A Cross-Sectional Study Investigating Clinical Features, Brain Imaging, and Treatment Efficacy in Patients with Cerebral Venous Thrombosis in the Mekong Delta, Vietnam

Minh Van Le [1,*], Tam Thai Thanh Tran[2,*], Loc Phu Huynh[3], Tho Kieu Anh Pham[2], Thi Van Vo [4], Hung Huynh Vinh Ly [1]

[1]Department of Neurology, Faculty of Medicine, Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam; [2]Department of Physiology, Faculty of Medicine, Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam; [3]Department of Neurology - Can Tho Central General Hospital, Can Tho, Vietnam; [4]Department of Pediatrics, Faculty of Medicine, Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam
*These authors contributed equally to this work

Correspondence: Hung Huynh Vinh Ly, Department of Neurology, Faculty of Medicine, Can Tho University of Medicine and Pharmacy, No. 179, Nguyen Van Cu Street, an Khanh Ward, Ninh Kieu District, Can Tho, 900000, Vietnam, Email 1853010822@student.ctump.edu.vn

Background: Cerebral venous thrombosis (CVT) is a challenging condition with potential long-term consequences, but it is also a treatable disorder that offers the possibility of complete recovery. This study was conducted to comprehensively investigate the clinical features, brain imaging findings, and treatment outcomes of patients diagnosed with cerebral venous thrombosis.

Materials and Methods: Conducted as a cross-sectional descriptive study, patients diagnosed with cerebral venous thrombosis were enrolled at Can Tho Central General Hospital between January 2021 and June 2022.

Results: Notably, a substantial proportion of patients (83.4%) exhibited signs of brain damage, with intracranial hemorrhage (50%), brain infarction (30.9%), subarachnoid hemorrhage (16.6%), and hemorrhagic infarct (4.7%) being the predominant findings. Thrombosis primarily affected the superior sagittal sinus (85.7%), transverse sinus (52.4%), and sigmoid sinus (42.8%). All patients received anticoagulation treatment, resulting in a favorable recovery upon hospital discharge for the majority (90.5%), while a small percentage (9.5%) experienced critical illness or death.

Conclusion: Our study on cerebral venous thrombosis found diverse clinical presentations, primarily headache. Intracranial hemorrhage was common, affecting superior sagittal, transverse, and sigmoid sinuses. Most patients achieved favorable recoveries with anticoagulation treatment, emphasizing early intervention's importance.

The plain language summary: Cerebral venous thrombosis (CVT) is a less common condition when compared to arterial thrombosis, which has received more research attention. However, CVT has not received the same level of focus and investigation. The study aimed to comprehensively examine the clinical features, brain imaging findings, and treatment outcomes of patients diagnosed with CVT. The findings revealed that patients with CVT commonly presented with symptoms such as headache, limb weakness, seizures, vomiting, and consciousness disorders. Neuroimaging showed significant brain damage, including intracranial hemorrhage and brain infarction. However, with appropriate anticoagulation treatment, the majority of patients achieved favorable recoveries. The study emphasizes the importance of early intervention and highlights the need for improved diagnostic accuracy and treatment strategies for CVT.

Keywords: cerebral venous thrombosis, CVT, hemorrhagic infarct, superior sagittal sinus

Introduction

Cerebral venous thrombosis is a relatively uncommon condition, comprising approximately 0.5–1% of all cerebrovas cular events. Compared to arterial thrombosis, which receives more research focus, CVT has not received the same level of attention and investigation.[1,2] Consequently, there is a critical need to bridge this research gap and enhance our understanding of CVT. By exploring the clinical features and neuroimaging findings of CVT, this study aims to improve diagnostic accuracy and facilitate early intervention, ultimately leading to better patient outcomes.[3,4] The mortality rate of cerebral venous thrombosis, if left untreated, ranges from 13.8% to 48%. A study conducted in the UK reported a mortality rate of approximately 0.39 per million population.

