Original Research Article

Critical Clinical and Radiological Predictors of Outcome in Cerebral Venous Sinus Thrombosis: A Hospital-Based Observational Study

Shubham Garg[1], Shreya Agarwal[2]

[1]Assistant Professor, Department of Neurology, Vyas Medical College and Hospital, Jodhpur, Rajasthan, India
[2]Assistant Professor, Department of Pathology, Dr SN Medical College Jodhpur, Rajasthan, India

Abstract:

Background: CVST is an uncommon cerebrovascular disorder with diverse clinical presentations and variable outcomes. Despite major advances in neuroimaging and therapeutic strategies, predicting prognosis remains a challenge. This study aimed to determine the major clinical and radiological factors influencing outcomes among patients with CVST.

Materials and Methods: A hospital-based observational study was carried out among 50 adult patients (>18 years) diagnosed with CVST at Vyas Medical College and Hospital, Jodhpur, between July and October 2025. Cases with mixed arterial-venous stroke, terminal illness, or prior bedridden state were excluded. MRV or CTV were used to confirm the diagnosis. After 30 days, results were assessed using the mRS and classified as either satisfactory (mRS <3) or poor (mRS ≥3). Fisher's exact and Chi-square tests were used to determine statistical significance.

Results: Among 50 participants (34 males, 16 females; mean age 35.2 ± 10.8 years), headache (86%), papilledema (60%), and seizures (48%) were the leading clinical presentations. The transverse sinus (46%), cortical veins (40%), and superior sagittal sinus (66%) were the most commonly impacted. Alcohol use (36%), hyperhomocysteinemia (28%), and anemia (22%) were common risk factors. At one month, 92% of patients achieved a good outcome, while 8% had poor outcomes. Significant predictors of poor prognosis were focal neurological deficits (P=0.04), low GCS score (<9, P<0.001), presence of mass effect (P=0.002), and requirement of decompressive craniectomy (P=0.001).

Conclusion: Prompt diagnosis and appropriate management contribute to favorable outcomes in most CVST cases. However, a focal neurological deficit, low GCS score, radiological mass effect, and surgical intervention needs remain key indicators of adverse prognosis. Larger multicentric studies are warranted to validate these findings in diverse Indian populations.

Keywords: Cerebral Venous Sinus Thrombosis, Clinical Predictors, Radiological Factors.

Introduction

Thrombosis of the dural venous sinuses and cortical veins causes cerebral venous sinus thrombosis (CVST), a rare but increasingly recognized cause of stroke that disrupts normal cerebral venous drainage. This obstruction leads to raised intracranial pressure and venous infarction, which may present with varied neurological manifestations. Unlike arterial strokes, which typically affect elderly individuals, CVST occurs more frequently among young and middle-aged adults, particularly women of reproductive age.[1] The clinical profile of CVST is highly variable, ranging from isolated headaches to seizures, focal neurological deficits, altered consciousness, or even coma, often making early diagnosis difficult.[2] With an estimated global incidence of 3–4 cases per million annually, CVST accounts for nearly 0.5–1%

of all strokes, though this figure may be higher in regions with limited diagnostic access.[3] In India, under-reporting remains common due to differences in awareness, resource availability, and clinical suspicion.

Advances in neuroimaging over the past two decades have significantly improved the understanding and diagnosis of CVST. The use of magnetic resonance venography (MRV) and computed tomography venography (CTV) has enabled clinicians to detect venous sinus occlusions and parenchymal lesions with greater accuracy and speed.[4] These developments have reduced CVST-related mortality from historical rates exceeding 30%–50% to below 15% in most contemporary studies.[5] Despite these improvements, CVST

continues to present a clinical challenge due to its heterogeneous causes and unpredictable course. The condition may occur as an isolated intracranial event or secondary to systemic conditions such as pregnancy, dehydration, infection, trauma, autoimmune disorders, and hematological abnormalities. Indian studies have identified anemia, hyperhomocysteinemia, vitamin B12 deficiency, and alcohol intake as major contributing factors, highlighting the influence of nutritional and environmental determinants in disease pathogenesis.[6] In contrast, Western literature emphasizes hereditary thrombophilias, pregnancy, and oral contraceptive use as dominant etiologies, indicating geographical and socioeconomic variations in risk factors.[7]

Although the introduction of standardized anticoagulation protocols has led to improved outcomes, the prognosis of CVST remains highly variable. While the majority of patients achieve near-complete recovery, a subset develops long-term neurological deficits or life-threatening complications such as herniation and massive cerebral edema. Several studies have attempted to identify predictors of poor prognosis, such as low Glasgow Coma Scale (GCS) scores, extensive sinus involvement, deep venous system thrombosis, parenchymal lesions, and the presence of mass effect on imaging. [5,7] However, inconsistencies exist across published data. Some reports have linked advanced age and male gender with poor outcomes, whereas others found no demographic association, emphasizing instead the prognostic significance of clinical and radiological features.[8] Variability in study populations, treatment protocols, and regional differences in disease spectrum may explain these discrepancies. Consequently, there remains a need for center-specific studies that evaluate outcome determinants in varied demographic and geographical settings.

