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A study on role of DSA in intracerebral vascular anomaly comparison with computed tomography angiography/magnetic resonance angiography

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ABSTRACT

Background: Brain imaging techniques provide the ability to noninvasively map the structure and functions of the brain. Brain vascular malformation mainly affects people in the 5th decade followed by 4th and 3rd decade. **Aims and Objectives:** The aim of the study was to compare the diagnostic supremacy of computed tomography angiography (CTA)/magnetic resonance angiography (MRA) and Digital subtraction angiography (DSA) for the detection of intracranial vascular anomalies. **Materials and Methods:** An observational descriptive study with cross-sectional design was performed among 50 patients of both sexes undergoing DSA test at Medical College and Hospital, Kolkata with acute stroke syndrome or any other symptoms suggesting intracranial vascular lesion, who were investigated with one or more index tests and a reference standard diagnosed by computed tomography (CT) or MR scanning or other parameters. DSA served as the standard of reference for presence of intracranial vascular anomalies. **Results:** Out of the 50 patients included in the study, 41 were diagnosed with vascular malformations by DSA. Moya moya disease was diagnosed in three and distal AV fistula in six patients. In the 41 patients with vascular malformations, CTA could correctly identify 17 (41.5%) cases whereas MRA could identify 73.2% cases. **Conclusion:** DSA can be used for both diagnostic and interventional angiography. Its high spatial and temporal resolution have maintained DSA as a very important tool. The study reveal DSA is more superior to accurate angioarchitectural delineation of different intracerebral vascular malformation.

Key words: Vascular malformation; Intracranial; CTA; MRA; DSA

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INTRODUCTION

Brain imaging techniques provide the ability to noninvasively map the structure and functions of the brain. Intracranial vascular anomalies including arteriovenous malformations (AVMs), cavernous angioma, developmental vascular anomaly, capillary telangiectasias, etc. are common findings on imaging studies. With brain imaging becoming available ubiquitously, these common lesions are expected to be discovered more and more in an asymptomatic stage.[1]

Although digital subtraction angiography (DSA) is still considered the "gold standard" in vascular imaging, many non-invasive imaging modalities such as computed tomography (CT) scan, computed tomography angiography (CTA), magnetic resonance imaging (MRI), and magnetic resonance angiography (MRA) can give a fair diagnostic idea of many of such lesions.[2]

CTA is a non-invasive volumetric imaging technique that does not require arterial puncture or catheter manipulation

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and can be a useful tool for surgical planning, using 3D reformatting, showing small vessels emerging from and near aneurysm and allowing one to plan the best craniotomy approach. CTA has, however, a number of pitfalls, namely, unreliable to diagnose, especially for small vascular lesion <3 mm size, difficulty to correctly visualize the posterior communicating artery region due to bony structure around it.[3]

MRA, on the other hand, is also a non-invasive imaging technique that is based on the detection of blood flow within the cerebral vessels. Its primary advantage is that it can provide us with very thin, almost sub-mm source images that can be viewed later on using both 2D and 3D modes. The main disadvantages of this technique are the prolonged acquisition time and the artifacts due to flow phenomena and patient motion.[4]

DSA has long been considered the reference standard for imaging evaluation of intracranial stenosis and occlusion. DSA is an important method of studying the intracranial vascular structures and DSA provides excellent visualization of the intracranial vasculature. However, the disadvantages of using DSA for intracranial studies include the inherent risks associated with invasive procedure like risk of vascular injury and stroke, superimposition of vessels, and serious degradation of image quality by patient motion.[5]

The purpose of this study is to evaluate the diagnostic supremacy of DSA over CTA/MRA.

Aims and objectives

The objectives of the study are as follows:

1. To know the distribution of age and sex in patients of brain vascular lesion.
2. To see the common location of different brain vascular lesions.
3. To compare the diagnostic supremacy of CTA/MRA and DSA for the detection of intracranial vascular anomalies.

