ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 01 | January - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COLOUR DOPPLER EVALUATION OF CAROTID ARTERY IN ACUTE ISCHAEMIC STROKE PATIENTS AND ITS ASSOCIATION WITH VARIOUS RISK FACTORS

Radio-Diagnosis

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ABSTRACT

INTRODUCTION: Stroke is one of the most common causes of death. Stroke is classified depending upon its etiology into either ischemic stroke (85%) or haemorrhagic stroke (15%) about 80% of strokes are thromboembolic in origin. Stroke is one of the leading causes of death and morbidity. The patient, family members, and caregivers are all affected by stroke-related neurological dysfunction.

AIM: To evaluate the role of carotid Doppler sonography in patients presenting with acute ischemic stroke and find an association between carotid artery stenosis and risk factors such as hypertension, diabetes mellitus, hyperlipidaemia, smoking age and sex.

MATERIAL AND METHODS: This study was carried out on 85 patients who had symptoms and Sign of strokes, or transient ischemic attacks at GMCH, Udaipur, during the period of one and half year. Detailed clinical history and findings were recorded like hypertension. diabetes mellitus, smoking and ischemic heart disease. CT/MRI Scan examination finding was noted in the patients wherever available.

RESULTS: 74 patients have <50% stenosis, 18 had 50-69% stenosis and 2 had completely occluded vessels. 67 patient's showed changes in the carotid arteries due to atherosclerosis which include increased carotid intima-media thickness and various types of plaques. Negative correlation were found between PSV of left ICA and hypertension diabetes, dyslipidemia and smoking.

CONCLUSION: Describing carotid color doppler as an efficient tool in evaluating atherosclerotic changes in carotid arteries in stroke patients or high-risk patient. Carotid color doppler can give us information about the thickness of CIMT, exact morphology and location of plaque, percentage of luminal narrowing, according to stenosis change in the peak systolic velocity in ICA & CCA, so carotid doppler examination can be used as a screening & diagnostic tool with a reasonable degree of diagnostic accuracy.

KEYWORDS

Colour Doppler, ICA, CCA, CIMT

INTRODUCTION

A stroke is a sudden onset of a focal neurological deficit caused by disorders of the cerebral vasculature and its contents. In India, community surveys show that the crude prevalence of hemiplegia is 200 per 100,000 people, accounting for nearly 1.5% of all urban hospitalizations, 4.5% of all medical cases, and about 20% of neurological cases.[1]

Stroke is one of the most common causes of death. Stroke is classified depending upon its etiology into either ischemic stroke (85%) or haemorrhagic stroke (15%) about 80% of strokes are thromboembolic in origin. Stroke is one of the leading causes of death and morbidity. The patient, family members, and caregivers are all affected by stroke-related neurological dysfunction. 17 percent will remain in institutions, while 25-30 percent will require moderate to entire assistance with everyday tasks.[2]

Atherosclerotic cerebral vascular disease is a disabling and life-threatening event can cause fatal neurological condition. It is the world's third greatest cause of death, after cancer and heart disease. Studies have shown that there is a close relation between carotid artery stenosis and ischemic cerebrovascular disease.[3]

Carotid Doppler Ultrasonography, transcranial Doppler, CT angiography, Magnetic Resonance angiography, and contrast enhanced Magnetic Resonance angiography are all non-invasive vascular procedures that can now be utilised to evaluate Carotid artery atherosclerosis.

The importance of a safe, non-invasive, and low-cost screening test is enormous. One such method is a Doppler ultrasonography investigation of the carotid system. Duplex sonography, which combines high-resolution grey scale imaging with Doppler spectrum analysis, has shown to be a popular, non-invasive, accurate, and cost-effective method of evaluating carotid artery disease.

Another main objective here is the risk factors and their analysis. Factors such as age, sex, and ethnicity are nonmodifiable, but hypertension, diabetes, dyslipidaemia, smoking, etc. provide us with important targets to help in our goal of stroke prevention. Our studies also explore individual risk factors to look into which would be the most dangerous risk factor here and should be watched out for the most.

Accurate diagnosis of significant stenosis is essential for identifying those Patients who will benefit from surgical intervention. Carotid endarterectomy/stenting is more beneficial than drug therapy in symptomatic treatment more than 70% of patients with carotid artery stenosis. Ultrasound can also assess plaque morphology, such as haemorrhagic or ulcerative Plaque, which increases the risk of thromboembolic events.[4]

AIM OF THE STUDY

AIM: To evaluate the role of carotid Doppler sonography in patients presenting with acute ischemic stroke and find an association between carotid artery stenosis and risk factors such as hypertension, diabetes mellitus, hyperlipidaemia, smoking age and sex.