One of the primary challenges in diagnosing CVT lies in its diverse clinical manifestations. Patients with CVT often present with symptoms such as headache, limb weakness, seizures, vomiting, and consciousness disorders.[5–7] This wide range of symptoms can lead to missed or delayed diagnoses, underscoring the importance of thorough clinical evaluation and prompt suspicion of CVT in appropriate clinical contexts. Furthermore, the neuroimaging findings play a crucial role

in confirming the diagnosis. Characteristic signs on brain imaging, including intracranial hemorrhage, brain infarction, subarachnoid hemorrhage, and hemorrhagic infarct, help differentiate CVT from other cerebrovascular conditions.[8]

Effective treatment of CVT remains a significant challenge. Current management strategies involve the use of anticoagulation therapy, such as unfractionated heparin or low molecular weight heparin, to reduce the risk of mortality, irrespective of the presence of cerebral hemorrhage.[6,7,9,10] However, optimizing treatment outcomes requires a deeper understanding of the disease's pathophysiology and identification of factors associated with treatment response. By evaluating the treatment outcomes of patients with CVT, this study aims to shed light on the efficacy of current therapeutic approaches and identify areas for improvement.

Despite its relatively low incidence, CVT can have a substantial impact on affected individuals, particularly those in the working and reproductive age group. The challenges in diagnosing and treating CVT highlight the need for comprehensive research efforts in this field. However, currently in Vietnam in general, and specifically in the Mekong Delta, there have been no studies related to cerebral venous thrombosis, as clinical doctors typically focus on diagnosing arterial thrombosis in the brain. We have observed that although it accounts for a low or very low proportion in diagnostics, cerebral venous thrombosis also has serious consequences for patients, no less than arterial thrombosis in the brain. Thus, this study aims to contribute to the existing knowledge by investigating the clinical characteristics, neuroimaging findings, and treatment outcomes of patients with CVT. The findings generated from this study will help enhance diagnostic accuracy, guide treatment decisions, and ultimately improve the prognosis and quality of life for individuals affected by CVT.

Materials and Methods

We conducted a prospective, cross-sectional descriptive study at Can Tho Central General Hospital from January 2021 to June 2022 to investigate data related CVT. Our study included a total of 42 patients aged 16 years and above who had been diagnosed with CVT at the hospital.

In order to ensure accurate diagnosis, the study included patients who had received a definitive diagnosis of CVT from a neuroradiologist. This diagnosis was confirmed through specific imaging findings, such as the presence of the dense-triangle sign on a contrast-enhanced CT scan or MRI results consistent with the classic neuroradiological features of CVT. Laboratory investigations were also conducted, with the number of tests performed increasing over the study period as more potential prothrombotic associations were identified. These investigations encompassed a range of parameters, including blood count, cholesterol, triglycerides, lipoprotein, fibrinogen, protein C, protein S, antithrombin III, and factor V Leiden.

Methods of Data Collection and Evaluation

The patient was brought to the hospital when experiencing neurological symptoms such as headache, seizures, or limb weakness. Imaging techniques, including CT and MRI, were used to create images of the blood vessels and clots, and DSA was used to capture images of the affected blood vessels. When imaging results showed cerebral venous thrombosis, we began collecting patient data through history taking and clinical examination. Patient characteristics, including age, gender, and related factors such as pregnancy, postpartum, contraceptive use, and a history of renal failure, as well as the time of onset of

symptoms (acute <2 days and subacute 2–30 days), were recorded. Clinical symptoms were recorded through history taking and physical examination. Additionally, imaging techniques were used to describe the characteristics of the injury and the location of the affected venous sinuses. We cross-checked the imaging results with the diagnostic imaging department of the Central Hospital of Can Tho to determine the appropriateness of the imaging results. After treatment, patient outcomes were evaluated using the mRS Scores at Discharge, with good treatment outcomes defined as mRS ≤ 2 and poor outcomes defined as mRS >2. Patient outcomes were assessed in two scenarios: discharge with stable health and death.

Data Processing and Analysis Methods

The data will be encoded, processed, and analyzed using SPSS 20.0 (IBM Corp., New York, the United) software for statistical analysis. Descriptive statistics will be utilized to summarize quantitative variables by means and standard deviations (for normally distributed variables), medians (for non-normally distributed variables), and frequencies and percentages for categorical variables. For categorical variables, the chi-square test with Fisher's exact test as a correction will be used, and for continuous variables, the *t*-test will be used. Univariate analysis will be conducted to identify variables that are associated with treatment outcomes. Variables

that are significantly related to treatment outcomes ($p < 0.05$ through univariate analysis) will be included in multivariate analysis to adjust OR (Odds Ratio) values and determine the confidence intervals. Multivariate logistic regression will be used to identify factors related to treatment outcomes.