MATERIALS AND METHODS

An observational and descriptive study with cross-sectional design was performed after obtaining approval from the Institutional Ethics Committee and after taking proper informed consent of the patients participating in this study. The study included 50 patients of both sexes undergoing DSA test at Medical College and Hospital, Kolkata with acute stroke syndrome or any other symptoms suggesting intracranial vascular lesion, who were investigated with one or more index tests and a reference standard diagnosed by CT or MR scanning or other parameters. Patients were included irrespective of the severity of their disease as long as they were stable enough to undergo an index test and a reference standard. Patients having a history of allergic manifestation to contrast or other drug and patients with implanted cardiac pacemaker or other such device were excluded from the study.

Data collection was done using a pre-designed and pre-tested proforma to detail the clinical and epidemiological profile of the patient along with the findings of imaging studies.

MRI techniques

MRI was acquired with either one of our 1.5 Tesla whole-body scanners using a standard head coil. Cerebral arteriovenous malformation would be suspected if MR dual echo or TOF MR 3D angiography source images showed a conglomerate of parenchymal curvilinear structures.

Dural arteriovenous fistulas would be suspected if MR dual echo or TOF MR 3D angiography source images showed multiple curvilinear structures over the surface of the brain without parenchymal evidence of nidus. Cavernous malformation was diagnosed by the persistence of a hemorrhagic lesion with a hemosiderin ring. The MRI and MRA were reviewed independently by neuroradiologists.

DSA techniques: DSA was carried out through a femoral arterial puncture. Depending on the location of the intracerebral hemorrhage, relevant cervical vessels would be catheterized for DSA. For example, for a left parieto-occipital hemorrhage, left internal carotid artery, left external carotid artery, and left vertebral artery would be selected for study. Cerebral arteriovenous malformation and dural arteriovenous fistula were diagnosed by their nidal location, identification of an early draining vein and identification of a venous sinus abnormality. DSA images were independently reviewed by a neuroradiologist.

DSA served as the standard of reference for presence of intracranial vascular anomalies. DSA as standard of reference was regarded to have a sensitivity and specificity for vascular anomaly detection and determination of best treatment of 100%.

RESULTS

The study included 50 patients. The youngest patient was 14 years old and the oldest patient was 82 years old. Out of the total 50 patients, 28 (56%) were males and 22 (44%) were females. The maximum proportion (42%) of patients belonged to the age group 45–59 years and the least were from the age group below 30 years (Table 1).

Table 2 deals with the clinical features at presentation. The most common clinical feature was headache (56%), followed by focal neurological deficit (42%). Visual disturbances and parenchymal hemorrhage were the least common finding at presentation.

The pie chart describes the location of lesion. Most of the patients presented with supratentorial region, followed by infratentorial region, least common was lesion in transverse or sigmoid sinus (Figure 1).

Out of the 50 patients included in the study, 41 were diagnosed with vascular malformations by DSA. Moya moya disease was diagnosed in three and distal AV fistula in six patients. (Table 3), (Figure 2 and 3)

In the 41 patients with vascular malformations, CTA could correctly identify 17 (41.5%) cases whereas MRA could identify 73.2% cases. CTA correctly identified one out of three Moya moya disease and MRA identified two out of three cases. Of the six patients who presented with dural AV fistula, CTA could identify only one case and MRA identified three cases correctly. (Table 4)

Table 1: Age and sex distribution of the study population (n=50)

Variables	Frequency	Percent
Age group		
<30 years	4	8
30–44 years	15	30
45–59 years	21	42
60 years and above	10	20
Sex		
Female	22	44
Male	28	56
Total	50	100

Table 2: Clinical features at presentation in the study participants (n=50)

Clinical features	Frequency	Percent
Headache	28	56
Parenchymal hg	9	18
Focal neurological deficit	21	42
Visual disturbances	9	18
Briuit/Tinnitus	12	24

Table 3: Diagnoses of lesions as identified by DSA

Diagnosis	Frequency	Percent
Vascular malformation	41	82
Moya moya disease	3	6
Distal AV fistula	6	12
Total	50	100

DSA: Digital subtraction angiography

DISCUSSION

Cerebrovascular anomalies of the brain are a heterogeneous group of disorders that represent morphogenetic errors affecting arteries, capillaries, veins, or various combinations of vessels. The presentation, natural history, and management approaches to CVMs depend on their type, location, size, and hemodynamic characteristics.

