FREQUENCY OF CAROTID STENOSIS USING CAROTID COLOUR DUPLEX ULTRASOUND IN PATIENTS WITH ISCHEMIC STROKE

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ABSTRACT

Objective: To determine the frequency of carotid stenosis using colour duplex ultrasound in patients with ischemic stroke.

Material and Methods: This descriptive study was conducted on 120 patients of ischemic stroke at the Department of Radiology, Lady Reading Hospital Peshawar for one year period from January to December 2011. During the study period Carotid Colour Duplex Ultrasound was performed on each patient with ischemic stroke. Patients fulfilling the inclusion criteria were selected for the study after obtaining an informed consent. Patients having age less than 20 years and having haemorrhagic stroke on C.T Scan were excluded from the study.

Results: Out of 120 diagnosed cases of ischemic stroke majority (64.16%) was males and also majority (25%) was aged between 61-70 years with mean age of 51.46 years. Carotid duplex ultrasound found carotid stenosis in 35.83% patients. Out of 43 patients, right carotid artery involved in 58.13%, left carotid artery in 32.55% and bilateral carotid arteries in 9.30% patients. In 48.83% cases degree of stenosis was high grade, moderate in 32.55% patients and mild in 18.60% patients. In 65.11% patients type of plaque was calcified and soft in 34.88% cases. The velocity of blood flow between 20-40 cms/second recorded in majority (48.83%) cases.

Conclusions: In this study carotid stenosis was diagnosed in 35.83% patients. It is a non-invasive, inexpensive and reliable diagnostic method in ischemic stroke patients and in remote areas where CT scan and MRI facilities are not available.

Key Words: Ischemic stroke-carotid artery-disease-diagnosis; carotid colour duplex ultrasound; velocity of blood flow.

INTRODUCTION

Ultrasonography provides a unique diagnostic perspective in cerebrovascular disorders, with extremely high temporal resolution and excellent spatial display of extracranial arteries. Unlike other imaging modalities, cerebrovascular ultrasound provides real-time information about the blood flow in addition to the hemodynamic changes as a result of various physiological as well as pathological states. The information obtained from cerebrovascular ultrasound has diagnostic, therapeutic as well as prognostic value in various disease states.[1]

Transcranial Doppler ultrasonography (TCD) is the only non-invasive examination that provides a reliable evaluation of intracranial blood flow patterns in real-time, adding physiological information to the anatomical information obtained from other neuroimaging modalities. Cerebrovascular ultrasonography is relatively cheap, can be performed bedside, and allows monitoring both in acute emergency settings as well as for prolonged periods with a high temporal resolution. Extended applications of TCD provide important information about the pathophysiology of cerebrovascular ischemia. Advanced applications of cerebrovascular ultrasonography have become an integral part of the armamentarium of stroke neurologists for evaluating stroke mechanisms, plan and monitor treatment and determine prognosis. It has been suggested as an essential component of a comprehensive stroke center.[1]

Doppler US is by far the most common imaging examination performed worldwide to aid in the diagnosis of carotid disease. Given the prevalence of patients with carotid disease and the frequency with which patients are referred for carotid imaging, the number of carotid US examinations performed annually is considerable.[2] This imaging modality is increasingly becoming the only examination performed before surgical intervention. It was estimated by the panelists that as many as 80% of patients in the United States undergo carotid endarterectomy after a US examination as the only preoperative imaging study.

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Therefore, it is of utmost importance that information provided by the US examination be reproducible and reliable.[3]

Considerable gains have been made in the quality of US examinations of the carotid arteries over the past 3 decades. The technology has experienced great advances in equipment, ranging from continued improvements in gray-scale resolution to landmark advances in Doppler methods, including color Doppler imaging. The imaging community has gained expertise in performance of carotid US and interpretation of the results through widespread use of technology, research, and continuing medical education.[3]

Transcranial Doppler ultrasonography (TCD) is being increasingly used for its ability to provide cerebral hemodynamic information in stroke. Few studies have explored its association with cerebral arteriographic changes and stroke subtype.[4]

This study was conducted with the aim to find out the diagnostic value of carotid colour doppler ultrasound in patients with ischemic stroke.

MATERIAL AND METHODS

The study was conducted in the Department of Radiology, Postgraduate Medical Institute, Lady Reading Hospital, Peshawar, during the one year period from 1st January 2011 to 31st December 2011. Patients fulfilling the inclusion criteria were selected for the study after obtaining an informed consent.

