International Journal of Research in Medical Sciences
Kumari TM et al. Int J Res Med Sci. 2017 Aug;5(8):3605-3609
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20173571

Original Research Article

Colour doppler study of extra cranial carotid vessels in South Indian population

T. Muni Kumari[1]*, P. N. R. SadhanaBonda[2]

[1]Department of Radiology, ACSR Medical College, SPSR Nellore, Andhra Pradesh, India
[2]Department of Radiology, Modern Government Maternity Hospital, Osmania Medical College, Hyderabad, Telangana, India

Received: 06 June 2017
Accepted: 29 June 2017

***Correspondence:**
Dr. T. Muni kumari,
E-mail: acsrm.faculty@gmail.com

ABSTRACT

Background: Colour doppler is non-invasive, cheaper and faster modality for evaluation of extra cranial course of carotid vessels. In evaluation of the extra cranial territory and its accuracy colour Doppler sonography was well established in comparison with angiography. Aim was to study the extra cranial carotid vessels by using colour doppler sonography.
Methods: A total of 80 patients were examined by duplex sonography who were attending the medical department of Osmania medical college and hospital, Hyderabad, Telangana, India, from June 2014 to December 2015.
Results: Highest incidence of the carotid disease is in the age group of 30 to 60 years. Out of 21 positive patients 13 patients were males and 9 were females. Male to female ratio is 1.5:1. Spectral trace was obtained in all the patients and cardinal four velocity parameters were measured. Takayasu's arteritis is found to be more common carotid disease second to atherosclerosis in present study.
Conclusions: Principal cause of carotid disease in Present study is atherosclerotic plaques. Atherosclerotic plaques are mostly found at the level of carotid bifurcation and the internal carotid artery. We suggest that colour doppler is significant advancement in carotid diagnosis.

Keywords: Carotid, Doppler, Vessels

INTRODUCTION

A total of 30-60% strokes are produced by atherosclerosis disease involving extra cranial arteries within 2 cm of the carotid bifurcation.[1] Pre-operative assessment of the carotid bifurcation by duplex sonography can replace angiography.[2]

Colour Doppler sonographic examination consists of real time B-mode image with colour doppler flow imaging and with built in doppler capabilities. Colour flow imaging is only a qualitative and not quantitative.[3]

Ratio of peak systolic velocity (PSV) is important in internal carotid artery (ICA) to that of common carotid artery (CCA). The ratio less than 1 is normal and greater than 2 corresponds to a stenosis of 50% approximately.[4] The present study was under taken to study the predictive role of colour doppler study in extra cranial carotid arteries diseases in south Indian population.

METHODS

The study was carried in patients with attributable neurological symptoms and signs who were attending the medical department of Osmania medical college and hospital, Telangana, India, from June 20014 to December 2015.

A total of 80 patients were examined by duplex sonography to study the extra cranial carotid vessels in South Indian population. Sonographic examination was done by 8.2MHz linear array transducer of the WIPRO GE LOGIQ 400MD ultra sound machine. All the examinations are done with a doppler angle of 60 degrees and sample volume of l to 5mm.

Measurement of the vessel lumen was done from frozen real-time images; the plaque characteristics are noted as seen on real time image. Additional colour flow evaluation is done for all the vessels. Peak systolic velocity of internal carotid artery (ICA), end diastolic velocity of ICA, velocity ratio of ICA/CCA (carotid index) is obtained from the spectral velocity maps. Ethical clearance for this study was accorded by institutional ethical committee, modern government maternity hospital, Osmania medical college, Hyderabad, Telangana, india.

RESULTS

A total of 80 patients were examined by colour doppler sonography and of these 21 showed carotid artery disease and remaining 59 were normal carotid vessels 9 (Table 1).

Table 1: Observation of carotid artery diseases in the present study.

Observation of carotid artery	
Atherosclerotic plaques	17
Takayasu's arteritis	2
Chemodectoma	1
Post traumatic pseudo aneurysm	1

Table 2: Age and sex distribution in the patients.

Age	Male	Female	Total
11 to 20 years	-	2	2
21 to 30 years	-	-	-
31 to 40 years	2		2
41 to 50 years	7	3	10
51 to 60years	3	2	5
60 to 80 years	1	1	2

Detailed work up of these 21 patients was done their clinical history and laboratory data was recorded. Among 21 patients studied 13 patients were males and 8 were females. The highest number of stroke patients in present study was found to be of age group 31 to 60 years which were 80% (Table 3).

Table 3: Characteristics of internal carotid artery plaques in the present study.

