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CASE REPORT

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# Cranial venous sinus thrombosis following early spontaneous abortion: a case report and literature review

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## Abstract

**Background** Pregnancy/puerperium cranial venous sinus thrombosis (CVST) is rare, mainly occurring in perinatal/late pregnancy, and less frequently in early pregnancy. None has been reported after early spontaneous abortion.

**Case report** This study reports a case of CVST following early pregnancy spontaneous abortion in a patient with no known risk factors such as hypertension, diabetes, coagulopathy, or antiphospholipid syndrome. Following aggressive endovascular thrombectomy and thrombolytic treatment with 300,000 units of urokinase administered through a catheter, the patient experienced marked improvement in headache symptoms, with nausea and vomiting completely resolving. Four days later, a repeat magnetic resonance venography scan demonstrated successful recanalization of the intracranial venous sinuses, accompanied by a notable decrease in D-dimer levels upon reassessment.

**Conclusion** For young patients with early pregnancy bleeding, comprehensive coagulation function and D-dimer tests could be conducted. Even after a spontaneous abortion, if the patient presents with symptoms such as headache, vomiting, or visual impairment, the possibility of pregnancy-associated CVST should be considered, and an immediate head CT or MRI should be arranged. In cases complicated by cerebral hemorrhage, endovascular thrombectomy and thrombolysis can be performed.

**Keywords** Cranial Venous Sinus Thrombosis, First Trimester Pregnancy, Early Pregnancy Loss

## Background

Cranial venous sinus thrombosis (CVST) is a rare event. In the general population, the annual incidence of CVST is about 7 per million in neonates and children and approximately 2 to 5 per million in adults [1]. Reports indicate that women are three times more likely to develop CVST than men, predominantly during pregnancy and oral hormone therapy, although the incidence has significantly decreased with the use of low-dose estrogen formulations. Approximately 22.4% of individuals have a genetic predisposition to thrombosis, and 5.9% possess antiphospholipid antibodies [2]. Common causes include malignancies such as adenocarcinoma, hematological disorders, and the peripartum or late pregnancy period. According to the reports, the highest risk of CVST related to pregnancy and puerperium is in the late pregnancy or the first four weeks after delivery [3, 4]. So far, there have been no reports of CVST occurring after early spontaneous abortion. Other factors include trauma, inflammation, antiphospholipid syndrome, and inherited hypercoagulable states (factor V Leiden

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mutation, protein S and C deficiencies, prothrombin mutation, and hyperhomocysteinemia) [5]. The mortality rates vary by region, currently ranging from approximately 11% to 20% [6].

A meta-analysis on CVST during pregnancy and the postpartum period reviewed 66 cases of pregnancy-associated CVST with an average age of 26.5 years [7]. Of these, 36% occurred during pregnancy and 64% postpartum. Seventy percent of the patients were primigravida. The most common clinical presentations included headache, seizures, motor deficits, coma or syncope, and visual disturbances. At least six instances were initially misdiagnosed due to imaging results that erroneously indicated negative findings. Some were diagnosed after patients experienced post-dural puncture headaches and eclamptic seizures. Hence, pregnancy-associated CVST is prone to misdiagnosis and oversight. The incidence is even lower in early pregnancy and often misdiagnosed due to nausea and vomiting associated with hyperemesis gravidarum, leading to further neglect.

Pregnancy-associated CVST may involve abnormalities in coagulation factors; triggers include antiphospholipid syndrome, hypertension, and pregnancy-induced hypertension. CVST commonly occurs during the peripartum and late pregnancy periods, while it is rare during early pregnancy [8]. There have been no reported cases of CVST occurring after spontaneous abortion in early pregnancy.

This study reports a case of CVST post spontaneous abortion in early pregnancy without any specific precipitating factors.

