RESEARCH

A STUDY OF MRI IN "CEREBRAL VENOUS THROMBOSIS"

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Abstract

Background: Cerebral venous thrombosis is a relatively uncommon but serious neurologic disorder that is potentially reversible with prompt diagnosis and appropriate medical care. Because the possible causal factors and clinical manifestations of this disorder are many and varied, imaging plays a primary role in the diagnosis. Study of MRI in Cerebral Venous Thrombosis as detection of venous thrombosis, Parenchymal abnormalities, detection of risk factors, prognosis of cerebral venous thrombosis, and detection of recanalization after treatment. **Materials and Methods:** At our institution all patients with clinical suspicion of CVT, intracranial vascular malformation, and/or with intracranial hemorrhage of unclear etiology undergo a standardized MR imaging for a period of 2 years in 40 patients. **Result:** The ages of the patients ranged from 1 year to 70 years (mean 30y) with peak incidence being in the age group of 21 to 30 years. In our study a total of 22 females were affected out of 40 cases, showing female predominance. Site of thrombosis is in the order of Superior sagittal sinus>transverse sinus>superior sagittal+ transverse sinus>sigmoid sinus>straight sinus>vein of galen. Out of the 40 cases, 31 cases were in subacute stage, 5 in acute stage and 4 in chronic stage, suggesting most of the cases are in subacute stage at the time of diagnosis. The sensitivity of MRI in detecting CVT is 100% in our study, whereas that of CT is 85%. **Conclusion:** Advantages of MR imaging over computed tomography for detecting the cerebral venous thrombosis. At this point we conclude that MR imaging should be used as routine imaging modality for cerebral venous thrombosis.

INTRODUCTION

Cerebral venous thrombosis is a relatively uncommon but serious neurologic disorder that is potentially reversible with prompt diagnosis and appropriate medical care. Because the possible causal factors and clinical manifestations of this disorder are many and varied, imaging plays a primary role in the diagnosis. Un-enhanced computed tomography, Magnetic resonance imaging, unenhanced time-of-flight MR venography, and contrast material enhanced MR venography and CT venography are particularly useful techniques for detecting cerebral venous and brain parenchymal changes that may be related to thrombosis.

To achieve an accurate diagnosis, it is important to have a detailed knowledge of the normal venous anatomy and variants, the spectrum of findings (venous sinus thrombi and parenchymal diffusion or perfusion changes or hemorrhage), other potentially relevant conditions (deep venous occlusion, isolated cortical venous thrombosis, idiopathic intracranial hypertension).

Thrombosis of the cerebral veins and sinuses is a distinct cerebrovascular disorder that, unlike arterial stroke, most often affects young adults and children. The symptoms and clinical course are highly variable. A teenager who has had recent headaches after starting oral contraception, a woman who has had seizures after delivery in the obstetrical ward, and a comatose man with a dilated pupil in the emergency room all may have sinus thrombosis.

The estimated annual incidence is 3 to 4 cases per 1 million population and up to 7 cases per 1 million among children. About 75 percent of the adult patients are women.[1,2]

During the past decade, increased awareness of the diagnosis, improved neuroimaging techniques, and more effective treatment have improved the prognosis. More than 80 percent of all patients now have a good neurologic outcome.[3] This review summarizes recent insights into the pathogenesis of sinus thrombosis, risk factors, and clinical and radiologic diagnosis and discusses the current evidence and controversies about the best treatment. This clinical entity was first described in the early 1800's by the French physician Ribes at the autopsy of a patient with a history of delirium and seizures. In this case, the sagittal sinus was involved.[2] In more recent studies (ISCVT study), the superior sagittal

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sinus (SSS) is most commonly involved (62%), transverse sinus (TS) (42%), the straight sinus (SS) (18%) and the cavernous sinus (CS) (1.3%). Both the SSS and TS are involved in 30% of cases. Approximately 0.5% of all strokes are complicated by concomitant cerebral venous sinus thrombosis.

MATERIALS AND METHODS

At our institution (Osmania General Hospital, Tertiary Care Centre), all patients with clinical suspicion of CVT, intracranial vascular malformation, and/or with intracranial hemorrhage of unclear etiology undergo a standardized MR imaging from December 2016 to October 2018. The number of patients proposed to be included in the study are forty.

Inclusion criteria:
Patients with clinically suspected cerebral venous thrombosis of any age group presenting with risk factors with clinically suspected cerebral venous thrombosis.

