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ORIGINAL RESEARCH

Assessment of prevalence of carotid and vertebral artery stenosis in acute stroke patients

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Abstract
Background: Stroke is a leading cause of disability and death worldwide. The World Health Organization defines stroke as a rapid onset of focal or global cerebral dysfunction, lasting 24 hours or longer, with no apparent cause other than vascular origin. The brain's blood supply comes from four vessels, including the internal carotid arteries and vertebral arteries. Hence; the present study was conducted for assessing the prevalence of carotid and vertebral artery stenosis in acute stroke patients.
Materials & methods: The cross sectional observational study was conducted in the Department of General Medicine, L.N. Medical College and J. K. Hospital, Kolar Road, Bhopal, M.P. 75 patients admitted to the hospital with acute stroke aged above 18 years and patient or attendant giving informed consent. The clinical profile of patients was evaluated. The radiological investigations were performed as per the guidelines. The following symptoms suggestive of Stroke were evaluated: Motor Weakness, Headache / Dizziness, Altered Sensorium, Memory, Speech, Cranial nerves, Sensory deficits, Visual disturbances,etc. If any of these symptoms were present, the duration of symptoms was noted. Carotid and vertebral artery stenosis was assessed by means of non-invasive ultrasonography of the carotid and vertebral arteries. High frequency linear probe (5-12 Hz) Ultrasonography combines gray scale ultrasound images with a Color Doppler ultrasound assessment of blood flow velocity.
Results: Results categorizes subjects based on Doppler ultrasound findings into Normal study, Mild, Moderate, Severe and Complete stenosis. The frequency distribution of Doppler findings categorized by the vascular territory involved (MCA, ACA, and Posterior Circulation). It lists the number of cases for each Doppler finding type: Normal study, Mild, Moderate, Severe and Complete stenosis. The Chi-square value is 9.48 with a p-value of 0.661, indicating no significant association
Conclusion: The study revealed that anterior circulation strokes were more common, accounting for 80% of cases, while middle cerebral artery territory was most vulnerable to vascular disease. The majority (53.3%) had normal Doppler findings and stenosis was observed in 46.7% cases, in which 30.3% cases had significant stenosis.
Key words: Carotid, Vertebral Stenosis

Introduction

Globally, stroke is a major cause of disability and the second greatest cause of death.[1] According to the definition proposed by the World Health Organization, "stroke is rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer, or leading to death, with no apparent cause other than of vascular origin".[2] The American Stroke Association for the 21st Century recently proposed a revised definition of stroke that includes clinical and tissue criteria. This is a much broader definition that encompasses any objective evidence, with or without clinical symptoms, of irreversible death of brain, spinal cord, or retinal cells linked to a vascular origin based on pathology or imaging evidence.[3- 5]

The brain is supplied by four vessels: the two internal carotid arteries (ICAs) and the two vertebral arteries. The internal carotid artery, being one of the most clinically relevant and vital arteries, supplies

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oxygenated blood to crucial structures such as the brain and eyes. The internal carotid arteries are branches of the common carotid arteries that bifurcate into the internal and external carotids at the level of the carotid sinus.[6] After this bifurcation, the internal carotids traverse through the base of the skull to reach the vital organs that they supply. Anatomically, the vertebral artery is divided into five segments (V0–V4).[7- 9] The first (V1) segment extends from the origin (V0) from the subclavian artery to its entry into the foramen of the transverse process of the sixth vertebrae (C6). V0/V1 is important as it is prone to hemodynamically significant lesions due to atherosclerosis or dissection.[10-11]

Determining the prognosis and customizing and monitoring the right course of treatment during the acute phase of an ischemic stroke depend on evaluating the etiology and mechanism. For many years, ultrasound has developed into a very good screening tool for assessing the extracranial and intracranial vasculature.[12- 14] It can also adequately supplement other acute imaging modalities such as computed tomography angiography (CT/CTA) or magnetic resonance imaging/magnetic resonance angiography (MRI/MRA). Ultrasound of carotid and vertebral arteries (cervical duplex ultrasonography; CDU) is an essential part of the diagnostic workflow in every acute stroke unit, and has some key advantages: high temporal and spatial resolution, real-time evaluation, low cost, bed side application of an exam that can be repeated multiple times throughout hospitalization without exposing the patient to any serious complications.[15] Hence; the present study was conducted for assessing the prevalence of carotid and vertebral artery stenosis in acute stroke patients

Materials & methods

The present study was conducted for assessing the prevalence of carotid and vertebral artery stenosis in acute stroke patients. The cross sectional observational study was conducted in the Department of General Medicine, L.N. Medical College and J. K. Hospital, Kolar Road, Bhopal, M.P. 75 patients admitted to the hospital with acute stroke aged above 18 years and patients or attendants giving informed consent were included in the study. Patient or attendant not giving informed consent, old CVA patients and Head injury patients were excluded from the study. The clinical profile of patients was evaluated. The radiological investigations were performed as per the guidelines. The following symptoms suggestive of Stroke were evaluated: Motor Weakness, Headache / Dizziness, Altered Sensorium, Memory, Speech, Cranial nerves, Sensory deficits, Visual disturbances, etc. If any of these symptoms were present, the duration of symptoms was noted. Carotid and vertebral artery stenosis was assessed by means of non-invasive ultrasonography of the carotid and vertebral arteries. High frequency linear probe (5-12 Hz) Ultrasonography combines gray scale ultrasound images with a Color Doppler ultrasound assessment of blood flow velocity. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) software version 28.0. Data was represented by frequency/percentages, mean and SD. The Chi-square test was used to check significance.

