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VALIDATION OF THE PROGNOSTIC CEREBRAL VENOUS THROMBOSIS-GRADING SCALE IN CEREBRAL VENOUS SINUS THROMBOSIS PATIENTS.

Internal Medicine

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ABSTRACT

Introduction: Cerebral venous sinus thrombosis (CVST) presents with symptoms ranging from mild headaches to severe neurological issues, resulting in variable prognosis. This study assessed the effectiveness of the cerebral venous thrombosis grading scale (CVT-GS) in predicting short-term prognosis and recovery by comparing initial scores with 30-day modified Rankin Scale (mRS) outcomes, serving as an effective tool to predict the prognosis of the patient on presentation and in clinical judgement for it's management. **Objective:** This study evaluates the prognostic accuracy of the CVT-GS tool in predicting short-term outcomes in cerebral venous sinus thrombosis (CVST) patients. **Methods:** A diagnostic accuracy study was conducted at a tertiary care hospital in Pune, India, from June 2022 to January 2024. Seventy-four CVST patients confirmed via CT/MR venography were evaluated. The prognosis was predicted on day 1 using the CVTGS tool and compared with outcomes assessed using the mRS at 30 days. **Results:** The mean age was 35.5 ± 12.5 years; males comprised 60.8%. The CVT-GS scores showed a strong positive correlation with mRS outcomes ($r = 0.594$, $p < 0.001$). ROC analysis indicated an optimal CVT-GS cut-off of 4.5 for predicting mRS > 2, with an AUC of 0.897. Transverse sinus involvement (79.7%) was most common, followed by sigmoid sinus (66.2%). Haemorrhagic infarctions were noted in 35.1%, while parenchymal lesions were observed in 45.9% of cases. **Interpretation:** CVT-GS is a robust tool for predicting outcomes in CVST patients. Regional validation highlights its utility in diverse populations and underscores the importance of early risk stratification.

KEYWORDS

cerebral venous sinus thrombosis, prognosis, CVT-GS tool, outcomes

INTRODUCTION:

Cerebral venous sinus thrombosis (CVST) is a rare form of stroke characterized by the presence of a thrombus in the cerebral veins or dural sinuses. It primarily affects young adults and is often underrecognized due to its varied clinical presentation [1]. Epidemiological data on CVST indicate an incidence of 2.45 to 3.16 per 100,000 in the general population, with a higher rate of 2.83 to 5.27 per 100,000 among those aged 18 to 64. Women are at increased risk, often due to hormonal factors and oral contraceptive use [2]. Notably, recent studies show a significant rise in CVST incidence in India, estimated at 96 per 100,000, nearly doubling in the past decade, underscoring the need for increased awareness and early detection [3].

Although CVST accounts for only 0.5%–1% of all strokes, it represents a significant 10%–20% of strokes in young adults. Its clinical presentation can be highly variable, making diagnosis challenging. Unlike other types of stroke, symptoms of CVST may take weeks to fully manifest and can include a range of headaches, neurological deficits, seizures, and coma [4]. For diagnosing CVST, various neuroimaging modalities are available, including computed tomography (CT), CT venography (CTV), magnetic resonance imaging (MRI), MR venography (MRV), and digital subtraction angiography (DSA) [5]. However, due to its diverse presentation, CVST is frequently underdiagnosed, which can lead to poor outcomes.

The risk factors for CVST are distinct from those associated with arterial strokes. They include modifiable factors like oral contraceptive use, prothrombotic medications, pregnancy, and infections, as well as non-modifiable risk factors such as genetic thrombophilic disorders, antiphospholipid syndrome, and cancer. Notably, up to 13% of CVST cases occur without any identifiable risk factors, adding another layer of complexity to their diagnosis and management [6].

To improve short-term clinical decision-making and predict outcomes after CVST, the Cerebral Venous Thrombosis Grading Scale (CVT-GS) was developed. This tool, with scores ranging from 0 to 13, helps predict poorer outcomes with higher scores and classifies the 30-day risk of mRS >2 and mortality as mild to severe [7]. It is a point-based scoring system based on readily available clinical data including demographic data and MRI findings, hence a simple and efficient tool. However, it is essential to note that the CVT-GS has not yet been evaluated in India. This study aimed to assess the effectiveness of the CVT-GS Scale in predicting short-term prognosis and recovery in CVST patients by comparing initial CVT-GS scores with 30-day modified Rankin Scale (mRS) outcomes.

