

To Determine Frequency of Carotid Stenosis in Patients with Recurrent Stroke

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ABSTRACT

Objective: To determine frequency of carotid stenosis in patients with recurrent ischemic stroke by Doppler ultrasound

Study design: Cross sectional study

Place and Duration: This study is performed at Divisional Headquarter Teaching Hospital, Mirpur AJK from January 2021 to January 2022

Methodology: This study is conducted in sample size of 99 patients, with history of minor stroke or TIA within three month. Now presented with recurrent ischemic stroke. All patients with recurrent ischemic stroke advised carotid Doppler of extracranial carotid arteries. Carotid artery intima media thickness, thrombus, atheromatous plaques and percentage of carotid stenosis and peak systolic flow velocity of affected artery were also determined on Doppler Ultrasound. In addition, association between carotid stenosis and its risk factors such as Age, gender, Hypertension, diabetes, smoking and dyslipidemia is also determined.

Results: We found that 59% of study population with recurrent ischemic stroke have carotid stenosis and percentage of carotid stenosis is variable among study population. Out of 99 patients with recurrent stroke 52% population are Hypertensive, 46% have diabetic, and 58% are smoker and 51% have Dyslipidemia.

Conclusion: We concluded that carotid artery stenosis is a risk factor for Recurrent ischemic stroke. It predisposes patients to further attacks of stroke in future. So Doppler Ultrasound must be advised to every patient with history of minor stroke/TIA. So that early intervention should be offered to patients to reduce risk of recurrent ischemic stroke.

Keyword: Carotid stenosis, carotid Doppler or Duplex scan, Stroke /TIA

INTRODUCTION

Ischemic stroke is defined as acute onset of focal neurological deficit in a vascular territory as a result of cerebrovascular disease. TIA is defined as a brief episode of neurological dysfunction caused by focal ischemia of brain, spinal cord or retina without acute infarction and duration less than 24 hours. Recurrent stroke any stroke that occurs 24 hours after an incident stroke in a different vascular territory or stroke that occurs in the same vascular territory 21 days after incident stroke¹. In United state there is 800000 stroke every year. Stroke is 5th leading cause of death and 1st leading cause of disability¹. There is a new stroke every 40 seconds². So, both ischemic stroke and TIA result in loss of neurological functions due to ischemia. As Both Ischemic stroke and TIA share same pathophysiology, carotid artery stenosis is a risk factor for developing stroke/TIA. According to WHO, 15 millions suffer stroke worldwide each year. Of these, 5 millions people die 5 millions suffer permanent disability³. Each year 150,000 patients die as a direct result of stroke while 600,000 patients develop complications such as Aphasia, bladder dysfunction and paralysis⁴. The prevalence of ischemic stroke is 88-92% of total strokes⁵. Almost 1/3rd of all Ischemic stroke attributed to carotid occlusion disease. Thereby, clinically significant Carotid artery Stenosis (stenosis >70%) can be detected Earlier on Doppler Ultrasound and it represents an important step in prevention of Cerebral Infarction⁶. Atheromatous disease affecting extracranial carotid artery is frequently found at bifurcation of proximal part of Internal Carotid artery and it is one of the leading cause of ischemic Stroke. The prevalence of carotid stenosis increases with advancing age, male gender, smoking, hypertension, diabetes and hyperlipidemia. Hypertension is a modifiable risk factor for atherosclerosis as it increases thickness of intima media of vessel wall⁷. Atherosclerosis is one of major causes of stroke and it causes occlusion of both extra and intracranial vessels and embolization from atheromatous plaque⁸. Carotid stenosis is a complex disease that causes atherosclerosis of extra cranial or intracranial vessel that results in reduced or absent blood flow in the vessels which encircles or supply Brain.

Doppler Ultrasound of Carotid arteries is an important step to detect the presence of atherosclerosis, stenosis or occlusion of carotid vasculature in acute stroke. It is a cheap and readily available investigation, that allows early detection of carotid stenosis in stroke patients. The overall 1 year mortality rate after ischemic stroke is 33% and after 1 year 37% survivor become dependent and 9% survivors present with recurrent ischemic stroke⁹. However prognosis after stroke is highly variable and it depends on stroke severity (calculated by NIHSS) and on patient comorbid conditions such as Age, gender and post stroke complication¹⁰. So as per stroke latest Guidelines Doppler ultrasound of carotids must be advised to every patient with an ischemic stroke/TIA to reduce risk of recurrent Ischemic stroke.

