Original Research Article

Comparative study of carotiddoppler with contrast enhanced MRA in patients with stroke

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Abstract

Background: Cerebrovascular accident or stroke is one of the most common causes of death. Ultrasonography of the carotid arteries is an easily available, costeffective, noninvasive method of evaluation. Treatment of stroke depends on reaching the most accurate diagnosis. Accurate and prompt diagnosis is crucial because timely and appropriate therapy can significantly reduce the risk of stroke and long term sequelae. Several modalities of investigation are available to determine carotid arterystatus. **Aim:** The purpose of this study is to compare the diagnostic value of extracranial carotid and vertebral artery Doppler and Magnetic Resonance Angiography for the diagnosis of carotid artery pathology in patients with stroke. The principal appealing points in favor of sonography are a patient comfort, accuracy, and lack of risk. MR Angiography produces a reproducible three dimensional image of carotid bifurcation with good sensitivity for high grade stenosis. **Materials, and Methods:** After taking consent, 50 patients presenting with focal neurological deficit underwent co, or Doppler and Gadolinium enhanced MRA examination of the carotid and vertebral arteries at Department Of Radiology, Meenakshi Medical College, Kancheepuram with the help of VOLUSON 730 [WIPRO GE ultrasound machine] with 612 MHz linear array High Definition[HD] probe and 1.5 TESLA MRI. **Results:** The highest incidence of stroke was found in the age group of 50 70 years with male population commonly affected. The various risk factors include a family history of stroke, hypertension and diabetes mellitus. Total pathologies were most commonly found on the right side. The most common site for the atheromatous plaque was a carotid bifurcation. Grading of stenosis was done based on the NASCET criteria and the findings of Doppler and MRA were compared. MRA had a better role than Doppler for detecting 8099% stenosis. **Conclusion:** Colour Doppler examination is a noninvasive, economic, safe, reproducible and less time consuming method of demonstrating the cause of cerebrovascular insufficiency in the extracranial carotid artery system and will guide in instituting the treatment. Doppler has a better role in the evaluation of the morphology of the stenosis particularly plaque morphology and estimating the degree of stenosis.
Key Words: Color Doppler; MRA, Stenosis, Stroke.

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INTRODUCTION

Stroke is a life threatening and debilitating neurological disease. It is the third leading cause of death in the world. Ultrasound of the carotid arteries is the modality of choice for the triage, diagnosis, and monitoring of the cases of atheromatous diseases.[1] There are several pitfalls that may mislead the operator to falsely interpret the color and spectral Doppler findings. Several modalities of investigation are available to determine the carotid artery status. The value of safe, noninvasive screening test is therefore great. The purpose of this study is to compare the diagnostic value of extracranial carotid and vertebral artery Doppler and Magnetic Resonance Angiography for the diagnosis of carotid artery pathology in patients with stroke.[2] Color Doppler sonography became a mainstay in the evaluation of the extracranial territory and its accuracy in comparison with MRA is well established. Carotid sonography has largely replaced angiography for

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http://www.medpulse.in/Radio%20Diagnosis/

suspected extracranial carotid atherosclerosis.[3] The principal appealing points in favour of sonography are a patient comfort, accuracy, and lack of risk. In contrast, the Digital Subtraction Angiography is invasive and expensive. Moreover, contrast related adverse effects also contribute to significant morbidity. In symptomatic patients like those with hemispheric symptoms or TIA, carotid ultrasound may be the only diagnostic imaging modality performed before carotid Endarterectomy.[4] Besides estimating the degree of stenosis, the biggest advantage of sonography is its ability to identify and characterize plaque and identify plaques with a higher risk of embolization with the use of higher solution ultrasound. Plaque can be characterized by relatively high risk groups for containing intraplaque hemorrhage which is thought by many to be the precursor of plaqueulceration.[5] Though the prime indication of color Doppler sonographic examination of the carotid vasculature is stroke prevention, it has nowadays ramified to evaluate various miscellaneous subjects such as suspected patients of an aneurysm, dissection, chemodectoma and Takayasu's arteritis.MR Angiography produces a reproducible three dimensional image of carotid bifurcation with good sensitivity for high grade stenosis. The advantage is that the more distal internal carotid artery, aortic arch and proximal great vessels, Circle of Willis, and the vertebrobasilar system can all be assessed and the method is not operator dependent.[6]

