Assessment Of Carotid Sonographic Parameter Pulsatility Index Associated With Stroke Risk Among Hypertension With Diabetic Stroke Patients Compared To Hypertension With Diabetic Controls

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Abstract: Background: Stroke is major public health problem leading to increased morbidity and mortality. Stroke is one of the leading causes of death and disability in India. Carotid sonographic hemodynamic parameter Pulsatality Index by using carotid Doppler Ultrasound is associated with the future risk of development of cerebrovascular stroke. Material And Methods: The present cross sectional study was conducted on 25 hypertension with diabetes stroke (Group A) and 30 hypertension with diabetes controls (Group B). CCA peak systolic velocity, end diastolic velocity and Pulsatility Index were assessed in each group by Doppler ultrasound machine. BMI and W/H was measured according to WHO protocol. Blood pressure was measured by sphygmomanometer. Biochemical analysis like Lipid profile and HbA1c were done by autoanalyser machine. Result: CCA PSV in Group A was found to be 65.50±21.58 and 69.75±15.51 in left and right side respectively & 70.51±16.70 and 68.64±13.73 in Group B. CCA EDV in Group A was found to be 13.56±2.78 and 11.53±4.65 in left and right side respectively & 20.32±4.54 and 18.17±4.39 in Group B . The data was highly significant ($p<0.0001$). CCA MV in Group A was found to be 39.53±11.72 and 40.64±9.25 in left and right side respectively & 45.41±9.39 and 43.40±7.70 in Group B ($p=0.04$ & $p=0.23$ left and right side respectively). CCA PI in Group A was found to be 1.28±0.15 and 1.44±0.22 in left and right side respectively & 1.05±0.23 and 1.14±0.16 in Group B . The data was highly significant ($p<0.0001$).Age in Group A and B was found to be 62.20±9.60 and 54.66±9.01 respectively ($p<0.004$). BMI in Group A and Group B was found to be 28.27±1.17 and 26.35±1.45 respectively ($p<0.0001$).W/H in Group A and Group B was 0.88±0.04 and 0.86±0.02 respectively ($p=0.01$). Systolic and diastolic blood pressure in both the groups was found to be 148.16±15.21 & 138.72±6.91 and 87.60±5.94 & 83.86±6.23 which was statistically significant with $p=0.003$ & $p=0.02$. The difference between mean of two groups for HbA1c, HDL , LDL , total cholesterol and triglyceride in both the groups were 8.6±0.82 &7.45±0.56, 39.04±5.85 & 49.97±8.34, 143.20±6.40 &113.26±17.09, 226.28±8.28 & 201.90±21.83 & 195.68±9.69, 201.03±55.82 respectively in which HbA1c, HDL, LDL, Total cholesterol were statistically very significant($p<0.0001$) and triglyceride was not statistically significant. Conclusion: In conclusion, among hemodynamic parameters that are measured by carotid Doppler ultrasound, Pulsatility Index may play a role for predicting cerebrovascular stroke in hypertension with diabetic patients. In this sense, we concluded that Pulsatility Index examination should be carried out in hypertension with diabetic patients by carotid Doppler ultrasonography. These findings need to be confirmed by a prospective study. [Gadhvi H sain A Natl J Integr Res Med, 2020; 11(3):11-14]

Key Words: CCA EDV,PSV, PI ,CV stroke, HDL, LDL, triglyceride

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Introduction: Stroke is major public health problem leading to increased morbidity and mortality. It is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas.[1-2]

The incidence rate is 119-145/100,000 based on the recent population based studies. Modifiable risk factors for stroke include hypertension, diabetes, atrial fibrillation, dyslipidemia and smoking. Among these risk factors, diabetes and hypertension are rapidly growing epidemics leading to a substantial increase in development of cerebrovascular stroke.[3] In this review, we assessed the risk factors for stroke with emphasis on the diabetic and hypertensive population. Globally, and particularly in developing countries like India, the prevalence of hypertension and diabetes is increasing with a consequent rise in the burden of stroke.

There is need to identify biomarkers of stroke, which can be used by stroke prevention programs. Carotid Doppler ultra sonography is an affordable and widely available modality that is ideal for the developing countries. As hypertension and diabetes are well established risk factors for stroke, in this study we have assessed carotid sonographic hemodynamic parameter Pulsatality Index by using carotid Doppler Ultrasound for future risk of development of stroke.

The Pulsality Index was calculated as follows:[4-5]

$$\text{Pulsatality Index} = \frac{\text{Peak Systolic Velocity} - \text{End Diastolic Velocity}}{\text{Mean Velocity}}$$

Aim and Objective: To assess and compare common carotid artery pulsatility index in hypertension with diabetes stroke and nonstroke patients for the future risk of development of cerebrovascular stroke.

Material & Methods: Present cross sectional study was conducted in GCS Medical college, Hospital and Research Centre, Ahmedabad. The Inclusion Criteria: Patients with stroke. Patients with hypertension and diabetes. Age greater than 40 years.

Exclusion Criteria: Patients with atrial fibrillation. Patients with any conduction abnormality, valvular heart disease. Renal disease or any other major illness.

