

PHYSIOLOGICAL ASSESSMENT OF COMMON CAROTID ARTERY RESISTIVE INDEX TO EVALUATE DIFFERENT RISK FACTORS FOR THE DEVELOPMENT OF CEREBROVASCULAR STROKE

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Abstracts: Background: The common carotid artery resistive index (CCA RI) is a hemodynamic parameter that reflects local wall extensibility and related vascular resistance. Value of CCA resistive index 1 indicate systolic blood flow but no diastolic blood flow. The value of CCA resistive index is correlated with severity of atherosclerosis. **Aim:** Assessment of CCA resistive index with future risk for development of Cerebrovascular stroke. **Objective:** Evaluation of various risk factors such as age, hypertension, diabetes, dislipidemia etc in CV stroke, hypertensive and diabetic patients for development of CV stroke. **Material method:** The present study was conducted on 30 CV Stroke patients (Group A) and 30 hypertensive and diabetic patients (Group B). CCA resistive index was assessed in each group by Doppler ultrasound machine. **Result:** CCA RI in Group A was found to be 0.81 ± 0.11 and 0.83 ± 0.11 in right and left side respectively. The data was highly significant ($p < 0.0001$). Age in Group A and B was found to be 62.8 ± 9.11 and 53.87 ± 10.06 ($p = 0.0007$). Systolic and diastolic blood pressure in both the groups was found to be 148.07 ± 14.77 & 138.93 ± 7.04 and 88.33 ± 5.977 & 84.5 ± 5.75 which was statistically significant with p value 0.003 and 0.014 respectively. The difference between mean of two groups for HbA1c, total cholesterol, HDL, LDL and triglyceride in both the groups were statistically very significant. **Conclusion:** Carotid hemodynamic alterations expressed in Resistive index should be measured for future risk of development of CV stroke in hypertensive and diabetic patients with advance age. These findings need to be confirmed by a prospective study.

Key Words: CCA RI, CV stroke, HbA1c, 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 worldwide³. 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 disabled³. Four out of 5 of the

ischemic events are caused by atherosclerotic diseases, with most changes affecting the carotid bifurcation⁴ 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. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas.

The WHO clinically defines stroke as 'the rapid development of clinical signs and symptoms of a focal neurological disturbance lasting more than 24 hours or leading to death with no apparent cause other than vascular origin' (WHO 2005).

The **arterial resistivity index** (also called as **Resistance index**, abbreviated as RI), developed by [Leandre Pourcelot](#), is a measure of pulsatile blood flow that reflects the **resistance to blood flow** caused by **microvascular bed** distal to the site of measurement.

RI is a hemodynamic parameter that is easily determined by Doppler sonography and basically reflects vascular resistance according to Pourcelot⁵.

The resistive index according to Pourcelot is not a morphological but a hemodynamic parameter that can be easily determined by Doppler sonography. It reflects local wall extensibility and the related vascular resistance.^{5,6,7} There is a clear correlation between increasing RI values and arteriosclerosis risk factors and manifestations^{8,9,10,11,12}.

A low or normal RI may represent a still healthy vessel not damaged by arteriosclerosis. The fact that the increase in relative risk is correlated more strongly with RI than with intima media

Material method :

Present study was case control study. It was conducted in General population at GCS Medical College , Hospital and Research Centre, Ahmedabad. Subjects were selected randomly. Study subjects were hypertensive , diabetic and CV stroke patients. The study was initiated after obtaining approval from Institutional Ethical committee. Informed consent was taken from each subjects. During the study period data were collected as per predesigned questionnaire. There were 60 subjects included in study. Subjects were placed into two groups . Group A consist of 30 subjects with CV stroke

The patient lie down in the supine or semi-supine position with the head slightly hyperextended and rotated 45° away from the side being examined. The formula used to calculate resistance index is:

thickness supports the assumption that RI detects the arteriosclerotic process at least as early as IMT.

The RI is altered not only by vascular resistance but also by the combination of vascular resistance and vascular compliance.^[13,14]

Aim:

Assessment of Common carotid artery resistive index with the future risk for development of Cerebrovascular stroke .

