ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 07 | July - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF MRI AND MR VENOGRAPHY IN THE EARLY DIAGNOSIS OF CEREBRAL VENOUS SINUS THROMBOSIS IN CLINICALLY SUSPECTED CASES

Radio-Diagnosis

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ABSTRACT

Background: Cerebral venous thrombosis (CVT) is the most common venous infarcts in young population, but it is completely reversible in most of the patients without any residual deficits. Initially CVT was diagnosed during post-mortem, later on it was diagnosed through Digital Subtraction Angiography (DSA) which was an invasive procedure. With the advancement in imaging techniques like screening MRI (Magnetic Resonance Imaging) brain which includes Fluid-attenuated inversion (FLAIR) sequence and Diffusion weighted Imaging (DWI) and Time of Flight (TOF), Phase Contrast (PC) sequences in MR venogram (MRV), most of the CVT cases can be diagnosed without any invasive techniques and radiation issues.

Aims And Objectives:

- To determine the ability and the role of MRI and MRV in early diagnosis of CVST in clinically suspected patients.
- To correlate the findings in MRV with FLAIR/ Diffusion weighted imaging sequences of brain.
- To study various patterns of Cerebral venous sinus thrombosis.
- To correlate the extent of venous thrombosis with clinical presentation and etiology.

Methods And Materials:

- It was a hospital based prospective descriptive study carried out on patients who underwent MRI brain and MR Venogram sequences referred to the department of Radio-diagnosis, Basaveshwar teaching and general hospital, kalaburagi.
- Study duration: January 2022 to August 2022.
- Sample size: 60.

Results:

- Out of 60 subjects, 42 subjects had cerebral venous thrombosis in which 52% were males and 48% were females. Most of the patients were in the age group of 21-40 years.
- Puerperium (20%) was found to be the most common cause in females, whereas smoking and alcoholism (18%) was found to be the most common cause in males.
- Major sinuses were involved in 90% cases, deep venous system was involved in 15% cases and superficial cortical vein in 2% cases.
- The most common sinus involved was superior sagittal sinus.
- Brain parenchyma was normal in 40% patients while 25% cases had non-hemorrhagic infarct and 35% patients presented with hemorrhagic infarct.
- The sensitivity and specificity of CE-MRI brain in our study was found to be 100%.
- In our study, headache and papilledema (65%) were the most common initial presenting features.

CONCLUSION:

- Cerebral venous sinus thrombosis is a frequently misdiagnosed condition because of its variability of clinical symptoms and signs. All age groups can be affected. The prognosis of CVST depends on early and accurate diagnosis of CVT.
- The result of present study shows that MRI and MRV are the most important noninvasive imaging sequences in diagnosing thrombosis and brain parenchymal changes.
- TOF and PC of MRV are the most sensitive imaging sequences in diagnosing thrombosis. Conventional MRI brain FLAIR sequence can be strongly recommended in CVT cases to know the parenchymal changes
- MRI and MRV effectively help in early detection and management of CVT and avoid further neurological deficits.

KEYWORDS

Magnetic Resonance Venography, Clinically Suspected Cases, Cerebral Venous Thrombosis

INTRODUCTION

- Cerebral venous thrombosis (CVT) is the most common venous infarcts in young and middle age population and is completely reversible in most of the patients with an estimated annual incidence of between 2-7 cases per million in the general population
- In comparison to arterial stroke, cerebral venous thrombosis is unusual and often seen to occur in early age individuals. CVT can transpire at any age group ranging from infancy to old age with a female predilection particularly in the course of the puerperium phase.
- CVT can cause acute neurological deterioration with increased morbidity and mortality if not diagnosed in early stages.
- CVT customarily manifests itself with headache, visual disturbances, seizures, papilledema, altered sensorium and focal neurological deficits. Neurological deficit occurs due to focal or diffuse cerebral edema and venous non-hemorrhagic or hemorrhagic infarct.
- Alcoholism is the major risk factor in males whereas puerperium and OCP intake are major risk factors in females.
- With the introduction of imaging modalities like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) and Magnetic Resonance Venography (MRV) the diagnosis of CVT has improved significantly.

AIMS & OBJECTIVES

- To determine the ability and the role of MRI and MRV in early diagnosis of CVST in clinically suspected patients.
- To correlate the findings in MRV with FLAIR/ Diffusion weighted imaging sequences of brain.
- To study various patterns of CVST.
- To correlate the extent of venous thrombosis with clinical presentation and etiology.