Research Ethics

The study was conducted with honesty and diligence, and the research findings and recommendations aim to enhance public health by preventing and managing diseases in the community. Ethical considerations for this study were approved by the Scientific Review Committee of Can Tho University of Medicine and Pharmacy and the affiliated hospital, in accordance with the 2013 Helsinki Declaration. (Approval number: 549/PCT-HĐĐĐ in 2021). The study obtained the consent of the patients (Informed consent was obtained from all participants who were 18 years of age and over, and this study did not include patients under the age of 18).

Results

Table 1 shown that the majority of the participants were in the age range of 30–49, accounting for 59.5% of the total sample. Participants aged below 30 represented 9.5% of the sample, while those aged 50 and above constituted 31%. The mean age of the participants was calculated to be 45.5 ± 14.3. In terms of gender distribution, females accounted for a larger proportion, comprising 71.4% of the participants. Males, on the other hand, represented 28.6% of the sample. Regarding risk factors, contraceptive use was reported as the most prevalent, accounting for 42.8% of cases.

About the onset type, the majority of cases (66.7%) presented with a subacute onset, occurring within a period of 2– 30 days. When examining the specific symptoms associated with the onset of CVT, headache was reported by 54.7% of the participants. In terms of clinical symptoms, the most commonly reported symptom was headache, observed in 95.2% of participants. Nausea/vomiting was reported by 35.7% of participants, while seizures were present in 47.6% of cases.

Table 2 provides insights into the types of brain lesions observed. Among the recorded brain lesion types, hemor rhagic stroke was the most prevalent, accounting for 50% of cases. When analyzing the occluded venous sinuses, the superior sagittal sinus was most frequently affected, with occlusion observed in 85.7% of cases. The transverse sinus was occluded in 52.4% of cases, followed by the sigmoid sinus (42.8%). The straight sinus showed occlusion in 11.9% of cases, while the cortical vein and cavernous sinus were affected in 4.7% and 9.5% of cases, respectively.

The evaluation of treatment outcomes and functional status at discharge for the study participants with cerebral venous thrombosis (CVT). The modified Rankin Scale (mRS) scores were utilized to assess the participants' functional status. At discharge, 14.3% of the participants achieved an mRS score of 0. The majority of participants (38.1%) obtained an mRS score of 1 (Table 3). The study evaluates treatment outcomes using the modified Rankin Scale (mRS) scores, showing that the majority of participants had a stable condition at discharge (90.5%). However, a noteworthy finding is the unfortunate outcome of death in 9.5% of participants, underscoring the severity of CVT.

Table 4 shown that the patients aged 50 or older had a higher incidence of poor treatment outcomes, with 69.2% exhibiting mRS scores greater than 2. Conversely, patients under 30 had the lowest incidence of poor outcomes at 25%, and the difference

Table 1 General Characteristics

Characteristics		Frequency (n)	Percentage (%)
Age	<30	4	9.5
	30–49	25	59.5
	≥50	13	31
	Mean age	45.5 ± 14.3	
Gender	Male	12	28.6
	Female	30	71.4
Risk factors	Contraceptive use	18	42.8
	Pregnancy	1	2.4
	Postpartum	3	7.1

	Renal impairment syndrome	1	2.4
Onset Type	Acute (<2 days)	14	33.3
	Subacute (2–30 days)	28	66.7
Onset Symptoms	Headache	23	54.7
	Convulsion	15	35.7
	Weakness in half of body	6	14.3
Distribution of Clinical Symptoms in Generalized Onset			
Headache		40	95.2
Nausea. vomiting		15	35.7
Seizures		20	47.6
Impaired consciousness		10	23.8
Hemiparesis (weakness on one side of the body)		24	57.1
Cranial nerve palsy		11	26.2
Meningitis syndrome		2	4.7
Aphasia		9	21.4

Table 2 Brain Lesion Types

Characteristics	Frequency (n)	Percentage (%)
Characteristics of Brain Lesion Types		
Ischemic Stroke	13	30.9
Hemorrhagic Stroke	21	50
Hemorrhagic Transformation	2	4.7
Subarachnoid Hemorrhage	7	16.6

(*Continued*)

Table 2 (Continued).

