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Case Report

Hypodense cerebral venous sinus thrombosis on unenhanced CT: A potential pitfall. Report of a case and review of the literature

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ARTICLE INFO

Article history:

Received 4 September 2019

Revised 7 October 2019

Accepted 9 October 2019

Available online 9 November 2019

Keywords:

Cerebral venous sinus thrombosis

Dural venous sinus thrombosis

Thrombosis

ABSTRACT

Cerebral venous sinus thrombosis is an uncommon disorder that requires prompt diagnosis and treatment to prevent serious complications. Due to the broad spectrum of clinical presentations, patients typically undergo noncontrast CT as the first imaging study. The classical description of cerebral venous sinus thrombosis on noncontrast CT is a hyperdense thrombus within the dural venous sinus. We report an unusual case of a hypodense cerebral venous sinus thrombosis on unenhanced CT imaging. It is important for radiologists to be aware of this atypical appearance that to our knowledge has not been previously published.

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Introduction

Cerebral venous sinus thrombosis (CVST) is an uncommon neurologic condition that may lead to serious complications including death. The clinical presentation is variable, including headache, focal neurologic deficits, seizure, and coma [1]. The preferred diagnostic exam for CVST is either CT venography or MR venography. However, due to the nonspecific presenting symptoms, the initial imaging exam is often a noncontrast CT (NCCT). The sensitivity of NCCT for the detection of CVST is limited, with normal findings in up to 25%-30% of cases [2]. Features of CVST on NCCT include direct visualization of a hyperdense thrombus within the venous sinus, present in 25% of cases [3]. Frequently, the thrombus is isodense to the venous sinus and therefore occult on NCCT.

Indirect signs of CVST include brain edema (20%-50% of cases), venous infarction, and hemorrhage [4].

CT venography is more sensitive compared to NCCT for the diagnosis of CVST. The typical finding is a triangular area of enhancement or high attenuation with a relatively low attenuation center within the region of the superior sagittal sinus (empty delta sign) [5]. Noncontrast MRI may show signal alterations within the venous sinuses indicative of thrombosis. Findings include direct visualization of an intraluminal thrombus (often T1 hyperintense) and lack of a normal flow void [2]. Contrast-enhanced MR venography and contrast-enhanced MR sequences (particularly 3D T1-weighted GRE) have higher sensitivity for CVST compared to noncontrast imaging [6]. The thrombus is depicted as a hypointense filling defect surrounded by hyperintense enhancing vascular structures.

Declaration of Competing Interest: None.

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<https://doi.org/10.1016/j.radcr.2019.10.012>

