ORIGINAL ARTICLE

# INTRACRANIAL VENOUS SINUS THROMBOSIS: RADIOLOGIC DIAGNOSIS

***TROMBOSE DOS SEIOS INTRACRANIANOS: DIAGNÓSTICO RADIOLÓGICO***

**Joanna Pimentel de Vasconcelos[1], Marcos Antônio Barbosa da Silva[2], Rafael Jackes Péres[3], Isadora Silva de Lira[1], David Placido Lopes[2], Fernando Augusto Pacífico[2]**

**[1] Medical student at Faculdade de Medicina de Olinda - FMO | [2] Professor at Faculdade de Medicina de Olinda - FMO | [3] Medical student at Faculdade Pernambucana de Saúde – FPS**

## ABSTRACT

**Introduction:** Intracranial venous sinus thrombosis is a rare condition whose diagnosis may be established using computed tomography (CT), magnetic resonance imaging (MRI), or catheter angiography. **Case report:** A 27-year-old female patient with severe holocranial headache, retroocular pulsating pain, visual blurring, and seizure for two hours. She started oral contraceptive use 45 days before symptom onset. A cranial CT revealed no significant abnormalities. However, catheter angiography demonstrated delayed venous drainage, congestion of the cortical veins, and filling defects in cerebral venous sinuses, consistent with extensive dural sinus thrombosis. **Comments:** MRI is the most sensitive technique for visualizing parenchymal or hemorrhagic sequelae of intracranial venous sinus thrombosis. MRI associated with contrast venography offers comparable diagnostic performance in detecting obstructions in intracranial venous structures. Catheter angiography is recommended for cases with inconclusive CT and MRI or for individuals undergoing endovascular procedures.

**Keywords:** Angiography; Venous thrombosis; Intracranial sinus thrombosis; Lateral sinus thrombosis; Sagittal sinus thrombosis.

## RESUMO

**Introdução:** A trombose do seio venoso cerebral é uma condição rara cujo diagnóstico pode ser realizado pela tomografia computadorizada, ressonância magnética ou por angiografia por cateterismo. **Relato do caso:** Paciente do sexo feminino, 27 anos, com quadro de cefaleia intensa holocraniana, pulsátil retro-ocular e turvação visual, além de crise convulsiva há duas horas. A paciente refere que iniciou o uso de anticoncepcional oral há 1 mês e 15 dias, sendo submetida ao exame de tomografia computadorizada do crânio, no qual não foram evidênciadas alterações significativas. No entanto, no exame de arteriografia cerebral foi evidenciada drenagem venosa apresentando lentificação no fluxo, com congestão importante das veias corticais e falhas de enchimento nos seios venosos cerebrais compatíveis com trombose extensa dos seios durais. **Comentários:** A ressonância magnética é o método mais sensível para visualizar sequelas parenquimatosas e/ou hemorrágicas da trombose do seio venoso cerebral. Por outro lado, a venografia por ressonância magnética quanto a venografia por contraste são métodos quase equivalentes para detectar obstrução das estruturas venosas intracranianas. No entanto, a angiografia por cateter deve sempre ser considerada para pacientes com TC e RM inconclusiva ou para candidatos submetidos a procedimentos endovasculares.

**Palavras-chave:** Arteriografia; Trombose venosa; Trombose dos seios intracranianos; Trombose do seio lateral; Trombose do seio sagital

## INTRODUCTION

Intracranial venous sinus thrombosis (ICVST) is a rare condition, with an annual incidence of about three to four cases per one million individuals, accounting for less than 1% of all strokes[1].

Most adult cases involve individuals aged 40 years or younger[2]. The superior sagittal and the transverse sinuses are the most frequently affected sites (60%), followed by the internal jugular and internal cortical veins (20%)[1]. Predisposing conditions, such as oral contraceptive use, pregnancy, and the puerperium, contribute to the predominance of women among ICVST patients, accounting for about 75% of cases. Obesity combined with oral contraceptive use presents a particularly high risk[2].