## Case report

A 38-year-old Han Chinese patient had a record of one normal childbirth approximately 10 years ago. Her child is currently in good health, and she had never sought medical treatment for infertility issues. Her past medical history was unremarkable, with no significant medical history, no hypertension, diabetes, prior miscarriages, or any other significant conditions. Prior to the onset of her current condition, she did not experience any fever. She has never taken oral contraceptive pills or other hormonal medications.

She visited People's Hospital of Putuo District in Zhoushan on November 23, 2023 due to 47 days delayed menstruation. The blood test results showed that human chorionic gonadotropin (HCG) was 6595 IU/L (normal range, 0–5.3 IU/L), and progesterone was 47.01 nmol/L. Ultrasound examination indicated a 10*18 mm cystic dark area in the uterine cavity. At 7 + weeks of her current pregnancy, she experienced symptoms of spontaneous abortion. HCG levels significantly decreased, On December 1, a follow-up blood test showed that HCG decreased to 829.30 IU/L, leading to an outpatient diagnosis of spontaneous abortion.

On December 5, she presented with severe headache lasting a day, predominantly on the right side, accompanied by nausea and vomiting twice.

Physical examination revealed: temperature 37.5 °C, blood pressure 148/90 mmHg, heart rate 96 beats/min, clear consciousness, and no motor impairments, Peripheral arterial pulse can be felt.

Emergency head computed tomography (CT) scan suggested an intracerebral hemorrhage localized in the right temporal lobe, accompanied by a small amount of subarachnoid hemorrhage, and increased density in the right transverse sinus suggestive of venous sinus thrombosis (Fig. 1A). computed tomography angiography (CTA) revealed vertebral and basilar artery fenestration abnormalities. There was about 8 ml hemorrhage in the right temporal lobe, accompanied by a small amount of subarachnoid hemorrhage. The left transverse and sigmoid sinuses were clearer in imaging compared to the right, and suspected right venous sinus thrombosis (Fig. 1B). The laboratory tests indicated progressively rising D-dimer levels. Liver and kidney function, coagulation profile, blood glucose, and lipid levels were unremarkable. Thyroid function tests indicated the presence of gestational hyperthyroidism. Blood routine showed slightly elevated inflammatory markers. Procalcitonin was 0.03 ng/ml (normal range < 0.5 ng/ml); interleukin-6 was 23.4 pg/ml (normal range < 7 pg/ml). Plasma protein C activity was 73%, and plasma protein S activity was 77%. Tests for antineutrophil cytoplasmic antibodies, antinuclear antibodies, and anticardiolipin antibodies were all negative. Complement C3 and C4 were within the normal range. The patient's clinical presentation exhibits similarities to moyamoya disease and migraine. However, upon examination, several key findings from the CTA scan rule out these conditions. Specifically, the absence of distal artery stenosis or occlusion in the CTA excludes moyamoya disease. Furthermore, the lack of any observable changes in gray matter volume, white matter damage, cortical alterations, or infarction-like brain injury indicates that migraine can be discounted.

The patient was referred to the Second Affiliated Hospital Zhejiang University School of Medicine. Magnetic resonance venography (MRV) angiography showed non-visualization of the right transverse and sigmoid sinuses, indicative of extensive venous sinus thrombosis (Fig. 2A, B, C).

Under local anesthesia, the right femoral vein was punctured, and an 8F vascular sheath was placed. A 6F 90 cm MAX catheter was introduced along the vascular sheath to the right internal jugular bulb. A 6F silverspeed catheter was introduced to the transverse sinus