Characteristics of internal carotid artery	
Calcified	6
Homogenous hypoechoic	3
Homogenous hyperechoic	6
Heterogenous	6

12 patients had unilateral involvement while 9 patients had bilateral involvement of carotid vasculature. Diameter stenosis of 60 to 70% at the origin of right internal carotid artery by a heterogeneous plaque was observed (Case 1). There is a calcific plaque in the left internal carotid artery at the origin resulting in approximately 30% diameter stenosis (Case 2). We have noted plaque causing 60 to 70% stenosis at the origin of right internal carotid artery and another plaque causing less than 40 percent diameter reduction in left ICA (Case 3).

There is a heterogeneous calcified plaque in the origin of right internal carotid artery causing diameter stenosis of 60-70% (Case 4). Homogenous hypo echoic plaque noted at the bifurcation of the left common carotid artery with velocity patterns with in normal limits suggestive of less than 40% stenosis (Case 5).

There is a homogenous hypoechoic plaque at the origin of right internal carotid artery causing 60-70 percentage of diameter narrowing. Both common carotid arteries are showing intimal thickening suggestive of atherosclerotic changes (Case-6). Chemodectoma of size 4x3x2.5 cm noted in the bifurcation of the right common carotid artery. Flow pattern in carotid vessels appear normal. The lesion is showing heavy vascularity (Case 7).

Homogenously hyper echoic plaque noted in the left internal carotid origin with resultant less than 40% diameter stenosis. Distal part of left internal carotid artery appears normal. Right internal carotid and common carotid arteries appear normal (Case 8).

Post traumatic pseudo aneurysm arising from the neck of right internal carotid artery (Case 9). Bilateral circumferential thickening of common carotid arteries with sparing of origins of the internal carotid arteries along with saccular dilatations of the subclavian arteries is suggestive of takayasu's arteritis (Case 10).

Calcified plaque causing less than 40% diameter stenosis noted in the origin of right internal carotid artery. Distal part of right internal carotid artery appears normal. Left internal carotid and both common carotid arteries appear normal (Case 11).

Complete occlusion of right internal carotid artery. Distal limit of occlusion cannot be defined. Both common carotid arteries appear normal left internal carotid artery appear normal (Case 12).

The results of all the cases with spectral trace measurements were tabulated in (Table 4).

Table 4: Spectral trace and cardinal four velocity parameters by using colour doppler sonography in patients.

Patients case	Carotid arteries	PSV	EDV	PSV ratio	EDV ratio
1	Rt CCA	55cm/s	20cm/s	-	-
	Rt ICA	165cm/s	57.5cm/s	3.0	2.9
	Lt CCA	58cm/s	32cm/s	-	-
	Lt ICA	112cm/s	60cm/s	1.9	1.8
2	Rt CCA	85cm/s	35cm/s	-	-
	Rt ICA	10icm/s	26cm/s	1.1	0.8
	Lt CCA	60cm/s	20cm/s	-	-
	Lt ICA	72.6cm/s	22cm/s	1.2	1.1
3	Rt CCA	65cm/s	19cm/s	-	-
	Rt ICA	174cm/s	45cm/s	2.6	2.8
	Lt CCA	72cm/s	22cm/s	-	-
	Lt ICA	90cm/s	25cm/s	1.2	1.1
4	Rt CCA	60cm/s	15cm/s	-	-
	Rt ICA	173cm/s	42.1cm/s	2.8	2.8
	Lt CCA	75cm/s	30cm/s	-	-
	Lt ICA	90cm/s	35cm/s	1.2	1.1
5	Rt CCA	65cm/s	35cm/s	-	-
	Rt ICA	78cm/s	40cm/s	1.2	1.6
	Lt CCA	75cm/s	40cm/s	-	-
	Lt ICA	97cm/s	38cm/s	1.3	0.9
6	Rt CCA	82 cm/s	17cm/s	-	-
	Rt ICA	165cm/s	49cm/s	1.9	3.0
	Lt CCA	64cm/s	20cm/s	-	-
	Lt ICA	80cm/s	32cm/s	1.2	1.6
7	Rt CCA	75cm/s	35cm/s	-	-
	Rt ICA	60cm/s	30cm/s	0.9	0.6
	Lt CCA	81cm/s	38cm/s	-	-
	Lt ICA	70cm/s	40cm/s	0.8	0.5
8	Rt CCA	60cm/s	32cm/s	-	-
	Rt ICA	75cm/s	40cm/s	1.2	1.2
	Lt CCA	50cm/s	25cm/s	-	-
	Lt ICA	49cm/s	30cm/s	0.9	1.2
9	Rt CCA	76cm/s	38cm/s	1.3	1.9
	Rt ICA	58cm/s	20cm/s	-	-
	Lt CCA	80cm/s	40cm/s	1.1	1.4
	Lt ICA	70cm/s	28cm/s	-	-
10	Rt CCA	25cm/s	10cm/s	-	-
	Rt ICA	35cm/s	15cm/s	1.4	1.5
	Lt CCA	28cm/s	14cm/s	-	-
	Lt ICA	40cm/s	20cm/s	1.4	1.4
11	Rt CCA	60cm/s	32cm/s	-	-
	Rt ICA	77cm/s	40cm/s	1.2	1.2
	Lt CCA	80cm/s	42cm/s	-	-
	Lt ICA	64cm/s	38cm/s	0.8	0.7
12	Rt CCA	28.2cm/s	6.5cm/s	-	-
	Rt ICA	NA	NA	NA	NA
	Lt CCA	40cm/s	10cm/s	-	-

