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Cerebral venous thrombosis in multi-ethnic patients from Malaysia

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Abstract

Background & Objectives: The literature on cerebral venous thrombosis (CVT) in South East Asia is limited. The objectives were to evaluate the clinical profile, predisposing factors and clinical outcome of the CVT patients in Malaysia. *Methods:* We conducted a retrospective descriptive study of the CVT patients admitted to the neurology ward. The clinical presentation, predisposing factors, radiological findings, treatment and prognostic characteristics were evaluated from the charts. Clinical outcome on discharge and six months was measured by Modified Rankin Scale (mRS) scores. Poor outcome and good outcome was defined as Modified Rankin Scale (mRS) scores of 3-6 and 0-2 respectively. *Results:* Forty nine CVT patients who presented between 2007 and 2017 were recruited. The mean age was 43.51±16.52. The patients consisted of 39 Malaysians (13 Indians, 12 Malays, 12 Chinese, one Iban, one Eurasian descent), and ten non-Malaysians. Thirty (61.2%) patients were women. The most common presenting complaint was headache (75.5%). Six percent had multiple risk factors, whereas 51% had idiopathic CVT. The most common predisposing factors were oral contraceptive pill use (18.4%), followed by infection (12.2%), especially central nervous system (CNS) infection (6.1%); 11.8% had prothrombotic disorder. The most common location for CVT was superior sagittal sinus (83.7%). On neuroimaging, 77.6% had parenchymal lesions, 53.1% had venous infarcts and 38.8% had intracerebral haemorrhage, one patient had CVT complicated by rare venous collateral channels. Poor outcome on discharge and at six months was 38.8% and 33.3% respectively. On univariate analysis, female gender (p=0.002), seizures (p=0.037) and cerebral oedema (p=0.018) were associated with poor functional outcome. On binary logistic regression, female gender (OR=14.50, 95% CI 2.10-99.94, p=0.003) and seizures (OR=6.54, 95% CI 1.33-32.07, p=0.017) were associated with poor outcome. *Conclusion:* The CVT patients in this study had a higher proportion of CNS infections. Poor outcome was independently associated with female gender and seizures.

Keywords: cerebral venous thrombosis, infarcts, intracerebral, haemorrhage, sinus

INTRODUCTION

Cerebral venous thrombosis (CVT) is an uncommon cause of stroke characterized by diverse clinical presentations.[1-4] CVT results in 0.5-1% of all the strokes.[1,5-10] The annual incidence of CVT is 5/1,000,000 people.[1,5,6,11]

There were not many publications on CVT in Asia, especially in the Far East. Most of the studies on CVT in Asia were conducted in South Asia and Middle East. There is a paucity of literature on patients with CVT from South East Asia with only two studies from Thailand and Singapore.[12-13] This current study was conducted in Malaysia, a country located in the South East Asia. Malaysia consists of three major ethnic groups: Malays, Chinese and Indians. Furthermore, there are other natives in Malaysia, such as Iban and numerous foreign workers, comprising of Filipinos, Indonesians, Myammarese and Vietnamese.

The primary objective of this study was to evaluate the clinical profile and predisposing factors in the patients with CVT in Malaysia. The secondary objective was to assess the clinical outcome in the patients with CVT.

METHODS

This study was a retrospective study on the patients with CVT. The study was conducted at the University Malaya Medical Centre (UMMC), a tertiary hospital in Kuala Lumpur, Malaysia over a 11 year period from 2007 and 2017. Consecutive patients with CVT who were admitted into the

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adult neurology ward in University Malaya Medical Centre (UMMC), were included in the study. The patients who were below 12 years of age were excluded from the study.

The charts of the CVT patients were reviewed. The demographic characteristics, clinical presentation, predisposing factors, radiological findings and treatment were reviewed. All the patients had an initial computed tomography (CT) scan of the brain. The diagnosis of CVT was confirmed by CT scan venography (CTV) or magnetic resonance venography (MRV) of the brain.

The predisposing factors were classified as oral contraceptive pill (OCP) use, pregnancy, puerperium, malignancy, infections, connective tissue disease (such as systemic lupus erythematosus), prothrombotic disorder (thrombophilia), nephrotic syndrome, inflammatory bowel disease (IBD) and paroxysmal nocturnal haemoglobinuria (PNH).