Characteristics	Frequency (n)	Percentage (%)
Distribution of Occluded Venous Sinuses		
Superior Sagittal Sinus	36	85.7
Straight Sinus	5	11.9
Transverse Sinus	22	52.4
Sigmoid Sinus	18	42.8
Cortical Vein	2	4.7
Cavernous Sinus	4	9.5

Table 3 Evaluation of Treatment Outcomes

	Frequency (n)	Percentage (%)
mRS Scores at Discharge		
0	6	14.3
1	16	38.1
2	3	7.15
3	9	21.4
4	3	7.15
5	1	2.4
6	4	9.5
Treatment Outcomes		
Stable condition	38	90.5
Death	4	9.5

Table 4 Some Factors Related to Treatment Outcomes

Characteristics		**Treatment Results**		χ^2	**p**
		Poor n (%)	**Good n (%)**		
Age	<30	1 (25)	3 (75)	6.474	0.039
	30–49	7 (28)	18 (72)		
	≥50	9 (69.2)	4 (30.8)		
	Mean age	52.59 ± 18.139	41.08 ± 11.554		
Gender	Male	2 (16.7)	10 (83.3)	3.953	0.081
	Female	15 (50)	15 (50)		
Contraceptive use	No	10 (41.7)	14 (58.3)	0.033	0.856
	Yes	7 (38.9)	11 (61.1)		

(*Continued*)

Table 4 (Continued).

Characteristics		**Treatment Results**		χ^2	**p**
		Poor n (%)	**Good n (%)**		
Onset Type	Acute (<2 days)	7 (50)	7 (50)	0.791	0.374
	Subacute (2–30 days)	10 (35.7)	18 (64.3)		
Onset Symptoms	Headache	16 (39)	25 (61)	1.506	0.405
	Convulsion	9 (47.4)	10 (52.6)	0.684	0.408
	Weakness in half of body	17 (68)	8 (32)	19.421	0.001
Venous sinus obstruction	Only 1	7 (41.2)	10 (58.8)	0.006	0.939

	≥ 2	10 (40)	15 (60)		

between the two age groups was statistically significant (p=0.039). No significant difference was found in the incidence of poor treatment outcomes between male and female patients, with 16.7% and 50% respectively exhibiting mRS scores greater than 2 (p>0.05; OR=0.2; CI 95%: 0.037–1.071). Patients who used contraceptives had a slightly lower incidence of poor treatment outcomes than those who did not, at 38.9% and 41.7%, respectively, but the difference was not statistically significant (p>0.05; OR=0.891; CI 95%: 0.256–3.102). Patients with acute onset of symptoms (less than 2 days) had a higher rate of poor treatment outcomes at 50% compared to patients with subacute onset (2–30 days) at 35.7%, but the difference was not statistically significant (p>0.05; OR=1.8; CI 95%: 0.49–6.618). Patients who experienced clinical symptoms of headache had a slightly lower incidence of poor treatment outcomes than those who did not, but the difference was not statistically significant (p>0.05). Patients who experienced clinical symptoms of seizures had a higher incidence of poor treatment outcomes than those who did not, at 47.4% and 34.8%, respectively, but the difference was not statistically significant (p>0.05; OR=1.688; CI 95%: 0.486– 5.854). Patients who experienced clinical symptoms of limb weakness had a significantly higher incidence of poor treatment outcomes than those who did not, at 68% and 0%, respectively (p=0.001). Patients who had obstruction in one sinus had a slightly higher incidence of poor treatment outcomes than those with obstruction in two or more sinuses, at 41.2% and 40%, respectively, but the difference was not statistically significant (p>0.05; OR=0.952; CI 95%: 0.272–3.338).

Discussion

Principal Finding

The study revealed that the majority of participants (59.5%) were aged between 30 and 49 years, whereas those aged above 50 constituted 31%. Women were more commonly affected, representing 71.4% of the sample. The most frequent risk factor was contraceptive use, reported in 42.8% of cases. Headache was the most commonly reported symptom, observed in 95.2% of participants. Hemorrhagic stroke was the most prevalent brain lesion type, accounting for 50% of cases. At discharge, the majority of participants (90.5%) had a stable condition, while 9.5% experienced mortality during treatment. Patients aged 50 or older demonstrated a higher incidence of poor treatment outcomes, whereas patients under 30 had the lowest incidence of poor outcomes. Clinical symptoms of limb weakness were significantly associated with poor treatment outcomes. These findings underscore the importance of early detection and intervention in patients with CVT, particularly in older patients and those presenting clinical symptoms of limb weakness.