MATERIALS AND METHODS

This study was carried out in patients who had symptoms and signs of strokes or transient ischemic attacks at Meenakshi Medical College, Kancheepuram from the period of November 2016 to September 2017. The study was carried out on 50 patients. A detailed clinical history was taken and clinical examination findings were recorded. Risk factors for hypertension, diabetes mellitus, smoking and ischemic heart disease were documented. The data gathered from the colour Doppler examination consisted of Peak Systolic velocity of the common carotidartery, Peak systolic velocity of the internal carotidartery, Velocity ratios between an Internal carotid artery and common carotidarteries. Plaque characteristics as seen in the real time image. The presence of Spectral broadening. All the examination was performed with a Doppler angle of 60 degrees. Color Doppler examination of the carotid arteries was done using Voluson 730[Wipro GE] machine with 612 MHz linear array High Definition[HD] probe. Carotid arteries were examined with the patient in the supine position. Neck exposure was enhanced by tilting and rotating the head away from the side being examined, and ipsilateral shoulder was drooped as far as possible. The examiner was seated on the right side of the patient. Guidelines about eating and drinking before an MRI exam vary at different facilities. Unless you are told otherwise, you may follow your regular daily routine and take medications as usual.MR angiogram may require you to receive an injection of contrast into a vein in your arm. The radiologist or technologist may ask if you have asthma or if you have allergies to certain drugs, food or to the environment. The contrast material used for an MRI exam, called gadolinium, does not contain iodine and is less likely to cause an allergic reaction than iodine containing contrast used for a CT scan. The radiologist should also know if you have any serious health problems and what surgeries you have undergone. Some conditions, such as severe kidney or liver disease may prevent you from receiving contrast material during an MRI exam.

Procedure: The patient is placed on a special table and positioned inside the opening of the MRI unit. A typical exam consists of two to six imaging sequences, each taking two to 15 minutes. Each sequence provides a specific image orientation and a specified degree of image clarity or contrast. Depending on the type of exam being done, the total time needed can range from 10 to 60 minutes, not counting the time needed to change clothing, have an IV put in and answer questions. When the contrast material is needed, a substance called gadolinium is given by IV injection during one of the imaging sequences. It highlights blood vessels, making them stand out from surrounding tissues. MR angiography studies were reviewed after post processing with a maximum intensity projection algorithm with targeted maximum intensity projection used to display 13 projections of each carotid bifurcation separately (14° angle). For the 3D gadolinium enhanced studies, the maximum intensity projection algorithm was applied after subtracting sequence that showed the best arterial enhancement from the sequence showing no arterial enhancement (the mask). In cases of venous enhancement, subtraction was performed with the last sequence containing low arterial signal intensity and intermediate venous signal intensity.

RESULTS

Table 1: Role of doppler and MR angiography in detecting total pathology Y

Total Pathologies	Total Patients	Doppler		MR Angiography		PValue
		No	%	No	%	
CCA	50	1	2.0	1	2.0	1.000
BULB	50	7	14.0	5	10.0	0.071+
ECA	50	0	0.0	0	0.0	
ICA	50	28	56.0	28	56.0	1.000
VERTEBRAL	50	26	52.0	26	52.0	1.000

Table 2: Role of doppler and MR angiography in detectingpathology

5069% STENOSIS	Total patients	DOPPLER		MR ANGIOGRAPHY		PVALUE
		No	%	No	%	
CCA	50	0	0.0	0	0.0	
BULB	50	2	4.0	0	0.0	0.077+
ECA	50	0	0.0	0	0.0	
ICA	50	1	2.0	0	0.0	0.241
VERTEBRAL	50	0	0.0	0	0.0	