Non-invasive imaging modalities, particularly CTA and MRA, have been gaining acceptance as practical alternatives to DSA for the diagnosis of cerebrovascular diseases.[6] The present study was done on 50 patients from medical and neurological wards of a tertiary hospital, with provisional diagnosis of vascular brain involvement.

Age of the patient may have a significant effect on several clinical and morphological AVM variables at the time of the initial diagnosis, including associations with established risk factors that may influence both the natural history and the risk of invasive AVM treatment.[7] AVMs of the brain affect 0.01–0.50% of the population and generally present in individuals in their 3rd–5th decade.[8] The findings of the present study are in line with the evidence. Males have a higher predilection toward developing AVM which was similar to the findings of the present study.[9]

Location of the lesion may be important as compared with supratentorial AVM patients presenting with hemorrhage, infratentorial AVM hemorrhage patients may have a higher frequency of feeding artery aneurysms and deep venous drainage component.[10] In the present study, most of the lesions were found to be located in supratentorial brain whereas, dural AVFs were mostly located in transverse, sigmoid, and transverse sinus.

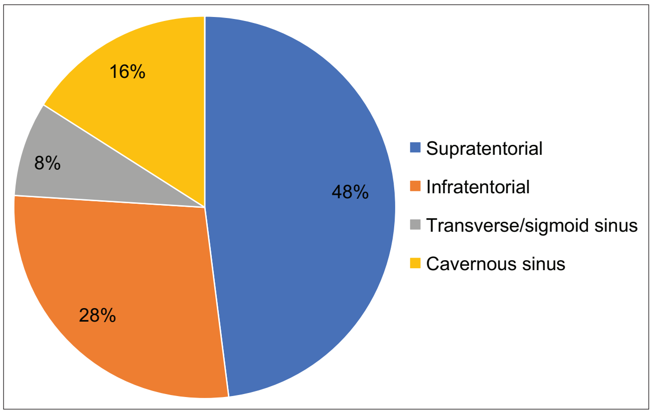

Figure 1: Distribution of location of lesion

The 3D reconstruction of CT angiography provides accurate size of AVM, but because of poor temporal resolution CT angiography is not accurate enough to determine the exact localization and size of the AVM nidus or differentiate in the nidus obliterated or normal blood vessels, such as arteries that bring blood to the AVM or drainage veins, which can be left out by CT angiography, while DSA provides a series of shots at different stages of the passage of contrast through the AVM.[11] However, due to the high ionizing radiation in CTA examinations and a higher possibility of an anaphylactic reaction to the CT contrast medium in patients, MRA is gaining importance for use in cerebral vascular lesions and has become a potential alternative for both diagnosis and follow-up.[12]

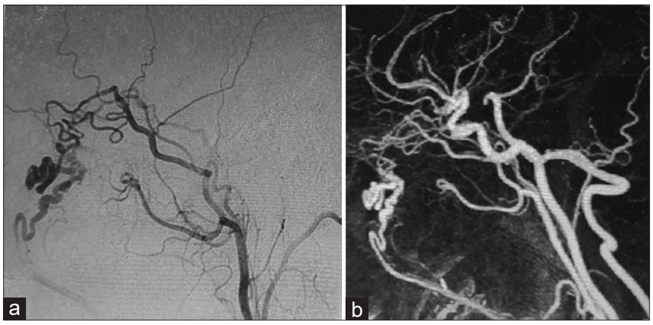

Figure 2: A 45-year-old woman with right orbital AVF. Lateral (a) projection of DSA and lateral (b) views of CTA show a very similar picture of arterial feeders from the branches of the right middle meningeal artery. The AVF has a drainage into the facial veins with no cortical venous reflux

