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RESEARCH ARTICLE

A Study of risk factors, Clinical and Radiological manifestations in patients with Cerebral Sinus Venous Thrombosis by using Magnetic Resonance Imaging and Magnetic Resonance Venography

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Abstract: ***Aim and Objective:*** The aim of our study is to evaluate the clinical profile of Cerebral Sinus Venous Thrombosis (CSVT) in our hospital and to look for the radiological features of various CSVT. CSVT is a disease of cerebral vascular etiology affecting the cerebral sinuses and veins. It has a varied clinical presentation commonest being headache, altered sensorium and behavioral changes. ***Materials and Methods:*** MRI and MRV evaluation of CSVT was carried out in the Radiology department of Meenakshi Medical College Hospital and Research Institute, Kanchipuram. A total of 50 patients, both genders were included in this study. ***Results:*** MRI brain with MRV has shown to have high sensitivity and gives good reliable information in identifying the disease when compared to CT scan thus making it a gold standard diagnostic modality in the diagnosis of CSVT. ***Conclusion***: In the present study was concluded that MRI with MRV brain is a simple, non-invasive and sensitive diagnostic modality, which is of great use in the evaluation of CSVT.

Keywords: Magnetic Resonance Imaging, Magnetic Resonance Venography, Cerebral Sinus Venous Thrombosis.

INTRODUCTION

Since the early 19th century Cerebral Sinus Venous Thrombosis (CSVT) has been recognized, but still remains a diagnostic and therapeutic challenge. When compared to arterial stroke Cerebral Sinus Venous Thrombosis is rare and often occurs in young individuals. Cerebral Sinus Venous Thrombosis may occur at any time from infancy to old age and most reported cases are women in association with puerperium[1]. Symptoms may be acute, sub acute or chronic. The most serious consequence of Cerebral Sinus Venous Thrombosis is venous infarction. Venous infarctions are often multifocal and bilateral affecting both grey matter and sub cortical white matter. Cerebral Sinus Venous Thrombosis usually presents with headache, behavioral changes, visual disturbances, seizures, papilloedema, altered sensorium and focal deficits due to thrombosis of intracranial veins and sinuses resulting in haemorrhagic infarctions and raised intracranial tension. The above features are present in various combinations ranging from syndrome of raised intracranial pressure without localization to deep altered sensorium and dense hemi paresis. Cerebral Sinus Venous Thrombosis forms a distinct subgroup of cerebrovascular disease in India and is supposed to be the leading causeof mortality in women of reproductive age group[2]. Post partum period in women forms the majority of cases in India, while alcoholism is a significant risk factor in males. From India Pangayara reported that Cerebral Sinus Venous Thrombosis accounted for half of young stroke and 40% for stroke in woman. Reviews of Cerebral Sinus Venous Thrombosis cases from Asian countries are suggestive of differences in risk factors profile and outcome in these patients as compared to European studies. Largest cohort of CSVT patients from Europe (n=624) reported that 50% of these cases were related to OCP pills, 6% were due to pregnancy and 14% were secondary to puerperium. In USA a study was conducted on 182 adult patients with Cerebral Sinus Venous Thrombosis and it was reported that 7% of causes was due to pregnancy and puerperium and 5% related to OCP use. A study from Pakistan (n=109) patients with Cerebral Sinus Venous Thrombosis reported that 17% were due to pregnancy and puerperium and 5% related to OCP use. Cantu from Mexico reported 59% cases due to Pregnancy puerperium. “Usually recovery is rapid and complete if patient survives the acute episode” was noted by Cross etal[3]. Three fourth of cases of Cerebral Sinus Venous Thrombosis in pregnancy and puerperium reported by him, survived with good recovery. In pre imaging era Cerebral Sinus Venous Thrombosis has been diagnosed exclusively