Table 3: Role of doppler and MR angiography in detectingmorphology of stenosis

MORPHOLOGY OF STENOSIS	Total patients	DOPPLER		MR ANGIOGRAPHY		PVALUE
		No	%	No	%	
CCA	50	0	0.0	0	0.0	
BULB	50	7	14.0	5	10.0	0.283
ECA	50	0	0.0	0	0.0	
ICA	50	2	4.0	1	2.0	1.000
VERTEBRAL	50	0	0.0	0	0.0	

Table 4: Role of doppler and MR angiography in detectingthrombosis

THROMBOSIS	Total patients	DOPPLER		MR ANGIOGRAPHY		PVALUE
		No	%	No	%	
CCA	50	1	2.0	1	2.0	1.000
BULB	50	0	0.0	0	0.0	
ECA	50	0	0.0	0	0.0	
ICA	50	26	52.0	26	52.0	1.000
VERTEBRAL	50	26	52.0	26	52.0	1.000

Table 5: Role of doppler and MR angiography in detectingcollaterals

COLLATERALS	Total patients	DOPPLER		MR ANGIOGRAPHY		PVALUE
		No	%	No	%	
CCA	50	0	0.0	1	2.0	0.241
BULB	50	0	0.0	0	0.0	0.0
ECA	50	0	0.0	0	0.0	0.0
ICA	50	0	0.0	15	30.0	<0.001**
VERTEBRAL	50	0	0.0	17	34.0	<0.001**

Table 6: Role of doppler and MR angiography in detectinglocation of stenosis

LOCATION OF STENOSIS	Total patients	DOPPLER		MR ANGIOGRAPHY		PVALUE
		No	%	No	%	
CCA	50	0	0.0	0	0.0	
BULB	50	7	14.0	7	14.0	1.000
ECA	50	0	0.0	0	0.0	
ICA	50	2	4.0	2	4.0	1.000
VERTEBRAL	50	0	0.0	0	0.0	

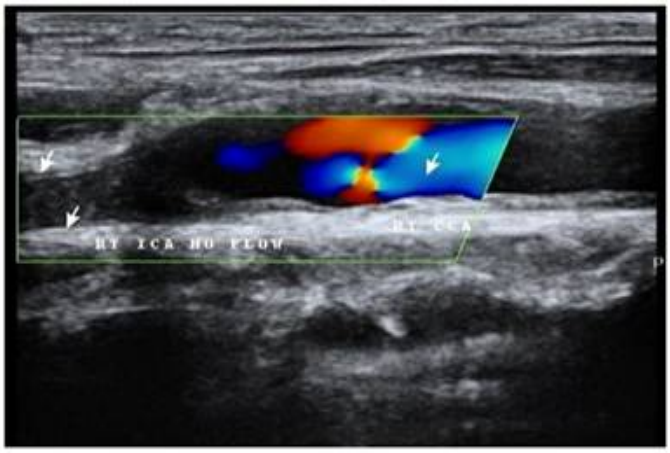
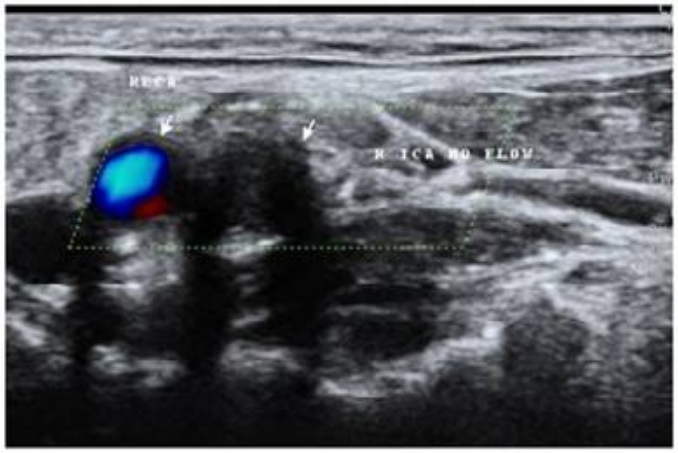


