

# APPRAISAL OF CAROTID COLOUR DUPLEX ULTRASOUND IN ISCHEMIC STROKE

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## ABSTRACT

**Objective:-** To determine the diagnostic value of Carotid Colour Duplex Ultrasound in Ischemic Stroke patients.

**Material and Methods:-** This hospital based non-invasive descriptive study was conducted on patients of ischemic stroke at Lady Reading Hospital Peshawar from January to August, 2008. Carotid Colour Duplex Ultrasound was performed on each patient in Radiology Department. Patients were selected by non-probability convenient sampling method after obtaining an informed consent. Patients less than 15 years of age and having haemorrhagic stroke on C.T Scan were excluded from the study.

**Results:** Out of 100 diagnosed cases of ischemic stroke there were 46% males and 54% females, with age range from 21 to 103 years and mean age was 60.34 years. On carotid duplex ultrasound, carotid stenosis was found in 31% patients. Out of these 31 patients, right carotid artery was involved in 16 (51.62%) and left in 13 (41.94%) patients. Normal blood flow was seen in 10 (32.26%) patients, between 20-40 cms/sec in 13 (41.94%) and below 20 cms/sec in 8 (25.81%) patients. High-grade degree of stenosis was found in 17 (54.84%), moderate in 8 (25.81%) and mild in 6 (19.35%) patients. Calcified type of plaque was noted in 18 (58.06%) and soft in 13 (41.94%) patients.

**Conclusions:** Carotid Colour duplex ultrasound is non-invasive, inexpensive technique, and can be used to assess the presence and severity of carotid artery stenosis. It can provide an efficient, accurate and reliable method for clinical evaluation and quantification of carotid blood flow volumes in ischemic stroke patients.

**Key Words:** Ischemic Stroke, Diagnosis; Ultrasonography, Carotid Duplex Ultrasound; Carotid Artery Blood Flow.

## INTRODUCTION

Stroke is one of the ancient diseases in the world. The World Health Organization (WHO) has defined stroke as “rapidly developing symptoms and/or signs of focal and at times global loss of cerebral function with no apparent cause other than that of vascular origin.”<sup>1,2</sup>

In developed countries, about 85-90% of strokes are due to cerebral infarction and 10-15% due to intracranial hemorrhage.<sup>3</sup> Ischemic stroke causes substantial death and disability than hemorrhagic stroke.<sup>4</sup>

Duplex imaging and color-coded doppler ultrasonography of blood flow velocity should be performed in patients with transient ischemic attack (TIA) or stroke in the carotid territories, to

identify internal carotid artery stenosis, occlusion and dissection. Auscultation for a carotid bruit does not identify all patients with significant internal carotid artery stenosis.<sup>5</sup> When the artery is 60% to 70% blocked the benefit of treatment is thought to outweigh the risk of the interventional procedure.

Carotid duplex ultrasound (CDUS) is a non-invasive, safe, and relatively inexpensive technique for evaluation of carotid arteries. Carotid Duplex Ultrasound uses B-mode Ultrasound imaging and Doppler Ultrasound to detect focal increase in blood flow velocity indicative of high-grade carotid stenosis. It can define the extent and the location of the plaque.<sup>6</sup>

Carotid ultrasound is now a well-validated

**SEX-WISE DISTRIBUTION OF PATIENTS (n=100)**

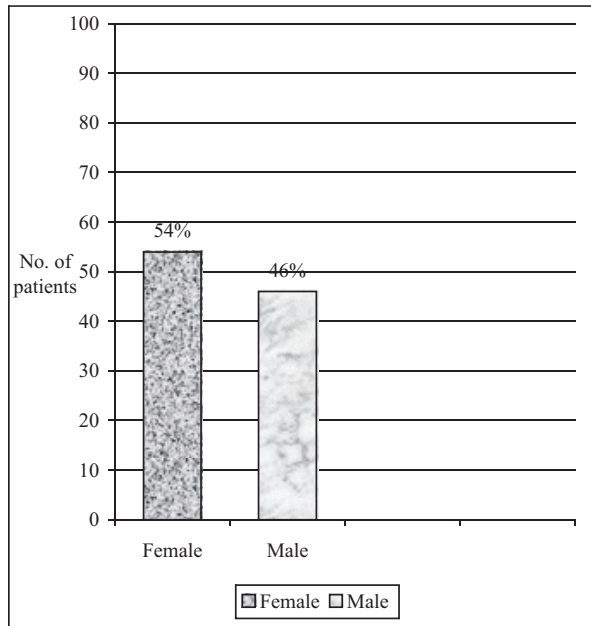


Figure 1

tool to study the presence and progression of cardiovascular disease. Using ultrasound one can determine elastic properties of the vessel wall (distensibility and compliance) as well as intima-media thickness (IMT). IMT is a useful predictor of future cardiovascular events such as myocardial infarction and stroke, and is well correlated with other traditional risk factors such as blood pressure, lipids, level of glycemic control, and smoking. For this reason carotid ultrasound may add valuable clinical information above and beyond that provided by traditional risk factors<sup>7</sup>.

