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Original Article

Clinical Profile and Risk Factors of Cerebral Venous Sinus Thrombosis

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ABSTRACT

Background: Cerebral venous sinus thrombosis (CVST) is a rare but serious neurovascular disorder that can lead to life-threatening complications such as hemorrhage and cerebral edema. This condition presents with a wide array of symptoms due to the formation of blood clots in the cerebral venous sinuses, impairing the drainage of deoxygenated blood and cerebrospinal fluid from the brain.

Objective: The aim of this study was to elucidate the clinical profile and risk factors associated with CVST, enhancing the understanding of its epidemiology and facilitating better diagnostic and therapeutic strategies.

Methods: This prospective cross-sectional study was conducted at the Department of Neurology, Jinnah Postgraduate Medical Centre, Karachi, Pakistan. A total of 135 participants diagnosed with CVST were enrolled through non-probability consecutive sampling. Participants underwent comprehensive physical and neurological examinations using a structured Clinical Patient Assessment Form. Diagnostic imaging included MRI, MRV, CT, and CT venography, although the principal diagnostic tools were CT and MRV. Data collection focused on demographics, clinical manifestations, and risk factors, with all information analyzed using SPSS version 25.

Results: The study population predominantly consisted of females (74.8%) with the age group of 31-40 years being the most common (31.1%). Headache was the most frequently reported symptom (90.4%), followed by hemiparesis (53.3%) and seizures (40%). Significant risk factors included postpartum status (50.4%), iron deficiency anemia (25.9%), and genetic prothrombotic conditions (9.6%). Imaging studies revealed that the transverse sinus was the most affected site (74.1%).

Conclusion: CVST exhibits a diverse range of clinical presentations and is associated with multiple demographic and physiological risk factors. Early diagnosis and management are crucial to prevent severe outcomes. This study highlights the importance of considering a detailed clinical and risk factor profile in patients presenting with neurological symptoms to aid in timely and accurate diagnosis of CVST.

Keywords: Cerebral Venous Sinus Thrombosis, CVST, Neurology, Venous Thrombosis, Brain Clots, Diagnostic Imaging, Epidemiology of CVST.

INTRODUCTION

Cerebral venous sinus thrombosis (CVST) is a rare yet potentially critical condition characterized by the formation of a blood clot within the brain's venous sinuses, which are vital for draining deoxygenated blood and cerebrospinal fluid back to the systemic circulation (1). The obstruction caused by a thrombus can lead to a spectrum of clinical manifestations, ranging from minor headaches to severe neurological deficits and even death (2). CVST can occur at any age but is more commonly seen in young and middle-aged adults, with a slight female predominance (3). The pathogenesis of CVST involves a complex interplay of genetic predisposition, acquired risk factors, and specific triggers. Known risk factors include hypercoagulable states, pregnancy, the postpartum period, use of oral contraceptives, head or neck infections, dehydration, hyperosmolar states, and head injuries (4, 5).

The clinical presentation of CVST varies widely, heavily influenced by the location and extent of the thrombus as well as individual patient factors (6). Typical symptoms include a persistent, severe headache and focal neurological deficits, but may also extend to seizures, altered mental status, or signs of increased intracranial pressure such as papilledema (7). Due to its non-specific symptoms and rarity, CVST presents significant diagnostic challenges, requiring high clinical suspicion for early detection (8). Prompt

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identification and treatment are crucial for favorable outcomes, emphasizing the need for awareness and understanding of this complex condition among healthcare professionals.

MATERIAL AND METHODS

This study was designed as a prospective cross-sectional investigation, conducted at the Department of Neurology in Jinnah Postgraduate Medical Centre, Karachi, Pakistan. A cohort of 135 participants was selected through non-probability consecutive sampling. Eligible participants were aged between 18 and 60 years, of any gender, and had confirmed diagnoses of cerebral venous sinus thrombosis (CVST) with symptom onset within the past six months. Individuals with significant unrelated neurological disorders, recent severe head trauma, or recent surgeries were excluded from the study. Patient identification was facilitated through medical records coded according to the International Classification of Diseases, Tenth Revision (ICD-10), specifically for CVST diagnoses.