MATERIAL AND METHODS

This study was carried out on 85 patients who had symptoms and Sign of strokes, or transient ischemic attacks at GMCH, Udaipur, during the period of one and half year. Detailed clinical history and examination findings were recorded. Detailed history of risk factors like hypertension. diabetes mellitus, smoking and ischemic heart disease were noted. CT/MRI Scan examination finding was noted in the patients wherever available.

The data gathered from the colour Doppler examination consisted of: Carotid intima media thickness on Gray scale. Peak Systolic velocity of common carotid artery. Peak systolic velocity of internal carotid artery. Velocity ratios between internal carotid artery and common carotid artery. Plaque characteristics and site seen on the real time image. The presence of Spectral broadening. All the examinations were performed with Doppler angle <60 degree. Carotid doppler Scanning was performed with Voluson E8 and E10 Ultrasound Machine with 7.5 MHz linear Array Transducer.

METHOD OF EXAMINATION OF CAROTID ARTERIES

Examination of the carotid artery in a supine position. Position, neck slightly extended & head tilted to opposite side from the side which is

being examined with use of a 7.5 MHz sensor probe.

Supine position with head tilted away from side of interest. Equipment gains and display settings were optimized while imaging vessels with respect to depth, dynamic range, and focal zones. Colour-flow Doppler images with proper colour scale to demonstrate areas of high flow and colour aliasing. Spectral Doppler gains was set to allow a spectral window and optimized to reduce artifact. An angle of 60 degrees or less was used to measure velocities. Doppler angle should always be parallel to the vessel wall.

In transverse plane, label External (E) and Internal (I) carotid arterials just distal to the bifurcation. Areas of suspected stenosis or obstruction included spectral Doppler waveforms and velocity measurements recorded at and distal to the stenosis or obstruction. Sites of examination included spectral Doppler waveforms and velocity measurements from the proximal, mid, and distal sites. Transverse images are taken perpendicular to the long axis of the vessel. Longitudinal images are taken along the long axis of the vessel.

Plaque was assessed and characterized as smooth, irregular, homogenous, or heterogeneous. Colour and spectral Doppler imaging may provide additional information including improved visualization of hypoechoic plaque. Transverse grayscale and colour images of moderate to severe plaque was documented. For ICA/CCA Peak Systolic Velocity ratio, use the highest PSV in the internal carotid artery and the PSV in the distal common carotid artery. Obtained bilateral brachial blood pressures.

Image bilateral subclavian arteries if unable to measure blood pressure on bilateral side. Obtained the PSV of subclavian and compare right to left. If there is a >20 cc/sec difference in the PSV or the BP from left to right, consider subclavian steal. Obtained waveforms of both the medial and lateral aspects of the subclavian artery.

Commonly used methods of acoustic estimation of the degree of stenosis includes the following:

- Measurement of peak systolic velocities and end diastolic velocities
- Measurement of ratios (e.g., Internal Carotid artery peak systolic velocity /Common Carotid artery peak systolic velocity).

A consensus conference in 2003 of the Society of Radiologists in Ultrasound recommended the following criteria for estimating stenosis: The same criteria is used in our study. As per the criteria it is classified as

- Normal: Peak ICA systolic velocity <125 cm, no visible plaque or intimal thickening.
- <50% stenosis: peak internal carotid artery systolic velocity <125 cm and visible plaque or intimal thickening.
- Stenosis 50-69%: The peak systolic velocity of the internal carotid artery is 125-230 cm and plaque are visible.
- >70% stenosis to near occlusion: peak systolic velocity of the internal carotid artery >230 cm and visible plaque and lumen stenosis
- Near occlusion: A markedly narrowed lumen is seen on colour Doppler ultrasound.
- Total occlusion: No detectable patent lumen is seen on grayscale ultrasound, and no flow is seen on spectral, power, and colour Doppler ultrasound.

