ABSTRACT: Cerebral vein and dural sinus thrombosis (CVT) is a type of cerebrovascular disease marked by thrombosis of blood in cerebral veins, or dural sinuses, and, in rare cases, cortical veins. CVT is now a days a disease that is easy to diagnose with MRI provided the clinician suspect CVT in patients. Before CT and MRI evolution, CVT was considered as a disorder of infectious origin. Between November 2012 and December 2013, 50 patients with CVT in the neurology at the Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, confirmed with radioimaging, were included and studied. The mean age of the patients was 27.67±9.1 years. Most of the patients were in the third decade of life; majority were women (70%). CVT. Procoagulant state is found to be major risk factor with majority belonging to postpartum state (32%) followed by dehydration (30%). Postpartum in combination with dehydration constituted the major risk factor because of local ritual belief that water should not be taken by the postpartum mother for initial few days after delivery, found to be a modifiable risk factor. Superior sagittal sinus is the commonest sinus involved (58%) with transverse sinus being the second most common sinus involved and most (64%) of the patients with CVT had involvement of more than 1 venous sinus and site of thrombosis didn’t show any correlation with presenting features. MRV brain detected CVT in all the 50 patients in the study but in 28% of the patients no evidence of CVT was found on CT brain plain and contrast suggesting the sensitivity of MRV over the CT. 70% of the patients had complete functional recovery at the end of hospital stay whereas 6% of the patients died. Early diagnosis and prompt institution of anticoagulation irrespective, antioedema measures and antiepileptic drugs brings down the mortality and morbidity in patients with CVT. Decompressive craniectomy is an effective procedure decreasing morbidity and mortality and should be considered in patients with mass effect and rapid deterioration of sensorium resistant to conventional antioedema measures in patients with CVT.

INTRODUCTION: Cerebral vein and dural sinus thrombosis (CVT) is a rare type of cerebrovascular disease marked by thrombosis of blood in cerebral veins, or dural sinuses, and, in rare cases, cortical veins. CVT accounts for 0.5% of all strokes and its annual incidence is estimated to be 3 to 4 cases per 1 million population and up to 7 cases per 1 million children. Until a few years ago, systemic or local infections commonly affecting the superior sagittal sinus were identified as the most common causes of CVT.

The recent introduction of non-invasive and highly sensitive diagnostic techniques such as magnetic resonance imaging (MRI), magnetic resonance venography (MRV), and computed
tomography (CT) angiography has changed our understanding of CVT. With increasing awareness, not only is CVT being diagnosed more frequently, but less clinically severe cases of CVT are also being detected presently.\(^{(4)}\) However, despite substantial improvements, the diagnosis of CVT is often missed because of the remarkable variations in the clinical presentation and neuroimaging signs. Furthermore, existing studies \(^{(5,6)}\) on CVT patients are often limited by small numbers; their retrospective nature and short term follow-up periods. Thus, CVT remains a diagnostic and therapeutic challenge, and scanty information still exists on the natural history and long-term prognosis of this disease.

Most patients with CVT have a benign prognosis.\(^{(5,6,7)}\) Only a minority of patients die during the acute phase or in the following months. Most patients surviving CVT recover completely, or have only mild functional or cognitive deficits. Unfractionated or low-molecular weight heparin is widely used as a first-line therapy of CVT. Vitamin K antagonists have been prescribed for secondary prevention, but the optimal duration of treatment remains unknown.

Because most patients with CVT have partial or complete re-canalization of the vessels within the first few months after the index event, and because recurrences of CVT after a first episode appear to be uncommon, routine use of long-term therapy or even life-long secondary prevention seem to be unnecessary.\(^{(8)}\) Given the paucity of information on this topic from this region of India, the present study was planned to document the risk factors, clinical manifestations, radiographic abnormalities and outcome in patients with CVT.

**MATERIAL AND METHODS:** All patients diagnosed to have CVT in the department of neurology at the Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati between November 2012 to December 2013 were included in this prospective study. Fifty patients with CVT, satisfying the inclusion criteria, were studied during the period from admission till discharge.

**The diagnosis of CVT was based on the following criteria:**

(i) A clinical presentation compatible with acute CVT

(ii) Evidence of CVT based on MRI combined with MRV.\(^{(7,9,10,11)}\)

**Inclusion Criteria:**

(i) Patients diagnosed to have CVT at the SVIMS, Tirupati during the study period

**Exclusion Criteria:**

(i) Patients unwilling to participate in the study.