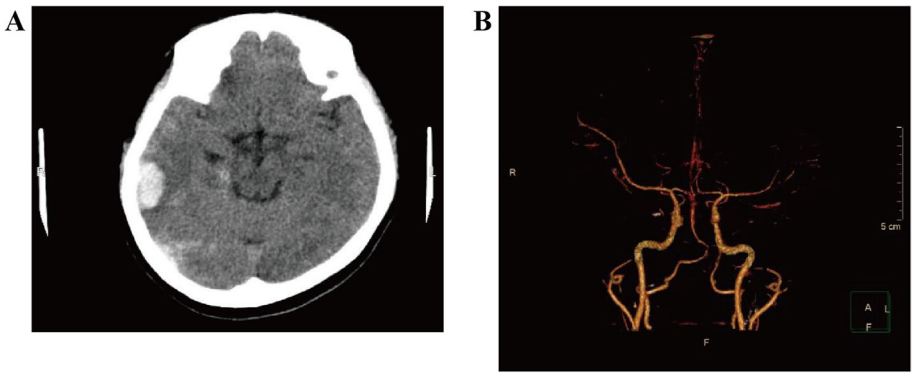


**Fig. 1** CT and CTA imaging manifestations. **A** CT scan suggested intracerebral hemorrhage in the right temporal lobe, minor subarachnoid hemorrhage, and increased density in the right transverse sinus suggestive of venous sinus thrombosis, **B** CTA revealed hemorrhage in the right temporal lobe, minor subarachnoid hemorrhage, clearer imaging of the left transverse and sigmoid sinuses compared to the right, and suspected right venous sinus thrombosis

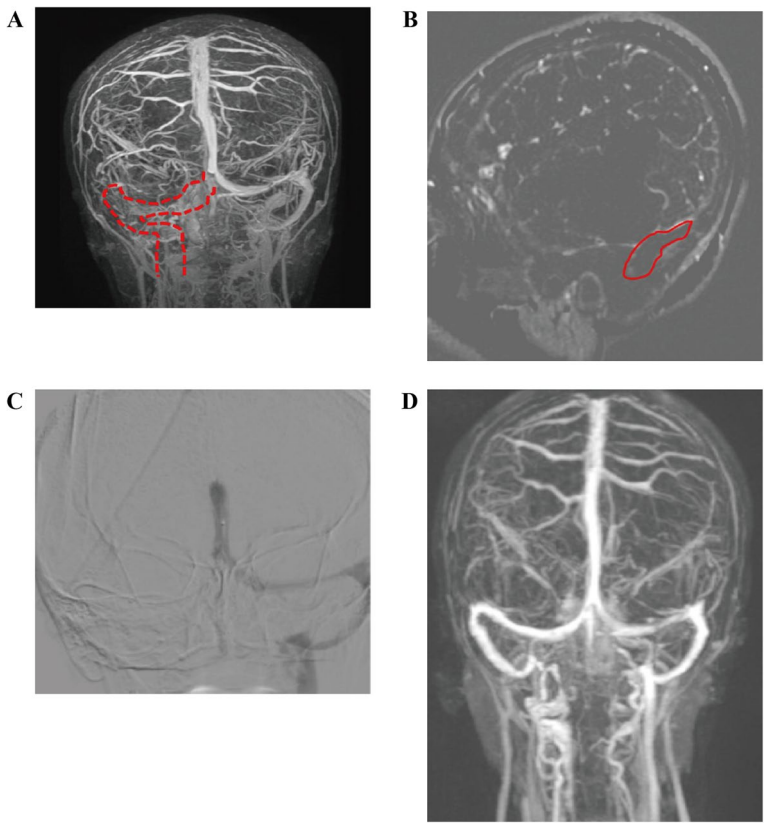


**Fig. 2** MRV performance before and after treatment. **A**, **B**, **C** MRV showed non-visualization of the right transverse and sigmoid sinuses, indicative of extensive venous sinus thrombosis. **D** A follow-up MRV indicated recanalization of the cerebral venous sinuses

to aspirate a large amount of thrombus. A microcatheter and a microwire were used together to catheterize the tip of the microcatheter to the superior sagittal sinus. The microcatheter was withdrawn, and a 4*60 mm balloon was introduced along the microwire to dilate the thrombus segment. Then, the microcatheter was exchanged and placed, and angiography confirmed that the catheter position was good. The microcatheter was slowly withdrawn while infusing urokinase segment by segment through the microcatheter, a total of 300,000

units. The microcatheter was then returned to the transverse sinus thrombus, and the microcatheter, 6F long sheath, and silverspeed catheter were retained, followed by heparin to maintain the activated partial thromboplastin time at 60–90 s. Four days later, a follow-up MRV indicated recanalization of the cerebral venous sinuses (Fig. 2D). A significant decrease in D-dimer levels was observed.