MATERIALS & METHODS

- It was a hospital based prospective descriptive study carried out on

patients who underwent MRI brain and MR Venogram sequences in the department of Radio-diagnosis, Basaveshwar teaching and general hospital, kalaburagi.
- Study design: Descriptive study.
- Study location: this was a tertiary care teaching hospital-based study done in department of Radiodiagnosis at BTGH, Kalaburagi, Karnataka.
- Study duration: January 2022 to august 2022.
- Sample size: 60.

Technique of examination
- All subjects were screened before entry into the MRI scanning room for ferromagnetic objects, cardiac pacemakers, aneurysmal clips etc.
- Subjects were examined in the supine position on the MRI table for proper positioning and immobilization of the head. The standard head coil was used for the scan.

Imaging protocol and interpretations
- Conventional screening MRI –These included FLAIR, DWI and ADC maps.

The images obtained were assessed to look for:
Venous sinus thrombosis
Loss of flow void within the thrombosed venous sinuses in FLAIR sequences.

Parenchymal changes
Flair
Change in signal intensity in the cerebral parenchyma due to haemorrhage or infarct or edema.

DWI
To look for high signal intensity within lesion or in perilesional edema that corresponds to low signal intensity on ADC maps and the ADC values are recorded.

DWI Protocol
The diffusion measurements were done using echo planar imaging (EPI) sequence in axial plane modified by addition of bipolar gradient on both sides of the refocusing radiofrequency pulse. The minimum ADC values were obtained in 10-3mm2/sec. The ROIs measurements varied from 8 to 20 mm2.

MR Venogram
2D TOF and 3D PC images with MIP in axial, sagittal and coronal planes.

2D TOF
Loss of signal intensity or irregular signal intensity within the thrombosed sinus or vein.

3D PC
Change in signal intensity within the venous sinuses and loss of signal intensity.

Contrast enhanced MRI brain
When there is a suspicion of CVT on routine MRV images contrast enhanced MRI brain using non –ionic intravenous contrast gadolinium was used at the dose of 0.1mg/kg. Loss of enhancement within the venous sinuses.

The entire qualitative variable was expressed in term of frequency and percentage. Sensitivity, specificity, positive predictive value and negative predictive value were calculated between MRV and MRI brain. McNamara's test was used to compare the MRV and MRI brain findings. P value <0.05 was considered statistically significant. SPSS 17 version was used for the analysis.

RESULTS
- Out of 60 clinically suspicious subjects who underwent MRI and MRV, 42 subjects had cerebral venous thrombosis while the remaining had other causes.

CLINICALLY SUSPECTED CVT	NO. OF PATIENTS	PERCENTAGE %
Subjects with CVT	42	70%
Subjects without CVT	18	30%
TOTAL	60	100%
Table-1: Frequency and percentages of cases with / without CVT		

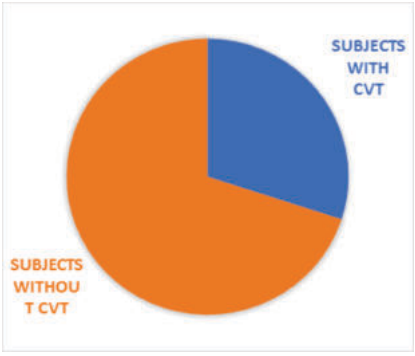


Chart 1: pie diagram showing Frequency and percentages of cases with and without CVT

- Out of 42 patients, 22(52%) were males and 20(48%) were females.
- Most of the patients were in the age group of 21-40 years of age (80%). 22(50%) belonged to 21-30 years age group, 12(30%) belonged to 31-40 years age group, 4(10%) belonged to 16-20 years age group, 3(8%) belonged to 41-50 years age group and 1(2%) belonged >50 years of age.

AGE	MALE	FEMALE	TOTAL (%)
<20 yrs	2	2	10%
21-30 yrs	12	10	50%
31-40 yrs	7	5	30%
41-50 yrs	1	2	8%
> 50 yrs	0	1	2%
TOTAL	22	20	100%
Table-2: Age and Gender distribution in CVT			

