International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2020; 3(4): 87-91
Received: 19-08-2020
Accepted: 21-09-2020

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Role of magnetic resonance venography in the evaluation of cerebral venous thrombosis in a tertiary care hospital in rural Tamil Nadu

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DOI: http://dx.doi.org/10.33545/26644436.2020.v3.i4b.141

Abstract
Background: Cerebral venous sinus thrombosis (CVST) is a common medical problem in India which has serious clinical consequences. MR venographic technique is one of the modalities of choice for diagnosis and evaluation of dural sinus and cerebral venous thrombosis wherever MRI facility is available. The present study was conducted to evaluate the spectrum of magnetic resonance venography in the diagnosis of cerebral venous sinus thrombosis.
Material and Methods: It was a record-based study, in which case records of CVST patients who attended the department of radiodiagnosis was reviewed. Total cases included were 30 over the period of 2 years. A complete clinical history of patients followed by general physical examination and detailed central nervous system with examination of other significant system was done. Non contrast MR imaging including T1 sagittal, T2 axial, Fluid Attenuated Inversion Recovery (FLAIR) coronal, axial diffusion weighted images(DWI), Susceptibility weighted images (SWI), 3D T1 Fast field echo (FFE), 2D Time of Flight (TOF) Source images and 3D maximum intensity projection(MIP) images were acquired and evaluated for presence of venous thrombosis as indicated. Data analysis was done.
Results: The results of the study showed that the incidence of CVST was more in female population. The peak incidence of CVST was found in the age group of 21 to 40 years. Headache was the commonest clinical feature seen in 09 patients (30%). The superior sagittal sinus is commonly involved in CVST, which is seen in 19 patients (63.33%), the next commonest sinus involved is right transverse sinus in 10 patients (33.3%) followed by right sigmoid sinus in 09 patients (30.0%).
Conclusion: This study concluded that MRI and MRV are valuable imaging modalities for the diagnosis of CVST. MRI and non contrast MRV should be recommended as they are safer, non-invasive, non-ionizing and highly accurate modalities.

Keywords: cerebral venous sinus thrombosis, magnetic resonance venography, magnetic resonance imaging, superior sagittal sinus, time of flight, susceptibility weighted imaging, flow voids, blooming

Introduction

Cerebral venous thrombosis (CVT) is a rare form of cerebrovascular disease. Young individuals and children constitute the main patient groups with CVT. Due to the age of onset and the different causes of CVT, its clinical manifestations are diverse. The common clinical manifestations of CVT include high intracranial pressure symptoms (headache, papilledema, and vomiting), focal symptoms, and encephalopathy-like symptoms. Encephalopathy-like symptoms are rare; however, most symptoms are severe, and the patient can develop epilepsy, mental disorders, and confusion and can go into coma [1]. Cerebral venous sinus thrombosis (CVST), once considered to be rare, is increasingly diagnosed with advancement in the diagnostic neuroimaging techniques and increasing awareness of the disease. As CVST accounts for 0.5% of all strokes and its annual incidence is estimated to be 3–4 cases per million population and up to 7 cases per million children [2]. About 75% of the adult patients are women [3].

In last few decades there have been tremendous recent advances in development of Magnetic Resonance Angiography (MRA) for depicting vessels and blood flow as well as evaluating the occurrence of various cerebrovascular diseases [4]. On the other hand MRI of venous system of brain (based on Susceptibility Weighted Imaging approach- SWI approach) is also important and offers new helpful insights into venous lesions and diseases, also has been

seen that neurologists and neuro-radiologists are paying active attention to the role of Intracranial Venous System (ICVS) in cerebrovascular diseases [4]. The present study was conducted to evaluate the spectrum of magnetic resonance venography in the diagnosis of cerebral venous sinus thrombosis.