The evaluation of prothrombotic disorder (thrombophilia) included protein C deficiency, protein S deficiency, antithrombin III deficiency, presence of antinuclear antibody (ANA), lupus anticoagulant, antiphospholipid antibody ± anticardiolipin antibody, activated protein C resistance (APC resistance) and Factor V Leiden (F5) R506Q mutation. The inherited prothrombotic disorder encompassed protein C deficiency, protein S deficiency, antithrombin III deficiency and Factor V Leiden. Testing for PNH was carried out in the setting of clinical haemolysis.

CVT was categorised as acute (onset of less than 48 hours), subacute (48 hours-one month) and chronic (more than one month) based on the duration of the onset of symptoms.[8] Initially, the patients were given either subcutaneous low molecular weight heparin or intravenous unfractionated heparin as acute treatment. Oral warfarin was given when the patients' condition stabilised (no further deterioration of disease or further intracerebral haemorrhage). The dosage of warfarin was increased or adjusted to keep the internationalised ratio (INR) within the therapeutic range of 2-3.

Clinical outcome was measured by modified Rankin Scale (mRS). The mRS scores on discharge and mRS at six months were recorded. The mRS scores of 3-6 were defined as poor outcome and mRS scores of 0-2 were categorised as good outcome.[14]

In the assessment of functional outcome, the study patients were categorised into age > 37 and age ≤ 37. In the literature, age more than 37 was associated with poor prognosis.[15]

Statistical analysis

All descriptive statistics were done using Statistical Package for Social Sciences, SPSS (Version 20.0, SPSS Inc., Chicago). Chi square test (or Fisher's test) analysis was used for categorical data. Continuous variables were analysed with students' T test. Binary logistic regression analysis was used to determine the independent factors associated with functional outcome on discharge. A p value of <0.05 was taken as statistically significant.

RESULTS

Demography and clinical presentations

Forty nine patients with CVT were recruited (Table 1a). Headache was the sole manifestation in 8.1% (3/37) of the patients with headache. The onset of CVT was predominantly subacute (29 patients, 59.2%), followed by acute (11 patients, 22.4%) and chronic (9 patients, 18.4%).

Predisposing factors

There were 6 (12.2%) patients with infection; 3 (6.1%) patients had central nervous system (CNS) infections. Two (4.1%) patients had meningitis, one (2%) patient each had subdural abscess, Lemmiere's syndrome, pulmonary tuberculosis (PTB), and pneumonia. Three (6.1%) patients had malignancies; including leukaemia, tonsillar carcinoma and gliomatosis cerebri.

Nine (18.4%) patients took oral contraceptive pills (OCP). Two (4.1%) patient was pregnant. No patient was in puerperium. Two (4.1%) patients had inflammatory bowel disease (both with Crohn's disease) and two other patients (4.1%) had systemic lupus erythematosus (SLE). One (2.0%) patient had history of nephrotic syndrome. One (2.0%) patient had systemic vasculitis.

Fifteen patients did not have blood tests for prothrombotic disorder (thrombophilia). Thirty four (69.4%) patients had blood checked to assess for the presence of prothrombotic disorder. Four out of 34 patients (11.8%) had prothrombotic disorder, of which 3 (8.8%) patients had inherited prothrombotic disorder.

Two out of 31 patients (6.4%) who had protein C testing were found to have protein C deficiency. None out of 33 patients who had blood tested for protein S, were found to have protein S deficiency.

Table 1a: Baseline demography and clinical characteristics

	Patients, n=49
Age (mean±SD)	43.51±16.52 (range 12-79)
Gender (n, %)	
Male	19 (38.8%)
Female	30 (61.2%)
Ethnic group (n, %)	
Malaysians	
Malay	12 (24.5%)
Chinese	12 (24.5%)
Indian	13 (26.5%)
Other Malaysians	2 (4.0%)
-Iban	1 (2%)
-Eurasian	1 (2%)
Non-Malaysians	9 (20.5%)
-Indonesian	4 (8.2%)
-Thais	2 (4.1%)
-Myammarese	1 (2%)
-Vietnamese	1 (2%)
- Filipino	1 (2%)
-Yemeni	1 (2%)
Clinical features (n, %)	
Headache	37 (75.5%)
Motor deficits	24 (49.0%)
Seizures	21 (42.9%)
Vomiting	12 (24.5%)
Dizziness	9 (18.4%)
Visual blurring	8 (16.3%)
Fever	7 (14.3%)
Nausea	6 (12.2%)
Sixth cranial nerve palsy	3 (6.1%)
Photophobia	2 (4.1%)
Status epilepticus	4 (8.2%)
Dysphasia	3 (6.1%)
Neck stiffness	1 (2.0%)
GCS on admission	
Mean±SD	13.78±2.53 (6-15)