Exclusion criteria:
Patients with claustrophobia. metallic implants, cardiac pacemakers.
CT Images of the brain were obtained on a Toshibha, Asteion TSX-021A Spiral CT Unit. Matrix size of 512*512 and slice section of 5mm. MR examinations were performed on a 1.5T MR scanner (GE Health care). Patients underwent the following sequences in the stated order: T2W images, TIW images, FLAIR images, DW images, GRE images, 2D TOF MRV.
MR parameters were: axial T2-TSE (TR/TE, 4620/98 ms; FA, 150°; 24 sections; section thickness,5 mm; matrix size, 512 x 384; FOV, 230 x 201 mm; TA, 2.15 minutes; NA, 2; AF, 2), coronal T2-TSE (TR/TE, 6970/ 101 ms; FA, 150°; 24 sections; section thickness, 5 mm; matrix size, 448 x 381; FOV, 230 x 201 mm; TA, 3.24 minutes; NA, 2; AF, 2), axial GRE images (TR/TE, 730/ 19.6 ms; FA, 20°; 24 sections; section thickness, 5 mm; matrix size, 256 x 205; FOV, 230 x 173 mm; TA, 1.54 minutes; NA, 1), and 2D TOF MRV (TR/TE, 26/7.2 ms; FA, 60°; 45 coronal sections; section thickness, 4 mm; FOV, 200 x 188 mm; matrix, 256 x 256; TA, 3.51 minutes).

The diagnostic criteria for CVT were as follows:
On T2W images, isointense or hyperintense signal intensity inside a cerebral vein lacking a normal flow signal intensity void; On GRE images, a typical magnetic susceptibility effect was only regarded as a positive sign if the lumen of an affected venous segment was encompassed by a strong hypointense signal intensity that was enlarged compared with adjacent normal vein (49). On TOF MRV images, a lack of normal venous flow signal intensity was considered positive. To rule out the possibility of an anaplastic or hypoplastic sinus, source images were analysed.

RESULTS

Table 1: Age and gender Distribution.

Age	No of patients	Percentage (%)
<10Y	1	2.5
11-20Y	7	17.5
21-30Y	20	50
31-40Y	5	12.5
41-50Y	4	10
>51Y	3	7.5
Total	40	100
Gender		
Males	18	45
Females	22	55

Age distribution chart shows average incidence of cerebral venous thrombosis in this study was between 20-30yrs, 20 members have cerebral venous thrombosis out of 40 was between 21-30yrs. Sex distribution pie chart shows cerebral venous thrombosis is more common in the female population in our study, 22 members of female population.

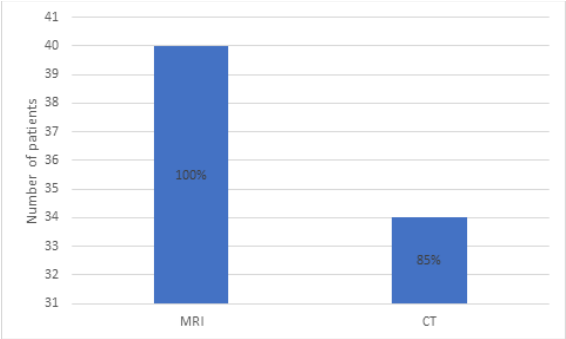

Figure 1: Detection Rate in both groups in study

A total of 40 cases out of 40 underwent both CT & MRI. Cerebral venous thrombosis detected by MRI was 100 % in our study and diagnosed 40 out of 40 cases but CT failed to pick up the lesions in six cases.

Table 2: Site of Thrombosis in present study

Site of Thrombosis	Number of Patients	Percentage
Superior Sagittal Sinus	30	75%
Transverse Sinus	22	55%
Straight Sinus	3	7.5%
Sigmoid Sinus	16	40%
Vein of Galen	2	5%
SSS+TS	18	45%.

Superior sagittal sinus thrombosis was most commonly involved in 75% cases (30 out of 40), Transverse sinus involved in 55% (22cases), Straight sinus 7.5% (3cases), Sigmoid sinus 40 % (16 cases), vein of galen in 5% (2 cases) and both SSS + TS are involved in 45% (18cases).

Table 3: Staging in present study

Total No of Patients	Acute	Sub-acute	Chronic
40	5	31	4

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Staging chart shows majority of cases come to hospital at sub-acute stage. This study reveals 31 cases in sub-acute stage out of 40,five in acute stage and only four in chronic stage.