Material and methods: It was a record-based study, in which case records of CVST patients who attended the department of Radiodiagnosis, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet, Tamil Nadu. The total cases included were 30 over the period of 2 years. Before the commencement of the study ethical approval was taken from the ethical committee of the institute. Patients who were diagnosed with CVST with or without comorbidity were included in the study. A complete clinical history of patients was taken which included name, age, sex, occupation and presenting complaints. This was followed by general physical examination and detailed central nervous system with examination of other significant systems. The patients were scanned using 1.5 Tesla superconducting magnet, Philips Achieva. The 2 dimensional time of flight (2D TOF) sequence was done in both the axial and coronal planes then the source images were reconstructed into three dimensional maximum intensity projection (3D MIP) images. Non contrast MR imaging including T1 sagittal, T2 axial, FLAIR Coronal, Axial diffusion weighted images(DWI), Susceptibility weighted images(SWI), 3D T1 FFE were also acquired and studied for the following details.

- Parenchymal changes in routine T1, T2, FLAIR and Diffusion weighted images for hemorrhagic venous infarct.
- Absence of flow voids and gradient blooming in all the sinuses were evaluated, which is suggestive of sinus thrombosis.
- Presence of edema, whether it is cytotoxic edema or vasogenic edema.
- 2D TOF source and MIP images were evaluated for all the sinuses for flow gaps and collateral venous channels.
- Cases were followed up clinically and radiologically as indicated. Data analysis was done using frequency distribution with regard to diagnosis and outcome made by MR Venogram were computed and compiled.

Results: A total of 53 patients who were clinically diagnosed as having cerebral venous thrombosis as per records were sent for MRV. Out of which 23 patients were found to be normal and 30 patients had cerebral venous thrombosis, which were included in the present study. In the present study, out of 30 patients in 8 patients the cause was unknown and the alcohol was the commonest cause for the CVST which was seen in 05 patients (16.66%) and the next common were dehydration and postpartum, each constituted 4 patients (13.33%).Headache was the commonest clinical feature seen in 09 patients (30%) and the next commonest clinical features were seizures in 07 patients (23.33%) and hemiparesis/focal neurological defects in 05 patients (16.66%). Out of total 30 CVST patients, Female predominance was seen in the present study of which 18 patients were female and 12 were male (female to male ratio was 1.5:1)

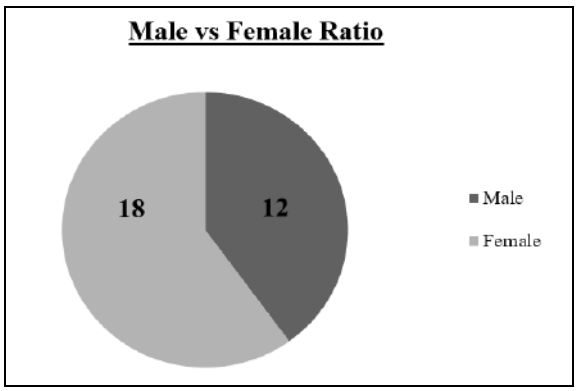

Table 1: Distribution of venous involvement in CVST Patients

Sinus	Cases	Percentage (%)
Superior Sagittal Sinus	19	63.33
Inferior Sagittal Sinus	01	03.33
Straight Sinus	02	6.66
Right Transverse Sinus	10	33.33
Left transverse sinus	02	6.66
Left cavernous Sinus	01	03.33
Internal Cerebral Vein	03	10.00
Vein Of Galen (VOG)	02	6.66
Basal Vein Of Rosenthal	01	03.33
Cortical Veins	05	16.66
Right Sigmoid Sinus	09	30.0
Left sigmoid sinus	01	03.33
Right Internal Jugular Vein (IJV)	06	20.00

The superior sagittal sinus is commonly involved in CVST, which is seen in 19 patients (63.33%), the next commonest sinus involved is right transverse sinus in 10 patients (33.3%) followed by right sigmoid sinus in 09 patients (30%).

Table 2: Distribution of patients with CVST depending on the extent of thrombosis (number of sinuses involved in each patient)

No. of Sinuses Involved	Cases	Percentage (%)
One	11	36.66
Two	08	26.66
Three	08	26.66
Four	03	10.00
Total	30	100%

The present study revealed single sinus involvement was common which was seen in 11 patients (36.66%) and two and three sinus involvement were equal, seen in 08 patients (26.66%) each. The hypoplastic transverse sinus was present in the 21 patients out of total 30 patients. Out of 21 patients the left transverse sinus hypoplasia (non dominant) was commonest, seen in 16 patients (76.20%).