Subsequently, long-term oral anticoagulation therapy with warfarin was initiated, and coagulation function was tested every 1–2 weeks to adjust the dosage of warfarin and maintain the international normalized ratio between 2 and 3. The result of HCG reexamination on January 29th was < 0.1 IU/L. The follow-up CT scan indicated changes due to sequelae of cerebral hemorrhage. There are patchy hypodense shadows in the right temporal-occipital lobe with relatively clear boundaries. Some of the linear hyperdense shadows in the cerebral sulci and cisterns have been absorbed. Currently, the patient still experiences headaches but no nausea or vomiting, motor impairments, speech, or visual disturbances.

## Discussion

CVST refers to the abnormal coagulation of blood within the cerebral venous sinuses, leading to partial or complete luminal obstruction. It accounts for less than 1% of all strokes. CVST is more common in children, young adults, pregnant women, females on oral contraceptives, and individuals under 45 years of age. The incidence of pregnancy-related CVST is approximately 6.3% [9]. The occurrence of CVST in early pregnancy is extremely rare, with only a few cases reported so far [8]. CVST can be categorized into inflammatory and non-inflammatory types. In the inflammatory type, the cavernous and transverse sinuses are most frequently affected, while the superior sagittal sinus is commonly involved in the non-inflammatory type [10]. Thrombosis of the cavernous sinus is often secondary to purulent mastoiditis or otitis media [11]. Recent cases of CVST associated with the ChAdOx1 nCoV-19 vaccine. It has been reported that vaccination with AstraZeneca and Johnson & Johnson's COVID-19 vaccines may be associated with CVST and thrombocytopenia [12]. The patient in this case had been vaccinated with vaccines from Sinovac Research & Development Co., Ltd, with the most recent vaccination in December 2022. There have been no relevant reports indicating a correlation, and it is unclear whether the patient's illness is related to COVID-19 vaccination.

Cerebral venous occlusions progress to cerebral venous infarction. Subsequent pathophysiological changes include venous and capillary dilatation, interstitial cerebral edema, increased cerebrospinal fluid (CSF) production, decreased CSF absorption, and cerebral venous rupture (hematoma), leading to elevated venous pressure. The Elevation of venous pressure and the increase in vascular wall permeability leads to the extravasation of red blood cells. Decreased cerebral blood flow and decreased energy levels causing cellular dysfunction, which subsequently triggers secondary cerebral edema [13, 14]. Consequently, CVST may lead to inadequate cerebral cell blood supply, cerebral edema, increased intracranial pressure, and secondary cerebral hemorrhage, manifesting as headache, vomiting, and cerebral bleeding [15].

The risk factors of CVST include prethrombotic state, autoimmune diseases, pregnancy, systemic diseases, cancer, infections, iatrogenic causes, and so on [16]. Pregnancy and childbirth are independent risk factors for CVST. Common causes and precipitating factors for pregnancy-related CVST include: 1) Dehydration, hyperemesis gravidarum leading to hypovolemia [17]; 2) Hypercoagulable states, such as protein C and S deficiencies [18, 19], antithrombin deficiency [20, 21], and antiphospholipid syndrome (APS) [22]; 3) Autoimmune diseases like Behçet's disease; 4) Other factors like hematological diseases and heterozygous factor V Leiden (FVL) mutation [17]. Studies [23] suggest hypertension as an independent risk factor for CVST in pregnant women, with preeclampsia or eclampsia being the strongest risk factors for stroke. Eclampsia can increase the risk of stroke in pregnant women by 65 times.