METHODS:

Study Design And Ethical Consideration

A diagnostic accuracy study was conducted at the Department of Medicine/Neurology, Bharati Hospital, Pune, from June 2022 to January 2024. The study methodology was approved by the Institutional Ethics Committees and written informed consent was obtained from all the patients before the commencement of the study.

Study Population

Patients aged 18 years or older with suspected cerebral venous sinus thrombosis and confirmed through CT venography, MR venography, or DSA were included in the study after informed consent. Patients with arterial strokes were excluded.

Data Collection

Data was collected and analysed using a specially designed proforma for each patient, which included information on demographics, chief complaints, risk factors (smoking, alcohol, malignancy, pregnancy, puerperium, and oral contraceptive use), laboratory investigations (Hemoglobin, homocysteine levels and antiphospholipid antibodies (APLA), connective tissue disorders, vitamin B12) and imaging data. The CVT-GS score (0–13) was assessed at the time of admission and were categorised as follows: Mild (0–2), Moderate (3–7) and Severe (8–13). Patient outcomes were assessed using the mRS score on day 30 after admission, as a good outcome (mRS <2) and a poor outcome (mRS >2). The relative frequency of patients with an mRS score greater than 2 was analysed across these three groups.

Statistical Analysis

Data were analysed using Statistical Package for the Social Sciences

(SPSS) Version 28.0s. Descriptive statistics were used to present the results of continuous variables, while categorical variables were reported as frequencies and percentages. Associations between various demographic variables were analyzed using the Chi-square test. The Pearson correlation coefficient was applied, and all results were reported with a 95% confidence level. P<0.05 was considered statistically significant.

RESULTS:

A total of 74 patients were included, with a mean age (SD) of 35.5 ± 12.5 years. All the demographic details are mentioned in Table 1. The most common chief complaint among participants was headache in 79.7%. 45.9% of patients had a history of smoking, and 41.9% of patients reported a history of alcohol consumption. (Table 1).

The majority of female patients (55.17%) had a history of use of oral contraceptive pills (OCP) and vitamin D deficiency (77%) was the most prevalent finding. All laboratory investigations have been shown below in Figure 1.

Table 1: Demographics Characteristic Of Patients

Parameters	Number of patients (N=74)
Age (years)	35.5 ±12.5
Gender	
Male	45 (60.8)
Female	29 (39.2)
Chief complaints	
Headache	59 (79.7)
Seizures	32 (43.2)
Neurological deficit	32 (43.2)
Comorbidities	
DM	7 (9.5)
Systemic HTN	7 (9.5)
History of CVST	4 (5.4)
Social history	
Smoking	31 (41.9)
Alcohol consumption	34 (45.9)
Family history	
CVST	3 (4.1)
IHD	23 (31.5)
CVA	15 (20.3)
DM	42 (56.8)
HTN	3 (4.1)

Data represented as n (%), unless otherwise specified.
CVST, cerebral venous sinus thrombosis; CVA, cerebrovascular accident; DM, diabetes mellitus; HTN, hypertension; IHD, ischemic heart disease.

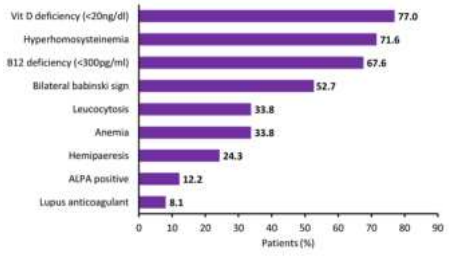

Figure 1: Clinical findings

Sinus involvement is as shown in Figure 2. Intraparenchymal bleeds occurred in 35.1% of patients, with 9.5% patients needing surgical intervention.

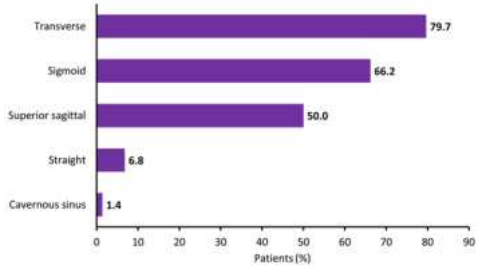

Figure 2: Patients according to involvement of sinuses

The findings of the Area under the curve (AUC) are depicted in Table 2. The optimal CVT-GS score cut-off for outcome prediction was 4.50, with an AUC of 0.89 (P<0.001), demonstrating 77% sensitivity and 77% specificity. A strong positive correlation (0.594) was observed between the total CVT-GS score (out of 13) and the mRS total on day 30 (out of 6). This correlation was statistically significant (P<0.01).

