

Frequency of significant carotid artery stenosis on doppler ultrasound in patients with recent ischemic stroke

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Abstract

Objective: To determine the frequency of significant extra-cranial carotid artery stenosis on Doppler ultrasound in patients with recent ischemic stroke.

Material and Methods: This study was carried in Radiology Department, Jinnah Postgraduate Medical Centre, Karachi, from 1st June 2016 to 30th November 2016. A total of 184 patients with 2 weeks history of ischemic stroke were included. Carotid Doppler ultrasound was performed on all patients with GE Doppler ultrasound machine. All the information was noted on pre-designed proforma.

Results: Frequency of significant carotid artery stenosis ($\geq 50\%$ stenosis) on doppler ultrasound in recent ischemic stroke patients is 27.7%. Regarding the degree of stenosis, 28(15.2%) cases had 50 to 69%, 19(10.3%) cases had 70 to 95% and 4(2.2%) had above 95% stenosis.

Conclusion: We conclude from this study that high risk patients should be screened by Doppler ultrasound for the presence of carotid artery stenosis in order to plan out medical / and surgical intervention for the primary as well as secondary prevention of cerebro-vascular events.

Keywords: Ischemic stroke, Carotid artery stenosis, Doppler ultrasound

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Introduction:

Stroke is one of the most common causes of disability and third most common cause of death in developed as well as developing countries.^{1,2} About one third of patients who survive after episode of stroke remain permanently disabled and care of permanently disabled patients as a result of stroke accounts for major health care expenditure in developed countries.³ Every 3rd person above age of 45 years is hypertensive in developing countries and majority of them remains unaware of its diagnosis till it becomes uncontrolled. Due to this increasing burden of risk factors stroke incidence is rising in Asia in general and Pakistan in particular.^{2,4} These risk factors are associated with damage to the vessel wall which consequently manifests as range of cerebrovascular events.⁵ Stroke is mostly ischemic followed by due to cerebral hemorrhage,

subarachnoid hemorrhage and 12% of uncertain origin.⁶ Extracranial carotid artery stenosis is one of the major preventable causes of recurrent stroke in patients with recent history of ischemic cerebrovascular accident (acute stroke and transient ischemic attack).^{7,8} The prevalence of significant carotid artery stenosis ($\geq 50\%$ stenosis) in ischemic cerebrovascular accident is 22.7%.⁹ Beside significant carotid artery stenosis, type of plaque is an important determinant of risk of further stroke in a patient with cerebrovascular accident. Hypoechoic plaque in carotid artery is associated with twice risk of further stroke than that with echogenic/calcified plaque.¹⁰ Carotid bifurcation and proximal internal carotid artery is the most common site for development of carotid artery stenosis and atheromatous plaque.⁷

All patients with recent history of ischemic

stroke are at increased risk of recurrent stroke. These patients should be screened with carotid doppler as patients with significant carotid artery stenosis (50 – 95%) can be prevented from developing further stroke by early intervention like carotid endarterectomy preferably within 2 weeks.^{6,11,12} Doppler ultrasound is considered as most accurate non invasive test for screening patients for carotid artery stenosis with sensitivity and specificity of 90 – 95% for detection of significant ($\geq 50\%$) carotid artery stenosis, although its sensitivity is lower in low grade (30 – 49%) stenosis.^{13,14}

With this study by determining the magnitude of different ranges of carotid artery stenosis in patients with 1st attack of ischemic stroke, we can categorize them into groups of those who may get benefit from surgical intervention like carotid endarterectomy ($\geq 70\%$ stenosis) and others who need medical intervention to prevent from recurrent stroke and further disability.

The purpose of this study is to determine the frequency of significant carotid artery stenosis and degree of extra-cranial carotid artery stenosis on Doppler ultrasound in patients with recent ischemic stroke.

Material and Methods:

This study was carried in Radiology Department, Jinnah Post Graduate Medical Centre, Karachi, from 1st June 2016 to 1st December 2016. Sample size was calculated and it turned out to be 184 patients. The cases were selected by non-probability consecutive sampling. We included all patients, of both genders, 40 to 80 years of old with 2 weeks history of ischemic stroke. Patients having history of head trauma, having evidence of intracranial hemorrhage or space occupying lesion on CT scan, having MRI evidence of posterior cerebral circulation infarction and signs of meningeal irritation such as neck rigidity, positive kerning and brudzinski signs were excluded from the study.

Every patient diagnosed within 2 weeks as ischemic stroke referred to radiology department for carotid doppler ultrasound was selected on

meeting the inclusion criteria. Informed consent from the patient and approval from ethical committee was taken.

Carotid doppler ultrasound was performed on all patients who meet the inclusion criteria with GE doppler ultrasound machine by a trained radiologist having post fellowship experience of greater than 5 years in performing doppler ultrasound. All positive and negative doppler findings were entered on a proforma which also includes MRI findings, demographic and clinical information.

Significant carotid artery stenosis and degree of extracranial carotid artery stenosis were labeled as per operational definition.

The collected data was analyzed through computer on statistical package of social science (SPSS Version 11) on the basis of filled in proforma. Qualitative variables like sex, range of carotid artery stenosis was presented in the form of frequencies and percentages. Mean \pm standard deviation were calculated for quantitative variables like age. Effects modifier were controlled through stratification age, gender, duration of symptoms & comorbidities. Chi square test was applied and p value of ≤ 0.05 was taken as significant.