Thirty two patients had testing for antithrombin III; but only one patient (2%) had antithrombin III deficiency. Two patients had testing for PNH, and one (2.0%) patient was diagnosed with PNH.

Seven out of 26 patients (26.9%) who had ANA testing were tested positive. Out of 22 patients who had testing for lupus anticoagulant, only one (4.5%) patient was tested positive for lupus anticoagulant. 25 patients had blood test sent for antiphospholipid antibody ± anticardiolipin antibody, but none tested positive.

Three (6.1%) patients presented with multiple (more than one) risk factors. One patient had protein C deficiency and was also on OCP. There were two patients who were pregnant; one had antithrombin III deficiency and another had prior history of taking OCP. Twenty five (51%) patients had idiopathic CVT (no identifiable risk factor).

Radiological findings

The radiological findings are illustrated in Table 1b; 38 (77.6%) patients had parenchymal lesions on brain neuroimaging. Altogether 26 (53.1%) patients presented with venous infarcts with or without intracerebral haemorrhage (ICH). A total of 17 (34.7%) patients had venous infarcts alone. Regarding ICH, 19 (38.8%) patients had ICH with or without venous infarcts. A total of 10 (20.4%) patients presented with ICH alone. Altogether, 9 (18.4%) patients had both venous infarcts and ICH.

Clinical outcome

Clinical outcome is shown in Table 1c**.** On discharge, 3 patients (6.1%) died (mRS 6). One patient with deep CVT died. Two patients died from massive ICH; one had anti-thrombin III deficiency and the other had Crohn's disease.

Table 2a shows univariate analysis of factors determining poor functional outcome on discharge. On binary logistic regression (Table 2b), female gender (OR=14.50, 95% CI 2.10-99.94, p=0.003) and seizures (OR=6.54, 95% CI 1.33-32.07, p=0.017) were associated with poor outcome.

Table 3 shows the factors determining functional outcome at 6 months. No patient had new thrombotic events at 6 months. Among the patients with CNS infections, all 3 patients (100%) had good outcome on discharge. At 6 months, one out of the 3 patients with CNS infections had poor outcome. The outcome of 2 patients were not available at 6 months. Two (4.1%) CVT patients had hydrocephalus, and they died later in the illness. Two out of the 3 patients (67%) with mRS of 6 had cerebral oedema and raised intracranial pressure (ICP).

Treatment

Six (12.2%) patients were given intravenous heparin, 21 (51%) patients were treated with subcutaneous enoxaparin, 33 (67.3%) patients were administered with oral warfarin.

Ethnic differences among the patients with CVT

Nine (75%) Malay patients were male patients, whereas 27 (73%) non-Malay patients were female patients (p=0.005). Ten (83.3%) Malay patients had good functional outcome, and 20 (54.1%) non-Malay patients had good functional outcome on discharge (p=0.095).

Unusual case of CVT complicated by venous collateral

In our series, there was an unusual case of a patient with CVT at posterior aspect of the superior sagittal sinus and left transverse sinus, complicated by collateral venous channel from anterior superior sagittal sinus into right cavernous sinus. The patient was a 13 year old male who presented with one month history of fever, as well as two to three days' history of dry cough with headache and vomiting. Figure 1a and Figure 1b showed the locations of the CVT.

Fundoscopic examination revealed bilateral severe papilloedema with bilateral venous tortuosity. He was given warfarin for six months. Repeat MRV 6 months after the initial presentation is illustrated in Figure 1c. The venous collateral was managed conservatively. Cerebral angiogram was performed 10 months later (Figure 2a). Repeat MRV is shown in Figure 2b. At this time, the intraocular pressure was normal bilaterally.