India represents a unique epidemiological context for studying CVST due to its diverse genetic, nutritional, and socioeconomic landscape. The burden of secondary, or "provoked," CVST in India remains higher than in Western countries, largely because of modifiable factors such as nutritional deficiencies, postpartum states, and infections.[6] However, data from northern and western India remain limited compared to southern centers, where most large-scale registries have been conducted. Recognizing this gap, the present hospital-based observational study was undertaken at Vyas Medical College and Hospital, Jodhpur, a tertiary care center in western India. The aim of this research was to assess the clinical characteristics, radiological findings, and prognostic factors associated with outcomes in CVST. By analyzing a defined cohort of fifty adult patients, this study seeks to identify key variables influencing short-term prognosis.

Establishing such region-specific evidence is crucial for improving early recognition, guiding management strategies, and reducing morbidity and mortality associated with CVST in the Indian population.

Materials and Methods

Study Design and Setting: From July 2025 to October 2025, the neurology department of Vyas Medical College and Hospital in Jodhpur, Rajasthan, conducted retrospective observational research. The IEC gave its approval to the study (IEC/VMC/NEURO/2025/12).

Inclusion Criteria

- Age ≥18 years
- Confirmed diagnosis of CVST by CT venography (CTV) or MR venography (MRV)
- Both male and female patients

Exclusion Criteria

- Patients with combined arterial stroke
- Age <18 years
- Bedridden or terminally ill individuals before onset
- Patients with incomplete follow-up data

Data Collection: Demographic, clinical, radiological, and etiological parameters were extracted from medical records. Variables included age, sex, symptom onset, Glasgow Coma Scale (GCS) at parenchymal lesions, admission, focal neurological deficits, mass effect, sinus involvement, presence of seizures, papilledema, and decompressive craniectomy.

All patients underwent baseline hematological and biochemical evaluations, including serum homocysteine, vitamin B12, ANA profile, and APLA testing as per clinical suspicion. Treatment consisted of UFH or LMWH, followed by oral anticoagulants.

Outcome Assessment: Outcomes were assessed after 30 days using the mRS:

- **Poor outcome:** mRS ≥3
- **Good outcome:** mRS <3

Statistical Analysis: SPSS version 25.0 was used to analyze the data. Categorical data were expressed as percentages, and continuous variables were expressed as mean ± SD. Finding correlations between variables and outcomes was done using either the Fisher's exact test or the Chi-square test. A P-value of less than 0.05 was considered statistically significant.

Results

Baseline Characteristics: The study comprised 50 patients (34 men and 16 women) with a mean age of 35.2 ± 10.8 years (range 18–68 years). Seven days

(IQR 3–10) was the median interval between the onset of symptoms and hospital presentation. Mean GCS at admission was 13.2 ± 2.5.

Clinical Features: Headache was the most prevalent symptom (86%), followed by seizures (48%), and papilledema (60%). Focal neurological deficits were seen in 36%, and altered sensorium in 28%. Idiopathic intracranial hypertension (IIH)-like presentation occurred in 18% of cases.

Table 1: Clinical Manifestations of CVST (n = 50)

Clinical Feature	n (%)
Headache	43 (86)
Seizures	24 (48)
Altered sensorium	14 (28)
Papilledema	30 (60)
Focal neurological deficits	18 (36)
Cranial nerve deficits	4 (8)
IIH-like presentation	9 (18)

Radiological Findings: The most often thrombosed sinuses were the superior sagittal sinus (66%), right transverse sinus (46%), and cortical veins (40%). Multiple sinus involvement was noted in 80% of patients. Mass effect was present in 76%, parenchymal lesions in 62%, and deep sinus thrombosis in 14%.

Table 2: Sinus Involvement on Imaging

Site of Thrombosis	n (%)
Superior sagittal sinus	33 (66)
Transverse sinus	23 (46)
Sigmoid sinus	17 (34)
Cortical vein	20 (40)
Straight sinus	8 (16)
Deep sinus vein	7 (14)
Multiple sinus involvement	40 (80)

Etiological Risk Factors: Provoked CVST was present in 90%, with alcohol use (36%), hyperhomocysteinemia (28%), and anemia (22%) as common risk factors. OCP use and postpartum CVST each accounted for 8% of female cases.

Table 3: Etiological Risk Factors

Risk Factor	n (%)
Alcohol use	18 (36)
Hyperhomocysteinemia	14 (28)
Vitamin B12 deficiency	10 (20)
Anemia	11 (22)
OCP use	4 (8)
Puerperal state	4 (8)
Ear infection	3 (6)
Idiopathic	5 (10)

Outcome Analysis: At one-month follow-up, good outcome (mRS <3) was seen in 46 patients (92%), and poor outcome (mRS ≥3) in 4 patients (8%). Poor outcome correlated significantly with GCS <9, mass effect, focal neurological deficits, and need for decompressive craniectomy.

