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Original Research Article

SONOGRAPHIC INTIMA- MEDIA THICKNESS, PULSATILITY INDEX INDEX (PI), RESTIVITY INDEX (RI) AND PEAKSYTOLIC VELOCITY (PSV) EVALUATION OF COMMONCAROTID AND INTERNAL CAROTID ARTERIES IN TYPE-2DIABETES MELLITUS AND CORRELATION WITH PHYSICALAND BIOCHEMICAL PARAMETERS

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Abstract

Background& Methods: The aim of the study is to study sonographic intima- media thickness, pulsatility index index (pi), resistivity index (ri) and peak sytolic velocity (psv) evaluation of common carotid and internal carotid arteries in type-2 diabetes mellitus and correlation with physical and biochemical parameters.

Result: This study measured four hemodynamic parameters (IMT, PI, RI, PSV) in the internal carotid arteries of diabetic patients, finding mean values of 0.88±0.12, 1.92±0.16, 1.08±0.16, and 129.68±38.87 respectively. BMI positively correlates with intima-media thickness (IMT), pulsatility index (PI), resistance index (RI), and peak systolic velocity (PSV) in both common and internal carotid arteries. Studies showed positive correlations between carotid artery intima-media thickness (IMT), pulsatility index (PI), resistive index (RI), and peak systolic velocity (PSV) with HbA1c, triglycerides, and random blood sugar (RBS). HDL showed a negative correlation with CCA IMT.

Conclusion:

Ultrasound guided CIMT measurement is non-invasive, reproducible method for detecting of early arterial structural changes associated with various risk factor for atherosclerosis. Carotid intima-media thickness (CIMT) ultrasound measurement is a quick, non-invasive, and reliable method for detecting early atherosclerosis. CIMT correlates with age, BMI, diabetes duration, and biochemical parameters like HDL, triglycerides, and HbA1c.Early detection via ultrasound allows for timely intervention and lifestyle modifications to reduce complications.

Keywords: sonographic intima- media thickness, pulsatility index index (pi), resistivity index (ri) and peak sytolic velocity (psv).

Study Design: Observational Study.

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1. INTRODUCTION

Diabetes is one of the largest global health emergencies of this century, ranking among the 10 leading causes of mortality together with cardiovascular disease (CVD), respiratory disease, and cancer. [1,2] According to the IDF in 2019, the top three countries with the highest number of individuals with diabetes are China (116.4 million), India (77.0 million), and the United States of America (31.0 million).[1].

Individuals diagnosed with diabetes mellitus (DM) have an elevated susceptibility to atherosclerotic CVDs, including cerebrovascular illnesses, coronary artery disease (CAD), peripheral arterial disease, and other vascular diseases. CVDs are primary contributors to death in individuals with DM and have a substantial negative impact on their overall well-being. Furthermore, individuals with DM experience a more unfavorable prognosis compared to non-diabetic patients once they get a CVD. Hence, it is necessary to promptly identify patients who are at a heightened risk for CVD and provide appropriate care. [3].

Various conventional risk factors, such as gender, advancing age, high blood sugar levels, abnormal lipid levels, high blood pressure, obesity, family history, and smoking, have a role in the development of atherosclerotic CVDs. Hence, the process of determining individuals who are at a greater risk for CVD necessitates evaluating their cardiovascular (CV) risk by considering these conventional risk variables. Nevertheless, this technique demonstrated just average performance in validation studies.[4-6].

Diabetes causes the carotid intima-medial layer to thicken, which is an early indication of atherosclerosis. [7] Multiple studies have demonstrated a correlation between elevated carotid intima-media thickness (IMT) and the occurrence of myocardial infarction (MI) or stroke in older individuals and those in their middle age. [8-10] Several factors, including hypertension (HTN) ,dyslipidemia, obesity, diabetes, smoking, have been associated with an elevated common carotid artery (CCA)-IMT. Ageing, hypertension, duration of diabetes, hyperglycemia, dyslipidemia, and smoking have been found as an important risk factors for stroke in people with type 2 diabetes.[11]

2. MATERIAL AND METHODS

A total of 90 subjects having diabetes mellitus in the age group of 30-75 years (M:F 50:40) were selected. All the participants were subjected to B-mode ultrasonography of both common and internal carotid arteries to determine IMT, along with history taking, physical examination such as BMI and routine laboratory investigations including included fasting glucose, lipid profile, and glycated hemoglobin.

