Assessment Of Common Carotid Artery Hemodynamic Parameters To Evaluate Risk Factor Smoking For Development Of Cerebrovascular Stroke By Using Carotid Doppler Ultrasound.

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Abstract: Background : Globally, smoking is considered to be associated with several public health problems including stroke . Common carotid artery (CCA) hemodynamic parameters peak systolic velocity (PSV), end diastolic velocity(EDV) and resistive Index(RI) have an association with the development of stroke. Material Method: The present study was conducted on 16 smokers with Stroke (Group A) and 22 hypertension with diabetic smokers non stroke patients (Group B) . CCA peak systolic velocity, end diastolic velocity and resistive 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. Lipid profile was done by autoanalyser machine . Result : CCA PSV in Group A was found to be 57.67±13.33 and 48.55±16.29 in right and left side respectively & 70.06±14.04 and 75.23±11.89 in Group B . The data was highly significant (p<0.0001). CCA EDV in Group A was found to be 10.43±5.97 and 10.43±4.57 in right and left side respectively & 18.79±2.89 and 21.76±2.68 in Group B . The data was highly significant (p<0.0001). CCA RI in Group A was found to be 0.82±0.09 and 0.80±0.09 in right and left side respectively & 0.72±0.03 and 0.70±0.04 in Group B . The data was highly significant (p<0.0001).Age in Group A and B was found to be 62.93±5.82 and 52.59±4.37 respectively (p<0.0001). BMI in Group A and Group B was found to be 28.30±3.10 and 28.43±2.11 respectively (p =0.87).W/H in Group A and Group B was 0.88±0.03 and 0.89±0.02 respectively (p=0.22). Systolic and diastolic blood pressure in both the groups was found to be 150.75±13.48 & 139.18±6.63 and 87.50±5.72 & 84.09±5.60 which was statistically significant with p=0.001 & p=0.07. The difference between mean of two groups for HbA1c, HDL , LDL , total cholesterol and triglyceride in both the groups were 8.70±0.71 &7.25±1.08, 36.93±5.20 & 46.00±5.13, 146.81±7.96 &116.63±13.91, 229.62±6.87 & 194.95±15.48 &155.81±38.38, 169.36±29.85 respectively in which HbA1c, HDL, LDL,Total cholesterol were statistically very significant(p<0.0001) and triglyceride was not statistically significant. Conclusion: Our finding revealed that Common carotid artery hemodynamic parameters PSV, and RI were increased in stroke patients as well as EDV decreased in these patients. Smoking has association of development of stroke in hypertensive and diabetic patients. Carotid Doppler sonography is useful diagnostic modality for predicting and preventing CV Stroke in smokers as well as patients with hypertension and diabetes mellitus. [Makwana M Natl J Integr Res Med, 2019; 10(5): 7-10]

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

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Introduction: Stroke is global health problem. [1, 2] It is the second commonest cause of death and fourth leading cause of disability worldwide. In developed countries, stroke is the first leading cause for disability, second leading cause of dementia and third leading cause of death. It is also a predisposing factor for epilepsy, falls and depression in developed countries and is a leading cause of functional impairments, with 20% of survivors requiring institutional care after months and 15% - 30% being permanently disabled. [3] About 15 million people suffer from first-ever stroke every year, with a third of these cases – or approximately 6.6 million – resulting in death (3.5 million women and 3.1 million men).

In terms of premature death and years of life lost, stroke is a greater problem in low- and middle income countries (LMICs) than in high-income countries. More than 81% of deaths from stroke are in LMICs. Developing countries like India are facing a double burden of communicable and non-communicable diseases. It is one of the leading causes of death and disability in India. More than four-fifth of all strokes occur in developing countries. Four out of 5 of the ischemic events are caused by atherosclerotic diseases, with most changes affecting the carotid bifurcation. [4]

The common risk factors for development of stroke are hypertension, diabetes, smoking, and dyslipidemia. These risk factors are prevalent and inadequately controlled; mainly because of less awareness by the people and inadequate infrastructure. 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 a need to identify biomarkers of stroke, which

can be used by stroke prevention programs. Carotid Doppler Ultrasonography is an affordable and widely available modality that is ideal for the developing countries.