During early pregnancy, severe nausea and vomiting can lead to significant fluid loss and hypovolemia; increased levels of clotting factors including fibrinogen, prothrombin, and factors V, VII, and VIII; increased whole blood viscosity and enhanced platelet adhesion and aggregation; and decreased levels and activity of protein S, contributing to a hypercoagulable state [24]. Prolonged bed rest for medical reasons can slow blood flow, promoting thrombus formation. Postpartum hemorrhage can concentrate blood, increasing its viscosity, and factors like prolonged bed rest postpartum can increase the risk of CVST. Thrombus formation can obstruct venous return, with pregnancy-related CVST commonly occurring in the superior sagittal sinus (70%) and transverse/sigmoid sinus (58%) [7].

Most patients with pregnancy and postpartum CVST have high-risk factors, with APS being common. Primary antiphospholipid syndrome (PAPS) is an autoimmune disease characterized by thrombosis, occurring at a rate of about 2.5% [25], most frequently in the lower limbs, with less common occurrences in upper limbs, cerebral veins, inferior vena cava, portal vein, renal vein, and retinal vein [26]. It often leads to pregnancy complications, characterized by elevated levels of antiphospholipid antibodies (APL) such as anticardiolipin antibodies and lupus anticoagulants (LA). Patients often experience venous

and arterial thrombosis, thrombocytopenia, cerebral vasculitis, and vascular lesions, leading to recurrent miscarriages, preterm birth, or intrauterine fetal death [27].

The patient's CTA revealed fenestration of the vertebral and basilar arteries. The most common cause of fenestration of the vertebral and basilar arteries is congenital dysplasia. It may lead to moyamoya disease and cerebral infarction. At present, there are no reports of combined CVST or other venous thrombotic diseases. We speculate that fenestration of the vertebral and basilar arteries may not be related to CVST.

Thyroid function test results: Free Triiodothyronine (FT3) at 8.36 pmol/L (normal range: 3.1–6.8); Free Thyroxine (FT4) at 34.33 pmol/L (normal range: 12–22); Thyroid Stimulating Hormone (TSH) at 0.06 μIU/ML (normal range for early pregnancy: 0.09–4.52); Anti-Thyroid Peroxidase Antibody (Anti-TPO) at 436.9 IU/ml (normal range: < 34). In hyperthyroid patients, anticoagulant function indicators are lower than those in healthy individuals, with intensified fibrinolysis inhibition and marked activation of the coagulation system, indicating a more severe hypercoagulable state [28]. Hyperthyroidism can disrupt endothelial function [29], and when it occurs in pregnant women, the already abnormal endothelial function becomes even more pronounced, further exacerbating the hypercoagulable state and leading to a sustained tendency for thrombosis and an increased risk of blood clots.

The patient has no history of immune-related diseases, tumors, or infectious diseases, which are potential risk factors. Her plasma Protein C activity is 73%, and plasma Protein S activity is 77%. It is possible that the occurrence of CVST may be due to unknown factors such as thrombophilia or mere coincidence. Considering her early pregnancy miscarriage and concurrent gestational hyperthyroidism, we speculate that these factors might have contributed to a hypercoagulable state, triggering CVST. Thrombophilia not only increases the risk of thrombosis during pregnancy but is also associated with various adverse pregnancy outcomes. Studies have found that hereditary thrombophilia accounts for 20% to 50% of pregnancy-related venous thromboembolism [30, 31]. It is also possible that her thrombophilia contributed to her miscarriage. Since this study only reports a single case, further research is needed to explore the underlying causes and risk factors.