MATERIAL AND METHODS

A cross sectional Hospital based study conducted from January 2021 to January 2022 at General Medicine department of DHQ hospital Mirpur AJK. The study is designed to determine frequency of carotid stenosis using Doppler ultrasound (Duplex scan) in patients with history of recurrent ischemic stroke. A sample size of 99 was calculated confidence level 95% with margin of $\pm 5\%$ with population proportion value of $p=0.90$ using formula $Z_{21} \cdot \frac{p}{s} \cdot 1 - P/E^2$ with the help of WHO calculator. Of these 99 patients who has history of at least one attack of Minor stroke [NIHSS <3] or high risk TIA (ABCD2 score >4) within 3 month of either gender, age >30 now again presented with recurrent attack of stroke were included in study^{11,12}. These patient with recurrent stroke attack are then subjected to carotid Doppler to detect carotid stenosis. Patients with cerebral trauma or intracerebral/intraventricular hemorrhage, subdural, epidural and Subarachnoid Hemorrhages, pregnant and lactating women are excluded. Patient were assessed as a case of ischemic Stroke on CT scan brain shows hypodense area (Ischemic infarction) and rule out Hemorrhage. Carotid artery stenosis assessed by using Doppler Ultrasound of carotids. Carotid Doppler also detects the presence of thrombus, atheromatous plaques, thickness of vessel wall and percentage of carotid stenosis and Peak systolic flow velocities¹³. After obtaining Approval from Institutional Ethic Review Board (IERB) patient are

subjected to study according to inclusion criteria. Written informed consent was obtained from study population and objectives of the study were explained to study population. Patient Name, age, laboratory reports was entered in specially designed Proforma. And all collected data was entered in SPSS version 20.

Doppler ultrasound is advised in all patients to detect internal carotid artery stenosis and peak systolic flow velocities. Patient should lie supine with neck extended to left lateral position. Patient meeting inclusion criteria are advised for carotid Doppler from Radiology Department at DHQ Hospital Mirpur. Doppler Ultrasound was interpreted by expert Radiologist. Carotid Artery Stenosis is detected on Greyscale and Doppler Ultrasound was divided into the categories of Normal, Mild, Moderate, Severe and very Severe Table 1¹⁵.

RESULT

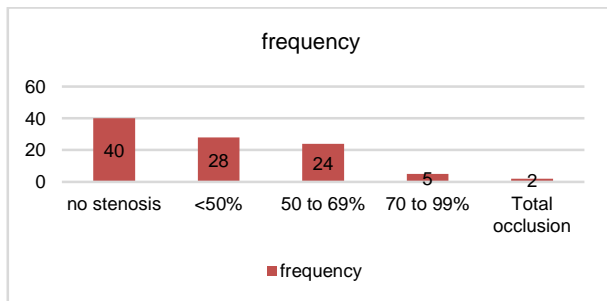
The results of our study revealed that median age is 53 SD±9.7. Male n= 73 (73.7%) female n= 26(26.3%). Out of 99 patients with recurrent ischemic stroke 78 (78.8%) have minor stroke and 21(21.2%) have TIA with in previous three month. Male patients are more frequently affected by stroke than female and evidence of carotid stenosis is more frequently found in male as compared to female. Table -II showing frequency of carotid stenosis in patients with recurrent stroke. In addition, we have also concluded that hypertension; diabetes, smoking and Dyslipidemia are also risk factor for developing atherosclerosis in carotid arteries and hence carotid stenosis Table IV.

Table-1: Doppler Ultrasound Showing ICA Velocities and Percentage of Stenosis

ICA Velocity on Grey scale	presence of thrombus plaque/intimal thickening	Carotid Stenosis
ICA velocity <125cm/sec	No plaque, thrombus or intimal thickening	Normal
ICA velocity <125cm/sec	plaque and intimal thickening visible	<50%(mild)
ICA velocity 125-230cm/sec	large Plaque visible	50 TO 69% (moderate)
ICA velocity >230cm/sec	visible plaque and lumen narrowing	>70 TO 99% (Severe)
No blood flow through vessel	marked lumen narrowing no patent lumen visible	TOAL OCCLUSION

Table-2: Demographic Data of Study Population (patient with recurrent Ischemic stroke)

AGE	Mean 53 SD±9.7 Min 34 Max 87
SEX	Male n =73 Female n=26
WEIGHT(KG)	69.5(57-82)
BMI	28(25-30)
MINOR STROKE(NIHSS<3)	N =78(78.8%)
TIA(ABCD2 SCORE>4)	N =21(21.2%)
Percentage of carotid stenosis In study population	
1.Normal	40(40.4%)
2.Mild	28(28.3%)
3.Moderate	24(24.2%)
4.Severe	5(5.1%)
5.Very severe	2(2%)
HYPERTENSION	N=52(52.5%)
DIABETES	N=46(46.5%)
SMOKING	N =58(58.6%)
DYSLIPIDEMIA	N =51(51.5%)
NIHSS score	3-25