Data collection encompassed demographic details, clinical manifestations, laboratory findings, and radiological results. Additionally, information on in-patient management and outcomes was compiled. The initial and follow-up physical and central nervous system examinations were conducted using a Clinical Patient Assessment Form to systematically document evidence of CVST. Diagnoses were primarily based on clinician discretion, supported by imaging techniques including brain MRI, MRV, CT, and CT venography, though the principal diagnostic tools were CT and MRV.

A structured questionnaire was developed to capture comprehensive epidemiological data, exposure history, and results from examination tests. All collected data were subsequently anonymized and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.

The study adhered to the ethical principles outlined in the Declaration of Helsinki, ensuring informed consent was obtained from all participants prior to their inclusion in the study. This ethical approval was granted by the institutional review board of the Jinnah Postgraduate Medical Centre. The methodology was structured to ensure a rigorous assessment of CVST, facilitating a detailed understanding of its clinical profile, management, and outcomes within the study population.

RESULTS

In this prospective cross-sectional study, the demographic characteristics of the study population indicated a diverse age distribution among the 135 participants, with the majority falling within the 31-40 years age group (31.1%), followed by 41-50 years (23.0%), 18-25 years (26.7%), 26-30 years (10.4%), and 51-60 years (8.9%) (Table 1). The gender distribution was significantly skewed, with females comprising 74.8% of the sample compared to 25.2% males. Regarding educational status, 38.5% of participants were graduates or above, while 28.9% had secondary education, 16.3% primary education, 11.1% were illiterate, and 5.2% had intermediate education. The majority of the participants were married (53.3%), followed by unmarried (32.6%), divorced (8.9%), and widowed (5.2%). More than half of the participants were workers (57.8%), with 37.0% not working and 5.2% retired. The majority resided in urban areas (63.7%), with the remaining 36.3% living in rural settings.

Table 1. Demographic Characteristics of Study Population

Demographic Data		Frequency	Percentage
Age Group	18 – 25 Years	36	26.7%
	26 – 30 Years	14	10.4%
	31 – 40 Years	42	31.1%
	41 – 50 Years	31	23.0%
	51 - 60 Years	12	8.9%
Gender	Male	34	25.2%
	Female	101	74.8%
Educational Status	Illiterate	15	11.1%
	Primary	22	16.3%
	Secondary	39	28.9%
	Intermediate	7	5.2%
	Graduate or Above	52	38.5%
Marital Status	Married	72	53.3%
	Unmarried	44	32.6%
	Divorced	12	8.9%

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Demographic Data		Frequency	Percentage
	Widowed	7	5.2%
Working Status	Worker	78	57.8%
	Non-Worker	50	37.0%
	Retired	7	5.2%
Residential Status	Urban	86	63.7%
	Rural	49	36.3%

Table 2. Clinical Profile of patients diagnosed with Cerebral Venous Sinus Thrombosis

Clinical Profile n (%)	Gender		Total n (%)	P-value
	Male n (%)	Female n (%)		
Headache	31 (91.2%)	91 (90.1%)	122 (90.4%)	0.854
Visual Disturbance	7 (20.6%)	20 (19.8%)	27 (20.0%)	0.921
Seizure	14 (41.2%)	40 (39.6%)	54 (40.0%)	0.871
Aphasia	5 (14.7%)	64 (63.4%)	69 (51.1%)	0.001
Hemiparesis	16 (47.1%)	56 (55.4%)	72 (53.3%)	0.397
Cranial Nerve Involvement	27 (79.4%)	21 (20.8%)	48 (35.6%)	0.001
Altered level of Conciousness	5 (14.7%)	61 (60.4%)	66 (48.9%)	0.001
Papilledema	19 (55.9%)	46 (45.5%)	65 (48.1%)	0.297