CVST is less common among ischemic cerebrovascular diseases, with pregnancy-related CVST predominantly occurring in the peripartum and late pregnancy periods, and less frequently in early pregnancy. A study by Zhou Qi [32] found that among 15,625 pregnant women who gave birth at Xuanwu Hospital from January 2002 to October 2009, the incidence of CVST during pregnancy and the postpartum period was 0.15%, with 29% occurring during pregnancy and 71% postpartum. Since 1988, there have been 10 cases of early pregnancy with CVST were reported, as shown in Table 1, the average age was 27.5 years, with an average gestational age of 8 + weeks. One patient, misdiagnosed with Wernicke-Korsakoff syndrome due to frequent nausea and vomiting, suffered a miscarriage and eventually developed sequelae of hemiplegia and aphasia despite aggressive treatment. Other patients experienced varying degrees of headache, but one patient's symptoms were initially mild, leading to a 9-day delay in diagnosis. She was suspected of bacterial meningitis and underwent lumbar puncture but fortunately only had minor right-eye visual field defects after treatment. Anticoagulant therapy with heparin or endovascular thrombectomy and thrombolysis may alleviate the condition and allow the patient to continue the pregnancy until delivery. Five patients underwent successful childbirth after prolonged anticoagulation therapy, two of whom had hematological diseases; one patient with positive antiphospholipid antibodies gave birth successfully and maintained on long-term antiepileptic drugs. Another five patients had their pregnancies terminated due to symptoms of miscarriage or serious illness after treatment.

CVST during early pregnancy is uncommon and tends to affect young women, with atypical clinical symptoms. Headache is reported in 70–80% of patients, often accompanied by motor dysfunction, aphasia, and other cerebrovascular accident symptoms [7]. CVST in early pregnancy is rare and can be confused with common pregnancy symptoms like headache [34], vomiting, nausea [33, 35, 36], somnolence [37, 39]. Laboratory tests may not reveal any specific findings, but D-dimer levels are often significantly elevated in CVST cases. CT is the primary diagnostic tool, showing abnormal density in the occluded venous sinuses, with or without bleeding. MRV can clearly demonstrate venous sinus thrombosis, providing definitive diagnosis [9]. T2SW imaging has additional diagnostic value for CVT. Even in cases where there is no visible occlusion on MRV, T2 susceptibility-weighted imaging (97%) and T1-weighted spin echo image (78%) detect thrombosed cortical veins more frequently than fluid-attenuated inversion recovery or diffusion-weighted images (< 40%) [38, 40]. In this study, the patient presented with headache post-spontaneous abortion, and fortunately, an immediate head CT scan detected the condition in time.

Regarding treatment, it can be treated with thrombolytic agents, such as streptokinase or tissue plasminogen activator. These are commonly used to treat post-pregnancy CVST without increasing the risk of complications [39, 41]. Some studies [40, 42] suggest that decompressive