at autopsy and therefore thought to be always fatal. Heparin in treatment has significantly brought down the mortality rate of Cerebral Sinus Venous Thrombosis and most of the recent studies have reported mortality <20% when compared to earlier studies reporting mortality between 30-50%. However, outcome of Cerebral Sinus Venous Thrombosis is highly unpredictable and it is a common sight to see dramatic recovery in deeply comatosed patients and sudden worsening in conscious patients due to extension of thrombosis. With the advent of imaging modalities like Computed Tomography (CT) scan and recently Magnetic Resonance Imaging (MRI) and Magnetic resonance venography (MRV), the diagnosis of Cerebral Sinus Venous Thrombosis has improved significantly. CT scan commonly shows haemorrhagic infarctions with or without "cord" or "empty delta" sign. MRI and MRV are used to confirm and clarify the diagnosis by showing thrombosed sinus and cortical veins . After the advent of MRV, many of the patients earlier diagnosed as Idiopathic raised Intra Cranial Hypertension (ICH) have been noted to have sinus thrombosis giving rise to syndrome of raised intracranial pressure without localization. Pathologically superior sagittal sinus with or without the involvement of transverse and sigmoid sinuses with thrombosis of cortical veins has been the most commonly involved sinus[1,2].Frequently haemorrhagic infarctions with mass effect and diffuse cerebral edema with herniation are the most common MRI findings. Involvement of deep venous system is less common than superficial venous system but by no means rare. The multi factorial causation for this condition has made it interesting to know the different patho physiological mechanisms operating in different clinical settings. Long term outcome of Cerebral Sinus Venous Thrombosis in this part of the state is not well described, so this study was undertaken to Identify the age & sex distribution, etiological spectrum, clinical manifestations and MRI & MRV findings of 50 patients with Cerebral Sinus Venous Thrombosis and further to attempt the correlation between site of venous occlusion and clinical parameters & prognosis of Cerebral Sinus Venous Thrombosis.

Cerebral Sinus Venous Thrombosis has been recognized but stills remains a diagnostic and therapeutic challenge. When compared to arterial stroke, accurate and prompt diagnosis of cerebral sinus venous thrombosis is crucial, because timely and appropriate therapy can reverse the disease process and significantly reduce the risk of acute complications and long-term sequelae. Since the possible causal factors and clinical manifestations of thrombosis are many and varied, imaging plays a primary role in the diagnosis. A wide range of cross-sectional imaging methods and venographic techniques may be used to detect abnormalities in the brain parenchyma as well as the cerebral veins and venous sinuses. The current study provides a survey of common findings and causative factors in cerebral sinus venous thrombosis and in several other disorders that may include a venous thrombotic process as a component. To provide a context for the discussion of abnormal findings, the normal venous anatomy and variants also are reviewed, and potential pitfalls related to image interpretation are described.

MATERIAL AND METHODS:

This is a Prospective and Observational Study. Data for the study was collected from patients who were diagnosed with cerebral sinus venous thrombosis on MRI in Meenakshi Medical College, Hospital and Research institute Kanchipuram. A total of 50 patients were included in this study. The study was performed for the period of two years from January 2024 to June 2025 excluding the period of data analysis and write-up. Ethical committee of Meenakshi Medical College Hospital and Research Institute approved the present study. An informed consent (oral and written) was obtained from every patient. MRI and MRV evaluation was performed using 1.5 Tesla Magnetom Essenza Siemens MRI machine. Patients underwent the following sequences in the stated order: DWI, FLAIR, GRE, T2W axial, T1W axial, T1W sagittal & T2W coronal and 2D TOF MRV sequences.

RESULTS AND OBSERVATIONS:

Age wise Distribution

Out of 50 patients in this study, there are 21 patients of the age group less than 25 years, 12 patients between 26-35years, 8 patients within 36-45 years and 9 patients above 45 years. (Table.1)

Age Range					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Upto 25yrs	21	42.0	42.0	42.0
	26- 35yrs	12	24.0	24.0	66.0
	36- 45yrs	8	16.0	16.0	82.0
	Above 45yrs	9	18.0	18.0	100.0
	Total	50	100.0	100.0	

Age Range Vs Gender distribution

The below table depicts the distribution of gender involved in CSVT according to the frequency of age range. According to Pearson Chi Square Test analysis there is a significant correlation between age group and gender. It shows that the female participants were more affected in the age group less than 25 years and the male participants were involved in the age range more than 45 years. A statistical significance is obtained where the 'p' value is 0.001 making it highly significant ($p < 0.1$). **(Table.2)**