Table 3. Risk Factors of patients diagnosed with Cerebral Venous Sinus Thrombosis

Risk Factors n (%)	Gender		Total n (%)	P-value
	Male n (%)	Female n (%)		
Postpartum	17 (50.0%)	51 (50.5%)	68 (50.4%)	0.960
Pregnancy	0 (0.0%)	11 (10.9%)	11 (8.1%)	0.036
Iron Deficiency Anemia	4 (11.8%)	31 (30.7%)	35 (25.9%)	0.029
Infection	22 (64.7%)	12 (11.9%)	34 (25.2%)	0.001
Autoimmune/APLA	32 (94.1%)	6 (5.9%)	38 (28.1%)	0.001
OCPS/HRT	3 (8.8%)	3 (3.0%)	6 (4.4%)	0.168
Genetic Prothombotic conditions	7 (20.6%)	6 (5.9%)	13 (9.6%)	0.012
Occult_Malignancy	1 (2.9%)	2 (2.0%)	3 (2.2%)	0.584
Vascular Malformations	1 (2.9%)	3 (3.0%)	4 (3.0%)	0.737
Dehydration	1 (2.95%)	4 (4.0%)	5 (3.7%)	0.629
Idiopathic	1 (2.9%)	2 (2.0%)	3 (2.2%)	0.584

Table 4. Sinus involved (on imaging) of patients diagnosed with Cerebral Venous Sinus Thrombosis

Sinus involved n (%)	Gender		Total n (%)	P-value
	Male n (%)	Female n (%)		
Superior sagittal sinus	2 (5.9%)	85 (84.2%)	87 (64.4%)	0.001
Transverse sinus	7 (20.6%)	93 (92.1%)	100 (74.1%)	0.001
Sigmoid sinus	10 (29.4%)	76 (75.2%)	86 (63.7%)	0.001
Straight sinus	5 (14.7%)	21 (20.8%)	26 (19.3%)	0.306
Cortical vein	1 (2.9%)	4 (4.0%)	5 (3.7%)	0.629
Deep venous system	8 (23.5%)	11 (10.9%)	19 (14.1%)	0.067
Internal jugular vein	1 (2.9%)	2 (2.0%)	3 (2.2%)	0.584
Bilateral	2 (5.9%)	3 (3.0%)	5 (3.7%)	0.437
Multiple cerebral venous sinuses	6 (17.6%)	26 (25.7%)	32 (25.7%)	0.337

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The clinical profile of the patients diagnosed with cerebral venous sinus thrombosis revealed that headache was the most common symptom, present in 90.4% of cases, followed by hemiparesis (53.3%), and altered level of consciousness (48.9%). Notably, the occurrence of cranial nerve involvement and aphasia was significant, with respective prevalences of 35.6% and 51.1%, where significant statistical differences were observed across genders (Table 2). Visual disturbances and seizures were relatively less frequent, reported in 20.0% and 40.0% of the cases, respectively. Papilledema was noted in 48.1% of the patients.

Risk factors varied widely, with postpartum conditions being reported in 50.4% of patients and pregnancy in 8.1%, showing a significant gender difference (P=0.036). Iron deficiency anemia was found in 25.9% of cases and had a statistically significant prevalence among females (P=0.029). Infections were identified in 25.2% of the population, with a marked gender disparity (P=0.001). Autoimmune disorders or antiphospholipid antibody syndrome (APLA) were particularly high among males (94.1%) compared to females (5.9%), showing a highly significant statistical difference (P=0.001). Other risk factors such as genetic prothrombotic conditions and oral contraceptive pill use or hormone replacement therapy (OCPs/HRT) were less common, reported in 9.6% and 4.4% of the cases, respectively (Table 3).