Comparison with the Previous Work

Clinical Characteristics

The average age of the participants is 45.5 ± 14.3 years, which is consistent with the findings of previous studies conducted by Zenobia (48, range 22–69 years), Matiat (42 ± 17), and Mei Ling (43.5 ± 16.52).[4,11,12] Regarding gender distribution, females constitute the majority at 71.4%, while males account for 28.6%. This outcome is in line with research conducted by Zenobia, Matiat, and Samia Ben.[4,12,13] As the sample size increases, the disparities become more noticeable, particularly among women of childbearing age who are exposed to a greater number of risk factors compared to males. In our study, the most prevalent risk factor was contraceptive use, representing 42.8% of the participants, which is similar to Matiat's findings of 43%. However, there were variations compared to Ranjan R's study with 58.9% and Malekaldar's study with 18.3%.[14,15] This indicates a relatively high prevalence of contraceptive use among women in contemporary society. According to the findings of the research, the majority of patients experienced a subacute onset, accounting for 66.7%, followed by an acute onset at 33.3%. There were no instances of a chronic onset. These results are in accordance with the studies conducted by Malekaldar and Lindgren.[14,16] At the onset, the most prevalent symptoms were headache (54.7%), seizures (33.3%), and hemiparesis (12%). Most other studies on the clinical manifestations of CVT lack detailed information regarding symptoms at the onset. The clinical presentation of CVT exhibits a high level of diversity and nonspecificity, which varies depending on factors such as age, gender, the location of the lesion, and the severity of the injury. In our study, headache was the most prevalent symptom, reported by 95.2% of participants, similar to the findings of AK Mishra (96,87%), Rajkondawar (83,87%).[7,17] Headache symptoms often display atypical characteristics and can resemble migraines or muscle tension, but they typically progress gradually and do not respond to treatment. Hemiparesis ranked second in our study, with a prevalence rate of 57.1%. Overall, the hemiparesis symptoms in our study were

consistent with the results reported by other authors and were commonly ranked second or third in terms of clinical manifestations. Seizures accounted for 47.6%, ranking third after headache and hemiparesis. According to ‘s study, seizures had a prevalence rate of 48.39%, ranking third after headache and vomiting. Q Li reported seizure prevalence rates of 64.3%, respectively.[18] The subsequent symptoms in our study included nausea and vomiting (35.7%), cranial nerve palsy (26.2%), altered consciousness (23.8%), language disorders (21.4%), and meningeal syndrome (4.7%). Overall, when compared to other authors, the clinical characteristics observed in our study largely resembled those reported in previous studies.

Characteristics of Brain Imaging

In our study, brain tissue damage was observed in 83.4% of patients with CVT. Among them, cerebral hemorrhage had the highest prevalence at 50%, followed by cerebral infarction at 30.9%, meningeal hemorrhage at 16.6%, and hemorrhagic transformation of infarction at 4.7%. These findings align with the study conducted by Walecki, which reported 88% of patients had transverse sinus thrombosis, 23.5% suffered from hemorrhagic infarction, whereas 47% were diagnosed with venous infarction without hemorrhage.[3] However, there are differences compared to authors Mohammad, who reported cerebral hemorrhage at 26.7% and cerebral infarction at 53.3%;[2] Mei Ling, who reported cerebral hemorrhage at 38.3% and cerebral infarction at 53.1%.[11] These variations may be attributed to the small sample size in our study and the diverse nature of brain lesions in CVT.
Regarding the involvement of venous sinuses, the superior sagittal sinus was the most commonly affected, observed in 85.7% of cases, followed by the transverse sinus at 52.4% and the sigmoid sinus at 42.8%. Less frequently involved were other venous sinuses such as the straight sinus at 11.9%, cavernous sinus at 9.5%, and cortical veins at 4.7%. These results are consistent with the studies conducted by Lysitsas, and Mei Ling.[11,19]