DISCUSSION

In this study, the two most common predisposing factors for CVT were OCP use and infections. The patients had higher frequencies of motor deficits and parenchymal lesions on neuroimaging. Interestingly, there was no patient with protein S deficiency. More of our study patients had central nervous system (CNS) infections.

Majority of our study patients were women, similar to the literature.[4,5] Women were more likely to develop CVT because of OCP use, pregnancy and puerperium.[4,5] In our study, interestingly there were more Malay men who had CVT compared to nun-Malays with statistical significance. There was a tendency for Malay patients to have good functional outcome on discharge compared to non-Malays. A possible reason was more Malay men had CVT, and men had better functional outcome on discharge.

The mean age of 43.51 in this study was higher than the mean age in the ISCVT study (39.1) the Indian study (31.3) and Saudi Arabian study (29.5).[16-18] Headache was the sole manifestation in 6.1% of the patients in the current study, and this was a lower percentage compared to other studies (14-32%).[5,8,18] There was a higher frequency of motor deficits (49%) in our study patients as compared to previous studies (20-45%).[1,2,4,5,10,16,20]

In the present study, the most common predisposing factor was use of oral contraceptive pills (OCPs); 18.4% of the patients took OCPs, a lower percentage compared to a study in

Table 1b: Radiological features

	Patients, n=49
Locations for CVT (n, %)	
Superior sagittal sinus	41 (83.7%)
Transverse sinus	22 (44.9%)
Sigmoid sinus	14 (28.6%)
Internal jugular vein	9 (18.4%)
Inferior sagittal sinus	4 (8.2%)
Straight sinus	3 (6.1%)
Internal cerebral vein and vein of Galen (deep CVT)	1 (2%)
Venous infarcts	
Frontal	16 (32.7%)
Parietal	12 (24.5%)
Temporal	6 (12.2%)
Occipital	3 (6.1%)
Brainstem	1 (2.0%)
Intracerebral haemorrhage (ICH) (n, %)	
Frontal	11 (22.4%)
Parietal	7 (14.3%)
Temporal	2 (4.1%)
Occipital	2 (4.1%)
Interhemispheric fissure	1 (2.0%)

Table 1c: Clinical outcome

	Patients, n=49
mRS on discharge (n, %)	
0	6 (12.2%)
1	15 (30.6%)
2	9 (18.4%)
3	3 (6.1%)
4	11 (22.4%)
5	2 (4.1%)
6	3 (6.1%)
Clinical outcome on discharge (n, %)	
Good outcome (mRS 0-2)	30 (61.2%)
Poor outcome (mRS 3-6)	19 (38.8%)
mRS at 6 months (n, %)	
0	8 (16.3%)
1	13 (26.5%)
2	1 (2%)
3	4 (8.2%)
4	2 (4.1%)
5	0
6	5 (10.2%)
mRS not available (lost to follow-up)	16 (32.7%)
Clinical outcome at 6 months (n, %)	
Good outcome (mRS 0-2)	22 (66.7%)
Poor outcome (mRS 3-6)	11 (33.3%)

Table 2a: Univariate analysis of factors determining poor functional outcome on discharge

	Poor functional outcome, n=19	Good functional outcome, n=30	P value
Gender (n, %)			
Female	17 (89.5)	13 (43.3)	***0.002***
Male	2 (10.5)	17 (56.7)	
Ethnic group (n, %)			
Malay	2 (10.5)	10 (33.3)	0.17
Chinese	6 (31.6)	6 (20)	
Indian	4 (21.1)	9 (30)	
Others	7 (36.8)	5 (16.7)	
Age more than 37 (n, %)			
Yes	14 (73.7)	15 (50)	0.14
No	5 (26.3)	15 (50)	
Headache (n, %)			
Yes	15 (78.9)	22 (73.3)	0.74
No	4 (21.1)	8 (26.7)	
Motor deficits (n, %)			
Yes	12 (63.2)	12 (40)	0.15
No	7 (36.8)	18 (60)	
Seizures (n, %)			
Yes	12 (63.2)	9 (30)	***0.037***
No	7 (36.8)	21 (70)	
GCS of less than 9 on admission (n, %)			
Yes	2 (10.5)	2 (6.7)	0.64
No	17 (89.5)	28 (93.3)	
Infection (n, %)			
Yes	1 (5.3)	5 (16.7)	0.38
No	18 (94.7)	25 (83.3)	
Malignancy			
Yes	0	3 (10)	0.27
No	19 (100)	27 (90)	
Prothrombotic disorder (out of 34 patients) (n, %)			
Yes	2 (14.3)	2 (10)	1.00
No	12 (85.7)	18 (90)	
Cerebral infarcts (n, %)			
Yes	12 (63.2)	14 (46.7)	0.38
No	7 (36.8)	16 (53.3)	
Intracerebral haemorrhage (n, %)			
Yes	10 (52.6)	9 (30)	0.14
No	9 (47.4)	21 (70)	
Cerebral oedema (n, %)			
Yes	9(47.4)	4(13.3)	***0.018***
No	10(52.6)	26(86.7)	
Raised intracranial pressure (n, %)			
Yes	5(26.3)	3(10)	0.23
No	14(73.7)	27(90)	