Objectives:

In order to assess common carotid artery resistive index with future risk for development of CV stroke , we have evaluated various risk factors such as age, hypertension ,diabetes ,dislipidemia , smoking etc. in CV stroke , hypertensive and diabetic patients.

and Group B Consist of hypertensive and diabetic patients without CV stroke . Common carotid artery resistive index was assessed in each groups by Colour Doppler ultrasound machine (Logiq P5 , GE Wipro) in Radiology department of GCS Medical College , Hospital and Research Centre, Ahmedabad. . Carotid sonography is a Noninvasive, accurate, and cost-effective unique imaging method for the investigation of carotid abnormalities. . Carotid sonography is a Noninvasive, accurate, and cost-effective unique imaging method for the investigation of carotid abnormalities.

$$RI = \frac{V_{\text{systole}} - V_{\text{diastole}}}{V_{\text{systole}}}$$

V_{systole} = Peak systolic velocity

V_{diastole} = End diastolic velocity

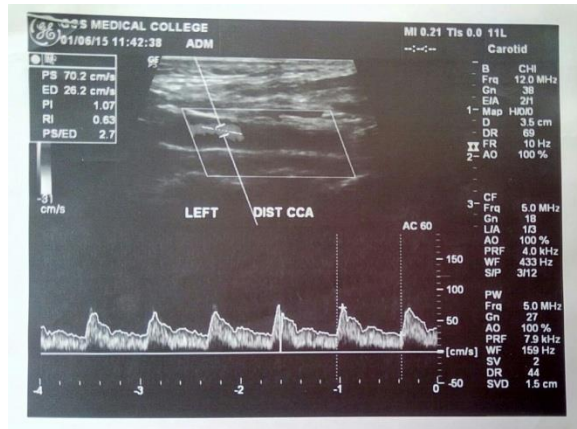


Fig.: Principle of RI measurement . The lower part of illustration shows normal Doppler flow curve with RI = 0.63

Description:

Resistance index	Description
0	Continuous flow
1	Systolic flow, but no diastolic flow
>1	Reversed diastolic flow

Blood pressure was measured by Sphygmomanometer. Lipid profile and HbA_{1c} was estimated by autoanalyzer machine (XL – 640) at the central laboratory of College GCS Medical College , Hospital and Research Centre , Ahmedabad.The data analysis was done by unpaired t-test using software MedCal 11.5.1.0.

Inclusion criteria :

Age : 45 to 75 yrs

Sex : Male and female

Patients with stroke , hypertension and diabetes

Exclusion criteria :

Patients with Atrial Fibrillation, Valvular heart disease

Result:

A total of 60 patients were selected for this study . We have made two groups .

Group A - CV stroke patients

Group B – Hypertensive and diabetic patients

Table 1. shows age group distribution in the study

Parameters	Group A		Group B	
	Mean	SD	Mean	SD
Age	62.8	9.11	53.87	10.06

In our study we found that age is significant parameter for future risk for development of stroke. Difference between two groups was very statistically significant with p=0.0007.

Table No.2 show comparison of Blood pressure in both the groups.

Parameter	Group A		Group B	
	Mean	SD	Mean	SD
Systolic blood pressure	148.07	14.77	138.93	7.04
Diastolic blood pressure	88.33	5.97	84.53	5.75

In our study we found that in comparison of both the groups by t-test for systolic and diastolic blood pressure was statistically significant with p value 0.003 and 0.014 respectively.

Table 3: Shows comparison of Lipid profile.

Parameters	Group A		Group B	
	Mean	SD	Mean	SD
HDL	38.7	5.42	49.91	8.33
LDL	143.37	6.25	113.63	17.42
Triglyceride	136.63	12.11	201.9	55.26
Total Cholesterol	226.37	8.006	202.4	22.08

Above table shows statistical comparison of different parameters of lipid profile between Two Groups. The difference between values of HDL ,LDL, Triglyceride and Total cholesterol shows significance by t-test with $p < 0.0001$ respectively.

Table 4: Shows comparison of HbA1c:

Parameter	Group A		Group B	
	Mean	SD	Mean	SD
HbA1c	8.61	0.84	7.47	0.56

Difference of HbA1c Values between two groups was statistically very significant by $p < 0.0001$ in t-test.

Table No. 5 Shows comparison of common carotid artery resistive index.

Parameter	Group A		Group B	
	Mean	SD	Mean	SD
Right CCA Resistive index	0.81	0.11	0.67	0.07
Left CCA Resistive index	0.83	0.11	0.69	0.09

Difference of CCA resistive index of both the groups was statistically very significant with $p < 0.0001$.