In this study, the patient initiated oral contraceptive use 45 days before the onset of symptoms and reported no history of seizures, hypertension, or diabetes. Neurological examination revealed mild neck rigidity, no motor deficits, drowsiness, and a facial expression indicative of intense headache. Fundoscopy demonstrated papilledema more pronounced on the left side.

Non-contrast cranial computed tomography (CT) showed no parenchymal abnormalities; preserved ventricular system topography, morphology, and dimensions; no alterations in the sulci, fissures, and cisterns; no abnormalities in the cerebellum and brain stem. No extra-axial collections were observed, and intracranial angiography was indicated.

The International Study on Cerebral Venous and Dural Sinus Thrombosis, which included 624 individuals, identified the most common symptoms as headache (88.8%), seizures (39.3%), paresis (37.2%), papilledema (28.3%), and mental status changes (22.0%) [3]. Diagnosis may be made by CT, magnetic resonance imaging (MRI), or catheter angiography[1 2].

Anticoagulation constitutes the cornerstone of ICVST treatment, aiming to block clot propagation and promote venous recanalization. Although clinical trial data are limited, anticoagulation is not contraindicated in intracranial hemorrhage. Endovascular procedures are reserved for individuals presenting severe or rapidly worsening neurological symptoms despite appropriate anticoagulation[1].

The present study aimed to report a rare ICVST diagnosis based on clinical findings and catheter angiography.

## CASE REPORT

The study was approved by the research ethics committee of the Faculdade de Medicina of Olinda (no. 43998421.0.0000.8033).

A 27-year-old female patient, referred by the mobile emergency care service, was admitted to the emergency department reporting severe holocranial headache, retroocular pulsation pain, and blurred vision. She also reported having suffered a seizure for two hours.

The examination was conducted through percutaneous puncture of the right common femoral artery, with selective catheterization of the aortic arch, common carotid arteries, and vertebral arteries. Non-ionic iodinated contrast was administered, and digital radiographic imaging was performed.

The following aspects were observed: (1) aortic arch and supra-aortic trunk without abnormalities; (2) internal carotid and vertebrobasilar system with smooth, regular walls, absence of dissections or arteritis, and without abnormalities in intracranial segments; (3) venous drainage demonstrating delayed flow, congestion of cortical veins, and filling defects in the superior sagittal sinus (Figure 1), transverse sinus, right sigmoid sinus, and jugular sinus in the proximal thirds, compatible with extensive thrombosis of the dural sinuses (Figure 2).

The patient received initial treatment with an anticonvulsant (Gardenal 200 mg) and full anticoagulation (Clexane 60 mg) for five days. Clinical improvement was observed during this period, after which anticoagulant therapy was transitioned to oral Warfarin. The patient was discharged after ten days without a headache. Fundoscopy, CT, and electroencephalogram showed no alterations at discharge. Oral anticoagulation with Warfarin was maintained for 12 months, and the patient was referred to a gynecologist for counseling about alternative contraceptive methods.