(ii) Patients whose radiological workup does not confirm CVT.

**Ethical Clearance:** Institutional Ethical Committee clearance was obtained for conducting the study.

**Initial Assessment:** The patients who presented with clinical manifestations suggestive of CVT, such as headache, altered mental status, seizures, focal neurological deficits, especially in the absence of the usual vascular risk factors were considered for inclusion into study.
A detailed clinical history, which included the presenting complaint, history of present illness, history of past illness, personal history, drug history, dietary history and menstrual history were recorded. Specifically, the history was focused on the possible risk factors for CVT. All the participants were subjected to a detailed physical examination, including general physical examination, a detailed neurological examination, Glasgow coma scale (12) and examination of other systems.

**Imaging Studies:** All patients were subjected to CT of the brain (plain and contrast). Patients whose CT brain was suggestive of other pathologies such as arterial infarcts, tumours, arteriovenous malformations were excluded from the study. MRI of the brain [T2 weighted (T2W) and diffusion weighted (DWI) images] and MRV.

**Laboratory Investigations:** In all the patients, the following laboratory testing were carried: complete haemogram; coagulation profile [bleeding time, clotting time, prothrombin time with international normalized ratio (INR) and activated partial thromboplastin time]; workup for other prothrombogenic disorders (protein C and S, homocystein levels); rheumatological work-up including rheumatoid factor (RF), antinuclear antibody (ANA), anti-double stranded deoxyribonucleic acid antibody (anti-dsDNA), anticardiolipin antibody (ACL); and serological testing for human immunodeficiency virus (HIV) infection.

**In-hospital Course:** All the patients were managed according to standard guidelines.(13) All the patients who have definite evidence of CVT were admitted in the neurology ICU. The treatment included management of the predisposing/precipitating conditions, antithrombotics, lowering intracranial pressure and symptomatic treatment for seizures, headaches. Patients with CVT without contraindications for anticoagulation were treated with dose-adjusted intravenous heparin with an at least doubled activated partial thromboplastin time.

Analogous to patients with a first episode of CVT, oral anticoagulation was given for 3 months if CVT was secondary to a transient risk factor, for 6–12 months in patients with idiopathic CVT and in those with mild thrombophilia. Indefinite oral anticoagulation was given in patients with two or more episodes of CVT and in those with one episode of CVT and severe thrombophilia.

Other symptomatic measures such as intravenous mannitol (100 ml, 6th hourly), were instituted. Antiepileptic drugs were started based on need. Large haemorrhages and infarcts associated with extensive cerebral oedema with progressive deterioration in sensorium were managed with decompressive craniectomy. Further course of illness, from hospital admission to the time of discharge, was assessed by progression of presenting complaints, neurological deficits and mental status assessment by Glasgow Coma Scale.(14)

**Final Assessment:** All the patients recruited in the study were assessed for functional status at the end of their hospital stay using Modified Rankin Scale (mRS)(6) which were classified as complete recovery - 0 to 1, partial recovery independent - 2, partial recovery dependent - 3 to 5 and death - 6.
Outcome: The in hospital outcome of the patients was studied in terms of duration of hospital stay, requirement of mechanical ventilator support, surgery and functional assessment at the end of hospital based on mRS.

Statistical Analysis: Data were recorded on a predesigned proforma and managed using Excel 2007 (Microsoft Corporation, Redmond, WA, USA). All the entries were double-checked for any possible error. Descriptive statistics for the categorical variables was performed by computing the frequencies (percentage) in each category. For the quantitative variables, approximate normality of the distribution was assessed. Variables following normal distribution were summarized by mean and standard deviation

RESULTS: During the study period 63 patients compatible with CVT were considered for screening and enrollment into the study. Of these, 13 patients were excluded not satisfying inclusion criteria. Fifty patients satisfying the inclusion criteria were included in the study.

Demographic Characteristics: Their mean age was 27.67±9.1 years. Most of the patients were in the third decade of life; majority was women (70%).

Risk Factors: Out of 50 patients in the study, procoagulant state is found to be major risk factor with majority belonging to postpartum state (32%) followed by dehydration (30%). Postpartum in combination with dehydration constituted the major risk factor (22%) because of local ritual belief that water should not be taken by the postpartum mother for initial few days after delivery.