Table 2b: Logistic regression of factors determining poor functional outcome on discharge

	β	p-value	Odds ratio	95% CI
Female gender	2.674	***0.007***	14.50	2.10-99.94
Seizures	1.877	***0.021***	6.54	1.33-32.07
Cerebral oedema	1.375	0.086	3.95	0.82-19.00

Table 3: Univariate analysis of factors determining poor functional outcome at 6 months

	Poor functional outcome, n=11	Good functional outcome, n=22	P value
Gender (n, %)			
Female	7 (63.6)	14 (63.6)	1.00
Male	4 (36.4)	8 (36.4)	
Ethnic group (n, %)			
Malay	3 (27.3)	6 (27.3)	0.95
Chinese	4 (36.4)	5 (22.7)	
Indian	3 (27.3)	9 (40.9)	
Others	1 (9.1)	2 (9.1)	
Age more than 37 (n, %)			
Yes	8 (72.7)	11 (50)	0.28
No	3 (27.3)	11 (50)	
Headache (n, %)			
Yes	6 (54.5)	17 (77.3)	0.24
No	5 (45.5)	5 (22.7)	
Motor deficits (n, %)			
Yes	8 (72.7)	12 (54.5)	0.46
No	3 (27.3)	10 (45.5)	
Seizures (n, %)			
Yes	7 (63.6)	10 (45.5)	0.47
No	4 (36.4)	12 (54.5)	
GCS of less than 9 on admission (n, %)			
Yes	3 (27.3)	1 (4.5)	0.097
No	8 (72.7)	21 (95.5)	
Infection (n, %)			
Yes	2 (18.2)	2 (9.1)	0.59
No	9 (81.8)	20 (90.9)	
Malignancy			
Yes	1 (9.1)	1 (4.5)	1.00
No	10 (90.9)	21 (95.5)	
Prothrombotic disorder (n, %)			
Yes	1 (16.7)	2 (11.8)	1.00
No	5 (83.3)	15 (88.2)	
Cerebral infarcts (n, %)			
Yes	8 (72.7)	12 (54.5)	0.46
No	3 (27.3)	10 (45.5)	
Intracerebral haemorrhage (n, %)			
Yes	4 (36.4)	8 (36.4)	1.00
No	7 (63.6)	14 (63.6)	
Cerebral oedema (n, %)			
Yes	4 (36.4)	5 (22.7)	0.44
No	7 (63.6)	17 (77.3)	
Raised intracranial pressure (n, %)			
Yes	2 (18.2)	3 (13.6)	1.00
No	9 (81.8)	19 (86.4)	

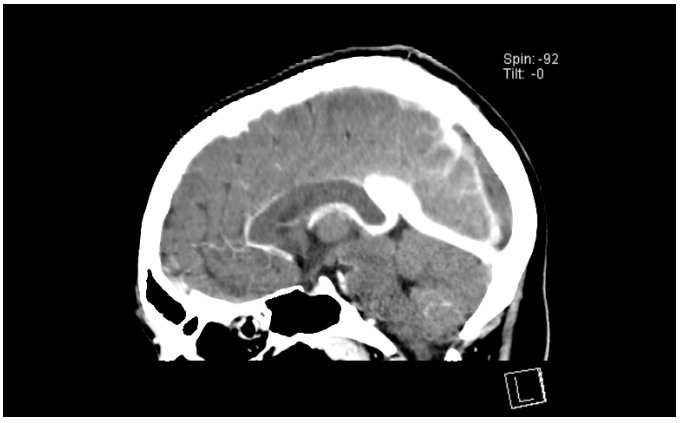


Figure 1a. CT brain with contrast showing thrombosis of posterior aspect of superior sagittal sinus