Table 3: Incidence of hemorrhagic infarct in patients with CVST

Hemorrhagic Venous Infarct	No. of Cases	Percentage (%)
Present	11	36.66
Absent	19	63.33
Total	30	100%

In the present study hemorrhagic venous infarct was present in 11 patients (36.66).

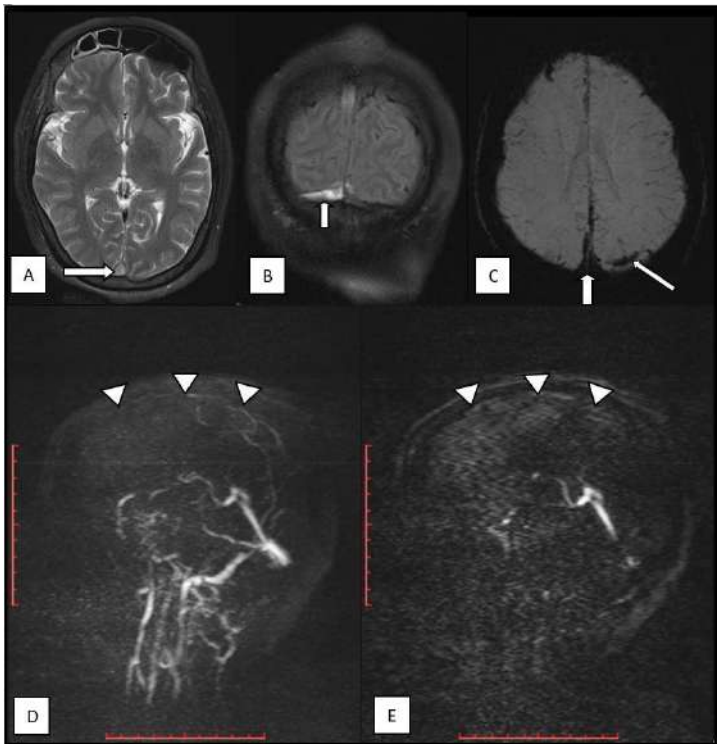

Fig 1: Non enhanced MRI images in a case of 32 year old female presenting with headache
(A) T2 TSE axial image depicting the loss of normal flow voids with hyperintense signal intensity involving the superior sagittal sinus (white arrow). (B) FLAIR coronal image depicting the loss of normal flow voids with hyperintense signal intensity involving the right transverse sinus (white arrow). (C) Axial SWI image showing the gradient blooming in the superior sagittal sinus (Broad arrow) and adjacent left cortical bridging vein (Thin arrow) suggestive of venous thrombosis. (D & E) MIP and 2D TOF MRV images depicting absence of flow signal (white arrow heads) involving the entire superior sagittal sinus confirming complete superior sagittal sinus thrombosis.