Results:

A total of 184 patients with 2 weeks history of ischemic stroke were included in the study. The average age and duration of symptoms of the patients was 59.66 ± 6.53 years and 3.99 ± 2.47 days respectively.

There were 55(29.9%) female and 129(70.1%) male patients. Distribution of duration of symptoms was less than 1 day in 4.3%, 1 to 5 days in 75.0% and 6 to 14 days in 20.7%. In 50.5% infarct was observed on left side and in 49.5% the infarct was observed on right side. On the basis of MRI findings middle cerebral artery was commonly involved i.e. in 53.8% cases, followed by anterior cerebral artery in 26.1%, Basal Ganglia Infarct in 14.7% and both middle cerebral artery–anterior cerebral artery involvement was

observed in 5.4% cases.

Frequency of significant carotid artery stenosis ($\geq 50\%$ stenosis) on doppler ultrasound in ischemic stroke patients is 27.7% (51/184).

Regarding degree of stenosis 28(15.2%) cases had 50 to 69%, 19(10.3%) cases had 70 to 95% and 4(2.2%) had above 95% stenosis. Rate of significant carotid artery stenosis was high in 51 to 70 years of age but not significant with respect to age ($p=0.836$). Rate of significant carotid artery stenosis was 78.4% in male and 21.6% in female but it was also not significant between genders (Chi-square = 2.33; $p=0.127$). Rate of significant carotid artery stenosis was significantly high in those cases whose duration of symptoms was below 1 day 5/8(62.5%) with Chi-Square= 6.627; $p=0.036$.

Discussion:

Stroke is a leading cause of death and disability in developed as well as developing countries.¹⁵ High degree internal carotid artery stenosis is the most well-known risk factor for the development of cerebrovascular events.¹⁶ Conventional angiography is the gold standard diagnostic tool for carotid artery stenosis but it is costly and invasive with potential risk of serious complications.

Doppler ultrasound is inexpensive, non-invasive and can provide functional and anatomical information about vessel stenosis and plaque morphology.¹⁷ The sensitivity and specificity of carotid duplex ultrasound is 90% to 95% for measurement of carotid artery diameter reduction. Duplex ultrasound may be more sensitive for detection of minimal atherosclerotic plaque.¹⁸ The aim of carotid imaging may be early detection, clinical staging, surgical road mapping, and postoperative therapeutic surveillance.¹⁹

Average age of our study subjects was 59.66 ± 6.53 years. Older age is an important and well known risk factor for the development of Carotid artery stenosis. An Indian study by Sethi et al²⁰ found that mean age of patients with carotid lesion

was 60.03 years against 48.83 years in patients without any carotid lesion. In present study frequency of significant carotid artery stenosis ($\geq 50\%$ stenosis) on doppler ultrasound in acute ischemic stroke patients is 27.7%(51/184) as compared to Razzaq et al who reported the rate of carotid stenosis in their study population to be 31%.²¹ However in Rukhsana et al²² study carotid doppler ultrasound of patients with ischemic strokes showed that 56% had involvement of carotid arteries (right, left or both).

Regarding degree of stenosis, in 28(15.2%) cases was 50 to 69%, 19(10.3%) cases had 70 to 95% and 4(2.2%) had above 95% stenosis in present study. While Razzaq et al reported mild stenosis in 35%, moderate stenosis in 21% and significant stenosis in 21%.²¹ In this study rate of significant carotid artery stenosis was 78.4% in male and 21.6% in female but it was also not significant between genders. The male preponderance (78.4%) is in accordance with most of the local as well as international studies. Atif et al have shown a 1.6: 1 male to female ratio in their study conducted at Karachi.²³ Khan SN et al reported male to female ratio of 1.05:1 in their study conducted at Ziauddin Medical University Hospital, Karachi.²⁴ Razzaq A et al²¹ have shown 25% incidence of severe stenosis. In Shaikh et al²⁵ study majority of patients with carotid artery stenosis were male but this gender difference was found to be not significant ($P < 0.442$). Hypertension was the most common risk factor present in 76.92% of cases either as an only risk factor or associated with other risk factors. Elevated systolic blood pressure accelerates the progression of intima medial thickness (IMT) in the carotid artery; however isolated hypertension occurs in only less than 20% of patients with stroke and is usually associated with other risk factors that is why antihypertensive treatment alone may fail to prevent stroke.^{26,27}

Conclusion:

Significant carotid artery stenosis is strongly associated with ischemic stroke. Carotid doppler is recommended for the high risk patients for primary as well as secondary prevention of ischemic stroke. All patients with recent (<2 weeks)

history of ischemic stroke are at an increased risk of developing further attack of stroke or progression to disability.

Patients with risk factors of developing ischemic stroke can benefit by early diagnosis and characterization of carotid artery stenosis with carotid doppler ultrasound which may help in planning further management and preventing from developing morbidity from cerebrovascular accident.

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Role and contribution of authors:

Dr Kelash Kumar, collected the data, references and did initial writeup

Dr Mahesh Kumar, helped in collecting the data and also helped in introduction writing.

Dr. Ghazala Shahzad, helped in collecting the references and

Dr. Saira mashkoo, helped in discussion writing

Dr. Maria Hameed shaikh, helped in collecting the references

Dr. Bhesham Kumar, critically review the article and made final changes

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