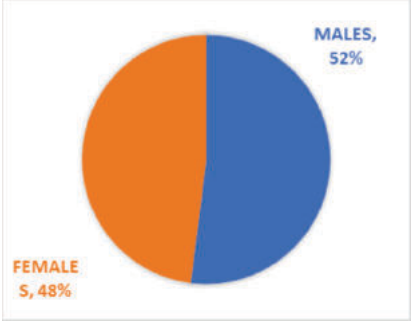


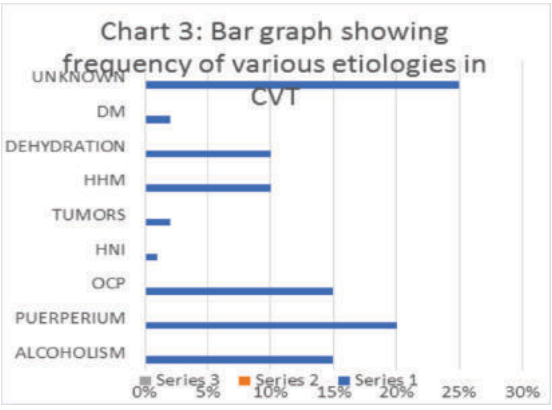
Chart 2: Pie diagram showing Gender distribution in CVT

- Puerperium (20%) and OCP pill ingestion (15%) was found to be the most common cause in females, whereas smoking and alcoholism (18%) was found to be the most common cause in males and no definite cause was found in 25% of patients.

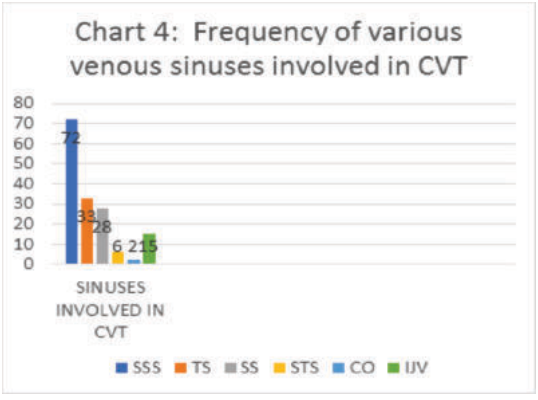
ETIOLOGIES	FREQUENCY
ALCOHOLISM	15%
PUERPERIUM	20%
OCP	15%
HEAD AND NECK INFECTIONS	1%
TUMORS	2%
HYPERHOMOCYSTEINEMIA	10%
DEHYDRATION	10%
DM	2%
UNKNOWN	25%
Table 3: depicting various etiologies of CVT	

- Major sinuses were involved in 38 cases(90%),deep venous system was involved in 6 cases(15%) and superficial cortical vein in 1 case(2%).
- In present study, the most common sinus involved was superior sagittal sinus with almost equal involvement of transverse sinus and sigmoid sinus.Commonest association was noticed between superior sagittal and transverse or sigmoid sinus.
- 32/42 (76%) patients showed complete absence of flow on MRV, while 10/42 (24) cases showed partial flow on MR venogram.
- Among the CVT positive patients, Brain parenchyma was normal in 17/42(40%) patients while 11/42 (25%) cases had non-

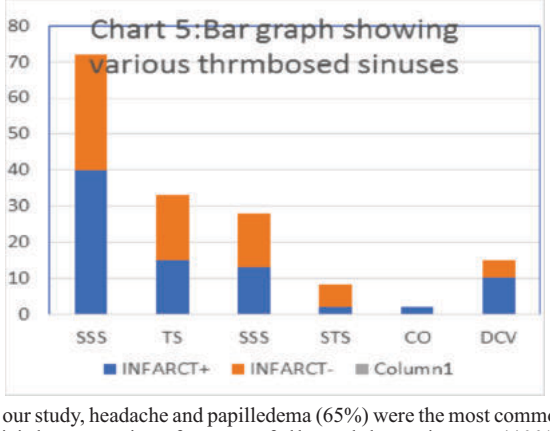
hemorrhagic infarct and 14/42 (35%) patients presented with hemorrhagic infarct.



SINUS	FREQUENCY
Superior sagittal sinus (SSS)	72%
Transverse sinus (TS)	33%
Sigmoid sinus (SS)	28%
Straight sinus (STS)	6%
Superficial Cortical veins (CO)	2%
Deep venous system	15%
Table-4: Frequency of various venous sinuses involved in CVT	

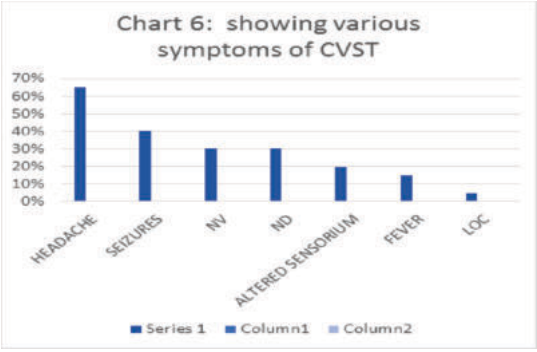


SINUSES	INFARCTS+	INFARCTS-
SSS	40%	32%
TS	15%	18%
SS	13%	15%
STS	2%	6%
CO	2%	-
DEEP CEREBRAL VEIN	10%	5%
Table-5: Frequency of various thrombosed sinuses with/without infarct		



In our study, headache and papilledema (65%) were the most common initial presenting features followed by seizures (40%). Nausea/vomiting and neurological deficits constituted 30% each, whereas altered sensorium and fever were present in 20% and 15% of patients respectively.5% patients presented with loss of consciousness.