**Table 1** 10 cases of early pregnancy with CVST

| Reported year and authors | Age | Gestational weeks | Possible inducement | Clinical symptoms | CT/MRI performance | Treatment | Pregnancy outcome | Sequelae |
|---|---|---|---|---|---|---|---|---|
| Raphael BertanRaphael Bertani [33] 2020 | 28 | 9 | hyperemesis gravidarum | nausea, emesis, confusion, and impaired balance | CT angiography revealed a significant filling defect on the TS | decompressive hemicraniectomy | spontaneous abortion | hemiplegia and aphasia, still presented residual motor deficits |
| Junkoh Yamamoto [34] 2013 | 32 | 9 | without obvious inducement | Mild headache, headache worse after 9 days | DSA reveal completely thrombosed SSS and right TS, vein of Galen, and SS, as well as engorgement of superficial veins | osmotic diuretics and sedation in the intensive care unit. An emergency right-sided decompression craniotomy was later performed | spontaneous abortion | only a slight visual field defect in the right eye |
| M. Oktem [35] 2013 | 25 | 6 | intrauterine insemination | moderate headache, nausea, vomiting, and pain particularly in the orbital region | Thrombosis in the sigmoid sinus, SSS and TS was reported on cranial MRV | Low-molecular weight heparin throughout the pregnancy | Full-term spontaneous delivery | without further complications |
| R. Mohamed, J. Am [36] 2012 | 25 | 8 | without obvious inducement | Headache and vomiting, neck stiffness and photophobia, conscious level started to decrease | CT showed a hyperdense SSS, right TS and SS with no evidence of acute intracranial bleed | low dose molecular heparin | full-term spontaneous delivery | without further complications |
| M. M. Kennelly [17] 2008 | 26 | 11 | Heterozygous factor V Leiden (FVL) mutation | vomiting, headaches and tonic clonic seizures, drowsy with a left homonymous hemianopia and brisk tendon reflexes in the left upper and lower limbs | Contrast-enhanced MR venogram showing complete occlusion of the SSS | she was transferred to Neuroradiology for venography and direct catheter thrombolysis with tissue plasminogen activator (tPA) | delivery via cesarean section | without further complications |
| W. J. MCAuley [21] 2005 | 32 | 11 | gestational hypertension; antithrombin deficiency | Headache, vomiting and visual impairment | Magnetic resonance angiography shows extensive SSS venous thrombosis | Anticoagulant therapy with heparin and warfarin | Full-term spontaneous delivery | Lifetime oral warfarin |
| Ohta Y [37] 1988 | 26 | 6 | without obvious inducement | Headache, nausea, vomiting and diplopia | CT shows extensive areas of hypo-absorption at the right posterior cerebral spine with irregular areas of hyper-absorption mixed in dots | anticoagulant therapy | Termination of pregnancy by artificial abortion | left upper corner blind |

**Table 1** (continued)

| Reported year and authors | Age | Gestational weeks | Possible inducement | Clinical symptoms | CT/MRI performance | Treatment | Pregnancy outcome | Sequelae |
|---|---|---|---|---|---|---|---|---|
| Quanmin Nie [38] 2015 | 27 | 5 | without obvious inducement | acute onset of severe diffuse headache and slurred speech | MRV showed that the left transverse and sigmoid sinuses were completely occluded | Mannitol; dose-adjusted low molecular heparin. oral warfarin when repeat CT showed subsidence of cerebral hemorrhage | Termination of pregnancy by artificial abortion | without further complications |
| Xuemin Feng [8] 2018 | 34 | 10 | without obvious inducement | experience headache and seizures | MRV showed the right transverse sagittal and sigmoid sinus were occluded | control the seizures, mannitol. dose-adjusted low-molecular-weight heparin was administered | abortion | without further complications |
| Tharangrut Hanprasertpong [22] 2009 | 20 | 10 | Antiphospholipid syndrome; LA positive | Headache and right hemiplegia | MRI presented a mixed-staged thrombus in the SSS and acute stage thrombi in the right frontal vein, right parietal cortical vein, right TS and right sigmoid sinus | 40 mg of s.c. nadroparin sodium twice daily, | Full-term spontaneous delivery | The patient continued taking antiepileptic drugs |

*SSS* Superior sagittal sinus, *TS* transverse sinus, *SS* straight sinus, *s.c.* subcutaneous injection

hemicraniectomy can eliminate the formation of fatal brain herniation, achieving good outcomes in the most severe CVST cases, especially in patients who failed multiple conservative or endovascular thrombolytic treatments. Early pregnancy patients are often treated with intracranial pressure reduction (craniotomy or mannitol) or low molecular weight heparin, and some benefit from these treatments and successfully deliver their babies [34, 35, 41]. Some studies have utilized heparin therapy in postpartum or post-abortion patients with CVST, administering 2500 units of subcutaneous heparin three times daily, starting within 24 h of diagnosis and continuing until 30 days postpartum or until symptom resolution. They have concluded that low-dose heparin is safe and effective in the treatment of postpartum CVST [42–44]. However, CVST patients often develop secondary bleeding, making thrombolytic therapy potentially hazardous. Though the evidence is not fully conclusive, thrombectomy can be considered for non-pregnant patients without immediate life-threatening danger [33, 35]. Jiansheng Yang et al. [44, 45] proposed that balloon-assisted thrombectomy and intravenous urokinase thrombolysis for CVST are safe and effective options. In this case, where the patient already developed cerebral hemorrhage, thrombectomy was not only necessary but also proved to be a highly successful treatment option. The specific treatment approach should be based on a comprehensive assessment of the patient's condition, the continuation of pregnancy, and the family's treatment preference.