Inclusion criteria:

In this study all cases, aged more than 20 years, with ischemic stroke who were sent from the various units of hospital for the diagnosis of carotid artery disease to the Radiology Department, PGMI/LRH, Peshawar.

Exclusion Criteria:

Patients having age less than 20 years and having haemorrhagic stroke on C.T Scan were excluded from the study.

Methodology:

During the study period, besides the clinical examination, routine laboratory investigations like blood sugar, lipid profile, blood complete with ESR, ECG, echocardiography, X-ray chest, Carotid duplex Ultrasound was done in these patients to find out the side, site and degree of stenosis, type of plaque and various ranges of velocity of blood flow.

All the qualitative variables like gender, demographic data, clinical examination findings, laboratory investigations findings, ECG, Echo, x-ray chest findings and Carotid duplex ultrasound findings like side, site and degree of stenosis, type of plaque and various ranges of velocity of blood flow were analyzed for percentages and frequencies. Mean + standard deviation was calculated for quantitative variables like age. For gender male to female ratio was calculated. The results were presented through tables, and figures. All the data was analyzed by statistical program SPSS version 12 for windows.

RESULTS

A total of 120 cases with diagnosed ischemic stroke were included in the study and there were 77 (64.16%) males and 43 (35.84%) were females with male to female ratio of 1.79:1.

Majority of patients 30 (25%) was in the age range of 61-70 years, followed by 24 (20%) patients in age group of 51-60 years. Twenty -three (19.16%) patients were in the age group of 20-30 years, 21 (17.5%) patients were in the age range of 41-50 years, 13 (10.83%) patients were in age group of 31-40 years, and 9 (7.5%) patients were in the age range of 71-80 years. The mean age was 51.46 + 17.47 years. Minimum age was 20 years and maximum was 80 years (ranged 20-80 years) (Table No. 1).

In all patients included in the study, Carotid duplex ultrasound was done and carotid stenosis was found in 43 (35.83%) patients. Out of these 43 patients, right carotid artery was involved in majority of patients i.e. 25 (58.13%) patients, left carotid artery was involved in 14 (32.55%) patients and bilateral carotid arteries involved in 4 (9.30%) patients.

Table no. 1 various characteristics of patients (n=120)

DEMOGRAPHIC DATA	NO. OF CASES	PERCENTAGE
Gender distribution:		
Male	77	64.16%
Female	43	35.84%
Age:		
20-30 years	23	19.16%
31-40 years	13	10.83
41-50 years	21	17.5%
51-60 years	24	20%
61-70 years	30	25%
71-80 years	09	07.5%

In 21 (48.83%) patients, degree of stenosis was high grade, moderate in 14 (32.55%) patients and mild in 8 (18.60%) patients.

In 28 (65.11%) patients, type of plaque was calcified and soft in 15 (34.88%) cases.

The peak systolic velocities were less than 150 cm/second in 08 (18.60%) patients, between 150-230 cm/second in 14 (32.55%) patients, and more than 230 cm/second in 21 (48.83%) patients (Table No. 2).

Table No. 2 Colour Doppler Ultrasound Findings In Patients With Carotid Artery Stenosis (N=43)

FINDINGS	NO. OF CASES	PERCENTAGE
SIDE INVOLVED:		
Right:	25	58.13%
Left:	14	32.55%
Bilateral:	04	09.30%
DEGREE OF STENOSIS:		
High grade:	21	48.83%
Moderate grade:	14	32.55%
Mild grade:	08	18.60%
TYPE OF PLAQUE:		
Calcified:	28	65.11%
Soft:	15	34.88%
INTRASTENOTIC PEAK SYSTOLIC VELOCITIES:		
< 150 cms/ second:	08	18.60%
150-230 cms/ second:	14	32.55%
> 230 cms/ second:	21	48.83%

DISCUSSION

Transcranial color-coded duplex sonography has become a standard diagnostic technique to assess the intracranial arterial status in acute stroke.[5]

TCD appears to offer a practical bedside method with a high temporal resolution for cerebral autoregulation evaluation in stroke patients. TCD studies have shown impairment of cerebral autoregulation in various subtypes of ischemic stroke.[6] More recent developments, such as TCD and servo-controlled finger photoplethysmography, have offered the advantage of investigating beat-to-beat dynamics of the pressure–flow relationship of the cerebral circulation and of differentiating between fast and slow response mechanisms.[7,8]