Bad obstetric history was found in 4 patients, of which, 3 patients had past history of abortion and 1 patient had past history of still birth. No cause was found in 7(14%) of the patients (Table 1).

| Variable                                | No. (%) |
|-----------------------------------------|---------|
| Anaemia                                 | 14(28)  |
| Postpartum                              | 16(32)  |
| Dehydration                             | 15(30)  |
| Alcoholism                              | 9(18)   |
| Oral contraceptive pills                | 5(10)   |
| Hyperhomocysteinaemia                   | 5(10)   |
| Antiphospholipid antibody syndrome      | 4(8)    |
| Thrombocytopenia                        | 2(4)    |
| Protein S deficiency                    | 1(2)    |
| Polycythaemia                           | 2(4)    |
| Meningitis                              | 1(2)    |
| Idiopathic                              | 7(14)   |

Table 1: Predisposing conditions in 50 patients with CVT at the time of initial presentation
Clinical Manifestations: Salient clinical manifestations at the time of presentation of CVT patients are shown in Table 2: Majority of patients had headache (86%), followed by papiloedema (66%).

| Clinical features     | No. (%) |
|-----------------------|---------|
| Headache              | 43(86)  |
| Papiloedema           | 33(66)  |
| Seizures              | 29(58)  |
| Vomiting              | 29(58)  |
| Altered sensorium     | 29(58)  |
| Hemiparesis           | 16(32)  |
| Seventh nerve palsy   | 16(32)  |
| Fever                 | 5(10)   |
| Status epilepticus    | 4(8)    |
| Meningeal signs       | 3(6)    |
| Sixth nerve palsy     | 3(6)    |
| Aphasia               | 3(6)    |
| Visual field defects  | 1(2)    |

Table 2: Clinical features in 50 patients with CVT at the time of initial presentation

CVT = Cerebral vein and dural sinus thrombosis.

Brain Parenchymal Findings by Radioimaging: Type and distribution of lesions in the brain parenchyma of the 50 patients included in the study are shown in table 3. Of the 50 patients, on imaging (CT/MRI), majority were having haemorrhagic infarct (50%). Of the 39 patients whose imaging finding was either a haemorrhagic infarct or infarct without haemorrhage, DWI showed facilitation in 32/39 (82%) patients and restriction in 7/39(18%) patients. No parenchymal lesion was found in 9(18%) patients.

| Site of lesion                        | Infarct without haemorrhage | Haemorrhage | Haemorrhagic infarct | Total |
|---------------------------------------|------------------------------|-------------|----------------------|-------|
|                                       | No. (%)                      | No. (%)     | No. (%)              | No. (%) |
| Frontal                               | 1(2)                         | 0           | 9(18)                | 10(20) |
| Temporal                              | 4(8)                         | 0           | 4(8)                 | 8(16)  |
| Occipital                             | 0                            | 1(2)        | 0                    | 1(2)   |
| Parietal                              | 2(4)                         | 0           | 0                    | 2(4)   |
| Fronto temporal                       | 0                            | 1(2)        | 2(4)                 | 3(6)   |
| Frontoparietal                        | 1(2)                         | 0           | 0                    | 1(2)   |
| Temperoparietal                       | 0                            | 0           | 5(10)                | 5(10)  |
| Frontotempo parietal                 | 0                            | 0           | 1(2)                 | 1(2)   |
| Temperoparietoooccipital             | 0                            | 0           | 3(6)                 | 3(6)   |
| Bilateral - thalamocapsuloganglionic  | 5(10)                        | 0           | 1(2)                 | 6(12)  |
| Cerebellum                           | 1(2)                         | 0           | 0                    | 1(2)   |
| No lesion                             | 0                            | 0           | 0                    | 9(18)  |
| Total                                 | 14(28)                       | 2(4)        | 25(50)               | 50(100) |

Table 3: Distribution and types of parenchymal lesions by radioimaging in 50 patients with CVT

CVT = Cerebral vein and dural sinus thrombosis.
No sinus or vein involvement was found in CT brain plain & contrast in 14 (28%) patients. But MRV was able to pick up the lesion in all the 50 patients included in the study. Comparison of patients, based on picking up of CVT, diagnosed by CT- brain plain and contrast and MRV of the brain is shown in Table 4. Thirty two patients had involvement of more than 1 venous sinus and of them 5 patients had involvement of both superficial and deep veins as per MRV brain.

