Effect of Diabetes and Hypertension on Right Carotid Artery Intima Media Thickness and Variable Spectral Waveform Indices And Parameters in Relation To Age for Iraqi Patients

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Abstract

Background: Arterial stiffness is related with atherosclerosis and cardiovascular disease events. Patients with atherosclerotic disease show to have larger diameters, reduced arterial compliance and lower flow velocities.

Aim of study : To compare between patients of two age groups with concomitant diseases diabetes and hypertension in regard to intima media thickness and blood flow characteristics in order to estimate the blood perfusion to the brain via the common and internal carotid arteries.

Subject and Methods : 40 patients with (diabetic and hypertension) diseases were enrolled , they were classified according to age. Color Doppler and B mode ultrasound was used to determine lumen Diameter (D), Intima – media thickness (IMT), end diastolic velocity (EDV), peak systolic velocity (PSV), Resistive Index (RI), Pulsatility Index (PI), and the flow rate indices were calibrated and calculated .

Results:- Results show that the change in the lumen diameter between the old patients group and the younger group were (2.02%) with insignificant (p value >0.05), and the difference in the in intima-media (IMT) thickness between the two age groups (35- 55) and (56-75) are (33.8%) with significant (p value <0.05). The change difference in peak systolic velocity was (-13.29%) with insignificant (p value >0.05), while the difference in the (EDV) between both age groups was (-38.02%), with significant p value <0.05. Pressure gradient and flow rate have given insignificant difference between both age groups.

Conclusion: The intima media is significantly thicker for the old age group than in the younger group. The increased thickness of intima media did not influence the lumen diameter significantly. A clear change in PSV, EDV, RI, and PI was observed which have influenced blood perfusion to the brain.

Keywords: *Diabetic and hypertension, Blood flow velocity, Right common carotid artery.*

Introduction

Several studies have shown that arterial stiffening occurs with age, and is associated with the increase of cardiovascular disease [1,2]. Increased intima media thickness of the common carotid artery is a good marker of atherosclerotic and predictor incidence of stroke [3]. Age effect on the particular smooth muscle (which found within and consist the majority of the wall of blood vessels , arteries have more bulk smooth muscle within their wall than vein , thus their greater wall thickness) can reduce elasticity and compliance , also increase in wall thickness, mainly affecting the media and intima, blood velocity also decreases, aged vessels show reduced collagen fiber and calcium are accumulated in the artery causing calcification and thus increase endothelial permeability. [4]

Diabetes and hypertension are a major risk factor for coronary heart disease and stroke and is the major

determinant atherosclerosis. These effects can be clearly observed on the major arteries [5].

B-mode ultrasound high resolution which is non-invasive method was used to evaluated intima-media thickness of the common carotid artery can serve indicator for carotid atherosclerosis [6].

Internal carotid artery stenosis is estimated by parameters (end-diastolic velocity, peak systolic velocity , and resistive index) are used to measure the pulsatile blood flow that related to vascular resistance and vascular compliance caused by microvascular bed distal and reflects wall extensibility [7].

Pulsatility index can be calculated by (peak systolic velocity - end diastolic velocity) / mean flow velocity [8]; increase pulsatility index may be indicate that severity of small vessel disease , contribute to vascular injury and progression of atherosclerosis in cerebral vasculature [9].

Doppler ultrasound was used to evaluate blood flow velocity in a cardiac cycle including end diastolic velocity (EDV), peak systolic velocity (PSV), pulsatility index (PI), and resistance index (RI) [10].

subject and methods

The study enrolled 40 patients with type 2 diabetes Mellitus and hypertension (21 females and 19 males, with a mean age of 56.17± 9.74 years). The consent of the patients were obtained for the purpose of conducting the study after being informed of the aim of the study and Medical Ethics Committee of hospital approved the study.

The present work was performed in National Diabetic center/ AL-Mustansyriah University, during the period May 2020 until July 2020.

Mindray (DC-60) Ultrasound and Doppler machine with a linear probe (7 L4A) at 6.6 – 13.5 MHz was used in this work.

All patients participating in the study suffering from hypertension and diabetes only.

The patient was lying in the supine position with aid of a pillow below the shoulder and neck to extend the neck and enable the examination of common and internal carotid arteries .

Intima-media thickness on the near and far wall (and mainly for far wall) of common carotid artery at both sides were selected and about 1cm proximal to the bifurcation of the common carotid artery was measured. lumen diameter was measured by placed a transducer at the lateral side of the neck correspond to the course of carotid artery.