Table 4: Recanalisation Rate

Total Cases	Complete Recanalisation.	Partial Recanalisation.	No Recanalisation.
12	9	2	1

In this study, out of 40 cases (2 cases death),12 cases were followed up after 4-6 months, CT/MRI done for follow up cases, revealed 9 cases with complete recanalization, 2 cases with partial recanalization, no change in only one case.

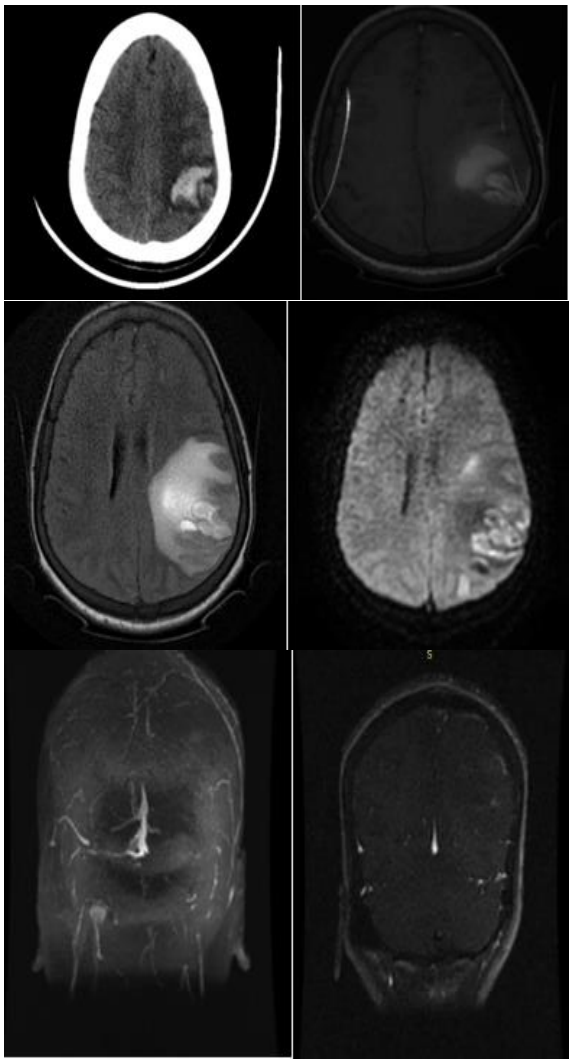

Figure 2: CT, MRI and MRV findings in study. (CT scan findings: E/O ill-defined hypodensity with area of hyperdensity noted in left parietal lobe –Suggestive of Hemorrhagic transformation of infarct), (MRI findings: E/O T2/ FLAIR hyperintensity noted with few areas of T1 hyperintensity with adjacent vasogenic edema noted in left parietal region. The lesion is showing diffusion restriction - Suggestive of Hemorrhagic transformation of infarct.), (MRV findings: Lack of normal venous flow signal intensity in superior saggital sinus, bilateral cortical veins- Suggestive of thrombosis.) Image shows Left transverse, sigmoid sinus and internal jugular vein are hypoplastic.