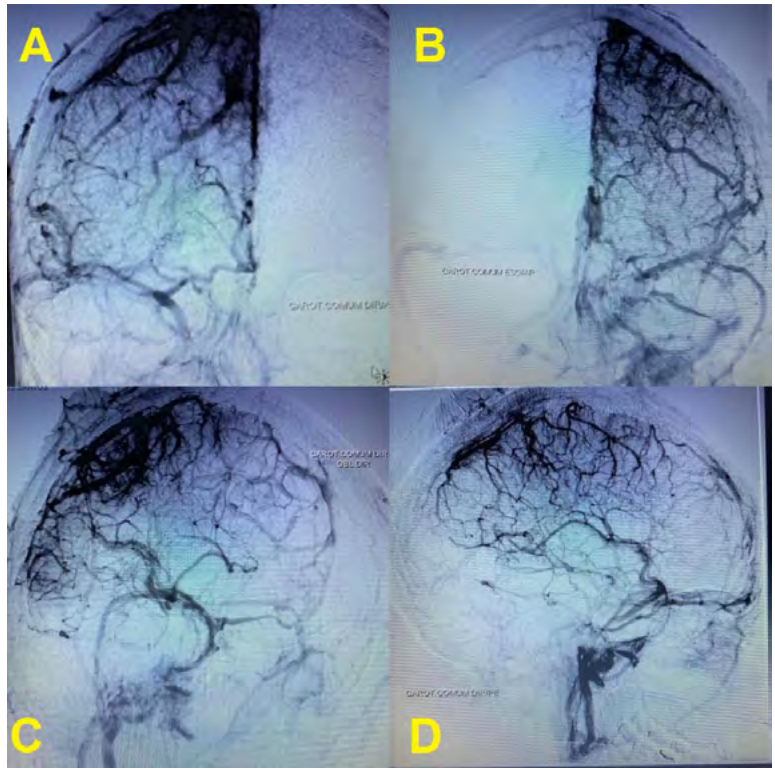


**Figure 1.** Arteriography of the internal carotid system, showing intracranial venous sinus thrombosis, specifically the superior sagittal sinus (yellow ellipses), with images captured in anteroposterior view showing cerebral venous drainage to the right (A), in anteroposterior view showing cerebral venous drainage to the left (B), in oblique view showing cerebral venous drainage to the right (C), and in profile view showing cerebral venous drainage to the left (D).

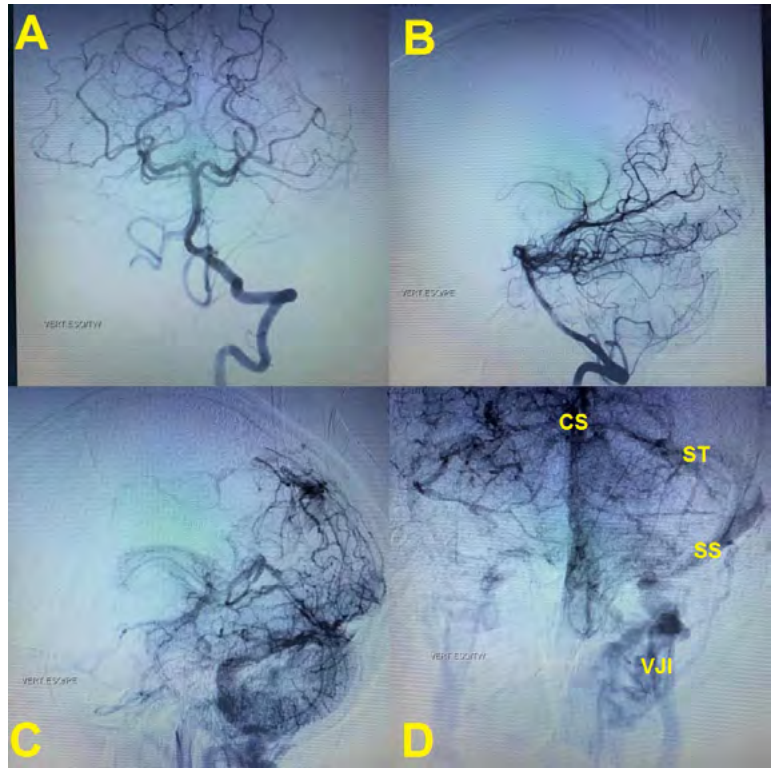


**Figure 2.** Arteriography of the vertebrobasilar system showing intracranial venous sinus thrombosis. Anteroposterior image of the vertebrobasilar irrigation (A), left profile image of the vertebrobasilar irrigation (B), left profile image of the cerebral drainage (C), and anteroposterior image of the cerebral drainage (D). CS: confluence of sinuses or torcula of Herophilus, TS: transverse sinus, SS: sigmoid sinuses, and IJV: internal jugular vein.