Peak systolic velocity, End diastolic velocity, and Flow velocity were measured from both internal arteries , (1–2) cm distal to the bifurcation, the continuous tracing of the intimal-luminal interface of the near and far walls of the common carotid artery with at least three – five cardiac cycles to obtain optimum and clearest view for the wall and also for blood flow velocity and indices measurement.

Resistive index (RI) and Pulsatility index (PI) were measured and recorded.

Statistical analysis

Statistical data analyses performed using Microsoft Office Excel 2007.

Normally distributed continuous variables were presented as

mean values ± standard deviation (SD). Differences between both age were analyzed with the unpaired t test. P value less than 0.05 was considered statistically significant.

Results

The study included 40 patients with hypertension and type 2 diabetes (21 females and 19 males), they have been divided into two age groups, the younger group age was 35-55 year old, mean age (47.7± 7.47 year) and the older group age was 56-75 year with mean age (62.43 ± 5.60 years). Table 1: shows the change difference between the two age groups 56-75 year old and young age group 35-55 year old for right common carotid and internal carotid arteries.

There was insignificant change in lumen diameter between the two age groups (2.02%), p value > 0.05. While the change in (IMT) between both age groups was (33.8%) with significant p value <0.05. The change in (PSV) was (-13.29%) was insignificant p value > 0.05. On the other hand the (EDV) change for younger and old

group (-38.02%) with significant value. The change in (RI) and (PI) between both age groups was (7.93%), (29.41%) respectively with significant p value < 0.05, and the change in pressure gradient and Flow rate for both age groups were insignificant p value > 0.05.

Table 1:-The measured parameters for the right common & internal carotid arteries for two age groups using Doppler and B-mode

Parameter	(DM+HT) Patients (RCCA) Mean ±SD		Change % = $\frac{old-young}{young} \times \frac{old-young}{young} \times 100$	p-value
	Age range (35-55)years	Age range (56-75) years		
RCCA IMT (mm)	0.71±0.21	0.95 ± 0.29	33.8%	<0.05
RCCA lumen D(mm)	5.44 ± 0.77	5.55 ± 0.944	2.02%	>0.05
Internal carotid artery				
PSV (cm/s)	40.85 ± 11.37	35.42 ± 11.47	-13.29%	>0.05
EDV (cm/s)	16.7± 6.29	10.35±3.20	-38.02%	<0.05
RI	0.63 ± 0.08	0.68 ± 0.061	7.93%	<0.05
PI	1.02 ± 0.19	1.32 ± 0.293	29.41%	<0.05
pressure gradient (mmHg)	0.72± 0.40	0.54±0.36	-25%	>0.05
Flow rate (cm^3/sec)	5.76±2.86	4.68±3.27	-18.75%	>0.05

Discussion

In the present study show that the change difference in intima media thickness for both age groups was (33.8%), It is expected that this increase in the thickness of intima media reduces the lumen diameter significantly which, in turn, reduce the blood flow but the overall change in the lumen diameter is very small between both groups, no more than (2.02%) in spite of change in the IMT thickness. This may be due to the arterial compliance decreases or increased arterial stiffness caused by aging , hypertension and diabetes is the result of changes in the artery wall [11,12], and also associated with increased collagen deposition due to increased wall thickness and elastin content of the intima declines, these changes in elastin and collagen content are important effects on the arteries stiffness; on the other hand age causes increase endothelial cell, and hypertrophy of vascular smooth muscle [13]. The result show that the small change in the lumen diameter with a large change in the peak systolic velocity may indicate that the slower velocity did not relate to the change in the diameter of the lumen but it may be mainly linked with the increase in the flow resistance, this conclusion is reflected on the resistive index as it is higher in the elderly than younger group by 7.93% this index is an indicator of an increased resistance in the distal vessels [14]. For this reason the reduction in peak systolic velocity in elderly is more than in the younger group by(-13.29%) ,table (1). In our study, the higher resistive index and lower end diastolic velocity for elderly group in patients with large artery atherosclerosis due to a greater resistance in intracranial

vessels that also associated with an increased risk of stroke and significantly increases the prediction of cardiovascular events [15,16].

We have observed a contralateral PSV and volume flow rate (VFR) in these cases gave a higher PSV and VFR for the young group than the old group , VFR is also higher for the younger group indicating less blood perfusion for the elderly [17]. Result in the present study show that pulsatility index which is higher in elderly than younger group. This increase is related to increase distal vascular resistance, and a peaked waveform causes of blood flow to be more pulsatile (increased systolic flow and decrement diastolic flow), which induce fibrosis ,calcification, hypertrophy of endothelium and smooth muscle cells in cerebral circulation, this led to marker of small vessel disease and microangiopathic changes in brain with subsequent of stroke events [18,19].

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the College of Science and all experiments were carried out in accordance with approved guidelines.

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