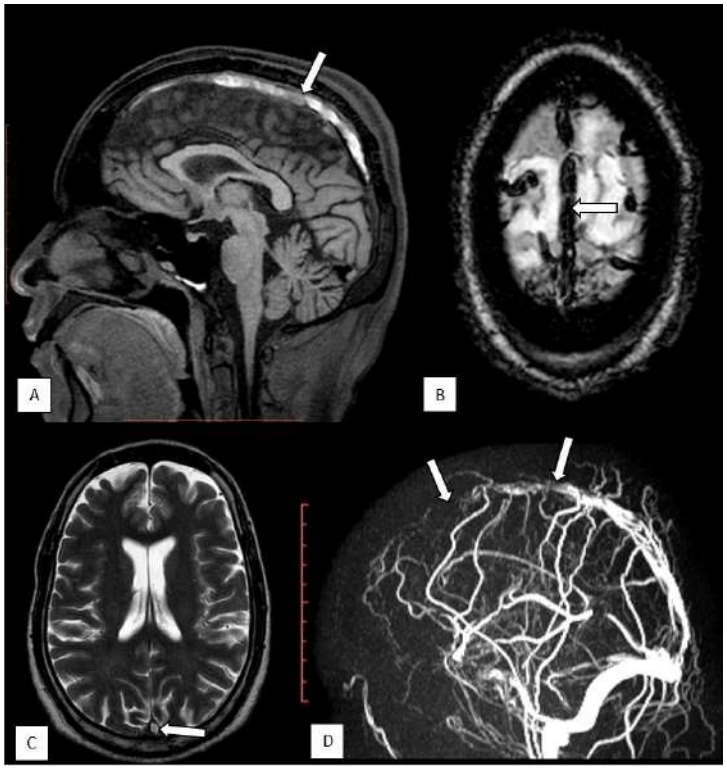

Fig 2: Non enhanced MRI with pulse sequences images acquired at selective sections in a case of 25 year old female patient presenting with post partum seizure.
Non enhanced MRI with pulse sequences images acquired at selective sections through the cerebral venous sinuses showing sagittal 3D T1FFE (A) hyperintense signal intensity of the superior sagittal sinus, axial SWI (B) showing blooming, axial T2TSE (C) loss of normal flow void & 3D MIP MRV (D) partial absence of flow signal involving superior sagittal sinus with adjacent collaterals with focal loss of signal in the straight sinus near the confluence of vein of Galen suggestive of superior sagittal sinus thrombosis as depicted by white arrows.

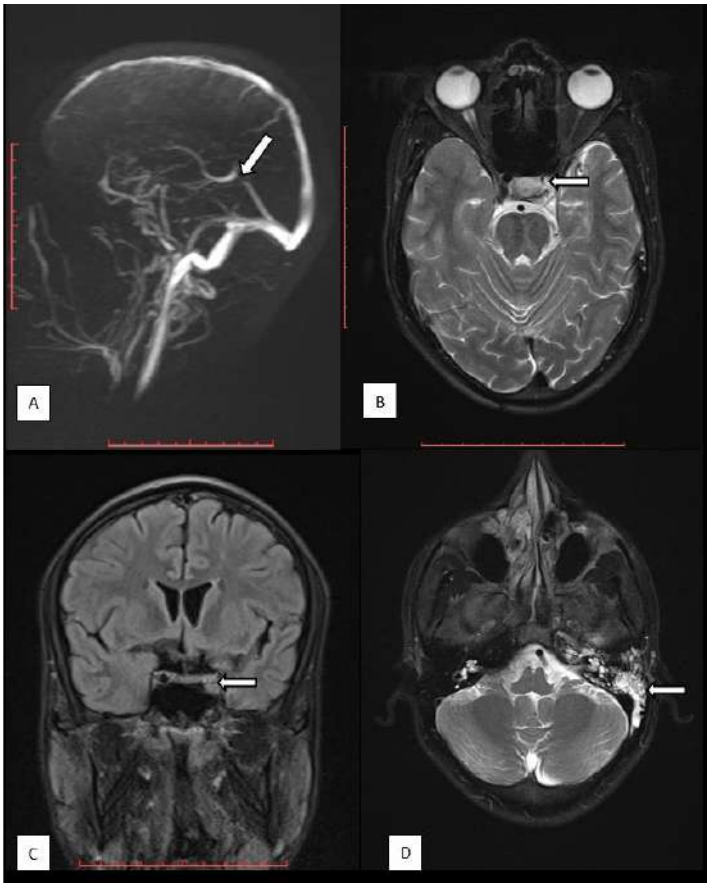

Fig 3: Non enhanced MRI images in a case of 35 year old male patient presenting with giddiness and visual disturbances, Non enhanced MRI with pulse sequences images acquired at selective sections through the cerebral venous sinuses & left mastoid were acquired
(A) 3D MIP MRV depicting focal non-visualization of the straight sinus near confluence of vein of Galen (arrow) into it suggestive of venous thrombosis. Axial T2TSE (B) & coronal FLAIR (C) images show absence of normal flow void involving left internal carotid artery(ICA)(arrow) at the level of cavernous sinus in both T2TSE & FLAIR images with associated fluid signal intensity in the left mastoid air cells shown in T2 TSE (D) suggestive left cavernous ICA thrombosis secondary to left mastoiditis (arrow).