Graph-1: Showing Frquency Of Carotid Stenosis In Patient With Recurrent Stroke

Table-3: Involvement of Carotid Artery (n=59)

Involvement of Carotid Artery	Frequency	Percentage
Unilateral	34	52.62%
Bilateral	25	42.38%
Total	59	100%

DISCUSSION

Ischemic Stroke is a disorder that is caused by occlusion of a vascular territory of Brain and that result in corresponding neurological defect. Ischemic stroke results from events that limit or stop blood flow such as extra cranial/ intracranial thromboembolism, thrombosis in situ or relative hypoperfusion. Smoking Hypertension, diabetes and dyslipidemia are modifiable risk factors for stroke¹⁴. Our study shows about half of the study population with recurrent ischemic stroke have carotid stenosis and clinically significant carotid stenosis (stenosis >70%) is found in 7 percent of population. Determining of carotid stenosis is an important steps in prevention of recurrent stroke attacks as early intervention such as carotid endarterectomy could be performed in these patient. Carotid endarterectomy is recommended if patient has suffered stroke in the carotid territory and they are not severely disabled and if carotid stenosis >70 % according ESCT (European carotid surgery trialists) criteria or >50% NASCET (North American carotid endarterectomy Trial). Earlier intervention in these patient help in prevention of recurrent attacks¹⁵.

Doppler Ultrasound is portable and readily available investigation which can be performed in stroke patients. This investigation can be repeated if needed without concern for hazardous effects of radiation or contrast. This can be performed in patient with aneurysm clips, pacemaker and spinal stimulator. Computed tomographic angiography (CTA) and Magnetic resonance angiography are alternative methods to detect carotid artery stenosis. A study conducted in India to detect prevalence of carotid stenosis shows out of 100 patient 46 percent have carotid stenosis and only 7 percent have clinically significant stenosis and they have also concluded that increased incidence of carotid stenosis with advancing age¹⁶. In our study, out of 99 patients 40 patient have no carotid stenosis on Doppler ultrasound and 59 patient have evidence of carotid stenosis with variable percentage. However clinically significant stenosis more than 70% is found only in 7 percent of population. Carotid Doppler though cheap and easily available investigation is rarely ordered in patient with stroke. Thus percentage of carotid stenosis can not be detected. And early intervention such as carotid endarterectomy in clinically significant carotid stenosis could not be performed which is an important step in stroke prevention. Another study conducted in North West General Hospital Peshawar shows increased incidence of carotid stenosis in patients with ischemic CVA, where 73 patient out of 131 shows carotid stenosis¹⁷. Control of modifiable risk factors such as Hypertension, diabetes, smoking and dyslipidemia is also an important step in prevention of stroke /TIA, as these risk factors accelerates process of atherosclerosis hence carotid artery stenosis¹⁸. Age and gender are non modifiable Risk factors for carotid artery stenosis. Advancing age and Male population are at risk of atherosclerosis thus more frequently affected by carotid artery stenosis. Overall all cases of stroke/TIA should be advised for carotid Doppler as an initial choice of investigation to find out the presence of atherosclerotic disease of carotid vasculature¹⁸. Patient who have carotid stenosis can be managed by medical and surgical intervention. We can offer Doppler Ultrasound to patient if we found carotid Bruit on physical examination. Though correlation between carotid stenosis and Carotid bruit is 10 to 20%. Thus Carotid Doppler is an important investigation in initial evaluation of patients who present with nonspecific symptoms related to stenosis or embolic carotid vessel disease.

CONCLUSION

59% of study population have carotid artery stenosis out of which 7 % shows carotid stenosis than 70% (clinically significant carotid

stenosis) on Doppler Ultrasound. Carotid artery stenosis is frequently found in patient with Stroke /TIA. Patients should be offered Carotid Doppler if they present with sign and symptoms suggestive of Stroke /TIA. Stenosis more than 50 % is managed by carotid Endarterectomy and stenosis less than 50% needs Medical intervention such as antiplatelet and lipid lowering therapy¹⁹.HTN, Diabetes, Smoking and dyslipidemia accelerates carotid stenosis by facilitating process of atherosclerosis. Recurrent stroke can thus be prevented if steps are being taken to detect Carotid artery stenosis and earlier intervention are being carried out in stroke patients

Limitations: Although carotid Doppler offers non invasive means of an initial evaluation of extra cranial cerebral vessels,the presence of dense calcification in carotid plaque makes the study less accurate. The quality of examination is dependent on sonographer skills and sensitivity and specificity 90 and 88%²⁰. And Doppler ultrasound does not help in assessing intracranial portion of carotid artery; tandem lesion of ICA can be missed. In a similar way, proximal portion of the artery as well as left carotid artery cannot be evaluated near Aortic arch.