## COMMENTS

Considering the variability of collateral venous drainage and the dynamics of ICVST progression, the clinical presentation is highly heterogeneous and often nonspecific. Symptoms may range from acute to chronic, and severity may vary from asymptomatic to coma. Therefore, diagnosis is usually delayed, with an average of seven days from symptom onset to clinical manifestations[3].

Headache is usually the initial manifestation. Due to its specific nature, high clinical suspicion is warranted when faced with a new-onset, progressively worsening headache, which occurs as the sole symptom in about 32% of patients4.

The anatomical location of the headache does not correlate with the site of the thrombosis. The absence of headache is typical in older patients, particularly men5, and in those with cortical vein thrombosis and preserved cerebrospinal fluid homeostasis. The pathophysiological mechanism of headache is attributed to elevated intracranial pressure due to impaired cerebrospinal fluid reabsorption. For this reason, headache intensity tends to increase in the supine position and after the Valsalva maneuver. Although not fully elucidated, headache is more common in patients with ICVST than in arterial stroke, presenting in only 25% of cases6.

Seizures are more frequent in ICVST than in arterial stroke (2% to 9%)7, potentially related to the accumulation of catabolic products due to venous stasis. Papilledema results from intracranial hypertension and may cause diplopia and visual impairment. In the case of cavernous sinus thrombosis, additional manifestations include proptosis, orbital pain, chemosis, and ophthalmoplegia secondary to palsy of the oculomotor (III), trochlear (IV), and abducens (VI) cranial nerves[1]. Non-invasive brain imaging should be promptly performed in all patients with suspected ICVST[2].

For initial adult assessment, the first-line imaging technique is non-contrast intravenous CT to exclude differential diagnoses, such as brain tumors, abscesses, or arterial stroke. In the acute phase, the ICVST may appear as a hyperdense signal in the vessel lumen, transitioning to iso- or hypodense after the first week. Specific radiological signs include the dense triangle sign when the thrombosis is located in the superior sagittal sinus and the dense cord sign in the cortical and deep veins8.

However, these signs are uncommon due to the low sensitivity of non-contrast intravenous CT, with positive findings in only 30% of confirmed ICVST cases9. The use of contrast increases the sensitivity to 99% for sinus thrombosis and 88% for venous thrombosis, similar to those obtained with MRI 10,11. The empty delta sign, a filling defect in the middle of the venous lumen surrounded by peripheral contrast, may also be observed[1].

Non-contrast CT alone is insufficient to exclude ICVST and must be followed by contrast venography, which provides a three-dimensional view of the venous anatomy similar to MRI12 and is considered equally capable of diagnosing ICVST[2]. Furthermore, CT may provide superior visualization of osseous structures adjacent to the venous sinuses in suspected septic thrombosis than MRI[2].

CT offers the advantages of widespread availability in emergency settings and the ability to detect local complications associated with ICVST, such as subarachnoid or intraparenchymal hemorrhage or cerebral edema. The disadvantages include radiation exposure and the requirement for contrast agents to enhance diagnostic accuracy[1].

MRI remains the gold standard for ICVST diagnosis. Nevertheless, the sensitivity and specificity are uncertain due to the lack of adequate comparative studies using catheter angiography. Maximum accuracy is achieved by combining classical MRI sequences, capable of visualizing the thrombus, with venography, which demonstrates absent or diminished flow and distinguishes among hypoplastic sinuses, partial sinus occlusion, thrombosed cortical cerebral veins, and filling defects due to hyperplastic arachnoid granulations13-15. MRI is advantageous due to its absence of radiation exposure, limited need for intravenous contrast, and the ability to estimate the age of the clot [1].