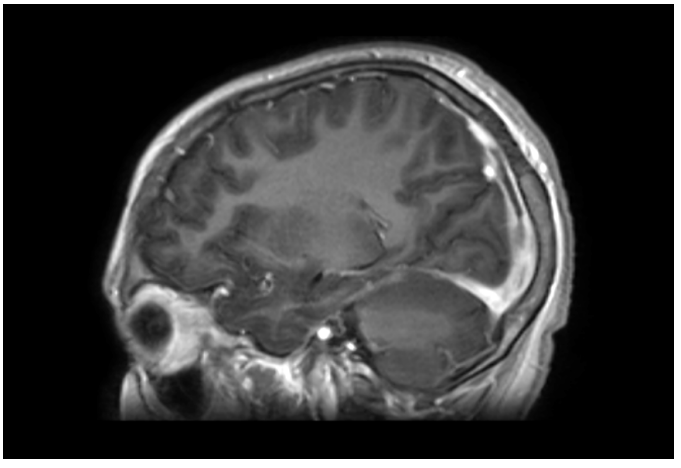
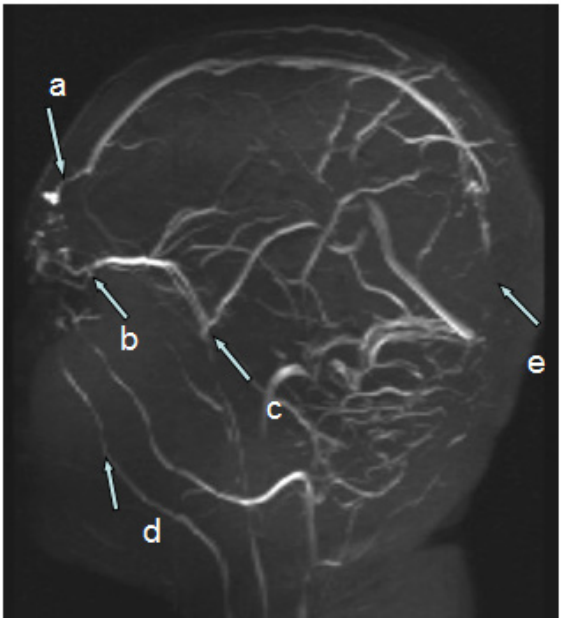
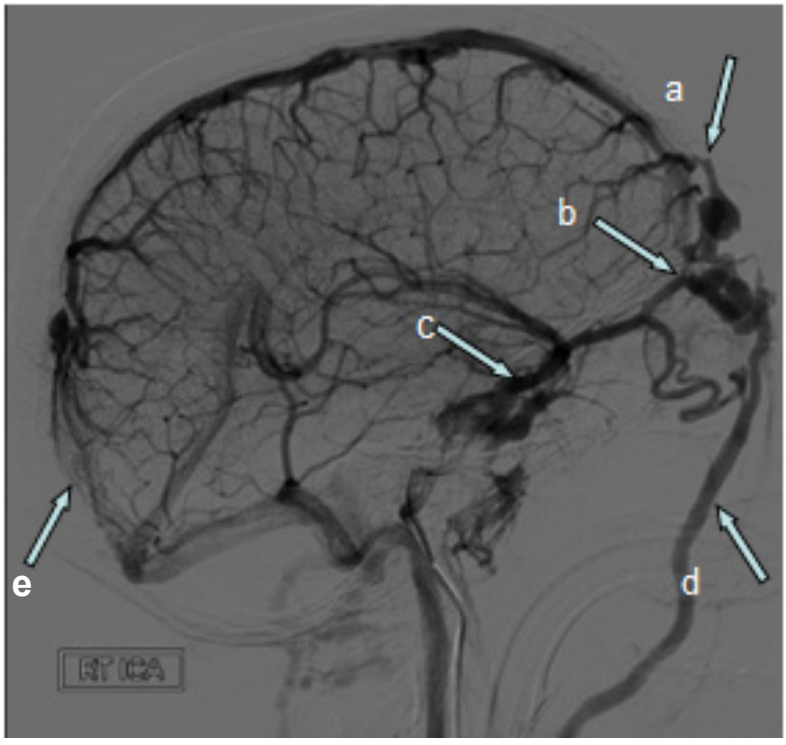