To date, no cases of CVST following early pregnancy miscarriage have been reported. In this case, no precipitating factors such as severe hyperemesis gravidarum, hereditary coagulation disorders, or antiphospholipid antibodies were identified. The patient developed severe headache and was found to have extensive thrombosis with hemorrhage upon medical consultation. She recovered well after aggressive treatment. The exact cause remains unknown; it may be induced by blood hypercoagulation caused by combined pregnancy with hyperthyroidism. It may be related to the hypercoagulable state during pregnancy and the concentration of blood due to excessive bleeding during spontaneous abortion, thereby promoting thrombus formation. Alternatively, thrombosis might have led to the miscarriage, with the condition worsening post-miscarriage, leading to thrombosis formation. The formation of thrombus in the uterine wound after spontaneous abortion, and the use of uterine contraction drugs may cause the thrombus to fall off and induce CVST. This also alerts us about the possibility of CVST after spontaneous abortion. Early identification of high-risk groups and the use of anticoagulant drugs may reduce its incidence. At the same time, reducing the use of uterine contraction drugs after spontaneous abortion may also reduce its incidence and benefit patients. Timely intravascular thrombectomy and thrombolysis can achieve better results. CVST is a relatively rare occurrence, but it can happen at any stage of pregnancy, even during early pregnancy abortions. It is hoped that this case will draw the attention of obstetricians and gynecologists to prevent misdiagnosis and missed diagnosis. Furthermore, it is important to take preventive measures to reduce the risk of recurrent abortions or CVST during subsequent pregnancies in such patients. We would like to introduce this case to suggest that early spontaneous abortion may also lead to the occurrence of CVST. However, current research is limited, and a single case report is not representative. Further prospective studies are needed.

## Conclusion

A woman with no obvious risk factors developed CVST shortly after an early spontaneous abortion. This is rare, and there may be a potential relationship, where either the early spontaneous abortion may lead to the development of CVST, or perhaps CVST made the spontaneous abortion inevitable. For young patients with early pregnancy bleeding, comprehensive coagulation function and D-dimer tests could be conducted. Even after a spontaneous abortion, if the patient presents with symptoms such as headache, vomiting, or visual impairment, the possibility of pregnancy-associated CVST should be considered, and an immediate head CT or MRI should be arranged. In cases complicated by cerebral hemorrhage, endovascular thrombectomy and thrombolysis can be performed.

#### Abbreviations

| | |
|---|---|
| CVST | Cranial venous sinus thrombosis |
| HCG | Human chorionic gonadotrophin |
| CT | Computed Tomography |
| CTA | Computed Tomography Angiography |
| MRI | Magnetic resonance imaging |
| MRV | Magnetic resonance venography |
| CSF | Cerebrospinal fluid |
| APS | Antiphospholipid syndrome |
| LA | Lupus anticoagulants |
| APL | Antiphospholipid antibodies |

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#### Authors' contributions

NW collected data. HZ wrote the paper. HL and LH analyzed the data. HZ and NW reviewed and verified all the raw data. All authors read and approved the final manuscript.

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#### Data availability

The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request.

## Declarations

### Ethics approval and consent to participate
Not applicable.

### Consent for publication
Written consent for publication was obtained from the patient. We declare that the patient has been informed and agrees to publish identifiable information in open access journals.

### Competing interests
The authors declare no competing interests.

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