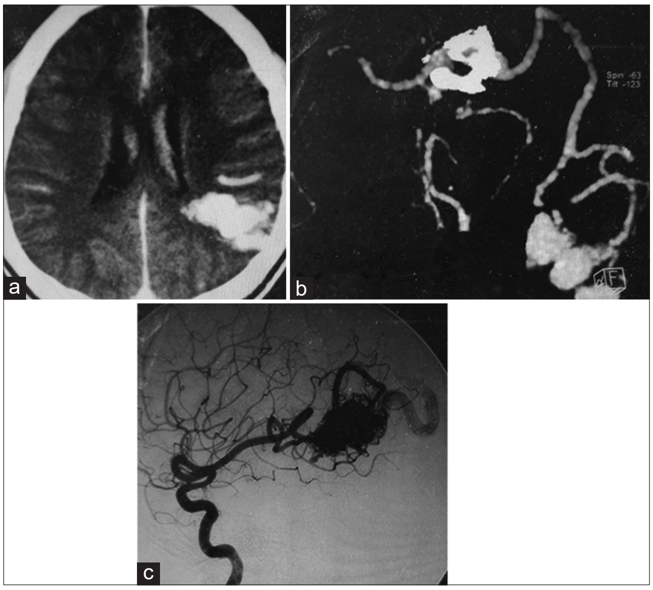

Figure 3: A 32-year-old man who presented with a left parietal hematoma. (a) Axial contrast material-enhanced CT scan shows a tangle of intensely enhancing tubular structures embedded in the left parietal lobe, a finding that is compatible with a nidus. Hyperattenuation representing intraventricular hemorrhage is noted in the ventricles. (b) Maximum intensity projection image (basal view) from CT angiographic data shows enlargement of the left middle cerebral artery (MCA) (relative to the right side), which supplies the nidus. (c) Lateral left internal carotid angiogram reveals a glomerular type nidus in a cortical location, supplied mainly by the posterior parietal and angular branches of the left MCA, with early drainage into a left parietal cortical vein, findings that confirmed the diagnosis of a brain AVM

In this study, 19 patients are nicely delineated by CTA by vascular architecture pattern but rest most of the patients remains indetermined. MRA depicts better than CTA, pick 35 patients to correctly delineate the vascular anatomical involvement.

In a study among patients with cerebral AVMs in hereditary hemorrhagic telangiectasia, the sensitivity and specificity of MR imaging as a whole in detecting AVMs then confirmed on DSA were 80.0% and 94.4%, respectively, and the positive and negative predictive values were 97.3% and 65.4%, respectively.[13]

Quantitative as well as qualitative data on relative hemispheric contrast transit times are obtainable. Precise and detailed anatomic detail of a lesion is possible by DSA. The great advantage of DSA is that, at the same sitting, DSA can help in interventional purpose such as embolization, clipping, and coiling. Post-operative intravenous DSA is useful for determining the results of surgical treatment of certain conditions and is suitable for assessing the patency of surgical bypass grafts.

Limitations of the study

The limitations of the study include the small sample size and the fact that the research was a single center study restricting the generalizability of the findings. Additionally, the cross-sectional design limits the causal relationship.

CONCLUSION

While CTA/MRA shaded surface display may be useful in depicting arterial supply and venous drainage patterns, the

Table 4: Corrective accuracy of CTA and MRA over DSA in patients of arterial malformations

Diagnosis	Correctly identified by DSA	Correctly identified by CTA	Correctly identified by MRA
Vascular malformation	41	17 (41.5)	30 (73.2)
Moya moya disease	3	1 (33.3)	2 (66.7)
Dural AV fistula	6	1 (16.7)	3 (50)
Total	50	19 (38)	35 (70)

DSA: Digital subtraction angiography

best imaging tool for detailed delineation is DSA for dural and CCF. Indeed, DSA with superselective catheterization of dural and transosseous feeders is usually required to identify arterial feeders, define the exact fistula site, delineate venous drainage, and identify feeding artery or remote aneurysms.

DSA is required for definitive diagnosis and treatment. Complete delineation of the arterial supply and venous drainage pattern is the goal. DSA can be used for both diagnostic and interventional angiography. Its high spatial and temporal resolution have maintained DSA as a very important tool.

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