Results

The largest age group is 61-70 years, comprising 36.0% of the subjects, followed by the 51-60 years group with 26.7%. The least represented age group is 21-30 years, with only 2.7%. There are 58 males (77.3%) and 17 females (22.7%), indicating a predominance of male subjects in the study. The majority of subjects, 64.0%, are from rural areas, while 36.0% are from urban areas, highlighting a higher participation from rural communities. The Lower class has the highest representation at 28%, followed by the Upper-middle class at 25.3%. The Upper class has the least representation at 2.7%. Table 1 categorizes subjects based on Doppler ultrasound findings into Normal study, Mild, Moderate, Severe and Complete stenosis. The majority (53.3%) have normal Doppler findings and minimum - complete stenosis found in 5.3% subjects. Table 2 shows the frequency distribution of Doppler findings categorized by the vascular territory involved (MCA, ACA, and Posterior Circulation). It lists the number of cases for each Doppler finding type: Normal study, Mild, Moderate ,severe and Complete stenosis. The Chi-square value is 9.48 with a p-value of 0.661, indicating no significant association.

Table 1: Distribution of study subjects according to the Doppler finding of the Carotid or Vertebral Artery of the Affected side of Infarct

Doppler findings	Number	Percentage
Normal Study	40	53.3
Mild stenosis (<50%)	13	17.3
Moderate stenosis (50-69%)	11	14.7
Severe stenosis (>70%)	7	9.3
Complete stenosis	4	5.3

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Table 2: Relation of Doppler findings with vascular territory involved in study subjects.

Doppler findings	Vascular territory		
	MCA	ACA	Posterior circulation
Normal Study	29	5	10
Mild stenosis (<50%)	11	3	0
Moderate stenosis (50-69%)	10	3	4
Severe stenosis (>70%)	7	1	0
Complete stenosis	3	1	1

Chi square value – 9.48; p value- 0.661

Discussion

Stroke is the second leading cause of death globally and the primary neurological disorder affecting adults. It is characterized by localized brain dysfunction, typically manifesting as hemiplegia, often accompanied by symptoms such as aphasia, hemisensory loss, visual field defects, or brainstem deficits. Stroke occurs when brain tissue is damaged due to interrupted blood flow (ischemia) or bleeding (haemorrhage). Ischemic stroke can result from various factors, including atherosclerosis, embolism, thrombosis, vasoconstriction, or from venous pathology.[16]

The largest age group is 61-70 years, comprising 36.0% of the subjects, followed by the 51-60 years group with 26.7%. The least represented age group is 21-30 years, with only 2.7%. There are 58 males (77.3%) and 17 females (22.7%), indicating a predominance of male subjects in the study. The majority of subjects, 64.0%, are from rural areas, while 36.0% are from urban areas, highlighting a higher participation from rural communities. The Lower class has the highest representation at 28%, followed by the Upper-middle class at 25.3%. The Upper class has the least representation at 2.7%. The subjects based on Doppler ultrasound findings into Normal study, Mild stenosis, Moderate, Severe and Complete stenosis. The majority (53.3%) have normal Doppler findings. Fernandes M et al conducted study to assess the carotid arteries with the help of colour Doppler sonography and to correlate cerebrovascular accidents. Of 50 patients, 12 patients showed significant stenosis (>60%). Atherosclerotic plaques were seen in 39 patients (78%). In our study, 53.3% patients had normal carotid and vertebral arteries which may be due to several reasons: (i) some strokes are caused by small vessel disease, (ii)Cardio embolic strokes – in which embolus that originate in the heart can cause stroke, (iii)emboli originating from other arteries, (iv) conditions like vasculitis, hypercoagulable state, or genetic disorders, and (v) undetermined etiology- despite a complete evaluation, the etiology of ischemic stroke remains unknown in about 30% of patients.[8]

The frequency distribution of Doppler findings categorized by the vascular territory involved (MCA, ACA, and Posterior Circulation). It lists the number of cases for each Doppler finding type:Normal study, Mild, Moderate, Severe and Complete stenosis. The Chi-square value is 9.48 with a p-value of 0.661, indicating no significant association In a comparative study by Allendoerfer et al, 121 (34%) had a normal MCA, 176 (48%) had branch occlusions, 7 (2%) had severe MCA stenosis, and 57 (16%) had a main-stem occlusion.[17]

Khan S et al identified studies that used non-invasive imaging and IAA as the reference standard to determine vertebral artery stenosis and provided adequate data to calculate sensitivity and specificity and analysed the quality of these studies, looked for evidence of heterogeneity and performed subgroup analysis for different degrees of stenosis. Posterior circulation stroke accounts for 20% of ischaemic strokes. Recent data suggest that the early stroke recurrence risk is high and comparable with carotid artery disease. Vertebral artery stenosis accounted for approximately 20% of posterior circulation stroke, and with endovascular treatment available accurate diagnostic imaging is important.[18]

Conclusion

The study revealed that anterior circulation strokes were more common, accounting for 80% of cases, while middle cerebral artery territory was most vulnerable to vascular disease. Results categorizes subjects based on Doppler ultrasound findings into Normal study, Mild, Moderate, Severe and Complete stenosis. The majority (53.3%) had normal Doppler findings and stenosis was observed in 46.7% cases, in which 30.3% cases had significant stenosis. These findings emphasize the importance of early hypertension detection and management, vascular risk factor assessment, Doppler ultrasound screening, cardiac evaluation, and stroke prevention strategies.

These findings highlight the importance of non-invasive ultrasonography in assessing carotid and vertebral artery stenosis in acute stroke patients. Early detection and diagnosis of stenosis can help guide treatment decisions and improve patient outcomes.

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