A thorough medical history including duration of diabetes, history of hypertension, smoking, and alcohol intake was obtained. All patients were subjected to complete physical examination followed by an array of investigations including fasting plasma glucose (FPG), glycated hemoglobin (HbA1C), lipid profile along with high-resolution B-mode ultrasonography for CIMT measurement.

Informed consent from all the patients will be taken before inclusion in the study. High resolution, real time USG examination of the carotid arteries was done together with an USG examination of the contralateral side for comparison in all patients.

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INCLUSION CRITERIA -
Referred to Radiodiagnosis Department for assessment of carotid artery doppler who is having diabetes mellitus.

EXCLUSION CRITERIA -
- Patients not giving consent.
- Cardioembolic stroke,
- Patients with hemorrhagic stroke, and
- Patients with stroke due to secondary causes like trauma, impaired coagulation or tumor.

3. RESULT

Table 1: Age group Distribution

	Frequency	Percent
≤ 30	1	1.1
31-40	10	11.1
41-50	23	25.6
51-60	32	35.6
61-70	20	22.2
>70	4	4.4
Total	90	100.0

In the present study, age group was categorized into six groups as followings: ≤ 30 years (1.1%), 31-40 years (11.1%), 41-50 years (25.6%), 51-60 years (35.6%), 61-70 years (22.2%) and >70 years (4.4%). Most common age group was 51-60 years whereas least common age group was ≤ 30 years.

Table 2:Duration of diabetes

	Min	Max	Mean	Std. Deviation
Duration of diabetes(years)	1.5	20.0	7.02	3.86

In the present study, overall mean duration of diabetes was 7.02 ± 3.86 years.

Table 3: Laboratory parameter

	Mean	Std. Deviation
Hba1c(%)	6.92	0.52
RBS (mg%)	278.36	44.62
Total cholesterol (mg %)	254.69	22.88
TG	305.62	36.81
HDL	49.87	5.85

- Overall mean HbA1c and RBS was respectively as 6.92±0.52 and 278.36 ±44.62
- Overall, mean total cholesterol was 254.69±22.88.
- Overall Mean triglyceride was 305.62±36.81
- Overall, mean HDL was 49.87 ± 5.85

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Table 4: Right and left arteries based on diabetes and diabetes with hypertension