Table.2. Age and Gender wise Distribution

Age	Female	Male	Total%
Upto25yrs	21	0	42%
26-35yrs	7	5	24%
36-45yrs	4	4	16%
Above45yrs	0	9	18%

Risk factors of CSVT

The below tabulated data and graph represents the most common causative factor for CSVT. From the above data we can come to a conclusion that OCP is the major factor for the etiology of CSVT. Women of the age group less than 25 years often have a history of usage of OCP's and hence we can conclude saying that women less than 25 years of age are more prone for CSVT with OCP as their major risk factor. From the above data OCP accounts nearly about 38%. The next common cause for this age group obtained from this study is Puerperium. This accounts to another 20% of the risk factor criteria.

In males the commonly seen etiology for CSVT is alcohol intake for nearly 24%. Smoking is also a very important contributing factor for 16%. From the previous data of this study on comparing the age group and gender analysis we can conclude that males are at an increased risk for CSVT when there is a history of alcohol or smoking and this can be seen presenting more in the age group of 45 years and above. **(Table.3)**

Risk factors	%
Puerperium	20
OCP	38
Dehydration	22
Alcoholic	24
Smoking	16
DVT	4
Diabetic mellitus	4
Menstrual irregularity	8
Head & Neck Infection	2

Clinical features involved in CSVT patients

The above table and graph depicts that headache is the most common clinical symptom with which the patient presents for CSVT, followed by altered sensorium. The least common symptom seen is Unconsciousness in this present study. **(Table.4)**

C/F	Negative (%)	Positive (%)
Headache	18	82
VisualDisturbance	80	20
Seizure	72	28
BehaviouralChanges	66	34
Limbweakness	90	10
Speechdisturbance	84	16
Unconsciousness	94	6
Ataxia	84	16
AlteredSensorium	32	68
Nausea&Vomiting	66	34
Fever	70	30

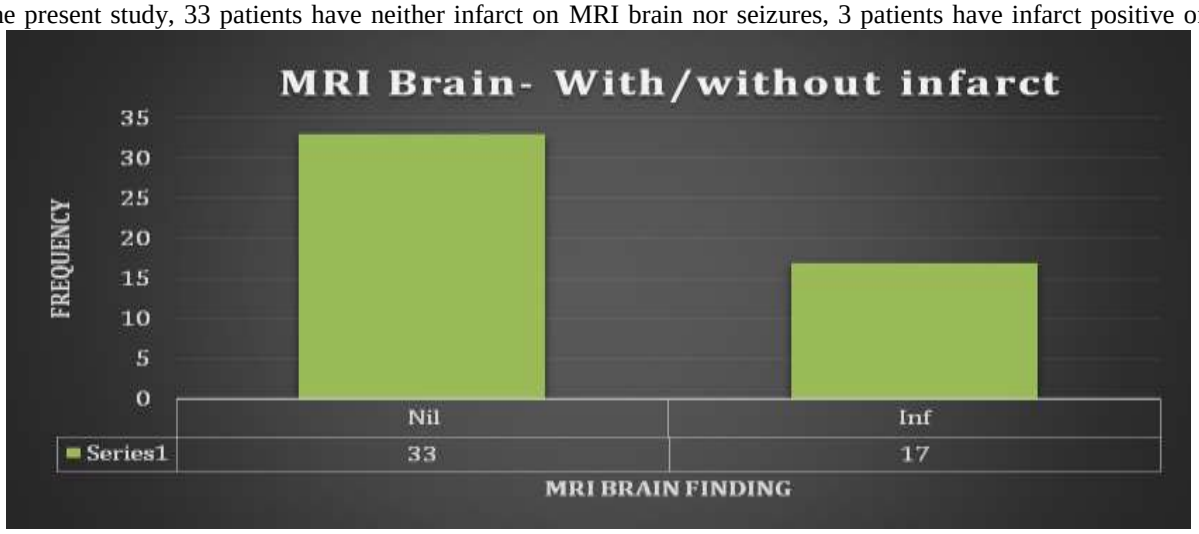
MRI with / without infarct

The below graph is depicted highlighting the frequency distribution of 33 patients with CSVT, when evaluated with MRI brain showing NO INFARCT. Whereas, 17 patients with CSVT showed INFARCT positive on MRI brain and also had hemorrhagic infarct involved along with it. **(Figure.1)**

Comparison of Seizures with MRI Brain

The above table and graph clearly signifies the comparison between Seizure as a clinical symptom in patients with CSVT on undergoing a MRI brain study.

