National Board of Examination - Journal of Medical Sciences
Volume 2, Issue 3, Pages 205–218, March 2024
DOI 10.61770/NBEJMS.2024.v02.i03.004

ORIGINAL ARTICLE

Decompressive Craniectomy Outcomes in Cerebral Venous Sinus Thrombosis: A Comprehensive Analysis from a Tertiary Neurosurgical Center

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Accepted: 18-January-2024 / Published Online 27-February-2024

Abstract

Background: Cerebral venous sinus thrombosis (CVST) is a rare cerebrovascular condition characterized by the formation of blood clots in the cerebral venous sinuses, which are responsible for draining blood and cerebrospinal fluid from the brain. CVST represents a significant cause of stroke in young individuals, with a mortality rate ranging from 6% to 15%. **Methods:** Common clinical presentations include symptoms like headaches, seizures, altered mental state, and focal neurological deficits. In India, a noteworthy occurrence of CVST is observed among postpartum women, while alcoholism poses a significant risk factor for males. **Results:** This study identifies headaches as the most prevalent initial symptom of CVST, followed by seizures and focal neurological deficits. The superior sagittal sinus is the most frequently affected in these patients. Notably, 83.3% of patients in this study achieved a favorable outcome. However, a midline shift exceeding 10mm was identified as a predictive factor for an unfavorable outcome in this series. **Conclusions:** Contrary to previous perceptions, CVST is not uncommon in males. The early diagnosis and prompt intervention have a positive impact on overall patient outcomes. This research sheds light on the importance of recognizing CVST in a broader demographic, its common symptoms, and the critical role of timely intervention for improved patient prognosis.

Keywords: CVST, Cerebral Venous Sinus Thrombosis, Clinical Presentation, Outcome Predictors, Timely Intervention

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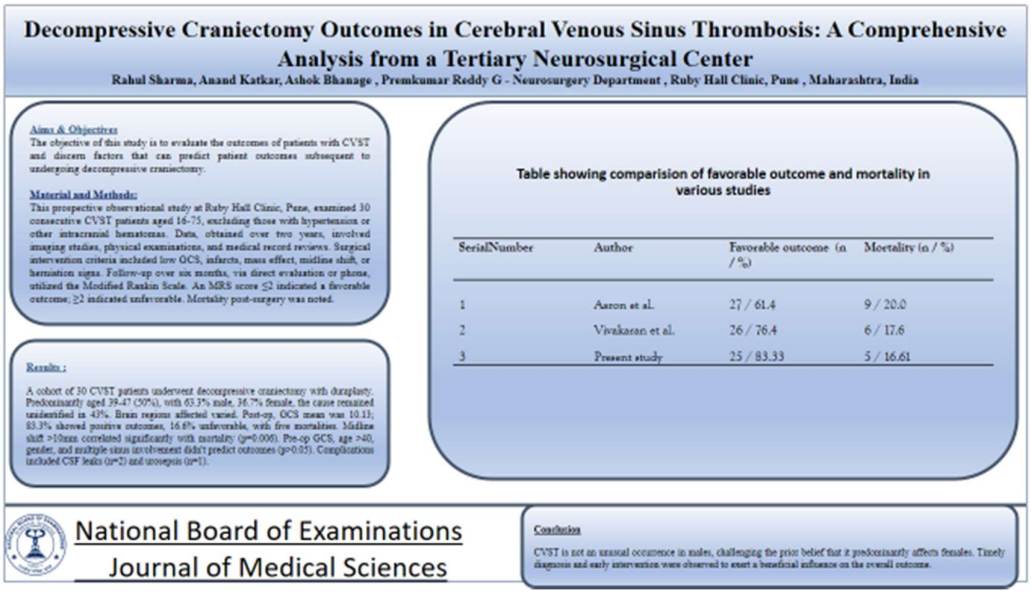
Graphical Abstract



Introduction

Cerebral venous sinus thrombosis (CVST) is a rare cerebrovascular disorder initially described by a 19th-century French physician. CVST primarily involves the blockage of dural sinuses in the brain, often coupled with cortical vein thrombosis. CVST restricts blood and cerebrospinal fluid outflow, resulting in venous infarcts in about 50% of cases [3].

CVST is a significant cause of stroke in young individuals, with mortality rates ranging from 6% to 15%. The International Study on Cerebral Vein and Dural Sinus Thrombosis (ISCVT) reported that most deaths occur within the first 30 days [1].