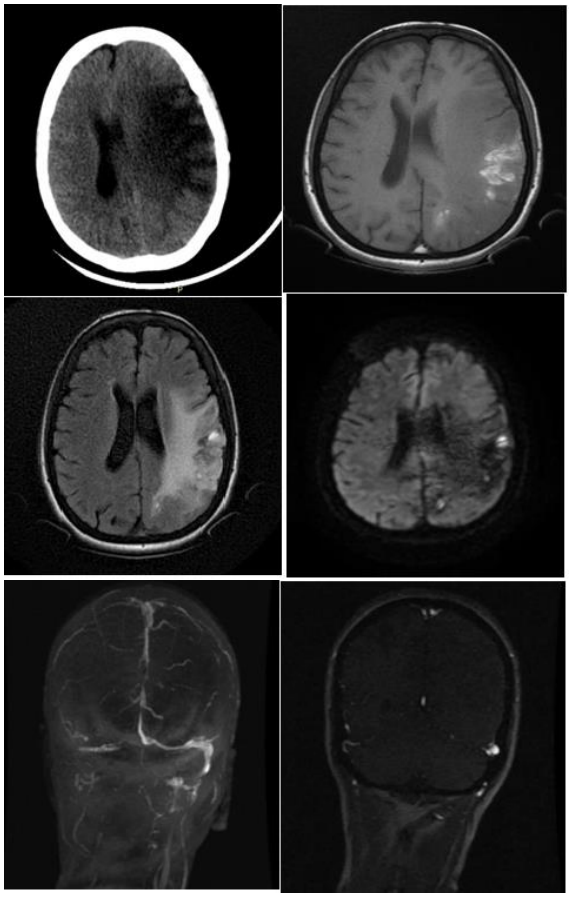

Figure 3: CT, MRI and MRV findings in study. (CT scan findings: E/O ill-defined hypodensity noted in left fronto-parietal lobe, causing mass effect in the form of compression of ipsilateral lateral ventricle and midline shift to right by 7 mm, with subtle hyperdensity noted in posterior interhemispheric fissure –Suggestive of left fronto- parietal infarct.), (MRI findings: E/O T2/ FLAIR hyperintensity noted with few areas of T1 hyperintensity with adjacent vasogenic edema noted in left fronto-parietal region. The lesion is showing diffusion restriction with compression of ipsilateral lateral ventricle - Suggestive of Hemorrhagic transformation of infarct), (MRV FINDINGS: Lack of normal venous flow signal intensity in superior saggital sinus, cortical veins, right transverse, sigmoid sinus and internal jugular vein noted –S/O Thrombosis.)

DISCUSSION

From December 2016 to October 2018, Forty patients diagnosed of cerebral venous thrombosis were examined with both CT & MR imaging at our hospital. The ages of the patients ranged from 1 year to 70 years (mean 30Y) with peak incidence being in the age group of 21 to 30 years. This data is agreed by most of the previous studies done earlier.

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Cerebral venous thrombosis is a relatively uncommon but serious neurologic disorder that is potentially reversible with prompt diagnosis and appropriate medical care. Because the possible causal factors and clinical manifestations of this disorder are many and varied, imaging plays a primary role in the diagnosis. MRI, un-enhanced computed tomography, unenhanced time-of-flight MR venography, and contrast material enhanced MR venography are particularly useful techniques for detecting cerebral venous and brain parenchymal changes.[4]

Thrombosis of the cerebral veins and the subsequent disruption of the blood-brain barrier and thrombosis of the cerebral sinuses contribute to intracranial hypertension. Thrombosis of the cerebral veins increases the venous pressure, reduces the capillary perfusion pressure, and increases the cerebral blood volume. Collateral flow pathways are recruited, and the resultant high pressure leads to a disruption in the blood-brain barrier and resultant vasogenic edema. A drop in cerebral perfusion pressure and blood flow additionally leads to the failure of the Na/K ATPase dependent pump, an important indirect regulator of intracellular water content, and cytotoxic edema follows.[5]

All patients with clinical suspicion of CVT, intracranial vascular malformation, and with intracranial hemorrhage of unclear etiology undergo a standardized MR imaging protocol, including the study protocol sequences. Patients underwent the following sequences in the stated order: T2W images, T 1W images, DW images, GRE images, 2D TOF MRV.

John N. Fink et al,[3] study examines the relationship of LST and mastoid air sinus abnormalities systematically. They performed a retrospective clinical and radiological review of a series of 26 patients with cerebral venous thrombosis. Mastoid abnormalities were detected ipsilateral to 9 of 23 thrombosed lateral sinuses (39%) and O of 29 unaffected lateral sinuses. They concluded that the mastoid changes observed are likely to be due to venous congestion as a consequence of LST, not mastoiditis. In our study, 3 cases of Mastoid abnormalities were detected ipsilateral to 22 thrombosed lateral sinuses. To rule out the possibility of an anaplastic or hypoplastic sinus, source of images was analysed. Our study has shown that when using 2D-TOF MR venography, flow gaps in non-dominant transverse sinuses can be observed in up to 25% (10 out of 40) of patients with normal MR imaging findings, and that such flow gaps should therefore be judged with caution when the diagnosis of dural sinus thrombosis is in question. The cavernous sinus thrombosis is usually a late complication of an infection of the central face or paranasal sinuses. Other causes include bacteraemia, trauma, and infections of the ear. The most common signs of CST are, sinusitis or a midface infection (most commonly furuncle) for 5-10 days, Headache is the most common presentation symptom and usually precedes fevers, periorbital edema, and cranial nerve signs. Without effective therapy, the patient rapidly develops mental status changes including confusion, drowsiness, and coma from CNS involvement and/or sepsis. Death follows shortly thereafter.