		Diabetes	Diabetes + Hypertension	Mean Difference (95%CI)	p-value
Right	CCA-IMT(mm)	0.83±0.09	0.87±0.15	-0.04(-0.11,0.03)	0.203
	CCA-PSV(cm/sec)	124.84±65.15	131.29±42.55	-6.45(-29.17,16.27)	0.574
	CCA- PI	2.04±0.29	1.98±0.24	0.07(-0.06,0.18)	0.279
	CCA- RI	0.98±0.19	1.01±0.18	-0.03(-0.11,0.06)	0.502
	ICA-IMT(mm)	0.8±0.14	0.85±0.11	-0.05(-0.11,0.01)	0.071
	ICA-PSV(cm/sec)	119.77±54.37	139.95±37.7	-20.19(-39.69,-0.68)	0.043
	ICA- PI	1.97±0.17	1.97±0.18	0.01(-0.08,0.08)	0.972
	ICA- RI	1.14±0.19	1.2±0.15	-0.06(-0.13,0.02)	0.123
Left	CCA-IMT(mm)	0.92±0.16	0.96±0.19	-0.04(-0.12,0.04)	0.323
	CCA-PSV(cm/sec)	126.87±64.28	132.15±41.88	-5.29(-27.67,17.11)	0.640
	CCA- PI	1.84±0.23	1.9±0.21	-0.07(-0.17,0.03)	0.164
	CCA- RI	0.95±0.19	1±0.14	-0.06(-0.13,0.02)	0.120
	ICA-IMT(mm)	0.78±0.19	0.86±0.14	-0.08(-0.15,-0.01)	0.035
	ICA-PSV(cm/sec)	114.67±54.85	132.15±41.88	-17.22(-37.3,2.87)	0.092
	ICA- PI	1.83±0.21	1.9±0.21	-0.07(-0.16,0.03)	0.166
	ICA- RI	0.95±0.19	1±0.14	-0.06(-0.13,0.02)	0.105
Mean	CCA-IMT	0.875±0.12	0.91±0.16	-0.04(-0.11,0.04)	0.2620
	CCA-PSV	125.85±64.65	135.92±32.84	-5.87(-28.38,16.64)	0.6060
	CCA-PI	1.94±0.21	1.93±0.17	-0.01(-0.09,0.09)	0.9550
	CCA-RI	0.96±0.15	1.1±0.15	-0.05(-0.11,0.02)	0.1760
	ICA-IMT	0.86±0.14	0.90±0.17	-0.07(-0.12,-0.01)	0.098
	ICA-PSV	117.22±47.49	131.72±42.1	-18.7(-35.72,-1.69)	0.032
	ICA-PI	1.9±0.16	1.94±0.2	-0.04(-0.11,0.05)	0.3930
	ICA-RI	1.05±0.19	1±0.13	-0.06(-0.13,0.02)	0.1130

- We observed significant difference in intima media thickness in right internal carotid artery between diabetic and diabetic with hypertensive patients. (p= 0.213)
- Mean CCA PSV of Diabetic with hypertensive patient was significantly higher as compared to diabetic patients.(p=0.043)
- Mean left ICA IMT was significantly higher in Diabetic with hypertensive patient as compared to diabetic patients IMT. (p=0.035)
- Mean ICA IMT of Diabetic with hypertensive patient was significantly higher as compared to diabetic patients.(p=0.026)
- Mean ICA PSV of Diabetic with hypertensive patient was significantly higher than compared to diabetic patients.(p=0.032)

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- However no significant difference noted in PI and RI in internal carotid artery between these 2 groups.

4. DISCUSSION

In the present study, overall mean age was 54.44± 10.71 years. Diabetic and diabetic with hypertension-affected patient of overall mean age was 48.2±10.58 and 57.57±9.4. in the present study, most common age group was 51-60 years whereas least common age group was ≤ 30 years. Kayastha P. et al. study also having similar study results with the present study findings.[12] According to Kota S. et al. study, 61-70 years of age group was more common during his observation.[13]

In the present study, we were observed 4 hemodynamic parameter of internal carotid artery respectively as intima media thickness, PI, RI and PSV among diabetic patients. In the present study, overall mean of common carotid artery of IMT, PI, RI and PSV were respectively as 0.88± 0.12, 1.92± 0.16 , 1.08± 0.16 and 129.68 ± 38.87. According to Sarkar P. et al. internal carotid artery of mean PI, RI and PSV were respectively as1.10± 0.25 , 0.63± 0.09 and 84.47 ± 47.10.[122] According to Guo HJ et al. study, He found that mean internal carotid artery of IMT was 1.37±0.23.[14]

Intima media thickness of CCA was positively as well as moderate correlated with HbA1c , triglyceride and RBS. PI ,RI and PSV of CCA was slightly positively correlated with HbA1c , triglyceride and RBS. IMT of Common carotid artery significantly correlated with triglyceride as well as RBS was observed during the study of Kota S. et al. [15].

5. CONCLUSION

Measurement intima-media thickness of CCA and ICA using high resolution ultrasound is a quick, noninvasive yet reproducible examination and CCA intima-media thickness is a good predictor of both the presence of bifurcation plaque and macrovascular disease.

CIMT correlates with age, BMI, diabetes duration, and biochemical parameters like HDL, triglycerides, and HbA1c.Early detection via ultrasound allows for timely intervention and lifestyle modifications to reduce complications.

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