Discussion:

The present study is to demonstrate that carotid haemodynamic alterations expressed in Resistive index was associated with future risk

for development of cerebrovascular event stroke. Originally RI was introduced by Pourcelot et al to detect peripheral vascular disease. Bai, C.-H et al studied that Lower blood flow velocity , higher resistive index and larger diameter of extracranial carotid arteries are associated with ischemic stroke independently of carotid atherosclerosis and cardiovascular risk factors. Nakatou et al measured carotid RI in type II diabetic patients and reported the usefulness of carotid RI in estimating of previous risk of cerebral infarction. In our study we found the difference of right and left CCA resistive index of both the groups was statistically very significant with $p < 0.0001$.

The mean IMT of the common carotid artery is a more reproducible measure than the intima media thickness of the internal carotid artery and is believed to be better suited for cardiovascular risk assessment and intervention studies . In contrast, the resistive index (RI) is a hemodynamic parameter that is easily determined by Doppler sonography and basically reflects vascular resistance according to Pourcelot ⁵. Using Pourcelot's formula, the minimum end-diastolic and systolic peak flow velocities are linked so that the RI increases with decreasing diastolic flow fraction. Like IMT, the RI is clearly correlated with age and with cardiovascular risk factors^(1,2,15) The RI relates to the elasticity or extensibility of the vessel and its related vascular resistance. The extensibility or elasticity of the vessel decreases with age and with any associated cardiovascular risk factors, whereas the related peripheral resistance increases as an expression of the arteriosclerosis.^{17,18,19} Before the appearance of morphological alterations that are detectable from the thickening of the intima-media complex, the early form of arteriosclerosis leads to endothelial dysfunction as an exclusively functional disorder. Even at this stage, it is already associated with increased cardiovascular mortality ^{.20,21} Similarly, before the appearance of sonographically detectable wall thickening, qualitative alterations of the vascular wall lead to reduced elasticity and to

the aforementioned increase in peripheral resistance.²⁰⁻²⁴ A low or normal RI may represent a still healthy vessel not damaged by arteriosclerosis. In contrast, with a still normal IMT, there may already be ultrastructural and functional alterations not detectable by the sonographic measurement. The fact that the increase in relative risk is correlated more strongly with RI than with IMT supports the assumption that RI detects the arteriosclerotic process at least as early as IMT. In our study we found that right CCA and Left CCA resistive index mean value

Age, vascular risk factors and clinically demonstrated vascular diseases are associated with an increase in RI^{25,26}. 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 $p=0.0007$. Age is an important nonmodifiable risk factor for stroke. The mean age of stroke onset in India (i. e., 63 years) is lower than that in Western countries (68 years in the USA and 71 in Italy).²³ There were several studies in India determining risk factors of stroke.

Carotid RI is related with age, systolic-diastolic blood pressure and LVMI (left ventricular mass index) in hypertensive patient. This evaluation could predict the presence of early cardiovascular damage and provide an accurate estimation of overall risk in this population. In our study we found that in comparison of both the groups by t-test for systolic and diastolic blood pressure was statistically significant with p value 0.003 and 0.014 respectively. A multicentric, hospital-based, case-control study in the 1990s revealed that diabetes mellitus, hypertension, tobacco use, and low hemoglobin, rather than cholesterol level, were the most important risk factors of ischemic stroke.^[8] The major risk factors identified in a recent North Indian study were hypertension (a diastolic blood pressure >95 mmHg), hyperglycemia, tobacco use, and low hemoglobin levels (<10 g%).^[14] All these studies indicate the importance of controlling

hypertension and biochemical risk factors and avoiding smoking.

In Statistical comparison of different parameters of lipid profile between two groups we found the difference between values of HDL, LDL, Triglyceride and Total cholesterol in both the groups statistically very significance by t-test with $p<0.0001$ respectively. In our study the mean concentrations of total cholesterol and low-density lipoprotein (LDL)-cholesterol are higher but those of triglycerides are lower in case group than in control group.^[27] Low high-density lipoprotein (HDL) and elevated low-density lipoprotein (LDL) was observed among stroke patients.⁹ In our study we found difference of HbA1c Values between two groups was statistically very significant by $p<0.0001$ in t-test.

Conclusion:

Carotid haemodynamic alterations expressed in Resistive index should be measured for future risk of development of stroke in hypertensive and diabetic patients with advance age. These findings need to be confirmed by a prospective study.

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