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CORRELATION STUDY OF TRANSCRANIAL DOPPLER WITH MRA AND CV DOPPLER IN ANTERIOR CIRCULATION ISCHEMIC STROKES

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ABSTRACT TCD using pulsed doppler transducer can show the spectral flow waveforms, blood flow direction, velocities and intensity in the intracerebral vessels,thereby we can assess the significance of intracranial vessel stenosis and the existing collateral circulation.

OBJECTIVES: To study correlation of transcranial Doppler study with MR angiography and CV Doppler in ischaemic strokes.

METHODOLOGY : We studied 48 patients admitted with ischaemic stroke in neurology department . MRI with MRA , CV Doppler and TCD studies were performed .TCD analysis showed decrease in mean flow velocity(MFV) in the upstream vessels distal to the occlusion with increase in pulsatility index(PI).There is a definite correlation between magnitude of extracranial carotid stenosis and intracranial MCA&ACA bloodflow reduction as assessed by TCD.Intra cranial vessel stenosis can be very well delineated by regional mean bloodflow reduction,increased flow velocity and increased pulsatility index in the upstream vessels[2-5].

RESULTS : Of the 48 patients,15 patients had extracranial and 27 patients had intracranial occlusion and rest had botetween eh. In intracranial proximal ICA occlusion , the decrease in MFV in ipsilateral MCA and ACA was 70% and 40% respectively. In MCA occlusions the decrease in MFV in ipsilateral MCA was 60%. Among patients with intracranial ICA occlusions , the increase in PI in ipsilateral MCA and ACA was 58% and 47% respectively . In MCA occlusions the increase in PI in ipsilateral MCA was 40% Among patients with extracranial CCA and ICA occlusion decrease in MFV and increase in PI was 70% and 60% in ipsilateral MCA and ACA respectively .

CONCLUSION : The statistical coefficient for mean flow velocity was $p = 0.662 / P < 0.05$ and that for pulsatility index was $p = 0.541 / P < 0.05$. Thereby TCD provides insight into a wide range of intra and extracranial vascular pathologic conditions and their effects on cerebral hemodynamics[2-5].

KEYWORDS :

Introduction :

TCD is a non-invasive, nonionising, inexpensive, portable and safe technique that uses a pulsed Doppler transducer for assessment of intracerebral blood flow[2]. TCD can show the spectral flow waveforms, blood flow direction, velocities and intensity in the intracerebral vessels. At present magnetic resonance angiography and transcranial sonography are the two most common noninvasive techniques used for assessment of intracranial hemodynamics . The results of both are almost same and can be used in the long term follow up of stroke patients . Thereby TCD is a useful adjunct to imaging in evaluating its haemodynamic consequences on the intracranial circulation[2-5].

TCD is a useful tool in detecting the presence , the location and severity of intracranial arterial occlusion in ischaemic strokes . It also evaluates the hemodynamic consequences of arterial occlusion like flow diversion , compensatory exaggerated flow in other vessels . TCD is useful in the following conditions in the assessment of intracranial hemodynamics[2]

1. arterial occlusive disease
2 sickle cell ischaemia
3 right to left shunts
4. subarachnoid hemorrhage
5. detection of emboli
6. periprocedural or surgical monitoring
7. brain death
8 . cerebral vasoactive reactivity

It also plays an important role in real time monitoring of arterial recanalisation during intravenous thrombolysis . It also helps in the risk stratification .

AIM OF THE STUDY:

To study correlation of transcranial Doppler with MR angiography and CV Doppler in ischaemic strokes .

MATERIALS AND METHODS:

- 45 patients admitted with ischaemic stroke in neurology department were included in the study . MRI BRAIN WITH MR ANGIOGRAM and CV DOPPLER was done for these patients . Parameters assessed using trans cranial Doppler include mean flow velocity and pulsatility index . Doppler study was performed in both anterior and posterior circulation arteries using transtemporal and transforaminal window. The changes in flow velocity was assessed in intracranial and extracranial occlusive disease in these patients . Correlation of TCD with imaging was done . P value less than 0.05 was considerd statistically significant.

MRA:

The MRI studies was performed in our radiology department using 1.5 tesla machine the appearance of vessels identified using MRA were reported to be normal , attenuated and absent vessel .

TCD:

It was done using a 2 hz probe . TCD should be done initially in the suspected uninvolved hemisphere to get an idea of the normal arterial waveform pattern and velocities as well as the expected quality of the temporal acoustic window. Using the transtemporal window arteries studied include MCA ,ACA, PCA and DISTAL ICA[1] . Through the transorbital window we look for ophthalmic artery and carotid siphon . Vertebral and basilar arteries are studied through the trans foraminal window . TCD has a sensitivity , specificity , positive and negative predictive value of 96%, 75%, 96% and 75%, respectively in ischaemic strokes[2-5]. The diagnostic yield is high when performed early after the onset of symptoms .