The imaging results demonstrated that the most commonly affected sinuses were the transverse sinus (74.1%), superior sagittal sinus (64.4%), and sigmoid sinus (63.7%). Other involved areas included the straight sinus, deep venous system, and cortical veins with lower frequencies. Significant gender differences were noted in the involvement of the superior sagittal, transverse, and sigmoid sinuses (Table 4). The pattern of sinus involvement highlights the complex and varied nature of CVST, underscoring the need for comprehensive imaging in suspected cases to accurately guide clinical management.

DISCUSSION

Cerebral venous sinus thrombosis (CVST) is a rare neurological disorder characterized by the formation of blood clots in the venous sinuses of the brain, which are crucial for draining deoxygenated blood and cerebrospinal fluid back to the systemic circulation (9). The obstruction caused by these clots can lead to diminished blood flow and increased intracranial pressure, resulting in a spectrum of potential life-threatening complications including hemorrhage and cerebral edema. The variable presentation of symptoms, ranging from severe headaches to altered consciousness and papilledema, poses significant diagnostic challenges, necessitating specialized tests for accurate identification (10).

The clinical presentation of CVST is highly variable and often mimics other neurological disorders, leading to frequent diagnostic delays. The most common symptom, a severe headache, occurs in up to 90% of cases and can be accompanied by nausea, vomiting, and photophobia (12). Seizures are also common, especially when cortical veins are involved, occurring in approximately 40-50% of patients (13). Focal neurological deficits such as hemiparesis, visual and speech dysfunctions may manifest, depending on the location and extent of the thrombosis. Altered mental status, ranging from confusion to coma, is another significant indicator of CVST, attributable to venous stasis and cerebral edema, with about one-third of patients presenting with papilledema indicative of elevated intracranial pressure (14).

Several risk factors predispose individuals to CVST, including thrombophilia, dehydration, hormonal influences, pregnancy, puerperium, infections, and inflammatory conditions (15). Thrombophilia, particularly conditions like Factor V Leiden, prothrombin gene mutation, and deficiencies in protein C or S, heightens the risk of clot formation in cerebral venous sinuses (16). Hormonal factors such as the use of estrogen-containing medications disrupt normal coagulation processes and increase CVST risk. Pregnancy and the postpartum period further elevate this risk due to a naturally hypercoagulable state and venous stasis (17).

Our findings highlighted headache as the predominant symptom, present in 90.4% of cases, corroborating other studies such as those by Ibrahim EA, et al. and Narayan D, et al. which reported headaches in 94.6% and 94.4% of cases, respectively (18, 19). Our study also found significant incidences of visual disturbances, seizures, and neurological impairments like hemiparesis and aphasia, aligning with the broader literature on CVST clinical manifestations.

Regarding risk factors, our study identified postpartum conditions, pregnancy, iron deficiency anemia, and infections as prevalent contributors to CVST. These findings were consistent with, yet distinct in their proportions from, other studies; for example, Ibrahim EA, et al. reported lower infection rates and higher malignancy rates, which highlights the variability in CVST risk profiles across different populations (18). The significant presence of autoimmune disorders and genetic prothrombotic conditions in our study also underscores the multifactorial nature of CVST risk.

The strengths of this study lie in its comprehensive assessment of both clinical features and a wide array of risk factors, contributing valuable data to the limited pool of knowledge on CVST. However, the limitations include the potential for selection bias due to the non-probability sampling method and the inherent challenges in diagnosing CVST, which may have influenced the accuracy of the clinical profiles observed. Future studies could benefit from larger, more diverse population samples and the use of standardized diagnostic criteria to enhance the generalizability and reliability of the findings (19, 20).

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CONCLUSION

In conclusion, CVST presents with a wide array of symptoms and is influenced by multiple risk factors, making early diagnosis and intervention critical. This study underscores the importance of recognizing the diverse clinical presentations and associated risk factors to improve outcomes for patients with CVST. Recommendations for future research include focusing on longitudinal studies to better understand the long-term outcomes of CVST and the effectiveness of various treatment strategies.

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