlation of IMT with visceral fat is more significant.

DISCUSSION

Carotid artery stenosis is a common disease of metabolic origin which is associated with general atherosclerosis and coronary artery disease. In this study the correlation with body fat amounts was assessed which showed that IMT had direct linear correlation with fat indices and BMI. The potency of correlation was alike across the genders.

Okada et al [21] demonstrate that IMT was independently correlated with BMI in men and women as well as our study.

Ren et al [15] reported that IMT of carotid artery was related to central obesity and it was higher in subjects with central obesity as well as our study.

Soliman et al [16] reported that IMT of carotid artery had direct significant correlation with visceral fat in both male and female subjects as seen in our study. However; totally the female patients had significantly lower measurements as well as our findings. Liu et al [17] assessed 282 patients and found that IMT had direct linear correlation with abdominal wall fats with higher potency of correlation in women. But in our study the effect size was alike between men and women.

Lawlor et al [18] assessed 800 patients and found that waist-to-hip ratio was correlated to IMT in both men and women with higher degree in men. But we found same effect for gender in our study. Zhang et al [19] reported that abdominal fat was related to IMT and increase of IMT was correlated to higher fat levels as demonstrated in our study. Also Singh et al [20] reported correlation of BMI and IMT in patients with ischemic stroke that is similar to our findings. Guldiken et al [22] reported stronger correlation of visceral fat with intima media thickness in comparison to subcutaneus fat which is best depicted in our study.

Totally, according to the obtained results, it may be concluded that there is significant correlation between abdominal wall fat and visceral fat and properitoneal fat with Intima Media Thickness of carotid arteries. For this matter further assessment of carotid artery IMT in obese patients is essential. However further studies with larger sample size and consideration of confounding factors would be beneficial.

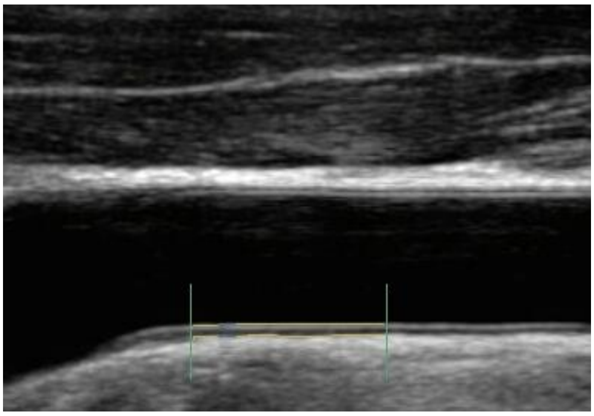

Fig. 1: carotid IMT measurment

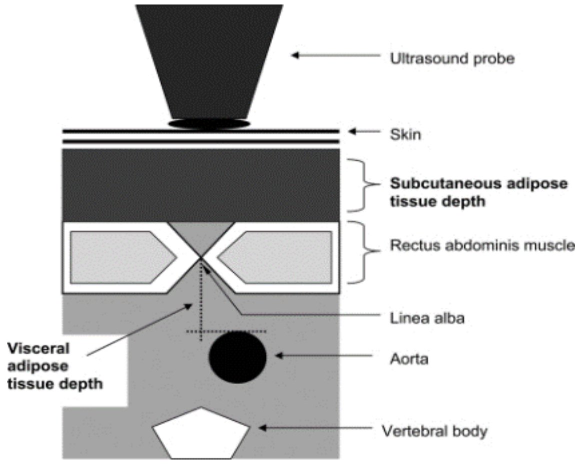

Fig. 2: subcutaneous fat thickness and visceral fat thickness mesurment [23].

REFERENCES

[1] Josse MO, Touboul PJ, Mas JL, Laplane D, Bousser MG. Prevalence of asymptomatic internal carotid artery stenosis. Neuroepidemiology. 1987;6(3):150-2.

[2] Shaikh NA, Bhatty S, Irfan M, Khatri G, Vaswani AS, Jakhrani N. Frequency, characteristics and risk factors of carotid artery stenosis in ischaemic stroke patients at Civil Hospital Karachi. J Pak Med Assoc. 2010 Jan;60(1):8-12.

[3] Cahan MA, Killewich LA, Kolodner L, Powell CC al. , Metz M, Sawyer R, etThe prevalence of carotid artery stenosis in patients undergoing aortic reconstruction. Am J Surg. 1999 Sep;178(3):194-6.

[4] Fernandes JF, Pedro LM, Freire JP, Correia A, Pedro MM, Damião A, et al. Prevalence of extracranial carotid occlusive disease. Non-invasive study. Acta Med Port. 1992 Jan;5(1):5-10.

[5] Cumming MJ, Morrow IM. Carotid artery stenosis: a prospective comparison of CT

angiography and conventional angiography. AJR Am J Roentgenol. 1994 Sep;163(3):517-23.