Catheter angiography, formerly the gold standard, is now indicated in specific cases, particularly in patients with inconclusive MRI or CT findings, suspected vascular malformation (e.g., dural fistula), or when endovascular intervention is considered. Although contrast-enhanced transcranial ultrasound was useful in some cases, it has not been established as a diagnostic tool and requires a high level of examiner expertise [2].

In summary, MRI offers the highest sensitivity for visualizing parenchymal or hemorrhagic

sequelae of ICVST. MRI and contrast venography are nearly equivalent to detecting intracranial venous obstruction. Due to its practicality and speed, contrast venography is the initial diagnostic option, even in critically ill patients. However, MRI is preferable in younger individuals, pregnant women, and those with renal failure. Catheter angiography should be reserved for cases with inconclusive CT and MRI or those undergoing endovascular procedures

## REFERENCES


1. Li H, Cui L, Chen Z, Chen Y. Risk factors for early-onset seizures in patients with cerebral venous sinus thrombosis: A meta-analysis of observational studies. Seizure. 2019 Nov;72: 33-9.
2. Koennecke HC. Cerebral venous thrombosis in adults. Vasa. 2019 Nov; 48(6): 473-82.
3. Ferro JM, Canhão P, Stam J, Bousser MG, Barinagarrementeria F, ISCVT Investigators. Prognosis of cerebral vein and dural sinus thrombosis: results of the International Study on Cerebral Vein and Dural Sinus Thrombosis (ISCVT). Stroke. 2004 Mar; 35(3): 664-70.
4. de Bruijn SF, Stam J, Kappelle LJ. Thunderclap headache as first symptom of cerebral venous sinus thrombosis. CVST Study Group. Lancet. 1996 Dec 14; 348(9042):1623-5.
5. Coutinho JM, Stam J, Canhão P, Barinagarrementeria F, Bousser MG, Ferro JM; ISCVT Investigators. Cerebral venous thrombosis in the absence of headache. Stroke. 2015 Jan; 46(1): 245-7.
6. Vestergaard K, Andersen G, Nielsen MI, Jensen TS. Headache in stroke. Stroke. 1993 Nov; 24(11): 1621-4.
7. Davoudi V, Keyhanian K, Saadatnia M. Risk factors for remote seizure development in patients with cerebral vein and dural sinus thrombosis. Seizure. 2014 Feb; 23(2): 135-9.
8. Stam J. Thrombosis of the cerebral veins and sinuses. N Engl J Med 2005; 352: 1791-8.
9. Leach JL, Fortuna RB, Jones BV, Gaskill-Shipley MF. Imaging of cerebral venous thrombosis: current techniques, spectrum of findings, and diagnostic Pitfalls1. Radiographics 2006; 26: S19-41.
10. Linn J, Ertl-Wagner B, Seelos KC, Strupp M, Reiser M, Brückmann H, et al. Diagnostic value of multidetector-row CT angiography in the evaluation of thrombosis of the cerebral venous sinuses. AJNR Am J Neuroradiol. 2007 May; 28(5): 946-52.
11. Agrawal K, Burger K, Rothrock JF. Cerebral Sinus Thrombosis. Headache. 2016 Sep; 56(8): 1380-9.
12. Coutinho JM, van den Berg R, Zuurbier SM, VanBavel E, Troost D, Majoie CB, et al. Small juxtacortical hemorrhages in cerebral venous thrombosis. Ann Neurol. 2014 Jun; 75(6): 908-16.
13. Saposnik G, Barinagarrementeria F, Brown RD Jr, Bushnell CD, Cucchiara B, Cushman M, et al. Diagnosis and management of cerebral venous thrombosis: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2011 Apr; 42(4): 1158-92.
14. Bonneville F. Imaging of cerebral venous thrombosis. Diagn Interv Imaging. 2014 Dec; 95(12): 1145-50.
15. Weimar C. Diagnosis and treatment of cerebral venous and sinus thrombosis. Curr Neurol Neurosci Rep 2014; 14: 417.