In the present study, 33 patients have neither infarct on MRI brain nor seizures, 3 patients have infarct positive on



MRI brain but do not present with seizures, whereas 14 patients present with Infarct on the MRI brain and also have a positive clinical feature of seizures for CSVT. Statistical analysis of the above comparison was done with the help of Pearson CHI Square test and also Fischer Exact test and the 'p' value was found to be 0.0001 which is <0.1, making it statistically highly significant for the above cross tabulation. **(Table.5)**

Table.5 Comparison of Seizures with MRI Brain

MRIBRAIN*Seizure Cross tabulation					Significance
Count					
		Seizure		Total	P value <.0001
		-	+		
MRI Brain	No Infarct	33	0	33	
	Infarct present	3	14	17	
Total		36	14	50	

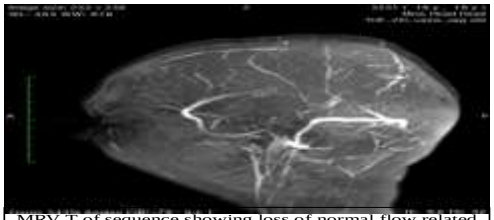
Commonly involved Sinuses

From the above data and graphical depiction it is seen clearly that five sinuses have been involved in CSVT while doing an MRV Brain. The most commonly involved sinus is the Superior Sagittal sinus accounting nearly 78% followed by the Transverse Sinus for about 38%, later by the Cortical Venous sinus for 14% and a proportionate involvement of 10% by the Sagittal sinus and Straight sinus. **(Table.6)**

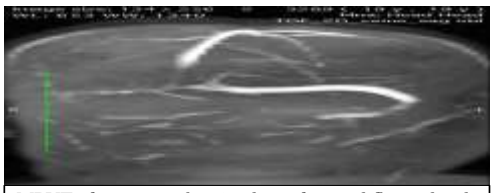
Table 6. Commonly involved Sinuses

Involvement	SSS	CV	TS	SgS	SS
-	22.0	86.0	62.0	90.0	90.0
+	78.0	14.0	38.0	10.0	10.0

MRV images shows sigmoid sinuses suggestive of thrombosis

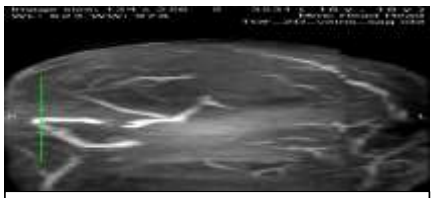


MRV T of sequence showing loss of normal flow related signal intensity in superior sagittal sinus suggestive of thrombosis



MRVT of sequence showing loss of normal flow related signal intensity in right transverse & sigmoid sinuses suggestive of thrombosis

MRV T of sequence showing loss of normal flow related signal intensity in right transverse sinus suggestive of thrombosis



MRV T of sequence showing loss of normal flow related signal intensity in superior sagittal, left transverse & sigmoid sinuses suggestive of thrombosis

DISCUSSION

The diagnosis of CVST has traditionally been made with conventional angiography (DSA). More recently, DSA has been superseded by MR imaging techniques as the method of choice. MR imaging with MR venography is now commonly considered the noninvasive "gold standard" in diagnosing thrombosis of the cerebral venous sinuses and also dominates the diagnostic arms in large international trials.

The diagnosis of CSVT is as difficult as its clinical manifestations are non-specific and may be subtle. Several factors combine to create an extremely elusive diagnosis of CSVT: wide spectrum of clinical presentations, various predisposing factors, and the fact that it affects individuals of all age groups. CSVT may mimic various medical conditions as arterial stroke, tumor, encephalitis, abscess and idiopathic intracranial hypertension (pseudo tumor cerebri). So it is a diagnosis of exclusion and imaging investigation. Although most different modalities as DSA, CT, CTV and others help in diagnosis of cerebral venous occlusion (CVO) but each one has specific side effects and some have normal findings.