SYMPTOMS	FREQUENCY
HEADACHE/PAPILLEDEMA	65%
SEIZURES	40%
NAUSEA/VOMITTING	30%
NEUROLOGICAL DEFICITS	30%
ALTERED SENSORIUM	20%
FEVER	15%
LOSS OF CONCIOUSNESS	5%
Table 6: table depicting symptoms of CVT	



The sensitivity and specificity of PC in diagnosing CVT considering TOF as gold standard as it picked up in 42 cases was calculated to be sensitivity of 91% with specificity of 100% with the P value of 0.12(not significant).

Table 7: showing sensitivity, specifity, PPV, NPV and P-value

Sequences	sensitivity	specificity	Positive predictive value	Negative predictive value	P value
PC	91%	100%	100%	93%	0.125
FLAIR	78%	100%	100%	84%	0.002
TOF, PC & FLAIR	78%	100%	100%	84%	0.002
The sensitivity and specificity of PC in diagnosing CVT considering TOF as gold standard					

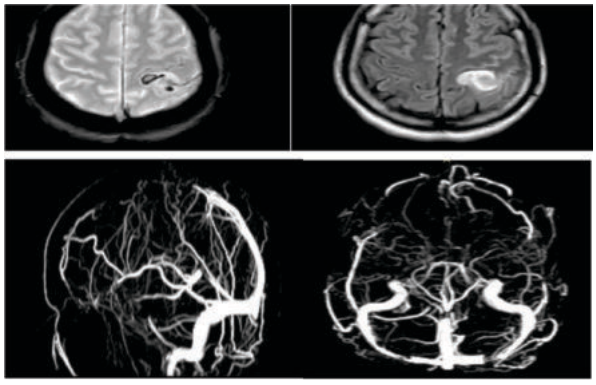


Figure 1: a) Axial GRE sequence showing blooming in left high posterior parietal lobar region. b) Axial FLAIR image showing high signal intensity left high posterior parietal lobar region. c) and d) MR Venogram images showing absent flow related signal intensity noted involving anterior and middle aspect of superior sagittal sinus and adjacent cortical veins.

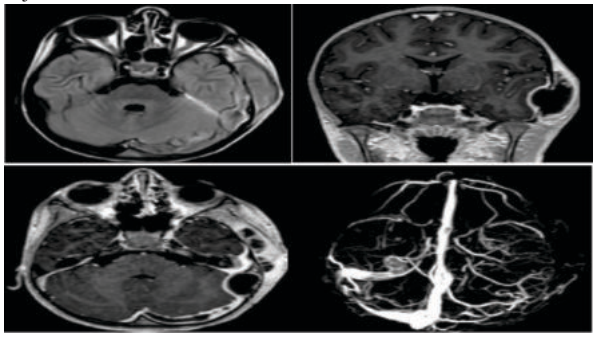


Figure 2: a) Axial FLAIR image showing extra axial intra and extra

Dural heterogenous collection in left temporal region extending into posterior fossa. b) Coronal post contrast image showing peripheral rim enhancement of the collection; a case of acute otitis media with coalescent mastoiditis. c) Axial post contrast image showing filling defect involving left transverse and sigmoid sinus. d) MR venogram image showing loss of flow related signal intensity involving left transverse and sigmoid sinuses.

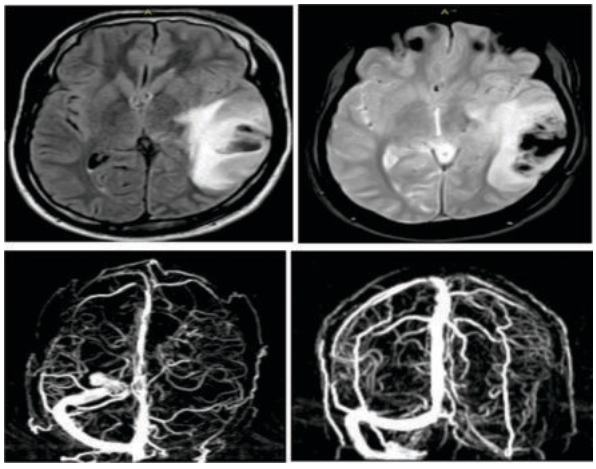


Figure 3: a) Axial FLAIR image showing high signal intensity in left parieto temporal lobar region. b) Axial GRE sequence showing blooming suggesting venous hemorrhagic infarct. c) & d) MR venogram images showing loss of flow related signal intensity involving left trans verse and sigmoid sinuses suggestive of thrombosis.