Increased venous pressure may cause breakdown of the blood brain barrier and vasogenic edema or may cause reduced cerebral blood flow and cytotoxic edema. Unlike conventional MR images, diffusion weighted (DW) MR images can differentiate between vasogenic and cytotoxic edema. Because DW images have both T2 and diffusion components, vasogenic edema may appear hypointense, isointense, or. slightly hyperintense on DW images, but it always produces hyperintensity on ADC images.

The priority of treatment in the acute phase is to stabilize the patient's condition and to prevent or reverse cerebral herniation. This may require the administration of intravenous mannitol, surgical removal of the hemorrhagic infarct, or decompressive hemi craniectomy.

The most obvious treatment option is anticoagulation with heparin to arrest the thrombotic process and to prevent pulmonary embolism, which may complicate sinus thrombosis.

In patients who have symptoms of chronic intracranial hypertension only, the first priority is to rule out a space-occupying lesion. If there are no contraindications, a lumbar puncture is then performed to measure the cerebrospinal fluid pressure. then start of treatment with Oral acetazolamide, for lower the intracranial pressure, to relieve headache, and to reduce papilloedema. Except for spontaneous abortions, other complications rarely occurred during or after new pregnancies. These findings strongly support the evidence that past CVT (including puerperal CVT) is not a contraindication to pregnancy.

R W Baumgartner et al,[6] in their study 33 consecutive patients presenting with cerebral venous thrombosis. Cerebral MRI and MRV were done at four months and repeated after 12 months if venous thrombosis persisted. 27 patients (82%) had no residual deficits. After four months, all deep cerebral veins and cavernous sinuses, 94% of superior sagittal sinuses, 80% of straight sinuses, 73% of jugular veins, 58% of transverse sinuses, and 41% of sigmoid sinuses had recanalised. In our study reveals 9 cases complete recanalization out of 12 cases, in two cases are partially recanalised, no change in one case.

Cross sectional TOF MRV was chosen for evaluation of cerebral venous recanalisation. This represents the standard imaging technique for cerebral venous thrombosis, recanalisation only occurs within the first four months following cerebral venous thrombosis and not thereafter, irrespective of oral anticoagulation, recanalisation of cerebral venous thrombosis in patients treated with warfarin is accomplished within the first four months. Late recanalisation was not observed in this study, irrespective of the use of oral anticoagulants.

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The sensitivity of MRI in detecting CVT is 100% in our study, whereas that of CT is 85%. To rule out the possibility of an anaplastic or hypoplastic sinus, source images were analysed, These amounts are lower than the study by Linn et al,[7] indicating sensitivity of 64.6% and specificity of 97.2% only for the cord sign. Moreover, the study by Avsenik et al,[8] showed the sensitivity of 100% and specificity of 83% in NCCT in patients with CVT. Probably due to our small sample size and because we did not include the finding of intracerebral edema alone in our positive results our study has shown that when using 2D - TOF MR venography, flow gaps in non-dominant transverse sinuses can be observed in up to 25% (10 out of 40) of patients with normal MR imaging findings, and that such flow gaps should therefore be judged with caution when the diagnosis of dural sinus thrombosis is in question. MR imaging has several advantages over CT such as, Diffusion weighted (DW) MR images can differentiate between vasogenic and cytotoxic edema.[9] Because DW images have both T2 and diffusion components, vasogenic edema may appear hypointense, isointense, or slightly hyperintense on DW images, but it always produces hyperintensity on ADC images. Cross sectional TOF MRV was chosen for evaluation of cerebral venous recanalisation. This represents the standard imaging technique for cerebral venous thrombosis recanalisation only occurs within the first four months following cerebral venous thrombosis and not thereafter, irrespective of oral anticoagulation.

CONCLUSION

Cerebral venous thrombosis is a relatively uncommon but serious neurologic disorder, imaging plays a primary role in the diagnosis of CVT. MRI, un-enhanced computed tomography, unenhanced time-of-flight MR venography, and contrast material enhanced MR venography are particularly useful techniques for detecting cerebral venous and brain parenchymal changes.

Our study shows that advantages of MR imaging over computed tomography for detecting the cerebral venous thrombosis. At this point we conclude that MR imaging should be used as routine imaging modality for cerebral venous thrombosis.

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