Discussion

The clinical manifestations of CVST are often vague and are easily mistaken for those caused by other neurological disease process. CVST may mimic various medical conditions as arterial stroke, tumor, encephalitis, abscess and idiopathic intracranial hypertension [5].

A total of 53 patients who were clinically diagnosed as having cerebral venous thrombosis as per records were sent for MRV imaging. Out of 30 patients with cerebral venous thrombosis in our study, in 8 patients the cause was unknown and the alcohol was the commonest cause for the CVST which was seen in 05 patients (16.66%). Headache was the commonest clinical feature seen in 09 patients (30%) and the next commonest clinical features were seizures in 07 patients (23.33%).

The superior sagittal sinus is commonly involved in CVST, which is seen in 19 patients (63.33%) followed by right transverse sinus involvement in 10 patients (33.3%) in our study. One case of left cavernous sinus thrombosis was also present in the present study owing to left mastoiditis with inflammatory extension along left petrous apex upto left cavernous sinus with resultant ipsilateral left cavernous internal carotid arterial thrombosis. The present study revealed single sinus involvement was common which was seen in 11 patients (36.66%) and two and three sinus involvement were equal, seen in 08 patients (26.66%) each. The hypoplastic transverse sinus was present in the 21 patients of total 30 patients. Out of 21 patients the left transverse sinus hypoplasia (non dominant) was commonest, seen in 16 patients (76.20%).

Female predominance was seen in the present study of which 18 patients were female and 12 were male (female to male ratio was 1.5:1). CVST is more frequent in the age group of 20 to 35 years in our study.

In a series of 110 cases, Ameri and Bousser found a female to male ratio was 1.29:1 [6].

Einhaupl *et al.* reported 75% of patients were females in their study and had been suggested that the use of oral contraceptives in women is behind the disparity between the sexes [7].

The International Sinus Cerebral Vein Thrombosis (ISCVT) trial, a collaborative study that enrolled more than 600 patients with CVST, showed higher incidence of CVST in females and in their third decade [8].

In the present study also 55.55% of women had CVST in the age group of 21 to 40 years.

In 1992, Ameri and Bousser reported a uniform age distribution in men with CVST while 61% of women were aged 20 to 35 years [6].

Comparing the age group involved, 20–40 years was the most common age group involved in the studies of Mehta *et al.* (77.8%) and Mangshetty and Reddy (87.5%) [9, 10].

Ameri and Bousser also reported that 75% of the 110 cases had history of headache [6].

In the study of D. Karthikeyen *et al*. headache is the most presenting and non-specific symptoms seen in 70-90% of cases [11].

The study done by Kalbag and Wolf showed the incidence

of superior sagittal sinus thrombosis in 72%, Lateral sinus thrombosis in 63% and sigmoid sinus thrombosis in 50% cases [12].

Greiner *et al*. concluded that in veno-occlusive stroke, the superior sagittal sinus followed by transverse, sigmoid, and straight sinuses were generally involved.[13]The study revealed that brain parenchyma was normal in 20/40 (50%) patients, while the infarction was non-hemorrhagic in 6/40 (15% cases), and 14 (35%) patients presented with hemorrhagic infarction [14].

In the present study hemorrhagic venous infarct was present in 11 patients (36.66%) and collateral development was seen in 33.33% of patients. In our study, even though non-contrast MRV imaging was done, we were able to identify thrombosis of dural venous sinuses as well as cortical veins very well as we correlated 2D TOF images with other MR imaging techniques especially with FLAIR, SWI and 3D T1FFE sequences.

Conclusion

This study concluded that MRI with MRV are valuable imaging modalities for the diagnosis of CVST. MRI and non contrast MRV should be recommended as they are safer, non-invasive, non-ionizing and highly accurate modalities.

Source of Support: None Declared
Conflict of Interest: None Declared

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