REFERENCES

- 1 Hui C, Tadi P, Patti L. Ischemic stroke. InStatPearls [Internet] 2022 May 1. StatPearls Publishing.
- 2 Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, De Ferranti S, Després JP, Fullerton HJ, Howard VJ, Huffman MD. Heart disease and stroke statistics—2015 update: a report from the American Heart Association. *Circulation*. 2015 Jan 27;131(4):e29-322.
- 3 Mackay J, Mensah GA, Greenlund K. The atlas of heart disease and stroke. World Health Organization; 2004.
- 4 Kim JS, Mukherjee D. Current status of carotid stenting. *Current Vascular Pharmacology*. 2008 Apr 1;6(2):143-7.
- 5 Grysiewicz RA, Thomas K, Pandey DK. Epidemiology of ischemic and hemorrhagic stroke: incidence, prevalence, mortality, and risk factors. *Neurologic clinics*. 2008 Nov 1;26(4):871-95.
- 6 Wajngarten M, Silva GS. Hypertension and stroke: update on treatment. *European Cardiology Review*. 2019 Jul;14(2):111.
- 7 Johansson EP, Arnerlöv C, Wester P. Risk of recurrent stroke before carotid endarterectomy: the ANSYSCAP study. *International Journal of Stroke*. 2013 Jun;8(4):220-7.
- 8 Harris S, Kurniawan M, Rasyid A, Mesiano T, Hidayat R. Cerebral small vessel disease in Indonesia: Lacunar infarction study from Indonesian Stroke Registry 2012–2014. *SAGE Open Medicine*. 2018 Jun 20;6:2050312118784312.
- 9 Appelros P, Nydevik I, Viitanen M. Poor outcome after first-ever stroke: predictors for death, dependency, and recurrent stroke within the first year. *Stroke*. 2003 Jan 1;34(1):122-6.
- 10 Cheng SF, Brown MM, Simister RJ, Richards T. Contemporary prevalence of carotid stenosis in patients presenting with ischaemic stroke. *Journal of British Surgery*. 2019 Jun;106(7):872-8.
- 11 Coutts SB. Diagnosis and management of transient ischemic attack. *CONTINUUM: Lifelong Learning in Neurology*. 2017 Feb 3;23(1):82.
- 12 Kwah LK, Diong J. National institutes of health stroke scale (NIHSS). *Journal of physiotherapy*. 2014 Jan 1.
- 13 Grant EG, Benson CB, Moneta GL, Alexandrov AV, Baker JD, Bluth EI, Carroll BA, Eliasziw M, Gocke J, Hertzberg BS, Katarick S. Carotid artery stenosis: grayscale and Doppler ultrasound diagnosis—Society of Radiologists in Ultrasound consensus conference. *Ultrasound quarterly*. 2003 Dec 1;19(4):190-8.
- 14 Abate TW, Zeleke B, Genanew A, Abate BW. The burden of stroke and modifiable risk factors in Ethiopia: A systemic review and meta-analysis. *PloS one*. 2021 Nov 1;16(11):e0259244.
- 15 Strömberg S. Symptomatic Carotid Stenosis-optimal timing of surgical treatment. 2017 Oct 17
- 16 Bharathkumisetty ,Stephen , Senthilnathan , R.Deepak Arjundas , Ayyar et al PREVALENCE AND RISK FACTORS OF CAROTID ARTERY STENOSIS IN ISCHAEMIC STROKE PATIENTS- A CROSS SECTIONAL STUDY IN A TERTIARY CARE HOSPITALDepartment of Neurology,Sree Balaji Medical College &Hospital,Chrompet,Chennai,India.2019 Feb24.
- 17 Afridi A, Afridi Z, Afridi F, Afridi A. Frequency of carotid artery stenosis in ischemic stroke patients. *Journal of Medical Sciences*. 2017 Sep 2;25(3):340-3.
- 18 Goldstein LB, Bushnell CD, Adams RJ, Appel LJ, Braun LT, Chaturvedi S, Creager MA, Culebras A, Eckel RH, Hart RG, Hinchey JA. Guidelines for the primary prevention of stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2011 Feb;42(2):517-84.
- 19 Rerkasem A, Orrapin S, Howard DP, Rerkasem K. Carotid endarterectomy for symptomatic carotid stenosis. *Cochrane Database of Systematic Reviews*. 2020(9).
- 20 Jahromi, A.S., Cinà, C.S., Liu, Y. and Clase, C.M., 2005. Sensitivity and specificity of color duplex ultrasound measurement in the estimation of internal carotid artery stenosis: a systematic review and meta-analysis. *Journal of vascular surgery*, 41(6), pp.962-972.