Patients with CVST typically exhibit symptoms such as headaches, seizures, papilledema, altered consciousness, and focal neurological deficits. These arise from the thrombosis of intracranial veins and sinuses, leading to hemorrhagic infarctions and increased intracranial pressure. In India, CVST forms a distinct subgroup of cerebrovascular diseases and is a major cause of mortality among women of reproductive age. Postpartum women are particularly susceptible, while alcoholism presents a significant risk factor in males.

Heparin represents the standard treatment for CVST, and most patients respond well to this therapy. However, approximately 20% of patients continue to experience disability or face a fatal outcome [13]. The main cause of death is transtentorial herniation resulting from extensive hemorrhagic infarctions [17].

In cases where patients exhibit a mass effect and midline shift and their condition worsens despite anticoagulation, emergency decompressive surgery has been

proposed as a life-saving measure [1]. Nonetheless, unlike in arterial strokes, decompressive craniectomy is not widely adopted for venous stroke patients, and its role in CVST remains uncertain.

This study aims to assess the outcomes of CVST patients and identify factors that predict patient outcomes following decompressive craniectomy.

Methods and Materials

I) Inclusion criteria

- Patients diagnosed by the imaging studies (CT Brain, MR Brain with Venogram) with CVST
- Patients of age group (16-75) presenting with Cerebral venous thrombosis.

II) Exclusion criteria

Patient with

- Hypertension
- Other intra cranial hematoma such as cavernoma etc

Study Area:

This study was conducted in the Department of Neurosurgery, Ruby Hall Clinic, Pune, after obtaining ethical clearance from the ethical committee.

Study population:

Data was obtained from 30 consecutive patients, out of which 19 were male and 11 were female admitted for surgeries at Ruby Hall Clinic, Pune.

Time frame:

Data was collected for a period of 2 years

Study design:

Prospective Observational Study.

Indications for surgery

Indications for surgery include: a low GCS at admission with large infarct on the CT/MRI scan; significant mass effect and midline shift on CT/MRI scan; clinical and radiological signs of transtentorial herniation; deterioration in the sensorium despite anti-edema measures.

Sample size:

Sample size was 30 patients.

Data collection technique and tools:

Data was collected by interviewing the relatives and examining the patients as well as patient's medical records i.e. CT Scan, MRI Scan, perioperatively. All the patients were followed post-operatively for assessment for a period of 6 months. Follow-up data were obtained either through direct clinical evaluation or telephone conversations. The MRS were used to assess the outcome of patients in the follow-up period and was statistically analyzed.Patients with mRS score ≤ 2 at follow-up were considered to have favourable outcome; whereas patients with mRS score ≥ 2 were considered to have poor outcome. Details about death

following the surgical procedure were recorded.

Results

Patient Population

There were 30 patients in the study. All the patients underwent surgical intervention. The mean age was 45.23 years, with a range from 18 to 75 years. There were 19 men (63.3%) and 11 women (36.7%).The mean age of the patients in the present study was 45.23%.Majority of them were in the age group 39-47 years contributing to 50%.The youngest age being 21 and highest is 73 years.There were 19 men (63.3%) and 11 women (36.7%).

In spite of all the investigations, no cause was found in 43% patients .The brain regions involved are mentioned in table 1. Distribution of thrombosed sinus in Figure 1.

Table 1 provides information about the brain regions involved.

	No. of Cases	Percentage
Brain Regions		
B/L Frontal Lobe	2	6.7%
B/L Frontoparietal Lobe	1	3.3%
LT F-P Lobe	4	13.2%
LT Frontal	1	3.3%
LT Frontotemporal Lobe	2	6.7%
LT FTP Lobe	1	3.3%
LT Parietal Lobe	1	3.3%
LT Parieto-Occipital Lobe	1	3.3%
LT Temporal-Parietal Lobe	4	13.2%
LT Temporo occipital Lobe	1	3.3%
LT Temporal Lobe	5	16.7%
RT Frontoparietal Lobe	3	9.9%
RT FTP Lobe	2	6.7%
RT Parieto-Occipital Lobe	1	3.3%
RT Temporoparietal Lobe	1	3.3%
Total	**30**	**100.0%**