Table 4: Association of Prognostic Factors with Outcome

Variable	Good Outcome n (%)	Poor Outcome n (%)	P-value
GCS ≤9	3 (50)	3 (50)	<0.001
Focal neurological deficits	15 (83.3)	3 (16.7)	0.04
Mass effect	34 (89.5)	4 (10.5)	0.002
Decompressive craniectomy	1 (25)	3 (75)	0.001

Discussion

This study, conducted in Western India, analyzed the clinical spectrum and outcome determinants of CVST among 50 patients. The findings largely

mirror those from prior Indian studies, reaffirming that CVST predominantly affects young adults with a slight male preponderance. The mean age (35 years) and male-to-female ratio (2.1:1) were consistent with reports from Manipal and Hyderabad cohorts. [9,10]

Headache, papilledema, and seizures were predominant, aligning with prior reports indicating headache in 80–90% of patients. [11,12] The high rate of papilledema underscores the subacute nature of intracranial hypertension. Superior sagittal sinus involvement (66%) and multiple sinus thrombosis (80%) remained characteristic patterns, suggesting extensive venous involvement at presentation.

Alcohol consumption emerged as a major risk factor, similar to other South Indian series, possibly reflecting lifestyle trends. Hyperhomocysteinemia and vitamin B12 deficiency were also common, reinforcing nutritional contributors to hypercoagulable states in the Indian context.[13]

The overall good outcome rate (92%) and zero mortality are encouraging, attributable to early imaging, rapid initiation of anticoagulation, and improved supportive care. Poor outcome correlated significantly with low GCS (<9), mass effect, focal neurological deficits, and requirement for decompressive craniectomy, consistent with earlier multicentric analyses. [14,15]

In contrast to conventional wisdom, our cohort's poor outcome was not linked to age, sex, delayed diagnosis, or multiple sinus involvement. This likely reflects enhanced accessibility to neuroimaging and prompt intervention.

Interestingly, the proportion of puerperal CVST was lower in this Western Indian population compared to Southern Indian series, where puerperium accounted for up to 20% of cases. This may reflect changing sociocultural and obstetric practices across regions.

Conclusion

This hospital-based observational study demonstrates that early diagnosis and timely anticoagulation lead to favorable short-term outcomes in most CVST patients. Nonetheless, specific neurological impairments, mass effect, low GCS upon admission, and the requirement for decompressive craniectomy continue to be significant predictors of a poor outcome. Larger multicentric and prospective studies are needed to further delineate regional variations and validate these predictors across India.

References

1. Ribes MF. Des recherches faites sur la phlebite. Rev Med Franc Etrang. 1825; 3:5–41.
2. Bousser MG, Ferro JM. Cerebral venous thrombosis: An update. Lancet Neurol. 2007; 6:162–70.
3. Stam J. Thrombosis of the cerebral veins and sinuses. N Engl J Med. 2005; 352:1791–8.
4. Coutinho JM, et al. Anticoagulation for cerebral venous sinus thrombosis. Cochrane Database Syst Rev. 2011;8:CD002005.
5. Piazza G. Cerebral venous thrombosis. Circulation. 2012; 125:1704–9.
6. Nagaraja D, et al. Puerperal cerebral venous thrombosis: Therapeutic benefit of low-dose heparin. Neurol India. 1999; 47:43–6.
7. Narayan D, et al. Risk factors, clinical profile, and long-term outcome of 428 patients of cerebral sinus venous thrombosis. Neurol India. 2012; 60:154–9.
8. Dash D, Prasad K, Joseph L. Cerebral venous thrombosis: An Indian perspective. Neurol India. 2015; 63:318–28.
9. Ferro JM, Canhao P, Stam J. Prognosis of cerebral vein and dural sinus thrombosis. Stroke. 2004; 35:664–70.
10. Halesha BR, et al. Clinical features and outcome of CVST in a tertiary care centre in South India. J Clin Diagn Res. 2011; 5:443–7.
11. Banakar BF, Hiregoudar V. Prognostic factors of cortical venous thrombosis. J Neurosci Rural Pract. 2017; 8:204–8.
12. Barboza MA, et al. Prediction of outcome after cerebral venous thrombosis. Front Neurol. 2018; 9:882.
13. Pai N, Ghosh K, Shetty S. Hereditary thrombophilia in CVST: An Indian study. Blood Coagul Fibrinolysis. 2013; 24:540–3.
14. Krishnan M, Nagarajan M. A study of 50 cases of cerebral venous sinus thrombosis. Int J Res Rev. 2019; 6:214–9.
15. Yadav K, et al. Clinical profile, risk factors, and outcome in CVST. SSRG Int J Med Sci. 2016;3:14–7.