Figure 1:



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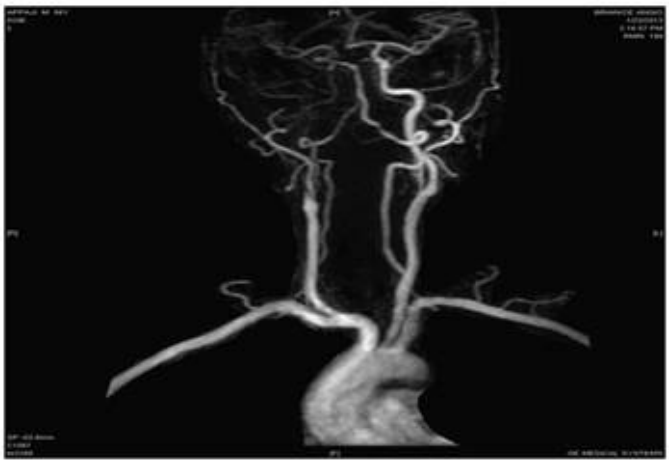

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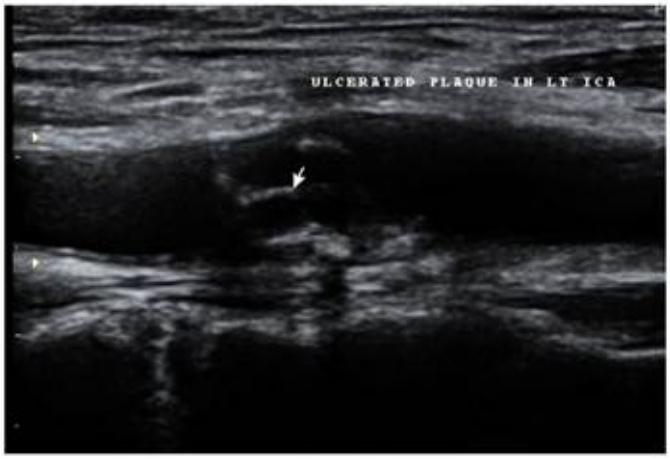

Figure 4:

Figure 5:

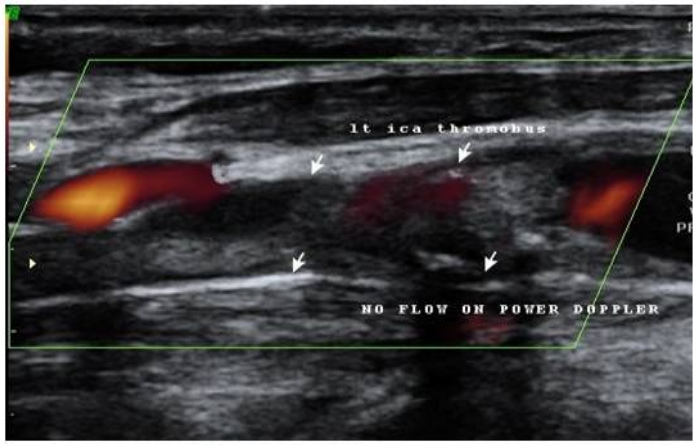

Figure 6:

Figure 1: Longitudinal us image with thrombus in right ica showing no flow on color doppler
Figure 2: Transverse us image with thrombus in right ica showing no flow on colour doppler
Figure 3: Complete occlusion of right ica on mra
Figure 4: longitudinal us image showing ulcerated plaque
Figure 5: Longitudinal us image showing calcified plaque in left bulb causing posterior acoustic shadowing
Figure 6: Left ica thrombus showing no flow on power doppler