| Sinuses & veins     | CT brain plain & contrast No. (%) | MRV of brain No. (%) |
|---------------------|-----------------------------------|---------------------|
| Superior sagittal sinus | 24(48)                           | 29(58)              |
| Transverse sinus     | 15(30)                            | 26(52)              |
| Sigmoid sinus        | 9(8)                              | 27(54)              |
| Straight             | 6(12)                             | 9(18)               |
| Internal jugular vein| 0                                 | 4(8)                |
| Deep veins           | 3(6)                              | 5(10)               |

Table 4: Comparison of patients, based on visualisation of CVT, diagnosed by CT- brain plain and contrast and MRV of the brain

CVT = Cerebral vein and dural sinus thrombosis; CT = Computed tomography; MRV = Magnetic resonance venography.

Outcome: Mean duration of hospital stay was 12.33±3.3 days, 13(26%) of the 50 patients required mechanical ventilation during the hospital stay, 10(20%) of them underwent decompressive craniectomy as the part of the treatment. Functional status of the 50 patients in the study was distributed according to mRS,. 35(70%) of the 50 patients had complete functional recovery, 9(18%) partial recovery independent, 3(6%) partial recovery dependent, whereas 3 (6%) of the patients died during the hospital stay.

DISCUSSION: CVT is a less common cause of cerebral infarction relative to arterial disease but is an important consideration because of its potential morbidity. In the evaluation of patients with venous thrombosis, knowledge of the anatomy of the venous system is essential because symptoms associated with the condition are related to the area of thrombosis. In early studies, mortality ranked between 30% and 50%(14,15) but in more recent studies, it is between 8% and 14%(2,6,16,17) and in the present one it is only 6%. Multiple reasons can explain this decrease, one being probably early diagnosis & another reason is that septic thrombosis has, since the use of antibiotics, become both far less frequent and severe, early diagnosis is possible with advent of MR imaging techniques and it is also possible, that the introduction of anticoagulant treatment early in the management of CVT has improved the outcome.

Demographic Characteristics: Age and Gender Distribution: Majority of the patients in the present study was in their third decade, the economically productive years of life; women were more often affected than men. This observation is consistent with observation from the International Sinus Cerebral Vein Thrombosis (ISCVT) trial(6) by Ferro et al, 2004, a collaborative
study that enrolled more than 600 patients with CVT, in which the incidence of CVT was higher in females and in the third decade of age. Pregnancy and postpartum status are known to result in increased incidence of the cortical venous sinus thrombosis due to the normal physiological changes in the pregnancy that results in hypercoagulability.

**Risk Factors:** The most widely studied risk factors for CVT include prothrombotic conditions. The largest study, the ISCVT by Ferro et al, 2004, is a multinational, multicenter, prospective observational study with 624 patients. Thirty-four percent of these patients had an inherited or acquired prothrombotic condition. In a study by Cantu et al, 1993, nearly 50% of CVT occurred during pregnancy or puerperium. Most pregnancy-related CVT occurs in the third trimester or puerperium. During pregnancy and for 6 to 8 weeks after delivery, women are at increased risk of venous thromboembolic events. Pregnancy induces several prothrombotic changes in the coagulation system that persist at least during early puerperium. Hypercoagulability worsens after delivery as a result of volume depletion and trauma. During the puerperium, additional risk factors include infection and instrumental delivery or cesarean section. One study reported that the risk of peripartum CVT increased with increasing maternal age, and cesarean delivery, as well as in the presence of hypertension, infections, and excessive vomiting in pregnancy. Post-partum constituted the major risk factor (32%) for CVT in our study.

In the present study 28% of patients with CVT were anemic, whether this is a reflection of high incidence of anemia in Indian population particularly in females or anemia is a real risk factor, needs further evaluation. In this study, only one patient was found to have infective cause which confirms the fact that the frequency of septic CVT has markedly declined with the advent of antibiotics and the patient was found to be suffering from HIV (Human immune deficiency virus) infection and CSF (cerebrospinal fluid) examination was positive for cryptoccus and was started on appropriate therapy. Oral contraceptives as aetiologic factor were seen in 5 of our patients. This has now led us, to stop oral contraceptives and promptly look for CVT in women presenting with any of the neurological manifestations particularly persistent headache, focal deficits or seizures. Other risk factors include hyperhomocysteinaemia (10%), antiphospholipid antibody syndrome (8%). In 7/50 cases (14%) no cause was found.