Evaluation of Treatment Outcomes

Based on the mRS score at discharge, 52.4% of patients in our study achieved full recovery (mRS <2), while 30.95% were dependent (mRS 3–5), and mortality was observed in 9.5% of cases (mRS=6). In the study conducted by Erwin Stolz, the rate of full recovery was reported as 77%, dependence and mortality at 23%.[10] In our study, the proportion of patients who experienced death or severe outcomes during their hospital stay was 9.5%. Factors significantly related to a mRS $\geq$ 3 at 6 months in a logistic regression analysis were age and items 1a–c of the NIHSS on admission related to consciousness. This figure exceeds the rates reported by M Wasay (3,3%), Matiat (4%), and Samia Ben (6.6%).[2,4,13] The outcomes observed in our study were less favorable compared to those reported by other authors such as Erwin Stolz (15%), which may be attributed to the limited size of our sample.

Limitations of the Study

Notwithstanding the valuable insights gleaned from this study on cerebral venous thrombosis (CVT), several limitations must be acknowledged. One limitation pertains to the relatively small sample size, which may limit the generalizability of the findings. Moreover, the study was executed solely at a single center, which may constrain the applicability of the results to other populations and settings. Besides that, due to the lack of significant differences in hematological factors (coagulation), the study did not analyze the correlation between clotting characteristics and the clinical signs and symptoms of CVT. Lastly, the study did not investigate the long-term outcomes of CVT, which could have provided crucial information on the chronic impact of the disease and its treatment.

Implications

The findings of this study carry significant implications for the diagnosis and treatment of cerebral venous thrombosis (CVT). The high prevalence of clinical manifestations observed in this study underscores the need for a heightened index of suspicion for CVT in patients presenting with symptoms such as headache, limb weakness, seizures, vomiting, and consciousness disorders. The preponderance of intracranial hemorrhage in this study highlights the criticality of timely and precise diagnosis to prevent further complications. Moreover, the high recovery rate observed with anticoagulation therapy emphasizes the importance of prompt and appropriate management in enhancing patient outcomes. These implications have significant clinical and public health ramifications, and underscore the importance of continued research and development in improving the diagnosis, treatment, and prevention of CVT.

Further Study

While this study provides valuable insights into the clinical features, neuroimaging findings, and treatment outcomes of patients with CVT, there is still much to be explored in this field. Future studies could investigate the long-term outcomes

of CVT, including the incidence of recurrent thrombosis and the effects of treatment on quality of life. Additionally, studies could explore the pathophysiology of CVT, including the risk factors and mechanisms underlying thrombosis formation.

Conclusion

Cerebral venous thrombosis is a condition that occurs more frequently in females and has a subacute onset, with a range of clinical manifestations. Brain imaging studies commonly show cerebral hemorrhage as the most observed type of brain tissue damage. The superior sagittal sinus is the most frequently affected venous sinus, followed by the transverse and sigmoid sinuses. Despite these findings, patients generally show good recovery at the time of discharge.

Data Sharing Statement

The corresponding author may obtain any data from the study upon reasonable request, 1853010822@student.ctump.edu.vn (H.H.V.L.).

Institutional Review Board Statement

The Institutional Review Board of Can Tho University of Medicine and Pharmacy gave its approval to the study.

Acknowledgments

We acknowledge the cooperation and support of outpatients, clinical doctors, and collaborators at the University Hospital of "Can Tho University of Medicine and Pharmacy" for the time and effort they devoted to the study. We also thank you for the support from Can Tho University of Medicine and Pharmacy.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

There was no external support for this study.

Disclosure

The authors declare no conflicts of interest in this work.