The rationale of the study was to find out the diagnostic value of carotid color duplex ultrasound in ischemic stroke patients admitted to Medical units of Lady Reading Hospital, Peshawar, which can be use for determining the underlying cause, planning treatment strategies, and preventing stroke and death.

**MATERIAL AND METHODS**

This study was conducted in the Postgraduate Medical Institute, Lady Reading Hospital, Peshawar. This was a hospital based descriptive study. It included 100 cases of Ischemic Stroke Presented to Casualty / Accident and Emergency Department of Post-Graduate Medical Institute, Lady Reading Hospital Peshawar from January to August 2008. These patients were admitted in the Medical Department and Carotid Duplex Ultrasound was performed in them in the Radiology Department.

Following inclusions and exclusion criteria were used.

**Inclusion Criteria**

1. All adult patients >15 years of age of either sex.
2. Patients having Ischemic Stroke on C.T Scan Brain.
3. Patients presenting for first time or with recurrence of stroke.

**Exclusion Criteria**

1. Patients having haemorrhagic stroke, subarachnoid hemorrhage, subdural hematoma on C.T Scan.
2. Patients having intra-cerebral tumors, CSF obstruction as a cause of stroke.
3. Patients on anticoagulants and with history of blood dyscrasia.
4. Patients less than 15 years of age.

After formal consent, patients fulfilling the inclusion criteria were further assessed through a detailed history, from patient or from the relatives. Clinical examination, routine laboratory investigations like blood sugar, lipid profile, blood complete with ESR, ECG, Echocardiography X Ray chest and Carotid duplex Ultrasound were done in these patients. While doing carotid duplex ultrasound, velocity of blood flow, degree of stenosis and type of plaque were noted.

All information was recorded on a slandered proforma. Data storage, processing and analysis was done using computer program SPSS version 12.

**RESULTS**

Out of 100 cases of diagnosed ischemic stroke were 46 (46%) males and 54 (54%) were

**AGE-WISE DISTRIBUTION OF PATIENTS (n=100)**

Age Ranges (in Years)	No. of Cases	Percentage
21-30 years	3	3%
31-40 years	06	06%
41-50 years	20	20%
51-60 years	26	26%
61-70 years	33	33%
71-80 years	08	08%
81 and above	04	04%
TOTAL	100	100%

Table 1

**PAST HISTORY IN PATIENTS  
(n=100)**

Past History	No. of Cases	Percentage
Known hypertensive	49	49%
Known Diabetic	31	31%
Smokers	28	28%
Previous stroke/TIA	12	12%
Previous MI/Angina/AF	03	03%
Alcohol intake	01	01%

Table 2

females with male to female ratio of 1: 1.17 (Graph No. 1).

The age of patients ranged from 21 to 103 years. The mean age was  $60.34 \pm 13.24$  years. Minimum age was 21 years and maximum was 103 years. Majority of patients (33%) were in the age range of 61-70 years, followed by 26 (26%) patients in age group of 51-60 years. Twenty (20%) patients were in the age range of 41-50 years. Eight (8%) patients were in the age range of 71-80 years, 6 (6%) patients were in age group of 31-40 years, 4 (4%) were in the age range of 81 and above years, and 3 (3%) patients were in the

**CAROTID DUPLEX ULTRASOUND  
FINDINGS IN PATIENT WITH CAROTID  
ARTERY STENOSIS (n=31)**

Carotid Duplex Ultrasound Finding	No. of Patients (n=31)	Percentage
<b>Side of carotid artery involved:</b>		
Right =	16	51.62%
Left =	13	41.94%
Bilateral =	02	06.45%
<b>Velocity of blood flow:</b>		
Normal =	10	32.26%
Between 20-40 cms/second =	13	41.94%
Below 20 cms/second =	08	25.81%
<b>Degree of stenosis:</b>		
High grade =	17	54.84%
Moderate =	08	25.81%
Mild =	06	19.35%
<b>Type of plaque:</b>		
Calcified =	18	58.06%
Soft =	13	41.94%

Table 3

age group of 21-30 years (Table No. 1).