PSV: peak systolic velocity; EDV: end diastolic velocity; PSV ratio: peak systolic velocity ratio; EDV ratio: end diastolic velocity ratio.

DISCUSSION

In present study, the highest incidence of carotid artery disease was found in age group of 30 to 60 years in 17 patients. Two female patients with clinical diagnosis of Takayasus's disease belonged to the age group of less than 20 years. Out of 21 patients 13 patients were males and 9 were females, male and female ratio is 1.5:1. In another study male and female ratio as 2:1 and highest incidence of carotid artery disease were among patients between 30 to 60 years.[5] In study 49 patients with various doppler velocity parameters for carotid artery stenosis correlated with angiography, and found that B-mode measurement of diameter stenosis is most accurate at less than 40% diameter stenosis. They have observed that peak systolic velocity and peak systolic velocity ratio of internal carotid artery (ICA) and Common carotid artery (CCA) are the most accurate parameters for patients with stenosis of 70% or greater.[6]

In current study, we observed that 10 out of 21 patients had more than 40% stenosis. 9 patients had less than 40% stenosis and Peak systolic velocity (PSV) is less than 120cm/s which agrees with previous literature.[7]We have found two patients with 70-79% stenosis and one patient with 80 to 99% stenosis. The percentage of stenosis is calculated when all the parameters corroborated with each other. Specificity of such examination is 75% and positive predictive value is of 72%.[8] In present study we have noted the PSV ratio is less than 1.5 for stenosis less than 40% in eight patients. Three patients with 70 to79% stenosis has PSV ratio greater than 1.8. PSV ratio in two patients with complete occlusion of ICA.

The peak systolic velocity ratio of ICA to CCA of 1.5 as an indicator of 50% diameter stenosis or greater. It was observed that PSV ratio to be more accurate than the isolated PSV of ICA.[9] We found eight patients with EDV more than 40cm/s but less than l00cm/s stratifying them with 50 to 80% diameter stenosis. EDV less than 40cm/s do not yield any accurate information about degree of stenosis. If the EDV is more than 40cm/s but less than 100cm/s we can estimate the stenosis to be ranging from 50 to 80%.[10]

In current study, we observed eight lesions with EDV ratio greater than 2.4 but less than 5.5 predicting the stenosis of 60 to 80%. EDV of ICA to ECA ratio greater than 5.5 predicts 80% or greater stenosis and greater than 2.4 suggests 60 to 80% diameter stenosis.[11]We found reversal of flow in two patients, Turbulence in the form of mosaic pattern in six patients and aliasing in three patients. There are no colour flow signals in two patients found to have complete occlusion. In the Posterio lateral aspect of carotid bulb there is a transient reversal of flow referred to as boundary layer phenomenon. Loss of this boundary layer is the earliest sign of atherosclerosis.[4] Principal cause of carotid disease in Present study is atherosclerotic plaques. Present study came across 6 lesions which are homogenously hyper echoic plaques. The plaque becomes echogenic when it becomes retracted and fibrosed.

Hyper echogenicity suggests the chronic nature of the plaque.[3] In this study came across a case of unilateral carotid body tumour correlating with above mentioned findings. Carotid body tumour can be identified by as highly vascularised soft tissue mass located at carotid bifurcation and sometimes encasing the external and internal carotid arteries.[12] We encountered 3 heterogeneous plaques in Present study. Plaque heterogeneity is due to presence of moderately echogenic collagen and fat content which is of low echogenicity.[13] We have observed a case of post traumatic pseudo aneurysm satisfying the above-mentioned criteria. It was stated that differentiation of true aneurysm from post-traumatic pseudo aneurysm is possible by identification of to and for movement in the neck and cavity of aneurysm.[14] We have observed in two young female patients with clinical suspicion of takayasu's arteritis showing concentric narrowing of common carotids with sparing of internal carotid arteries diagnosed as takayasu's arteritis.