Rapid progress in non-invasive ultrasound techniques has resulted in a wide variety of clinical applications for the assessment of cerebrovascular diseases. Recent highlights in ultrasound research include the evaluation of vascular ageing as a degenerative process, the demonstration of plaque development, motion and vulnerability in athrosclerosis and multidimensional as well as innovative imaging techniques (compound imaging) to depict early and small vascular lesions.[9]

Easy to apply measures to identify patients at risk of secondary worsening are also needed. Several studies reported a prognostic value of the initial neurovascular status assessed by transcranial color-coded duplex (TCCS) or Doppler sonography (TCD), which are noninvasive and can be applied at the patients' bed side.[10]

Extracranial carotid artery occlusive disease is a major cause of ischemic stroke in whites. However, intracranial artery occlusive disease, especially middle cerebral artery (MCA) stenosis, is more prevalent in Asians.[11]

In our study majority of patients were males while in contrast to this, few local and international studies reported that females were in preponderance than males in their respective studies.[12-15] The high ratio of males in our study may be due to the fact that in our male oriented society females are not allowed to seek medical treatment from male doctors due to social, traditional and customary norms.

Older age is a major risk of stroke. Carotid artery disease is estimated to affect 30% of persons older than 50 years. While in many studies it is reported to be more than 50 years (mean age of 60-62 years).[15-21] Higher rates of percentage in this study have also been found in the age range of 61-70 with overall mean age of 51.46 years. Differences in the mean age in above quoted studies and our study could be due to varied sample size selection in respective studies.

A local study[15] showed that carotid duplex ultrasound was performed in 100 patients and 31% of their patients were having carotid stenosis, right side carotid artery involved in 51.62% cases, left carotid artery involved in 41.94% cases, and bilateral arteries involved in 6.45% cases out of total 31 ischemic strokes patients. Velocity of blood flow was normal in 32.26% cases, between 20-40 cms/sec in 41.94% and below 20 cms/sec in 25.81% patients. High-grade degree of stenosis was detected in 54.84% cases, moderate in 25.81% and mild in 19.35% patients.[15]

While in this study carotid duplex ultrasound was performed in 120 ischemic stroke patients which accurately, efficiently and easily diagnosed the carotid stenosis in 35.83% patients. Right side of carotid artery was diagnosed in 58.13% cases, left carotid artery in 32.55% cases, and bilateral arteries in 9.30% cases.

Intrastenotic peak systolic velocities (PSV) were also recorded in our study. PSV was less than 150 cm/sec in 18.60% cases, between 150 and 230 cms/sec in 32.55% cases, and more than 230 cm/sec in 48.83% cases. High-grade, moderate grade and mild stenosis was recorded in 48.83%, 32.55%, and 18.60% cases respectively.

In a study of the 125 patients examined with duplex TCD US, 10 (8.0%) were classified as abnormal cases. Five patients had abnormal findings on only one side, and five had abnormal findings on both sides. Sixteen (12.8%) patients were classified as having conditional studies; 91 (72.8%), normal studies; and eight (6.4%), inadequate studies.[22]

In our study calcified type of plaque was found in majority of patients i.e. 65.11% cases and soft in 34.88% cases. Similar findings are also described in few national and international studies which correlate with our findings.[23,24]

Transcranial Doppler imaging provides noninvasive, reproducible measurements and monitoring of Vasomotor reactivity (VMR) without contrast and radiation use, and the predictive value of cerebral hemodynamic testing with TCD has been shown in patients with carotid artery disease.[25-27]

CONCLUSIONS

It is concluded on the basis of this study's results that majority of male in the age range of 61-70 years were affected more than female patients. Carotid duplex ultrasound diagnosed carotid stenosis in 35.83% patients, with right carotid artery and high grade stenosis in majority of patients. In most of patients calcified type of plaque and intrastenotic peak systolic velocity of more than 230 cm/sec were recorded.

It is a non-invasive, inexpensive diagnostic technique, and can be an efficient, accurate and reliable method for clinical evaluation and quantification of carotid blood flow volumes in ischemic stroke patients and in remote areas where CT scan and MRI facilities are not available.

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