CSVT is more common in India compared to western countries but the exact prevalence is not known as not much bigger studies are available.
Gender and Age:

In this present study 50 participants of both genders were included. Out of which there were 32 female patients and18 male patients. Male participants in this group are 36% and female participants are 64%. Therefore this study is predominantly female oriented. In the available studies of both Indian and International studies CSVT was found to have more female preponderance than males5.

Out of 50 patients in this study, there are 21 patients of the age group less than 25 years, 12 patients between

26-35years and 8 patients within 36-45 years and 9 patients above 45 years. Hence from the results it's clearly understood that the age group less than 25 years is more commonly affected and prone to a higher risk for CSVT. This is in agreement with similar literature reported by Tunlayadechanont P et al., 2024 in their respective studies that the most patients with this disease present in young-to-middle-aged patients6.

A Canadian study done on children in 2001 reported that CVST occurs in 10% in the first year of life and this is a higher percentage in comparison with the percentage in our study that reported no patients (0%) in the first year of life7.

Our study shows that the female participants were more affected in the age group less than 25 years and the male participants were involved in the age range more than 45 years. A statistical significance is obtained where the 'p' value is 0.001 making it highly significant ($p< 0.1$). This is in accordance with other studies, which has put forth that females of the age group less than 25 years are most commonly involved.

Risk factors

In my study the commonest risk factor assessed with the involvement of females less than 25 years was puerperium, pregnancy and intake of Oral Contraceptive pills. This leads to risk of patient more prone to CSVT at a very young age. The most common predisposing factor was OCP's and puerperium and this is agreed with Li H et al8who had found that 200 out of 230 cases (86%) of CVT, seen over eight years, were puerperal in nature.

Akhavi Milani A, et al 20259 reported that 75% of patients were females and had been suggested that the use of oral contraceptives in women is behind the disparity between the sexes. Narayan et al10 in his study in the year 2012 also reported similar findings that females on OCP were at a higher risk for CSVT and in his study it accounted for nearly 11.4% Puerperal CSVT is almost 10 – 12 times more common in Indian population than in western population because of associated predisposing factors like anaemia, increased coagulability of blood, slowing of bloodstream and dehydration aggravated by local custom of withholding fluid intake in puerperium10.

Pratibha Issar et al 201711 in a clinical study of 44 cases of hemiplegia in adult women, observed that CVT can occur antenatally or in association with abortion, and that majority of cases of peripartum CVT are seen11 in the first four weeks of delivery. In this study the risk factors associated with males were seen to be alcohol and smoking, this proved to be a reason for men being more prone to CSVT and the age group more prevalent was 45 years and above.

According to newer studies there is an increase in male population who are diagnosed as CSVT because of modern diagnostic modalities like CT and MRI, and due to reduction in puerperal sepsis rates because of the recent medical advances and awareness in general population. Congenital or acquired coagulation abnormalities also make another important risk factor for the development, management and prognosis of CSVT. In our study dehydration accounts to nearly 22% in both genders, this is because dehydration causes haemo-concentration and sludging which results in thrombosis again being a significant risk factor for CSVT.

Clinical Presentation

The clinical features are variable depending on the site, extent, type and duration of the lesion. When the thrombosis affects cortical vein leading to an infarct, it results in seizures and paralysis, and if thrombosis is limited to superior sagittal sinus and lateral sinus, it may present with symptoms of raised intracranial tension. Unlike arterial stroke the presentation of CSVT can vary from acute to chronic. The clinical features may range from headache, papilledema, visual symptoms, focal deficits, seizures, delirium, dysexecutive symptoms and altered level of consciousness.

In our study, there was a spectrum of clinical features seen, headache being the most frequent and earliest complaint with which the patient presented for further evaluation. Around 41 out of the 50 cases had a positive complaint for headache giving about 82%, which is significant. Hashmi K 12 et al. in their study on CSVT reported that 75% of the 110 cases had their main complaint as headache which is again in accordance with the current study.