[6] Polak JF, Bajakian RL, O'Leary DH, Anderson MR, Donaldson MC, Jolesz FA. Detection of internal carotid artery stenosis: comparison of MR angiography, color Doppler sonography, and arteriography. Radiology. 1992 Jan;182(1):35-40.

[7] Anderson CM, Saloner D, Lee RE, Griswold VJ, Shapeero LG, Rapp JH, et al. Assessment of carotid artery stenosis by MR angiography: comparison with x-ray angiography and color-coded Doppler ultrasound. AJNR Am J Neuroradiol. 1992 May-Jun;13(3):989-1003; discussion 1005-8.

[8] Borisch I, Horn M, Butz B, Zorger N, Draganski B, Hoelscher T, et al. Preoperative evaluation of carotid artery stenosis: comparison of contrast-enhanced MR angiography and duplex sonography with digital subtraction angiography. AJNR Am J Neuroradiol. 2003 Jun-Jul;24(6):1117-22.

[9] Holmes DR Jr, Elveback LR, Frye RL, Kottke BA, Ellefson RD. Association of risk factor variables and coronary artery disease documented with angiography. Circulation. 1981 Feb;63(2):293-9.

[10] Yildirim N, Arat N, Doğan MS, Sökmen Y, Ozcan F. Comparison of traditional risk factors, natural history and angiographic findings between coronary heart disease patients with age <40 and >or=40 years old. Anadolu Kardiyol Derg. 2007 Jun;7(2):124-7.

[11] Tewari S, Kumar S, Kapoor A, Singh U, Agarwal A, Bharti BB, Garg N, Goel PK, Sinha N. Premature coronary artery disease in North India: an angiography study of 1971 patients. Indian Heart J. 2005 Jul-Aug;57(4):311-8.

[12] Sharma M, Ganguly NK. Premature coronary artery disease in Indians and its associated risk factors. Vasc Health Risk Manag. 2005;1(3):217-25.

[13] Silbiger JJ, Stein R, Trost B, Shaffer J, Kim JH, Cohen P, Kamran M. Coronary angiographic findings and conventional coronary artery disease risk factors of Indo-Guyanese immigrants with stable angina pectoris and acute coronary syndromes. Ethn Dis. 2012 Winter;22(1):12-4.

[14] Salonen R. Salonen JT. Determinants of carotid intima media thickness. A population Based ultrasonography study in eastern Finnish men J intern. Med 2008: 229 (3): 225-31.

[15] Ren C, Zhang J, Xu Y, et al. Association between carotid intima-media thickness and index of central fat distribution in middle-aged and elderly Chinese. Cardiovasc Diabetol. 2014 Oct 30;13:139.

[16] Soliman EZ, Ding J, Hsu FC, Carr JJ, Polak JF, Goff DC Jr. Association between carotid intima-media thickness and pericardial fat in the Multi-Ethnic Study of Atherosclerosis (MESA). J Stroke Cerebrovasc Dis. 2010 Jan;19(1):58-65.

[17] Liu KH, Chan YL, Chan JC, Chan WB. Association of carotid intima-media thickness with mesenteric, preperitoneal and subcutaneous fat thickness. Atherosclerosis. 2005 Apr;179(2):299-304.

[18] Lawlor DA, Ebrahim S, Whincup P, et al. Sex differences in body fat distribution and carotid intima media thickness: cross sectional survey using data from the British regional heart study. J Epidemiol Community Health. 2004 Aug;58(8):700-4.

[19] Zhang H, Ma Z, Pan L, et al. Hepatic fat content is a determinant of metabolic phenotypes and increased carotid intima-media thickness in obese adults. Sci Rep. 2016 Feb 23;6:21894.

[20] Singh AS, Atam V, Patel ML, Chaudhary SC, Sawlani KK, Das L. Carotid Intima Media Thickness as a Reflection of Generalized Atherosclerosis is Related to Body Mass Index in Ischemic Stroke Patients. N Am J Med Sci. 2013 Mar;5(3):228-34.

[21] Okada m,miida T,Hama H,Yata S,Sunaga T,Tsuda A,and Saito H:Possible risk factors of carotid artery atherosclerosis in Japanese population:a primary prevention study in non diabetic subjects.Intern Med,39:362-368,200

[22] S. Guldiken, N. Tuncbilek, O. O. Okten, E. Arikan, et al., Visceral Fat Thickness Determined Using Ultrasono- graphy Is Associated with Anthropometric and Clinical Parameters of Metabolic Syndrome, International Journal of Clinical Practice, Vol. 60, No. 12, 2006, pp. 1576-1581.

[23] Martin AM,Berger H,Nisenbaum R,Lausman AY,MacGarive S,Crerar C,Ray JG.Abdominal visceral adiposity in the first trimester predicts glucoseintolerance in later pregnsncy.Diabetes care.2009 jul;32(7):1308-1310.