Circumscribed narrowing of common carotid arteries with sparing of internal carotid artery and regions of secular dilation during disease as angiographic signs of takayasu's arteritis.[15] The results of Present study suggesting that colour Doppler study is more effective in diagnosis of carotid arteries diseases when compared to angiography. Evaluation of carotid artery disease by duplex sonography had 92-95% accuracy compared to conventional angiography. They pointed out that the positive predictive value of the test is 97% and that is 3% false positive result. The results of the present study agreed with the previous literatures.[5,7,8,16].

CONCLUSION

Colour doppler sonography is significant advancement in carotid diagnosis. It is useful in assessing the prognosis of transient ischemic attacks and thrombo-embolic stroke patients and in deciding the immediate medical or surgical line of subsequent management.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. D. Srinivas, Radiologist, Vijayawada, Andhra Pradesh, India.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Blaisdell FW, Hall AD, Thomas AN, Ross SJ. Cerebrovascular occlusive disease. Experience with

panarteriography in 300 consecutive cases. Calif Med. 1965;103(5):321-9.
2. Patel MR, Kuntz KM, Klufas RA, Kim D, Kramer J, Polak JF, et al. Preoperative assessment of the carotid bifurcation. Can magnetic resonance angiography and duplex ultrasonography replace contrast arteriography? Stroke. 1995;26(10):1753-8.
3. Zwiebel WJ, Knighton R. Duplex examination of the carotid arteries. Semin Ultrasound CT MR. 1990;11:97-135.
4. Blackshear WM, Phillips DJ, Chikos PM, Harley JD, Thiele BL, Strandness DE. Carotid artery velocity patterns in normal and stenotic vessels. Stroke. 1980;11(1):67-71.
5. Paivansalo M, Leinonen S, Turunen J, Tikkakoski T, Suramo I. Quantification of carotid artery stenosis with various doppler velocity parameters. Rofo. 1996;164:108-13.
6. Erickson SJ, Mewissen MW, Foley WD, Lawson TL, Middleton WD, Quiroz FA, et al. Stenosis of the internal carotid artery: assessment using color doppler imaging compared with angiography. Am J Roentgenol. 1989;152:1299-305.
7. Erickson SJ, Mewissen MW, Foley WD, Lawson TL, Middleton WD, Quiroz FA, et al. Color doppler evaluation of arterial stenosis and occlusions involving the neck and thoracic inlet. Radiographics. 1989:9(3):389-406.
8. Carpenter JP, Lexa FJ, Davis JT. Determination of 60% or greater carotid artery stenosis by duplex doppler ultrasonography. J Vasc Surg. 1995;22: 697-703.
9. Grant EG, Wong W, Tessler F, Perrella R. Cerebrovascular ultrasound imaging. Radiol Clin North Am. 1988;26(5):1111-30.
10. Langlois YE, Greene FM, Roederer GO, Jager KA, Phillips DJ, Beach KW, et al. Computer based pattern recognition of carotid artery doppler signals for disease classification: prospective validation. Ultrasound Med Biol. 1984;10(5):581-95.
11. Bluth EI, Stavros AT, Marich KW, Wetzner SM, Aufrichtig D, Baker JD. Carotid duplex sonography: a multicentre recommendation for standardized imaging and doppler criteria. Radiographics. 1988;8(3):487-506.
12. Zweibel WJ. Doppler evaluation of carotid stenosis in Introduction to vascular sonography. 4th ed. Philadelphia, PA: WB Saunders; 2000:125-135.
13. Polak JF. Carotid ultrasound. RCNA. 2001;39(3):569-89.
14. Carrol BA. Duplex Doppler carotid sonography. In: Rumack Wilson, Eds. Diagnostic Sonography Principles and Clinical applications Saunders. 1999:762-790.
15. Gupta SK, Khanna MN, Lahiri TK, Goel AK. Involvement of cardiac valves in Takayasu's arteritis. Report of seven cases. Indian Heart J. 1980;32(3):147-55.
16. Wood GW, Lukin RR, Tomsick TA, Chambers AA. Digital subtraction angiography with intravenous injection: assessment of 1,000 carotid bifurcations. AJR Am J Roentgenol. 1983;140(5):855-9.

Cite this article as: Kumari TM, SadhanaBonda PNR. Colour doppler study of extra cranial carotid vessels in South Indian population. Int J Res Med Sci 2017;5:3605-9.