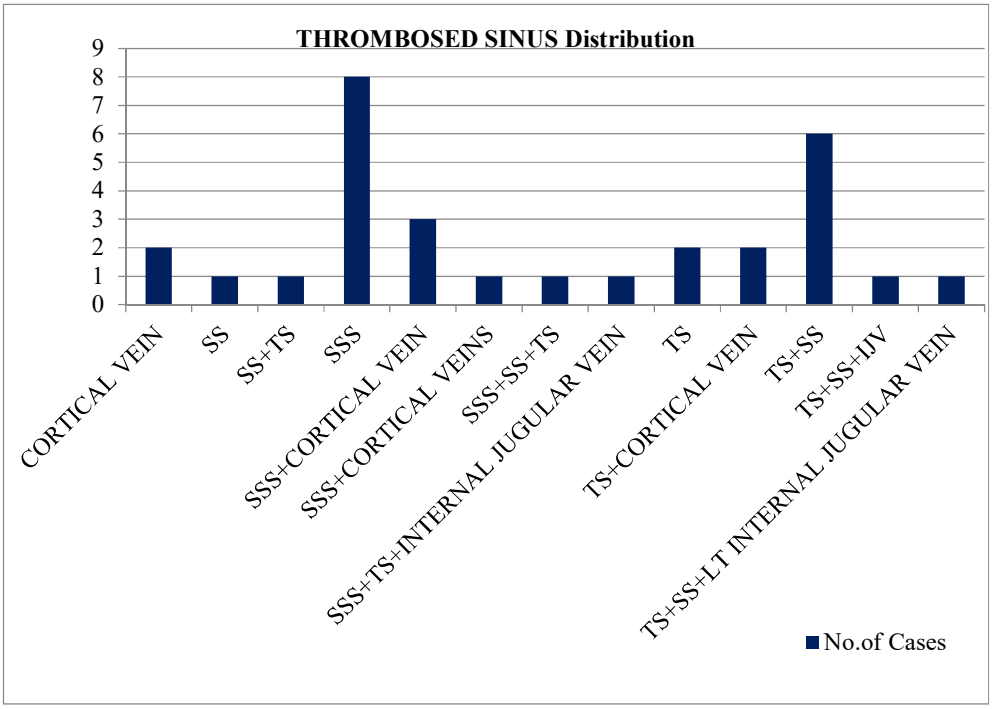


Figure 1. Graph showing distribution of thrombosed sinus

Surgical Management

All the 30 patients underwent decompressive craniectomy of adequate size, with duraplasty performed with a pericranial graft or Dura patch. Re-implantation of the bone flap was performed within 3 months.The comparative radiological imaging pre and post decompression presented in Figure 2a & 2b. After Post operative day 2, patients were started on Low Molecular Weight Heparin followed by Oral Anti Coagulants.

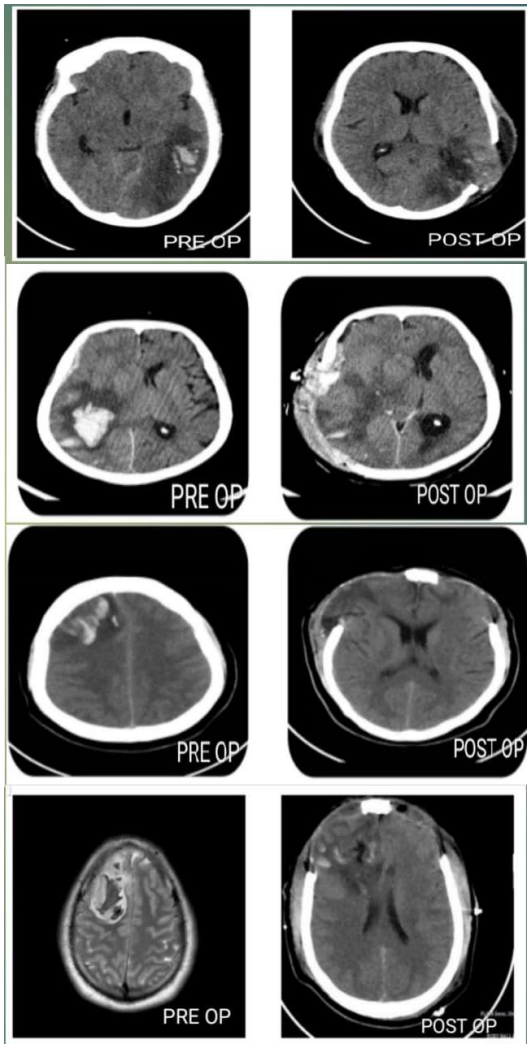


Figure 2a. Sshowing comparative images pre and post surgery.