DISCUSSION

Two randomized clinical trials, the North American Symptomatic Carotid Endarterectomy Trial (NASCET) and European Carotid Surgery Trial (ECST) have clearly shown the benefit of Endarterectomy in symptomatic patients with greater than 70 % carotid stenosis. The same reports showed lack of any benefit for surgery on lesions of 30% diameter. [7] Another randomized trial Asymptomatic carotid surgery trial showed a distinct advantage for surgical intervention for a patient who had at least 60% stenosis as quoted by Blank M,[8]. Angiography is the gold standard, but it is invasive and expensive and involves significant risk to the patients. Sonography is unique among vascular imaging procedures, in that it can assess plaque composition. Sonographically detected plaque characteristics may have prognostic value and may be useful for the selection of medical and surgical therapy. [9]Our present study consists of evaluating extracranial carotid artery system in 50 patients with color Doppler and contrast enhanced Magnetic resonance Angiography in the population presented with stroke. Puetz V, Dzialowski *et al* found that MRA is inaccurate in assessing 5070% stenosis because of its false positives due to overestimation of the stenosis. In our study comparison of the Doppler and MRA findings in the evaluation of the 5069% stenosis.[10] Doppler showed abnormalities in 3 patients [6%] whereas in MRA it is 0. P value is 0.077+. The difference was found to be statistically significant.[11] Schramm P, *et.al* found that MRA has better discriminatory power compared with duplex ultrasonography in detecting 7099% stenosis. For detecting occlusion both MRA and ultrasound are accurate. In our study comparison of the Doppler and MRA findings in the evaluation of the 7079% stenosis. Abnormal findings are equal on both Doppler and MRA. P value is 1.[12] comparison of the Doppler and MRA findings in the evaluation of the 8099% stenosis. MRA showed abnormalities in 3 patients [6%] whereas in the Doppler it is 0. P value is 0.077+. The difference was found to be statistically significant. comparison of the Doppler and MRA findings in the evaluation of the occlusion. Abnormal findings are equal on both Doppler and MRA. P value is 1.[13] Lev MH, Romero as stated above. Aburahma Ali F, wulu John T and Crotty Brad. have confirmed that soft plaques and nonhomogeneous plaques are more positively correlated with symptoms than with any degree of stenosis and were the cause of adverse neurological events. Out of 50 patients in this study, 2 patients had soft plaques, 5 had nonhomogenous plaques, 2 had calcified plaques and one patient was found to have ulcerative plaque. comparison of the Doppler and MRA findings in the evaluation of the thrombosis. [14]Abnormal findings were equal on both Doppler and MRA. P value is 1. shows a comparison of the Doppler and MRA findings in the evaluation of the collaterals.[15] Abnormal findings were seen in 33 patients in MRA, none on Doppler. P value is <0.001** suggests strongly significant. comparison of the Doppler and MRA findings in the evaluation of the location of the site.[16]Aburahma AF found that the carotid bifurcation was commonly involved by the atherosclerotic plaque followed by the origin of the carotid. In our study also Bulb was found to be the commonest site affected by the plaque. In the Bulb, a plaque was identified in 7 patients followed by 2 patients in internal carotid artery.[17]

CONCLUSION

MRA has progressively gained clinical relevance in the evaluation of cerebrovascular disease and has become a powerful tool for accurate and early diagnosis of causes of cerebralischemia. In cases where doppler assessment does not allow full visualization of carotid bifurcation, MRA isrequired.MRA has been developed as an alternative technique to digital subtraction angiography in the evaluation of intracranial and extracranial vasculature as it is noninvasive and probably gives a more precise estimate of stenosis because it provides a direct measurement of the stenoticlumen.MRA has better discriminatory power compared with duplex ultrasonography in detecting 8099% stenosis. The most common site for the atheromatous plaque was a carotid bifurcation. Out of 50 patients, in this study 2 patients had soft plaques, 5 had nonhomogenous plaques, 2 had calcified plaques and one patient was found to have ulcerative plaque. In the present study, Doppler was able to assess the calcified plaques but not MRA. MRA is not sensitive to arterialcalcification.

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