All carotid ultrasonography examinations were performed with the use of Logiq P5, GE Wipro sonography machine equipped with a 7 MHz linear-array transducer. With the subject in the supine position and the neck in slight hyperextension the common carotid artery was identified and examined of both the sides in Radiology department of GCS Hopital & Research centre, Ahmedabad. Same sonologist performed all the sonographic examination to eliminate interobserver variations. All the data of subjects institutional ethics committee permission was sought. Informed consent was taken from all the patients. Data was collected as per the predesigned questionnaire. We included 55 subjects in the study and for comparison we made two groups. Group A comprised of CV stroke patients with hypertension & diabetes and Group B comprised of hypertension with diabetic controls. BMI, Waist circumference and waist – hip ratio were measured as per WHO Protocol.[6]

Blood pressure was measured by sphygmomanometry. Biochemical tests like HbA1c and Lipid profile were estimated by auto analyser machine (XL-640) of GCS Hospital Laboratory, Ahmedabad.
were statistically summarized, expressed as mean ± sd and comparison between groups was done by using un-paired student t-test. Statistical software Medcal 11.5.1.0 was used for statistical analysis and $p<0.05$ was Considered as significant.

Results: Clinical Profile of Subjects and doppler ultrasonographic measurements are shown in table 1 and 2.

Discussion: Carotid sonography is a noninvasive, accurate, safe, reproducible and cost effective unique imaging method for the investigation of carotid abnormalities. Carotid Sonographic hemodynamic parameter pulsatility index was assessed in each groups by Doppler ultrasonography. Pulsatility index is a reflection of the vascular resistance distal to the examined artery.

TableNo. 1 Clinical Profile Of Subjects

Clinical Profile		Study Subjects Group A (N=25)		Control Group B (N =30)		P Value
		Mean	SD	Mean	SD	
Age (Years)		62.20	9.60	54.66	9.01	P=0.0041
Waist Circumference (cm)		85.44	16.67	89.53	7.56	P=0.23
Waist/Hip		0.88	0.04	0.86	0.02	P=0.019
BMI (Kg/m^2)		28.27	1.17	26.35	1.45	P<0.0001
Blood Pressure (mmHg)	Systolic BP	148.16	15.21	138.72	6.91	P=0.0036
	Diastolic BP	87.60	5.94	83.86	6.23	P=0.027
Pulse (per min)		82.80	5.31	77.80	6.57	P=0.003
HDL (mg%)		39.04	5.85	49.97	8.34	P<0.0001
LDL (mg%)		143.20	6.40	113.26	17.09	P<0.0001
Total Cholesterol (mg%)		226.28	8.28	201.90	21.83	P<0.0001
Triglyceride (mg%)		195.68	9.69	201.03	55.82	P=0.63
HbA1c %		8.6	0.82	7.45	0.56	P<0.0001

Table No. 2 Doppler Ultrasonographic Measurements Of Subjects:

Parameter (Cm /Sec)		Study Subjects Group A (N=25)		Control Group B (N=30)		P Value
		Mean	SD	Mean	SD	
Left CCA	PSV	65.50	21.58	70.51	16.70	P=0.33
	EDV	13.56	2.78	20.32	4.54	P<0.0001
	MV	39.53	11.72	45.41	9.39	P=0.04
	PI	1.28	0.15	1.05	0.23	P=0.0001
Right CCA	PSV	69.75	15.51	68.64	13.73	P=0.77
	EDV	11.53	4.65	18.17	4.39	P<0.0001
	MV	40.64	9.25	43.40	7.70	P=0.23
	PI	1.44	0.22	1.14	0.16	P<0.0001

PSV – Peak Systolic Velocity, EDV – End Diastolic Velocity, MV – Mean Velocity, PI – Pulsatile Index

Therefore, the pathologies of small intracranial perforating arteries may affect the pulsatility index of proximal artery so useful parameter for predicting cerebral infarction.

Thus, it is diagnosed that pulsatility index of CCA may also be surrogate markers of atherosclerosis in cerebral arteries. This findings was also confirmed by Lee et al.[9]

In light of these considerations, we assessed carotid pulsatility index in hypertension with diabetic stroke and none stroke patients. Our findings revealed that statistical comparison of common carotid artery pulsatility index was highly significant with p<0.0001 by student t-test in both the groups. In this study we found significant association of carotid hemodynamic parameters like end diastolic velocity and pulsatility index with development of cerebrovascular stroke in hypertension and diabetic patients.[7-9]

Cerebrovascular disease (CVD) is the second leading cause of death and ranks first in terms of disability. It is also an important economic and social health problem. Age, vascular risk factors and clinically demonstrated vascular diseases are associated with the increase in pulsatility index.[14] In our study we found that age is significant parameter for future risk for development of stroke. Difference between two groups was statistically very significant with p<0.004. In statistical comparison of different parameters of lipid profile between two groups we found the difference between values of HDL, LDL, and total

cholesterol in both the groups were statistically very significant with p<0.0001. our findings were in line with the study done by Shepherd J, Cobbe SM et al.[16] In case of biochemical parameter HbA1c value between two groups was statistically very significant with p<0.0001.

Conclusion: In conclusion, among hemodynamic parameters that are measured by carotid Doppler ultrasound, Pulsatility Index may play a role for predicting cerebrovascular stroke in hypertension with diabetic patients. In this sense, we concluded that Pulsatility Index examination should be carried out in hypertension with diabetic patients by carotid Doppler ultrasonography. This finding needs to be confirmed by a prospective study.

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