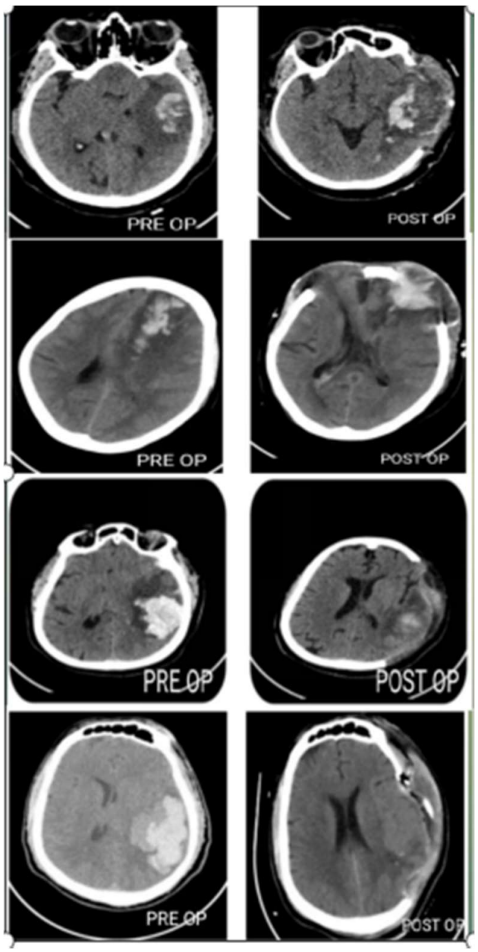


Figure 2b. Showing comparative images pre and post surgery.

Postoperative Course

The GCS score recorded 48 hours, 72 hours and 96 hours after surgery showed a mean of 10.13. Four patients showed no improvement in their GCS score, and in 1, there was further deterioration in the score. postoperative complications were seen in eight patients. Two patients had cerebrospinal fluid (CSF) leak, associated with wound dehiscence and flap necrosis. one patient developed urosepsis. Five patients died; among these, 4 died due to progression of the disease and one patient died due to chest infection.

Prognostic factors

Favourable outcome following surgery were seen in 25 patients (83.3%) and poor outcome (including death) in 5 patients (16..6%). Factors associated with mortality in our study were analysed. Midline line shift more than 10mm was shown to be significantly associated with mortality in Table 2. ($p=0.006$; considered extremely significant) Factor that did not predict outcome were preoperative GCS ($p=0.56$), Age > 40 ($p=0.52$), gender ($p=0.65$), multiple sinus involvement ($p=0.75$).

Table 2 shows the analysis of prognostic factors

Survival	Total	Alive (Count)	Death (Count)	MIDLINESHIFT <10	MIDLINESHIFT >10 nt)
	Count	25	5	22	3
	%	100.0%	100.0%	88.0%	12.0%
Chi-Square Tests					
Pearson Chi-Square	Value	10.770a			
	Df	1			
	Asymp. Sig. (2-sided)	.001			
	Exact Sig. (2-sided)	.006			
	Exact Sig. (1-sided)	.006			
Continuity Correctionb	Value	7.304			
	Df	1			
	Asymp. Sig. (2-sided)	.007			
Likelihood Ratio	Value	9.246			
	Df	1			
	Asymp. Sig. (2-sided)	.002			
	Exact Sig. (2-sided)	.006			
	Exact Sig. (1-sided)	.006			

Fisher's Exact Test					
	Exact Sig. (2-sided)		.006		
	Exact Sig. (1-sided)		.006		
N of Valid Cases					
	30				

Discussion

The present study included 30 patients with cerebral venous sinus thrombosis. The highest incidence of our cases was during the third and fourth decades of life, with a mean age of 45 years, which was coincident with the study by Mahale [18] et al. who had 36.7 years as a mean of age. Men represented about 63% and women represented about 37%. In our study, males formed the majority (63.3%) of the total 30 patients similar to that observed in Narayan et al. [30] who observed a male predominance (53.7%).

The presenting symptoms in upto 90% of patients with CVST complain of headache which is the most frequent symptom and often the initial one [31]. By ISCVT, headache was the only symptom in 9% of patients with CVST [13]. In our study headache was the most common symptom (50%) similar to the observations of most other studies [5,6,18,30].