RESULTS :

GENDER	MALE	FEMALE
TOTAL -48	39	9

AGE	<30	30-50	50-60	60-70
48	2	17	21	8

TYPE OF CIRCULATION	ANTERIOR	POSTERIOR
TOTAL 48	41	7

Vessel occluded	ICA	MCA	ICA+MCA	VA	NIL
	19	11	8	2	15

OCCLUSION	EXTRACRANIAL OCCLUSION	INTRACRANIAL OCCLUSION	BOTH	NORMAL
	15	26	11	15

Vessel OCCLUSION	MFV DECREASE MCA	MFV decrease ACA	PI increase MCA	PI increase ACA
ICA - 19	15	8	9	6
MCA - 11	9	-	7	-
ICA +MCA - 8	7	4	6	4

Among 21 patients with normal MRA 10 patients had normal TCD and 11 had hemodynamic changes in TCD . Of those 11 patients 5 had decrease in MFV in MCA /ACA , 3 showed increase in pulsatility index and 3 showed both the changes. Among those 11 patients with normal MRA 3 had around 40-45% extracranial occlusion of CCA .

DISCUSSION :

- Intracranial atherosclerosis is responsible for up to 10% of TIA and strokes[1]. Sensitivity, specificity, and positive and negative predictive value of TCD are generally higher in detecting abnormalities of the anterior circulation than in the vertebrobasilar circulation, as the latter has more anatomical variations and can be difficult to localise for TCD insonation[2].

The primary parameter of stenosis is a focal increase in mean flow velocity at the site of luminal narrowing. Secondary parameter of stenosis include decreased velocity and increased pulsatility upstream from the lesion and abnormal flow immediately downstream from the lesion. Intra cranial stenoocclusive disease results in focal velocity increase, collateral flow patterns ,decrease in flow velocity in poststenotic segment upstream to stenosis. Ultrasound criteria for intracranial occlusion is segmental flow acceleration of > 50% from baseline and side difference between intracranial vasculature of > 30%[2,5] .

Thereby if any flow is detected in TCD in a vessels which showed no flow or stenosis in MRA indicates patency of vessels and that the MRI findings are attributed to the slow or turbulent flow. Conversely no flow on TCD indicates either true occlusion or technical error[2,5].

The noninvasive vascular ultrasound evaluation (NVUE) in patients with acute ischemic stroke has a high yield and accuracy in diagnosing lesions amenable to interventional treatment (LAIT). LAIT is defined as an occlusion or near-occlusion or ≥ 50% stenosis or thrombi in an artery supplying brain area affected by ischemia[2].

The normal spectral waveform –a sharp systolic upstroke and stepwise deceleration with positive end diastolic flow

Mean flow velocity – is calculated as EDV plus one third of the difference between PSV and EDV .

Pulsatility index- it is the assessment of flow resistance calculated by subtracting EDV from PSV and dividing the value by MFV
PI value more than 1.2 represent high resistance blood flow pattern .

SPECTRUM WITH ABNORMAL FLOW ACCELERATION :

Seen distal to a proximal stenotic lesion . The waveform shows delayed systolic acceleration , flattened systolic upstroke and slow diastolic deceleration[2] .

EDV is usually more than 50% of PSV due to compensatory distal vaasodilation . It is called as blunted flow signals[2] .

TCD criteria for stenosis is focal increase in Mean flow velocity > 80 cm/sec for MCA and ICA , >75cm/ sec for ACA , .65cm/sec for BA and 60 cm/sec for PCA and VA[1,2] . The optimal mean flow velocity (MFV) cut-off for the detection of ≥70% stenosis was 128 cm/s (sensitivity 78%, specificity 96%) in the anterior circulation and 119 cm/s (sensitivity 100% and specificity 99%) in the posterior circulation. However 60% of the attenuated vessels and 30% of stenotic vessels by MRA are normal by TCD[2] .

CONCLUSION :

- The statistical correlation for MFV of MCA was $P < 0.05$ and that for pulsatility index of MCA was $P < 0.05$ in ICA and MCA occlusion.
- The correlation for MFV and PI of ACA was $P > 0.05$ in ICA occlusion.
- There was significant statistical correlation between TCD study and intra / extracranial vascular imaging for Middle cerebral artery in ICA and MCA occlusion[4,5].
- The mean flow velocity in vessels distal to occlusion were more correlative to MRA or CV Doppler imaging than pulsatility index in near total occlusive disease[2,4].
- Thereby TCD provides insight into a wide range of intra and extracranial vascular pathologic conditions and their effects on cerebral hemodynamics[2].
- Abnormal TCD findings are highly suggestive of ICA and MCA stenosis. Normal TCD results, however, do not exclude such a lesion, especially in patients with distal M1 or M2 disease. Because distal M1 and M2 disease was found in approximately half of our patients, we recommend the use of TCD sonography as a screening test for ICA stenosis[4,5].
- Thereby a simple bedside investigation is helpful in assessment of stenotic lesion , the degree of stenosis , presence of collaterals , and prognostication[1,2] .
- Still a good interpretation depends on the good acoustic window , age of the patient and observer skill[1] .

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