**Clinical Features:** CVT has no single clinical presentation and this is why it is necessary to systematically contemplate this diagnosis in order not to overlook it. The most frequent, but least specific clinical presentation of CVT is headache, which is present in 75–90% of adult patients. Even in present study headache (86%) was the most common symptom with which patients with CVT presented.

Comparison of clinical presentation among patients with CVT in other studies by Ferro et al, 2004, Wasay et al, 2008, Kumaravelu et al, 2008 showed similar results. CVT is an (caused by sixth nerve palsy) even without other neurological focal signs suggestive of idiopathic intracranial hypertension. When focal brain injury occurs because of venous ischemia or hemorrhage, neurological signs and symptoms referable to the affected region are often present; most common are hemiparesis and aphasia, but other cortical signs and sensory symptoms may occur.
Clinical manifestations of CVT are independent on the location of the thrombosis. The superior sagittal sinus is most commonly involved, which may lead to headache, increased intracranial pressure, and papilledema (23).

**Imaging:** Given the diverse clinical presentations, CVT should be considered as a cause of many central nervous system symptoms and signs, and appropriate neuroimaging investigations should be performed whenever suspicion is raised. A CT scan is usually the first investigation performed in emergency departments. Although it can sometimes detect the spontaneously hyperdense thrombosed sinus, it usually shows nonspecific changes such as hypodensities, and contrast enhancement, and in up to 30% of cases, it is normal.

The present “gold standard” for the diagnosis of CVT is the combination of magnetic resonance imaging (MRI) to visualise the thrombosed vessel and magnetic resonance venography (MRV) to detect the non-visualisation of the same vessel (24,25). Also the present study shows that CT scan can be normal up to 28% (14/50) in patients with CVT. The present study confirms the fact that sinuses most frequently involved are superior sagittal sinus (58%) & transverse sinus (52%) but it shows that the occlusion is only rarely limited to one sinus (29%). Thus in most cases, occlusion involved at least two sinuses or sinus and cerebral veins.

The overall diffusion-weighted imaging and apparent diffusion coefficient pattern is very different from that of arterial infarcts, and is mostly suggestive of vasogenic oedema and far less commonly of cytotoxic oedema. This difference shows that so-called venous infarcts have little in common with arterial infarcts and probably explains, at least partly, the much better recovery reported in those with CVT. The most common pattern is heterogeneous signal intensity with normal or increased apparent diffusion coefficient corresponding to vasogenic oedema. Even in the present study, of the 39 patients whose imaging finding was either a haemorrhagic infarct or infarct without haemorhage, DWI showed facilitation in 32 (82%) patients and restriction in 7 (18%) patients explaining the better functional status of the patients at the time of discharge.

**Management:** In the present study, the lowering of intracranial pressure was achieved by intravenous mannitol. All patients received anticoagulants. Patients with procoagulant factors were given anticoagulants for a longer duration, at times for the rest of their lives. Prophylaxis with antiepileptic drugs was given for the patients presenting with seizures.

Ten (20%) patients underwent decompressive craniectomy as they were having mass effect with rapid deterioration of sensorium of the who underwent decompressive craniectomy 5/10 patients had complete recovery, 4/10 patients had partial recovery but were independent, 1/10 patients died in the post-surgical period in the present study prevalence of surgery in our study is much higher compared to study by wasay et al, 2008(6) which was a multicentric trial in United States of America which included 182 patients in which 8% of the patients in the study underwent decompressive craniectomy and 1% of the patients died following surgery. As evidenced by the present study decompressive craniectomy is an effective procedure decreasing morbidity and mortality and should be considered in patients with mass effect with rapid deterioration of sensorium resistant to conventional antiedema measures.
Outcome: Mean duration of hospital stay in the present study 12.44±3.33 days is much less compared to Ferro et al\(^6\) where the duration of stay was 17 days. Out of the 50 patients in our study 35 (70%) had complete functional recovery, 9(18%) had partial recovery and were independent, 3(6%) had partial recovery and were dependent at the time of discharge from the hospital. Three (6%) patients died during the hospital stay this is comparable to study by Ferro et al.\(^6\) Out of 3 patients who died in the present study one patient died due to mass effect, herniation and denial of surgical management by patient attendants, one died due resistant status epileptics and cardiac arrest and one died with deep venous thrombosis, delayed hospitalization, mechanical ventilation and finally cardiac arrest. It shows CVT managed in a tertiary care with appropriate measures have good functional recovery.

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