Smoking leads to development of cerebrovascular stroke because tobacco smoke contains number of different chemicals including heavy metals and other toxins that promote the development of free radicals, inducing vascular endothelial dysfunction and inflammation, ultimately leading to the development and acceleration of the atherosclerotic process. Smoking causes an increase in fibrinogen concentration, a decrease in fibrinolytic activity, so an increase in platelet aggregability. [5] Smoking also decreases cerebral blood flow, which may further increase the risk of clot formation and subsequent stroke risk through a slowed flow or stasis phenomenon. [6] As smoking is a well-established risk factor for stroke, in this study we have evaluated risk factor smoking for development of cerebrovascular stroke in hypertensive and diabetic patients by the assessment of hemodynamic parameters of common carotid artery by using Carotid Doppler Ultrasound.

Aims and objectives : Smoking is associated with cerebrovascular stroke risk. In the present study we aim to assess common carotid artery hemodynamic parameters like peak systolic velocity , end diastolic velocity and resistive index to evaluate risk factor smoking for development of stroke in hypertensive and diabetic patients.

Materials And Methods: Present study was prospective study. It was conducted in General population at GCS Medical College, Hospital and Research Centre, Ahmedabad. Study subjects were hypertensive, diabetic and CV stroke patients with smoking. We included sixteen CV stroke patients with smoking in study group A and 22 hypertensive and diabetic patients with smoking in Group B as control subjects. The study was initiated after obtaining approval from Institutional Ethical committee. Informed consent was taken from each subject and data were collected as per predesigned questionnaire.

Anthropometric measurements like BMI , Waist circumference and waist :Hip ratio were measured as per standard WHO protocol. [7] The Brachial artery Blood Pressure was obtained with mercury sphygmomanometer using standard method. HbA_{1C} , HDL , LDL , Total Cholesterol and Triglyceride were estimated by autoanalyzer machine (XL – 640) at the central laboratory of College GCS Medical College , Hospital and Research Centre , Ahmedabad.

Carotid Sonographic hemodynamic parameters like peak systolic velocity , end diastolic velocity and resistive index were assessed in each groups by Doppler ultrasound machine (Logiq P5 , GE Wipro) in Radiology department. To eliminate interobserver variation, the same sinologist performed all sonographic examinations. The common carotid arteries on each side of the neck were examined with the patients in the supine with the head turned away from the side to be examined to adequately visualize the vessels.
Clinical and laboratory characteristics of subjects were summarized statistically. The data analysis was done by unpaired student t-test using software MedCal 11.5.1.0. $P<0.05$ considered as significant.

Inclusion criteria include participatns of CV stroke, hypertensive, diabetic patients with smoking with Age More than 40 years from both Gender

Exclusion criteria were Patients with atrial fibrillation & other conduction abnormality, Valvular heart disease and Kidney disease or any other major illness

Results : A total 38 patients were selected for this study and two groups were made. Comparision of group a and group b are shown in Table 1 & 2

Group A : smokers with CV stroke
Group B : smokers with hypertension and diabetes

Table 1 : Shows comparison of various parameters between smokers study group A and smokers control B group.

Parameters	Study group A (n=16)		Control group B (n=22)		p value
	Mean	SD	Mean	SD	
Age(years)	62.93	5.82	52.59	4.37	<0.0001
BMI (Kg/m^2)	28.30	3.10	28.43	2.11	0.87
WC (cm)	93.62	8.46	94.36	7.74	0.70
W/H	0.88	0.03	0.89	0.02	0.22
Sys. BP (mmHg)	150.75	13.48	139.18	6.63	0.001

Dia. BP (mmHg)	87.50	5.72	84.09	5.60	0.07
HDL (mg/dl)	36.93	5.20	46.00	5.13	<0.0001
LDL(mg/dl)	146.81	7.96	116.63	13.91	<0.0001
Total Chole. (mg/dl)	229.62	6.87	194.95	15.48	<0.0001
Triglyceride(mg/dl)	155.81	38.38	169.36	29.85	0.22
HbA_1c(%)	8.70	0.71	7.25	1.08	<0.0001