RESULTS

Table 1: Risk Factors With Gender

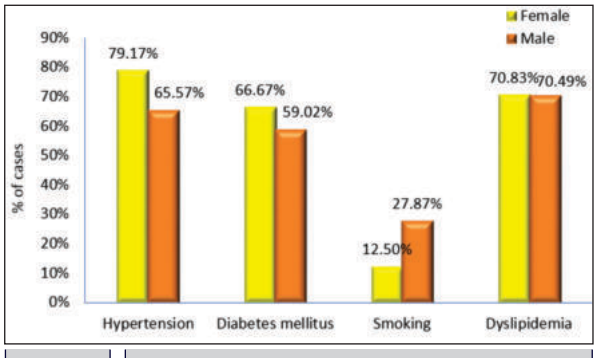


Table 1: Stenosis And Age Group

Age Group	<50%		50-69%		>70%		Occluded		No stenosis	
	No.	%	No.	%	No.	%	No.	%	No.	%
21-30	0	0.00%	0	0.00%	0	0.00%	0	0.00%	6	8.22%
31-40	5	6.76%	0	0.00%	0	0.00%	0	0.00%	15	20.55%
41-50	6	8.11%	2	11.11%	1	33.33%	0	0.00%	11	15.07%
51-60	26	35.14%	6	33.33%	1	33.33%	1	50.00%	6	8.22%
61-70	22	29.73%	6	33.33%	0	0.00%	1	50.00%	17	23.29%
71-80	15	20.27%	4	22.22%	1	33.33%	0	0.00%	18	24.66%
Total	74		18		3		2		73	

Table 2: Visible Plaque

SIDE	LEFT SIDE		RIGHT SIDE	
	NO.	PERCENTAGE	NO.	PERCENTAGE
Normal (CIMT ≤ 0.7)	17	20%	25	29.41%
No Plaque (CIMT≥0.8)	15	17.65%	16	18.82%
Type 1 Plaque	20	23.53%	20	23.53%
Type 2 Plaque	12	14.12%	14	16.47%
Type 3 Plaque	16	18.82%	10	11.76%
Type 4 Plaque	4	4.71%	-	-

Table 3: Correlations Of Hypertension, Diabetes, Smoking And Dyslipidemia With Ica/ Cca Psv Ratio In Stroke Patients

Risk Factors	Left ICA/ CCA	Right ICA/ CCA
Hypertensive Correlation P value	0.046 >0.05	-0.027 >0.05
Diabetic Correlation P value	0.065 >0.05	0.047 >0.05
Smokers Correlation P value	-0.138 >0.05	0.096 >0.05
Dislipidemia Correlation P value	0.072 >0.05	-0.099 >0.05

Table 4: Correlations Of Hypertension, Diabetes, Smoking And Dyslipidemia With Psv ICA In Stroke Patients

Risk Factors	Left PSV ICA	Right PSV ICA
Hypertensive Correlation P value	0.145 >0.05	0.051 >0.05
Diabetic Correlation P value	0.086 >0.05	-0.061 >0.05
Smokers Correlation P value	-0.056 >0.05	0.071 >0.05
Dislipidemia Correlation P value	0.162 >0.05	-0.104 >0.05

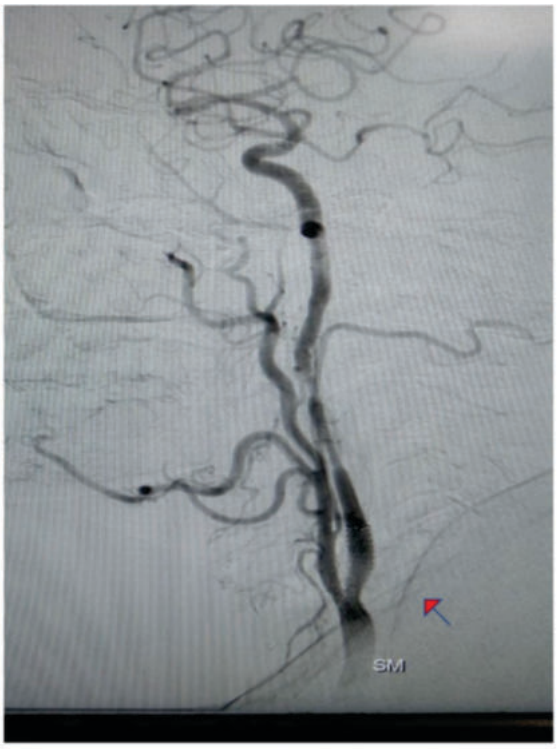
CCAs: Common carotid arteries. *Correlation is significant