Past history of the patients shows that majority (49%) were known hypertensive, followed by diabetic 31 (31%) patients, smokers were 28 (28%), previous stroke/TIA was present in 12 (12%) patients, previous MI/angina/AF in 3 (3%) patients, and alcohol intake was noted in 1 (1%) patient (Table No. 2).

Carotid duplex ultrasound done in all patients and carotid stenosis was found in 31 (31%) patients. Out of these 31 patients, right carotid artery was involved in majority of patients i.e. 16 (51.62%) patients, left carotid artery was involved in 13 (41.94%) patients and bilateral carotid arteries involved in 2 (6.45%) patients.

Out of 31 patients, velocity of blood flow was normal in 10 (32.26%) patients, between 20-40 cms/second in 13 (41.94%) patients and below 20 cms/second in 8 (25.81%) patients.

Degree of stenosis was high grade in majority of patients that is 17 (54.84%), moderate in 8 (25.81%) patients and mild in 6 (19.35%) patients.

Type of plaque was calcified in 18 (58.06%) patients and soft in 13 (41.94%) cases (Table No. 3).

**DISCUSSION**

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<sup>8</sup>.

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 atherosclerosis and multidimensional as well as innovative imaging techniques (compound imaging) to depict early and small vascular lesions.<sup>9</sup>

In this study females were greater in number, with male to female ratio of 1:1.17, which has also reported by few local and international studies in which female were in preponderance than males.<sup>10-13</sup> The high rate of female in our study may be probably due to the fact that in our society trend has been changed and females are allowed to seek medical treatment from male doctors.

It is well documented that the risk of stroke increases with older age. Higher rates of percentage have been reported in the age range of

60-70 years in majority of studies (mean age of 60-62 years).<sup>3,14-20</sup> These findings are also observed in this study. Majority of our patients were in the age range of 61-70 years with overall mean age of 60.34 years.

Besides Carotid duplex ultrasound the different routine investigations were also performed in all cases to know the other risk factors associated with the disease and their early and effective treatment and adaptation of various preventive measures. Following investigation like blood sugar, lipid profile, blood complete with ESR, ECG, echo and x-ray chest were performed. These investigations were also done in other local studies.<sup>3,16,21,11,22</sup>

In our study past history of patients showed hypertensive (49%), diabetics (31%), smoker (28%) and patients having previous history of stroke/TIA (12%), MI/Angina/AF (3%) and alcohol take (1%) case. These risk factors which are independent risk factors associated with carotid stenosis are also observed in some other studies.<sup>21,23,24</sup>

Carotid artery disease is estimated to affect 30% of persons older than 50 years.<sup>24</sup> Common carotid artery (CCA) volume flow rate (VFR) is clinically useful for study of cerebrovascular disease.<sup>25</sup> In this study carotid duplex ultrasound was performed in all patients and our findings show that 31% of our patients were having carotid stenosis. Carotid duplex ultrasound can be performed accurately, efficiently and easily and diagnosed side of stenosis as in this series right carotid artery involvement in 51.62% cases, left carotid artery involvement in 41.94% cases, and bilateral arteries involvement 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. Soft type of plaque was found in 41.94% patients and calcified in 58.06% out of 31 total Ischemic strokes patients. Similar findings are also described in few international studies which correlate with our findings.<sup>24,26</sup>

Length of stay (LOS) in hospitals is the largest contributor of direct stroke care cost. Rehabilitation accounts for 16% of health-care cost in the six-month post-stroke period.<sup>27</sup> In our series of 100 stroke patients, majority of the patient stayed in hospital for 5 days, maximum for 13 days and minimum for 1 day.

## CONCLUSION

Ultrasound imaging is a largely wide spread bedside technique that is easily accessible and valuable in cases of critical ill patients. Carotid duplex ultrasound is a noninvasive, inexpensive technique and can be used to assess the presence and severity of carotid artery stenosis which is one of the important causes of ischemic stroke. It can provide an efficient, accurate and reliable method for clinical evaluation and quantification of blood flow volumes in ischemic stroke patients. In our local set up it can be utilized as a reliable diagnostic tool where CT scan or MRI facilities are not available.