Figure 1b. MRI of the brain showing thrombosis of posterior aspect of superior sagittal sinus and left transverse sinus



a – cortical vein
b – superior ophthalmic vein
c – cavernous sinus
d – facial vein
e – sagittal sinus

Figure 1c: MRV of the brain showing venous collateral from the superficial cortical vein which drain into the right cavernous sinus through the right superior ophthalmic vein



a – cortical vein
b – superior ophthalmic vein
c – cavernous sinus
d – facial vein
e – sagittal sinus

Figure 2a: Venous phase of the right internal carotid angiogram after completed anticoagulation shows complete recanalization of occluded sinus (arrow) with persistent cortical venous collateral which drain into superior ophthalmic vein and then to the cavernous sinus and facial vein

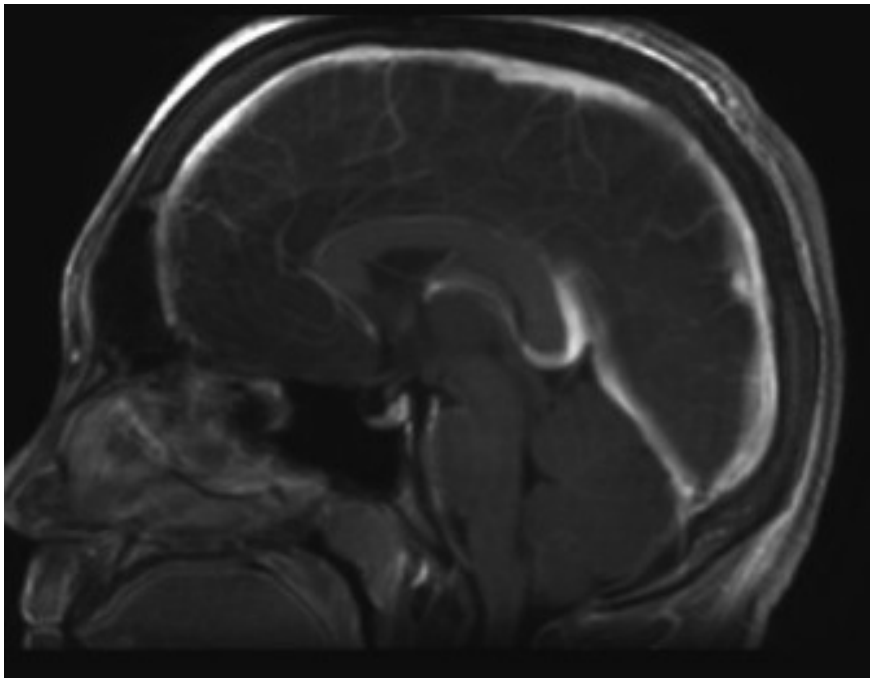


Figure 2b: Sagittal MRI brain (enhanced) shows complete recanalization of the sagittal sinus.

Thailand (23.4%).[12] Furthermore, the proportion was much lower in comparison with a Western study (55.5%).[5] This could probably due to lack of education.[21] In previous studies conducted by Narayanan *et al*. (India) and Khealani *et al*. (Pakistan/UAE), the use of OCP was reported to be only 11.45 and 14% respectively.[10,17]

The second most common predisposing factor in this study was infection (12.2%), and this frequency was nearly similar to the frequency in the South Korean study.[9] Infections were the second most common cause of CVT in Pakistan/UAE (18%) and Morroco (26%).[10] Eight percent of our patients had central nervous system (CNS) infection, which was a higher percentage compared to a previous study (5%).[10]

In our patients, only 11.8% of the patients with CVT had prothrombotic disorder. This percentage was lower than the reported percentage in a South Korean study (35%).[9]

8.8% of the patients in the current study had inherited prothrombotic disorder, and this was within the range reported in previous studies (5-22%).[2,3,10,16,22-24]