Other common symptoms noted in our study were altered sensorium, focal neurological deficit and seizures similar to other studies [32,33]. Next to headache, most common symptom observed in our study was convulsion and focal deficit.

Seizures are more frequent in CVST than in other stroke types [31]. About 30 to 40% of patients present with seizures, either focal or generalized or with status epileptics. Seizures was observed in 33.33% of our patients however seizure incidence was slightly higher in other studies [18,26].

Focal neurological deficit, was observed in 33.33% of our patients however incidence was higher in 73% in Mahale et al. [18] and 52% in Aaron et al. [26].

Comparison of the common clinical presentations in our study with other studies is shown in the Table 3.

Table 3. Shows comparision of different studies

Symptoms	In present study	Mahale et al. [18]	Aaron s et al. [26]	Vivakaran et al. [5]
Headache	50%	86.70%	75%	82.40%
Seizures	33.33%	33.40%	68%	52.90%
Motor deficit	33.33%	73.40%	52%	88.20%
Altered sensorium	13.33%	63.40%	36%	97.10%

In the present study group, the most common sinus involvement was superior sagittal sinus in 26.7%. The study done by Mohindra et al. and Mahale et al. represented 30% and 43.4% respectively in their observations.

The information on decompressive surgery in CVST is limited to case reports and results from small series.A multinational registry of decompressive surgery in 38 patients with malignant CVST by Ferro et al., (2011)reported favourable outcome (mRS score of 0–2) in 21 patients (55.3%), unfavourable outcome (mRS score of 5–6) in 8 patients (21.1%) and mortality in 7 patients (18.4%) at the follow-up of 14.5 months.

They concluded that the decompressive surgery acts as a lifesaving procedure in selected CVST patients [25]. A study by Aaron et al. [26] on 44 CVST patients who had decompressive surgery showed good outcome in 27 patients (61.4%) and mortality in 9 patients (20%). Another study by Vivakaran et al. [5] on 34 CVST patients who had decompressive surgery showed good outcome in 26 patients (76.4%) and mortality in 6 patients (17.6%).

In present study 30 patients with CVST studied over a period of 2 years who had decompressive surgery. Favourable outcome was seen in 25 out of 30 patients (83.33%) and were comparable to the other studies (Table 4). The mortality rate was 5 out of 30 patients (16.61%)

Table 4. Shows comparision of favorable outcome and mortality in various studies

Serial Number	**Author**	**Favorable outcome (n/%)**	**Mortality (n/%)**
1	Aaron et al. [26]	27/61.4	9/20.0
2	Vivakaran et al. [5]	26/76.4	6/17.6
3	Present study	25/83.33	5/16.61

This study shows that decompressive craniectomy in CVST is not only life-saving but that the survivors can have an excellent long-term outcome.Compared with arterial strokes where an mRs of 2 after 12 months was achieved only in 14%, we had 60% of survivors having an mRs of ≤2 by 6 months itself. It is interesting to note that the mRs improved maximally after the third month. Similar findings were observed by Bousser's [34].

In the present study,we found the GCS at presentation and GCS at 48 hours , 72 hours, 96 hours following decompressive craniectomy showed significant improvement ($p<0.05$).The prognosis of patients in our case study with presenting GCS was compared with the final outcome at the end of 6 months.There was statistically significant difference of the same comparison ($p<0.05$).

The Factor predicting poor outcome in our series were midline shift more than 10mm. Factors that did not predict outcome were presence of headache, seizures, preoperative GCS score, age, gender, low GCS at presentation and involvement of multiple sinus. Lath et al. [6] reported GCS<8, deep venous system involvement ,malignancy among few factor affecting favourable outcome.Mahale et al. [18] found following factor predicting poor outcome were age more than 50 years, midline shift more than 10mm and total effacement of basal cistern.

The present study has limitations. The limitation of the study was its small sample size due to the rarity of malignant CVST. In conclusion, decompressive surgery should be considered in large malignant venous infarcts with midline shift. Survivors can expect excellent outcome.

Conclusion

CVST is not uncommon in males, contrary to the previous perception that it primarily affects females. The prompt diagnosis and early intervention were found to have a positive impact on the overall outcome.

Ethics declarations

Funding

This study did not receive any funding.

Conflict of interest

The authors declare that they have no competing interests.

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