Table 2: Shows comparison of common carotid artery hemodynamic parameters between smokers study group A and smokers control group B

Parameters	Study group A (n=16)		Control group B (n=22)		p value
	Mean	SD	Mean	SD	
Left CCA PSV (cm/sec)	48.55	16.29	75.23	11.89	<0.0001
Left CCA EDV(cm/sec)	10.43	4.57	21.76	2.68	<0.0001
Left CCA RI	0.80	0.09	0.70	0.04	<0.0001
Right CCA PSV(cm/sec)	57.67	13.33	70.06	14.04	0.009
Right CCA EDV(cm/sec)	10.43	5.97	18.79	2.89	<0.0001
Right CCA RI	0.82	0.09	0.72	0.03	<0.0001

Discussion: Carotid Doppler Ultrasonography is used for assessment of cerebrovascular diseases. It is initial diagnostic modality as well as safe, accurate and less expensive. Hypertension, diabetes mellitus, dyslipidemia and smoking were the most prevalent risk factors for the development of cerebrovascular stroke. In this study we have assessed common carotid artery hemodynamic parameters like Peak systolic velocity, end diastolic velocity and resistive index in smokers with hypertension and diabetic patients by Carotid Doppler ultrasonography. We have measured peak systolic velocity, end diastolic velocity and resistive index in smokers stroke patients (study group) with hypertension & diabetes and smokers with hypertension and diabetic (control group) patients. Smokers has an increased risk of overall stroke compared with nonsmokers. Additionally, smoking has also proven to be related to diabetes, high blood pressure, and elevated resting heart rate, which are all risk factors for stroke.[9,10]

Age is an important nonmodifiable risk factor for development of cerebrovascular stroke. In our study we found that mean age of smokers with hypertension and diabetes is 62.93±5.82 years for the development of cerebrovascular stroke. In statistical comparison we found difference of age in both the groups was highly significant with p<0.0001. In our previous study we found that age for the development stroke in hypertensive and diabetic patients without smoking was higher than the smokers. The mean age of stroke onset in India is lower than that in Western countries[11]. This is because of inadequate control of the common modifiable risk factors like hypertension, diabetes and smoking.

Difference of mean values of Anthropometric measurements like BMI, Waist circumference and Waist : Hip Ratio were not significant with P value 0.87 , 0.70 & 0.22 respectively. In the statistical comparison of Systolic and diastolic blood pressure by student t - test we found that mean of systolic blood pressure was higher in study group than control group. Table No. 1 In biochemical analysis we found that mean values of LDL , Total Cholesterol and HbA1c were higher in study group than control group while HDL and triglyceride were lower in study group than control group.Table No. 1 Our findings were supported by Lipska K, Sylaja PN et al.[12] They found in their study that smoking, elevated systolic blood pressure, diabetes, and lower HDL cholesterol as important risk factors for stroke. Presence of more than three metabolic syndrome components were associated strongly with stroke compared with hospital and community controls.

In the statistical comparison of common carotid artery hemodynamic alterations expressed in peak systolic velocity, end diastolic velocity and resistive index by student t-test we found the difference of these hemodynamic parameters were highly significant in both the groups with p< 0.0001. Table No. 2 Our finding were supported by Sarah Tagelsir, Moawia Bushra Gameraddin et al. [13] In their study they found that Hypertension, diabetes, and smoking have an association with stroke and had significant effect on carotid artery hemodynamic and atherosclerotic disease. The Doppler RIs were significantly correlated with smokers. Patients with risk factors of stroke should be scanned with Doppler sonography as early as possible. In the study we found significant association of Peak

systolic velocity, end diastolic velocity and resistive index of common carotid artery with hypertension, diabetes and smoking for the development of cerebrovascular stroke. This finding agreed with Haq et al.[14]

Conclusion : Our finding revealed that Common carotid artery hemodynamic parameters peak systolic velocity and resistive index were increased in stroke patients as well as end diastolic velocity decreased in these patients. Smoking has association of development of cerebrovascular stroke in hypertensive and diabetic patients. Carotid Doppler sonography is useful diagnostic modality for predicting and preventing CV Stroke in smokers as well as patients with hypertension and diabetes mellitus.

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