## REFERENCES

1. World Health Organization Recommendations on stroke prevention, diagnosis, and therapy: Report of the WHO Task Force on stroke and other cerebrovascular disorders. *Stroke* 1989;20:1407-431.
2. Ahmed MM, Nasarullah M. Study of clinical presentation versus CT findings regarding the type of lesion in stroke. *Pak J Neurol* 2004; 10: 17-22.
3. Alam I, Haider I, Wahab F, Khan W, Taqweem MA, Nowsherwan. Risk factors stratification in 100 patients of acute stroke. *J Postgrad Med Inst* 2004; 18: 583-91.
4. Shafqat S. Clinical guidelines for the management of ischemic stroke in Pakistan. *J Pak Med Assoc* 2003; 53: 600-2.
5. Khan A, Ziauddin. Management of acute stroke. *J Postgrad Med Inst* 1998; 15: 126-43.
6. Berry M, Chowdhary V, Suri S, Mukhopadhyay S, ed. *Diagnostic radiology, neuroradiology including head and neck imaging*. 2nd ed. New Delhi: Jaypee Brothers, 2006: 101-25.
7. Parikh A, Daneman D. Is carotid ultrasound a useful tool in assessing cardiovascular disease in individuals with diabetes? *Diabetes Technol Ther* 2004; 6: 65-9.
8. Gao S, Wong KS, Hansberg T, Lam WWM, Droste DW, Ringelstein EB. Microembolic signal predicts recurrent cerebral ischemic events in acute stroke patients with middle cerebral artery stenosis. *Stroke* 2004; 35: 2832-6.
9. Hennerici M, Baezner H, Daffertshofer M. Ultrasound and arterial wall disease. *Cerebrovasc Dis* 2004; 17(Suppl 1): 19-33.
10. Kurth T, Gaziano JM, Rexrode KM, Kase CS, Cook NR, Manson JE, et al. Prospective study

- of body mass index and risk of stroke in apparently healthy women. *Circulation* 2005; 111: 1992-8.
11. Khan A, Sherin A, Ahmad H, Khalil MA. Acute complications of stroke. *J Postgrad Med Inst* 2004; 18: 220-4.
  12. Arakawa M, Miyake Y, Taira K. Hypertension and stroke in centenarians, Okinawa, Japan. *Cerebrovasc Dis* 2005; 20: 233-8.
  13. Jones CA, Nagpal S. An update: women, hypertension and therapeutic efficacy. *Can J Cardiol* 2001; 17: 1283-9.
  14. Khan J, Rehman AU, Shah AA, Jielani A. Frequency of hypertension in stroke patients presenting at Ayub Teaching Hospital. *J Ayub Med Coll Abbotabad* 2006; 18: 59-61.
  15. Sherin A, Shabbier G, Rehman S, Shah NH, Zarif M. Hypertension in acute ischemic and haemorrhagic stroke. *J Postgrad Med Inst* 2005; 19: 220-5.
  16. Ahmed MM, Nasarullah M. Study of clinical presentation versus CT findings regarding the type of lesion in stroke. *Pak J Neurol* 2004; 10: 17-22.
  17. Khan SN, Vohra EA. Risk factors for stroke: a hospital based study. *J Postgrad Med Inst* 2006; 20: 30-5.
  18. Iqbal I, Hussain S, Hassan M. Hypertension, diabetes mellitus and hypercholesterolaemia as risk factors for stroke. *Pak J Med Res* 2003; 42: 17-22.
  19. Ramirez MF, Tibayan RT, Marinas CE, Yamamoto ME, Caguioa EV. Prognostic value of hemodynamic findings from impedance cardiography in hypertensive stroke. *Am J Hypertens* 2005; 18 (2 Pt 2): 65S-72S.
  20. Devkota KC, Thapamagar SB, Malla S. Retrospective analysis of stroke and its risk factors at Nepal Medical College Teaching Hospital. *Nepal Med Coll J* 2006; 8: 269-75.
  21. Khan H, Afridi, Ashraf S. A hospital based study on stratification of risk factors of stroke in Peshawar. *Pak J Med Sci* 2006; 22: 304-7.
  22. Naseem A, Mahmood, Hussain T, Khan IA. Clinical spectrum of stroke in our adult population. *Pak Armed Forces Med J* 2003; 53: 59-67.
  23. Ghandehari K, Saqqur M, Shuaib A. Validation of carotid duplex and power M-mode transcranial doppler for detection of internal carotid artery stenosis. *Arch Iranian Med* 2004; 7: 182-5.
  24. Likittanasombut P, Reynolds P, Meads D, Tegeler C. Volume flow rate of common carotid artery measured by doppler method and color velocity imaging quantification (CVI-Q). *J Neuroimaging* 2006; 16: 34-8.
  25. Trego ME, Pagani JM. Three presentations of monocular vision loss. *Optometry* 2006; 77: 82-7.
  26. Tomonori T, Keiko S, Shinkichi H, Yoji N, Akira T. Carotid atherosclerosis and arterial peripheral pulse wave velocity in cerebral thrombosis. *J Clin Neurosci* 2006; 13: 45-9.
  27. Saxena SK, Koh GC, Ng TP, Fong NP, Yong D. Determinants of length of stay during post-stroke rehabilita.

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