Table 5: Correlations Of Hypertension, Diabetes, Smoking And Dyslipidemia With Psv Cca In Stroke Patients

Risk Factors	Left PSV CCA	Right PSV CCA
Hypertensive Correlation P value	0.154 >0.05	0.111 >0.05
Diabetic Correlation P value	0.056 >0.05	-0.032 >0.05
Smokers Correlation P value	0.026 >0.05	-0.034 >0.05
Dislipidemia Correlation P value	0.174 >0.05	-0.037 >0.05

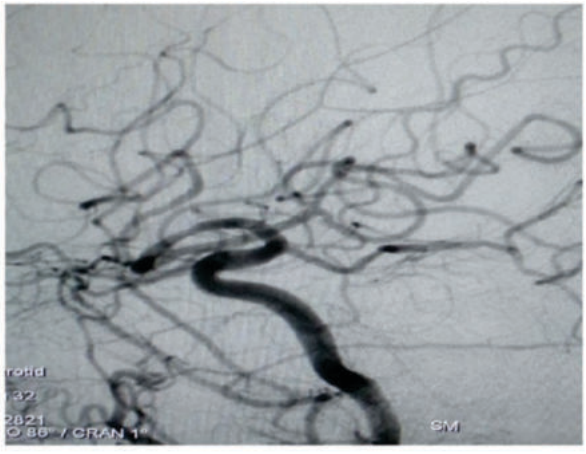
DS angiogram of the neck obtained at the beginning of the procedure confirmed 90% stenosis (arrow).

Case 1



Lateral angiogram shows that after angioplasty of the stent with a 6 3 40-mm balloon, the lumen of the ICA (arrow) is normal. The stent is well attached to the arterial walls in the ICA and CCA. The external carotid artery (arrowhead) is patent

Case 2.



Anteroposterior angiogram of the right CCA obtained after stent placement documents restored normal perfusion of the anterior cerebral arterial territory (arrow). This perfusion was absent before treatment

Case 3

DISCUSSION

Out of 85 patients 59 patients had hypertension out of which 40 patients was Male & was 19 Female. 52 patients had diabetes mellitus out of which 36 patients was Male & was 16 Female. 20 patients had history of smoking out of which 17 patients was Male & was 3 Female. 60 patients had dyslipidemia and out of which 43 patients was Male & was 17 Female.

Sethi et al also stated that among the various modifiable risk factors, hypertension had the most striking association with stroke in our study (69%). Hypertension was closely followed by smoking and dyslipidemia (61%). Diabetes and previous history were present in 12 patients.[5]

A.P.S. Tomar et al found that stroke is more common in men, with 58% of patients being men and 42% of patients being women. This is more common in the 5th and 6th decade. The most common risk factor for stroke is high blood pressure, followed by smoking.[6]

Among total patients 85 patients we will have 170 carotid arteries out of which 74 patients have < 50% stenosis, the age distribution was maximum in the age group of 51-60 & 61-70 years. Next was the age group of 71-80 years with 15 patients. 18 patients have 50-69% stenosis. 73 patients don't have any stenosis on either side. 2 patients have completely occluded vessels.

Shovan Kumar Das et al In this age and sex matched study, higher CIMT measurement was found among patients of acute ischemic stroke than healthy controls (0.849 ± 0.196 vs 0.602 ± 0.092; p < 0.001). The CIMT was well correlated with smoking (Beta = 0.295; t = 5.728; 95% CI 0.088 to 0.181; p < 0.001); hypertension (Beta = 0.387; t = 6.518; CI 0.112 to 0.209; p < 0.001); diabetes (Beta = 0.237; t = 4.848; CI 0.074 to 0.175; p < 0.001); hypercholesterolemia (Beta = 0.292; t = 5.840; CI 0.096 to 0.195; p < 0.001), but not with age (p = 0.153). The CIMT was also found to be higher among acute ischemic stroke patients who were smoker, hypertensive, diabetic and hypercholesterolemic than non-smoker, normotensive, non-diabetic and normo-cholesterolemic respectively. So, in our study results were similar to previous study.[7]

In our study among 85 patients 17 patients have normal CIMT & 15 patients show raised CIMT but don't have any plaque. 52 patients show atheromatous plaques in which 20 patients have type 1 plaques, 12 patients have type 2 plaque, 16 patients have type 3 plaque & 4 patients have type 4 plaques on left side.