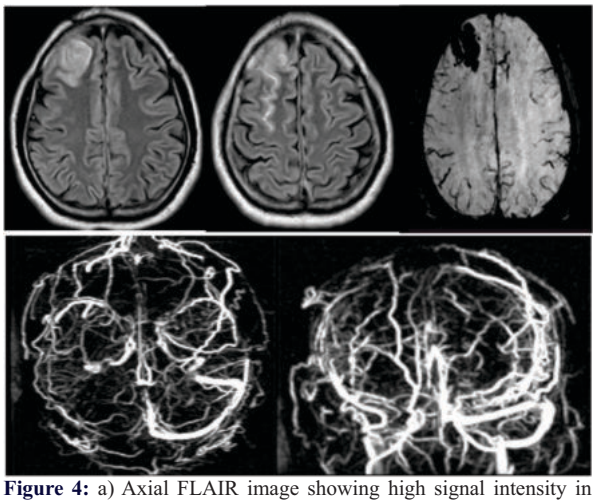


Figure 4: a) Axial FLAIR image showing high signal intensity in cortical and subcortical white matter of right frontal lobar region. b) Axial FLAIR image showing sulcal hyperintensities in right frontal region suggestive of sub arachnoid hemorrhage. c) Axial GRE sequence showing blooming. d) And e) MR venograms showing loss of flow related signal intensity involving superior sagittal, right transverse, right sigmoid sinuses and adjacent cortical veins suggestive of thrombosis.

DISCUSSION

- MR imaging with venography is currently considered as the non-invasive "gold standard" in establishing thrombosis of the cerebral venous sinuses.
- Diagnosis of CVT is challenging due to wide-range spectrum of clinical presentations, compound predisposing factors, and it distresses people of all ages. Impersonations of CVT are demonstrated as arterial stroke, tumor, encephalitis, abscess and idiopathic intracranial hypertension.
- Hence, diagnosis is by elimination of the differential diagnosis along with supportive imaging investigations.
- Imaging modalities which includes, but are not limited in the diagnosis of cerebral venous thrombosis (CVT) are DSA, CT, CTV and MRV. However, their limitations as well as diagnostic potential along with their advantages and disadvantages should always be taken into consideration.
- The clinical features are variable depending on the site, extent, type and duration of the thrombosis. When the thrombosis affects the cortical veins leading to an infarct, it results in seizures and paralysis, and if the thrombosis is limited to superior sagittal sinus and lateral sinuses it may present with symptoms of increased intracranial hypertension.13
- Unlike the arterial stroke the presentation of CVT can vary from acute to chronic. The clinical features may range from headache, papilledema, seizures, altered sensorium, fever and unconsciousness.
- As CVT has varieties of clinical presentation it needs to be suspected in cases that have occipital headache or new onset of headache with visual disturbance, young patients with hemiplegia, seizures following pregnancy, few other acquired conditions because CVT when compared to arterial stoke can be reversible in many cases without deficits.
- Hence radiologist in emergency department needs to aware of the imaging features of CVT and if suspected MRV with MRI brain should be recommended, as they are safe, non-invasive, non-ionizing and has accurate results. Also phase contrast has the ability to differentiate thrombosed sinuses from other variants and pitfalls.
- CVT is more commonly found in India when compared to the western countries however the exact prevalence remains unknown with the need for studies with a higher sample size**.**

CONCLUSION

- Cerebral venous sinus thrombosis is a frequently misdiagnosed condition because of its variability of clinical symptoms and signs. It is very often missed on initial imaging. All age groups can be affected. The prognosis of cerebral venous sinus thrombosis depends on early and accurate diagnosis of CVT.
- The result of present study shows that MRI and MRV are the most sensitive imaging sequences in diagnosing thrombosis and brain parenchymal changes as they have high sensitivity and specificity.
- Deep venous system involvement and isolated cortical vein thrombosis can also be detected.
- MRI and MRV effectively help in early detection and management of CVT and avoid further neurological deficits.
- MRV is also helpful in demonstration of recanalization of thrombosed venous sinuses.

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