Similar findings have been reported by Akhavi Milani A, et al 20258 when they observed that 91% of patients presented with headache and 48% with seizures.

He j et al13 found that headache was one of the most common symptoms, seen in 70% of non puerperal and 88% of puerperal cases. Hashmi K et al12. reported that headache was the leading symptom seen in 82%of patients whereas seizures were seen in only10% of patients. The next most common symptom with which patient presents is with altered sensorium which accounts for 68%. Other features such as behavioral changes (34%) and Nausea and vomiting (34%), fever accounting for 30% and are noted in our study. These findings seem to vary and differ with each literature and other studies.

A seizure accounting for 28% in our study seems to be in the minimal range in the history of presenting complaints. Hashmi K et al12 in his study reports to about 69% and Narayan et al in his study also seemed to find seizures to a milder level for about 45.2%. Toole F James in his literary work on venous thrombosis obtained similar data: generalized seizures being more common, seen in 40% of patients. MRI Brain done on 50 patients with CSVT resulted in, 33 patients of CSVT, showing NO INFARCT. Whereas, 17 patients with CSVT showed INFARCT positive. Out of 17 patients 10 had a haemorrhagic infarct and 10 patients had non haemorrhagic infarct in the brain parenchyma.
In our study single and multiple sinuses were involved for patients undergoing MRI brain with MRV. Out of 50 cases, 31 had single sinus involvement and 19 had multiple sinus involvement. The sinuses, which were involved in CSVT, were Superior Sagittal sinus, transverse sinus, straight sinus, cortical sinus and sagittal sinus. The predominant and commonly involved sinus was Superior sagittal sinus or SSS which accounted for about 78% in this study.

The other sinuses, which are next affected, are the Transverse sinuses accounting for 38%, cortical sinus for14% and Sagittal sinus and Straight sinus both equally accounting for about 10% each. The study done by Jacob M et al in 202014 showed the incidence of superior sagittal sinus thrombosis in72 %, lateral sinus thrombosis in 63% and sigmoid sinus thrombosis in 50% cases.

Incidence of thrombosis in superior sinus is higher, because the lumen of superior sinus with laminal and fibrous trabeculae favours thrombosis. Similar findings have been reported by Cantu et al also Bousser et al had 3 patients with cavernous sinus involvement.
It is hence seen that even if multiple sinuses are involved while doing a MRI with MRV Brain for evaluating CSVT that SSS is most commonly affected

and these patients do present with Headache as well as their main complaint

.

We finally concluded that MRI and MRV are valuable imaging modalities for the diagnosis of CVO especially as the clinical presentation and CT findings are usually non-specific. CT was positive in diagnosing CSVT in 60% of cases while MRI with MRV diagnosed in all 100% of cases.

Therefore, the radiologist in the emergency department should be familiar with the imaging findings of CSVT, and if it is suspected on CT, MRI and phase contrast MRV should be recommended, as they are safer, non-invasive, non-ionizing and highly accurate modalities. Also phase contrast MRV has the ability to differentiate thrombosed sinuses from normal variants and other pitfalls.

CT is the most popular and common craniocerebral examination technique. In CT, the direct signs of CVST include the 'band sign', the 'empty δ sign' and intravenous high-density shadows, indicating thrombosis. The indirect signs include hemorrhagic cerebral infarction, extensive brain edema and irregular perimeters. Although the direct and indirect signs of CT have significant diagnostic values, the rate of positives is low.

MRI is able to better reflect the pathophysiological evolution process of CVST. In addition, MRV may better reflect the blood flow state of the venous sinus, which is not influenced by thrombus signal time change, and more clearly reveal local edema and hemorrhage of the brain parenchyma. Therefore, the combination of MRI and MRV is able to provide a CVST diagnosis sensitivity reaching 90% or more.

CONCLUSION

In the present study conclude that the CSVT is more commonly affected in females than in males. The peak incidence of CSVT was found in the age group less than 25 years of age in females and 45 years and above in males. MRI with MRV brain is a simple, non-invasive and sensitive diagnostic modality, which is of great use in the evaluation of CSVT.

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