On right side among 85 patients 25 patients have normal CIMT & 16 patients show raised CIMT but don't have any plaque. 34 patients show atheromatous plaques in which 20 patients have type 1 plaques, 14 patients have type 2 plaque, 10 patients have type 3 plaque & none patients have type 4 plaques.

Hence it is observed that 67 of our patient's showed changes in the carotid arteries due to atherosclerosis which include increased carotid intima-media thickness and various types of plaques. Hence increased intima-media thickness alone with or without visible plaques can be taken as one of the risk factors for developing stroke.

Einstein et al. found in his study that Out of a total of 200 arteries, 144 arteries had IMT within the normal range and 56 arteries were above the normal range. In patients <60 years of age, only 4 of 74 arteries have IMT. >0.8 mm, and in patients >60 years old, 46 of the 124 arteries. Four patients aged 80-90 years had an IMT <0.8 mm. The 60-69 age group has the largest number of arteries, that is, 14 IMT> 0.8 mm.[8]

Madhavi Chamarthi et al. found that approximately 111 plaques were evaluated in a total of 150 blood vessels examined. Out of the 111 plaques, 34 (31%) were calcified, 33 (30%) were uniformly echogenic, 27 (24%) were predominantly echogenic, 10 (9%) were predominantly echo lucent and 7(6%) were uniformly echo lucent. Two vessels were completely occluded.[9] so, finding in our study are almost similar to previous studies.

Correlations of hypertensive, diabetic, dyslipidemia and smokers with ratio peak systolic value of ICA/CCA in the participants. Hypertension have a significant positive association with ratio peak systolic value of ICA/CCA, (P = >0.05 and 'r' value -0.027). Diabetic, dyslipidemia and smoker had a negative correlation with ratio peak systolic value of left ICA/CCA.

Correlations of peak systolic velocity (PSV) of left ICA in carotid arteries with, hypertension, diabetes, smoking and dyslipidemias. Negative correlations were found between PSV of left ICA and hypertension diabetes, dyslipidemia and smoking (P = >0.05,>0.05, >0.05 and >0.05 respectively) & ('r'= 0.145, 0.086, -0.056 & 0.162). Summarizes correlations of peak systolic velocity (PSV) of right ICA in carotid arteries with, hypertension, diabetes, smoking and dyslipidemias. Negative correlations were found between PSV of left ICA and hypertension diabetes, dyslipidemia and smoking (P = >0.05,>0.05, >0.05and >0.05 respectively) & ('r'= 0.051, -0.061, 0.071 & -0.104).

Correlations of peak systolic velocity (PSV) of left CCA in carotid arteries with, hypertension, diabetes, smoking and dyslipidemias. Negative correlations were found between PSV of left ICA and hypertension diabetes, dyslipidemia and smoking (P>0.05, >0.05, >0.05 and >0.05respectively) & ('r'= 0.154, 0.056, 0.026 & 0.174). it also Summarizes correlations of peak systolic velocity (PSV) of right

CCA in carotid arteries with, hypertension, diabetes, smoking and dyslipidemias. Negative correlations were found between PSV of left ICA and hypertension diabetes, dyslipidemia and smoking (P = >0.05,>0.05, >0.05 and >0.05respectively) & ('r'= 0.111, -0.032, -0.034 & -0.037), however prevalence of various risk factors like hypertension, diabetes, dyslipidemia & smoking were high in stroke patients.

These data are consistent with the views of Siddhartha Das et al. The results are based on ultrasound measurements and indicate that there are significant association between diabetes, hypertension and smoker stroke, dyslipidemias and CIMT, & PSV ratio of ICA/CCA values (P> 0.05). The current study proposes that positive correlation of PSV ratio of ICA/CCA with hypertension (correlation 0.046), dyslipidemia (correlation 0.072), diabetes (correlation 0.065), & smoker (correlation -0.138) patients and the p>0.05.[7] So, in our study only hypertension has positive corelation with PSV of ICA, rest other findings are not similar to previous study.

CONCLUSION

Describing carotid color doppler as an efficient tool in evaluating atherosclerotic changes in carotid arteries in stroke patients or high-risk patient. Carotid color doppler can give us information about the thickness of CIMT, exact morphology and location of plaque, percentage of luminal narrowing, according to stenosis change in the peak systolic velocity in ICA & CCA, so carotid doppler examination can be used as a screening & diagnostic tool with a reasonable degree of diagnostic accuracy.

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