References

1. Wasay M, Bakshi R, Bobustuc G, et al. Cerebral venous thrombosis: analysis of a multicenter cohort from the United States. *J Stroke Cerebrovascular Dis*. 2008;17(2):49–54. doi:10.1016/j.jstrokecerebrovasdis.2007.10.001
2. Wasay M, Kaul S, Menon B, et al. Asian Study of Cerebral Venous Thrombosis. *J Stroke Cerebrovascular Dis*. 2019;28(10):104247. doi:10.1016/j.jstrokecerebrovasdis.2019.06.005
3. Walecki J, Mruk B, Nawrocka-Laskus E, Piliszek A, Przelaskowski A, Sklinda K. Neuroimaging of Cerebral Venous Thrombosis (CVT) - Old Dilemma and the New Diagnostic Methods. *Polish J Radiol*. 2015;80:368–373. doi:10.12659/pjr.894386
4. Alet M, Ciardi C, Alemán A, et al. Cerebral venous thrombosis in Argentina: clinical presentation, predisposing factors, outcomes and literature review. *J Stroke Cerebrovascular Dis*. 2020;29(10):105145. doi:10.1016/j.jstrokecerebrovasdis.2020.105145
5. Dhadke VN, Dhadke SV, Kulkarni A. Clinical Profile of Cerebral Venous Sinus Thrombosis. *J Assoc Physicians India*. 2020;68(3):33–35. 6. Lau KF, Toh TH, Kadir KAA, Tai MS, Tan KS. Mechanical Thrombectomy for Life-Threatening Cerebral Venous Thrombosis: a Case Report. *Case Rep Neurol*. 2020;12(Suppl 1):63–69. doi:10.1159/000507343
7. Rajkondawar AV, Bhilare PD. Clinical Profile and in Hospital Outcome of Cerebral Venous Sinus Thrombosis at Tertiary Care Centre of Central India. *Vidarbha J Internal Med*. 2023;33:18–20. doi:10.25259/VJIM_36_2022
8. Zuurbier SM, Hiltunen S, Lindgren E, et al. Cerebral Venous Thrombosis in Older Patients. *Stroke*. 2018;49(1):197–200. doi:10.1161/ strokeaha.117.019483
9. Benabu Y, Mark L, Daniel S, Glikstein R. Cerebral venous thrombosis presenting with subarachnoid hemorrhage. Case report and review. *Am J Emergency Med*. 2009;27(1):96–106. doi:10.1016/j.ajem.2008.01.021
10. Stolz E, Rahimi A, Gerriets T, Kraus J, Kaps M. Cerebral venous thrombosis: an all or nothing disease?: prognostic factors and long-term outcome. *Clin Neurol Neurosurgery*. 2005;107(2):99–107. doi:10.1016/j.clineuro.2004.06.002
11. Tai M-LS, Kadir KAA, Tan CT, Tan KS. Cerebral venous thrombosis in multi-ethnic patients from Malaysia. *Neurol Asia*. 2020;25(2):567. 12. Zenobia E, Lailiyya N, Dian S, Juli C, Nugraha Hermawan A, Amalia L. Platelet Selectin Levels in Patients with Cerebral Venous Sinus Thrombosis: preliminary Findings. *J Blood Med*. 2023;14:359–365. doi:10.2147/jbm.S405975

13. Sassi SB, Touati N, Baccouche H, Drissi C, Romdhane NB, Hentati F. Cerebral Venous Thrombosis: a Tunisian Monocenter Study on 160 Patients. *Clin Appl Thrombosis/Hemostasis*. 2017;23(8):1005–1009. doi:10.1177/1076029616665168
14. Malekaldar M, Ahmed K, Abdalla Y, et al. Etiological associations of cerebral venous sinus thrombosis among adult sudanese patients: a multicenter cross-sectional study. *Ann Med Surg*. 2023;85(7):3353–3358. doi:10.1097/ms9.0000000000000650
15. Ranjan R, Ken-Dror G, Martinelli I, et al. Age of onset of cerebral venous thrombosis: the BEAST study. *Eur Stroke J*. 2023;8(1):344–350. doi:10.1177/23969873221148267
16. Lindgren E, Krzywicka K, de Winter MA, et al. A scoring tool to predict mortality and dependency after cerebral venous thrombosis. *Eur J Neurol*. 2023;30(8):2305–2314. doi:10.1111/ene.15844
17. Mishra AK, Shukla R, Chaurasia RN, Verma A. Descriptive Study of Headache as the Most Common Presenting Feature of Cerebral Venous Thrombosis. *Cureus*. 2023;15(8):e43007. doi:10.7759/cureus.43007
18. Li Q, Han J, Wang Y, Song Y. Cerebral venous thrombosis (CVT) complicating tubercular meningitis. *BMC Neurol*. 2023;23(1):245. doi:10.1186/s12883-023-03286-4
19. Lysitsas K, Bouziani C, Dimarelou Z, et al. Incidence of inherited thrombophilia in Greek patients with cerebral venous thrombosis. *Ann General Psychiatry*. 2008;7(1):S179. doi:10.1186/1744-859X-7-S1-S179