Table 2. The ROC Curve For CVT-GS Score For The Prediction Of Outcome

Parameter	Optimal cutoff based on ROC	AUC ± SE	95% CI of AUC	P-value
CVT-GS	4.50	0.897 ± 0.047	0.805-0.990	0.000

AUC, area under the curve; CVT-GS, cerebral venous thrombosis grading scale; CI, confidence interval; ROC, receiver operating characteristic; SE, standard error.

DISCUSSION:

In our study, the mean (SD) age of patients was 35.5 (12.5). Similarly, recent studies reported that the mean age of patients is around 35 years of age [8-11]. The majority of patients in this study were males, in contrast to a study done by Miguel A. Barboza et al. which showed a female preponderance. These differences in gender distribution across studies may reflect variations in disease characteristics, population demographics, or methodological factors.

Our study highlighted key risk factors, including smoking, alcohol consumption, use of OCPs in females, and co-morbidities such as like dehydration, deranged coagulability, and increased platelet count [12]. Unfortunately, genetic studies were not possible due to financial constraints of the patients. Green et al. provided insights into genetic and acquired risk factors for adult CVST. Their findings indicated that alcohol consumption increased the risk of CVST by 2.7 times (1.8–3.9) among non-genetic variables. However, smoking was not associated with an increased risk of CVST in their study [13]. All the demographic data as per our study has been mentioned in table 1.

We report headache to be the most common chief complaint among patients. This finding is consistent with previous studies [4, 14,15]. However, despite these common presentations, diagnosing CVST at initial presentation often proved challenging due to delays in seeking medical attention. Headaches were frequently dismissed as tension headaches or misdiagnosed as migraines until additional symptoms emerged, by which time the condition had typically progressed. In some cases, patients presented more acutely with convulsions, limb weakness, or cranial nerve palsies, further complicating early diagnosis [16].

Vitamin D deficiency, hyperhomocysteinemia, B12 deficiency increase the risk of patients with CVST. Consistent with our findings, Khealani et al. reported anaemia as a common comorbidity in CVST patients, possibly due to its effects on blood viscosity and cerebral perfusion [19].

In our study, the involvement of various venous sinuses was analysed, revealing that the transverse sinus was the most commonly affected. These findings were consistent with those of Patil et al., although it contrast with other studies that indicated the superior sagittal sinus as the most frequently affected. Despite the variations in sinus involvement, all studies consistently demonstrated that the cavernous sinus remained the least likely to experience thrombosis; however, when it was affected, it was almost always associated with significant cranial nerve involvement[21-23].

In the current study, the optimal cut-off for the CVT-GS score to predict outcomes was determined to be 4.50, with an AUC of 0.89, and both sensitivity and specificity at 77%. A strong positive correlation was found between the total CVT-GS score (out of 13) and the total mRS score on day 30 (out of 6), with a significance level of less than 0.01, indicating that higher CVT-GS scores are associated with higher mRS scores. These findings align with the study by Miguel A. Barboza et al., which proposed a realistic metric system for forecasting CVST outcomes. In that study, the 30-day mortality rate was 8.7%, with the CVT-GS demonstrating a prediction accuracy of 85.3% for mRS scores greater than 2, and 91.6% for predicting 30-day mortality [7].

CONCLUSION:

This study provides an in-depth understanding of CVST, emphasizing

the need to recognize common symptoms, identify various risk factors, and implement appropriate diagnostic and treatment strategies. The consistency in clinical presentations and sinus involvement across diverse populations enhances the reliability of existing diagnostic methods. Additionally, the validation of the CVT-GS score as a predictor of outcomes further establishes its usefulness as a prognostic tool in clinical practice. Future research should focus on larger, multicenter studies to confirm these findings and explore further risk factors and treatment options.

Limitation:

This study includes a relatively small sample size, which limits the generalizability of the findings to larger populations. Additionally, during the study period, no patients with an mRS score of 6 were observed at presentation or the 30-day follow-up, restricting our ability to comment on mortality in CVST. Since the study was conducted at a single centre, the results may not be representative of CVST patients from other regions or ethnic groups. Moreover, conducting the study at a single centre may limit the diversity of the patient population, affecting the generalizability of the findings to other contexts. If the follow-up period was limited, it could also influence the assessment of long-term outcomes and the prognostic value of the CVT-GS scale.

Additionally, the scale does not include various risk factors and previous medical histories which could strengthen the ability of this score to be a better predictor of outcomes.

Declaration Of Interest And Funding:

This research did not receive specific grants from any funding agencies, and the authors declare that they have no known competing financial interests or personal relationships that could influence the work reported in this paper.

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