In this study, there were 6.4% of the patients with protein C deficiency, and this was within the range reported in United Arab Emirates (UAE), Pakistan, Japan and South Korea (4.5%-8.3%).[8,10,25] Moreover, only-2% had antithrombin III deficiency, which was within the range in the studies conducted in India, UAE, Pakistan and Japan (2%-7%).[8,10,22] Whereas no patient in our study had protein S deficiency in our study, in comparison to previous studies in UAE, Pakistan, India, Japan and South Korea (4.8%-70%).[8,10,17,22,25,26]

In our study, only 4.1% of the CVT patients were pregnant. In addition, no patient was in puerperium, and this was different from the study conducted in Pakistan/United Arab Emirates (17%) and India (9.8%).[10,17] CVT significantly contributes to pregnancy-related strokes in the Asian women in the literature.[27]

Interestingly, only 16.3% of our patients presented with multiple risk factors, similar to an Indian study (17.9%).[17] Notably, the Asian studies reported much lower frequency of multiple risk factors compared to the West (44%).[2,3,5] A higher number of our patients (42.9%) had idiopathic CVT, in contrast to other studies (8%-20%).[5,6,16,28]

One distinctive feature in this study was the higher percentage of patients (77.6%) with parenchymal lesions on neuroimaging, whereas only 44-48.3% had parenchymal brain lesions reported in other studies.[2,23,29] Furthermore, 53.1% of our patients had venous infarcts, and this was slightly higher than the reported 24.5-47% of in other studies.[1,16,20,30] Moreover, 38.8% had intracerebral haemorrhage, which was within the range reported in previous studies (37.4-44%).[1,5,12,16,29]

In the current study, the common locations of thrombosis were the superior sagittal sinus (83.7%), and the percentage was higher than studies in Thailand (74.7%), Pakistan/United Arab Emirates (71%), India (74%), Kuwait (54.5%) and Iran (56.5%).[10,12,20,22,28] In terms of deep CVT, 2.5% of our patients had deep CVT, in comparison to 12% in the study by Yii *et al*.[1]

In our study, 38.8% of the patients had poor functional outcome on discharge, and this was within the range reported in the studies in Pakistan, United Arab Emirates (UAE, Thailand and Japan (13.6-45.9%).[8,10,12] Female gender was more likely to be associated with poor functional outcome on discharge compared to the male gender. This was different from previous studies as male gender was associated with less favourable outcome in the literature.[2,16,31]

In this study, there was a trend towards poorer functional outcome on discharge and at six months in CVT patients with venous infarcts, in concordance with another study.[1,10,32] The poor outcome in the patients with venous infarcts can be attributed to progression of thrombus to the collateral veins.[1,33]

Generally, CVT is associated with low in-hospital mortality rate.[1-3,5,16,23] The in-hospital mortality rates in various studies in Asia were 6.4-8.2%.[10,12,17] One patient with deep CVT died during hospitalisation in this study. Deep CVT is associated with poorer outcome in the literature compared to CVT in the other sites.[2,3,16,31]

Venous collaterals secondary to CVT are uncommon in the literature.[34-37] Venous collaterals are usually found in the patients with CVT during the acute phase.[35]

These collaterals contribute to better outcome in the patients with CVT.[34-37] The venous collateral channels play a vital role in connecting the intracranial circulation to the extracranial circulation for subsequent systemic drainage.[34,36] The collaterals function as shunts or conduits from the cortical vein to the cavernous vein.[34-37] Furthermore, regular monitoring of the intraocular pressure is necessary in the patients with papilloedema.

The strength of this study was the inclusion of patients from different ethnic groups over a 11 year period. So far, there is no literature on CVT

in Malays. In addition to the Malays, Chinese and Indians, this study also included patients from the other South East Asian countries such as Philippines, Indonesia and Vietnam. There is also no literature on CVT from these countries.

There were several study limitations. The limitations were the small sample size from a single centre and the retrospective design of study. In addition, some patients did not have blood tests for thrombophilia due to logistical and financial reasons. Only the clinical outcome (mRS) for 33 patients were available at six months (a follow up rate of 67%).

In conclusion, the most common symptom was headache. This CVT study of multiple ethnic groups representing the population in South East Asia had a higher proportion of CNS infections compared to other parts of the world. Moreover, there was lower frequency of pregnancy and post-partum complications compared to other regions in the world. Poor outcome was independently associated with female gender and seizures.

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