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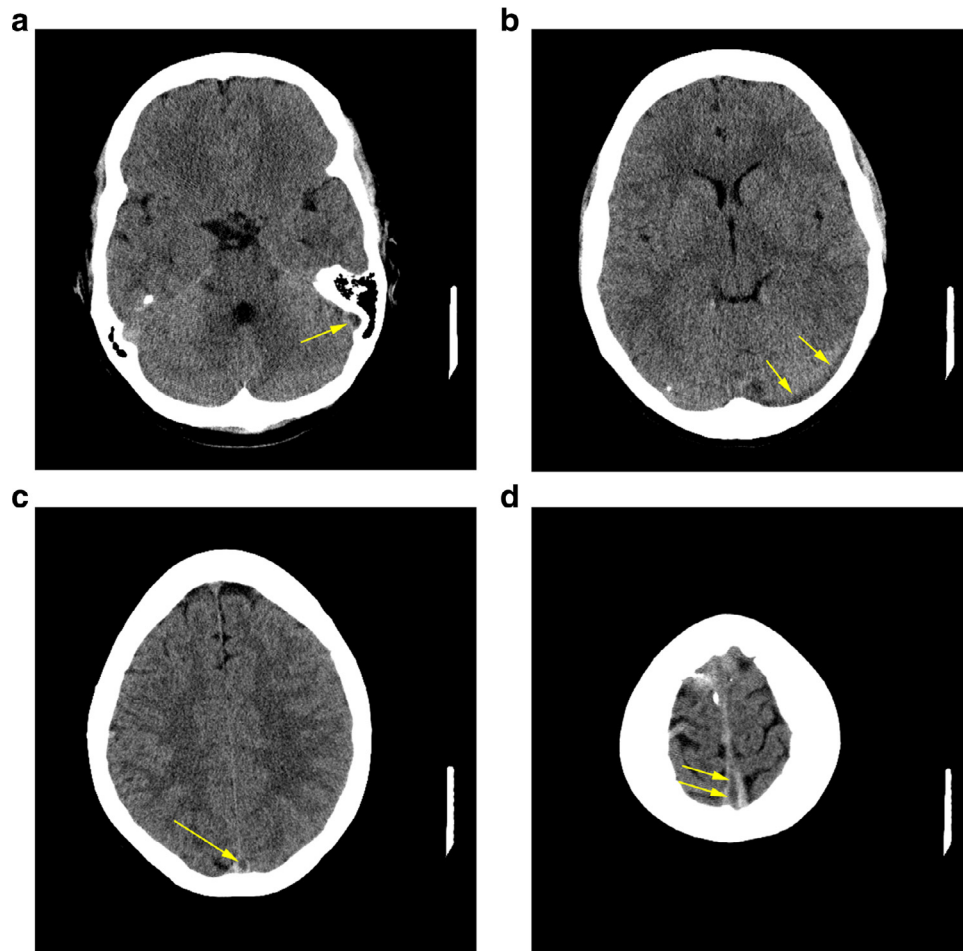


Fig. 1 - (a-d) CT demonstrates hypodense thrombus in the left sigmoid sinus (a), left transverse sinus (b), and superior sagittal sinus (c,d).

Case report

The patient is a 43 year old female who presented to the emergency department complaining of several episodes of transient right arm numbness and weakness during the prior 2 days. The patient had a history of migraine headaches that became severe 3 days prior to admission. Physical exam revealed mild right upper extremity weakness but was otherwise unremarkable. The patient's complete blood count revealed a normal hematocrit, hemoglobin, and RBC count.

A NCCT (Toshiba Aquilion 64, Canon Medical systems, Otawara, Japan, kvp 120, mA 220-280) performed during the Emergency room visit demonstrated extensive hypodense (25-26 HU) thrombus expanding the left sigmoid, left transverse, and superior sagittal sinuses (Fig. 1a-d). Images from the patient's comparison NCCT performed 4 years earlier demonstrated normal density and thickness of the venous sinuses (Fig. 2a-d). An MRI (1.5T GE Signa HDxt, General Electric Healthcare, Chicago, IL) performed the next day demonstrated extensive T1-hyperintense thrombus involving the superior sagittal sinus, left transverse sinus, and left sigmoid sinus (Fig. 3a-c). The T2-weighted images demonstrated high signal

thrombus within the involved venous sinuses (Fig. 3d). The CVST is depicted as a filling defect on the T1 post contrast images (0.1 mmol/kg Multihance, Bracco Diagnostics, Monroe Township, NJ) (Fig. 4). The time of flight MRV shows thrombosis of the superior sagittal, left transverse, and left sigmoid sinuses (Fig. 5). Appropriate anticoagulation was initiated and the patient's symptoms improved during the hospital admission. She was discharged on day 4 with no residual neurologic deficits.

Discussion

CVST is an uncommon neurologic condition that can have serious complications, including death, if not promptly diagnosed and treated. Patients can present with a wide range of clinical symptoms including headache, stroke like deficits, and coma. Although CT and MR venography are the preferred techniques for imaging CVST, the nonspecific presentation often initiates a NCCT as the first imaging exam. Radiologists are typically taught that the major sign of CVST on NCCT is a dense (60-90 HU) dural venous sinus. The hyperattenuation is

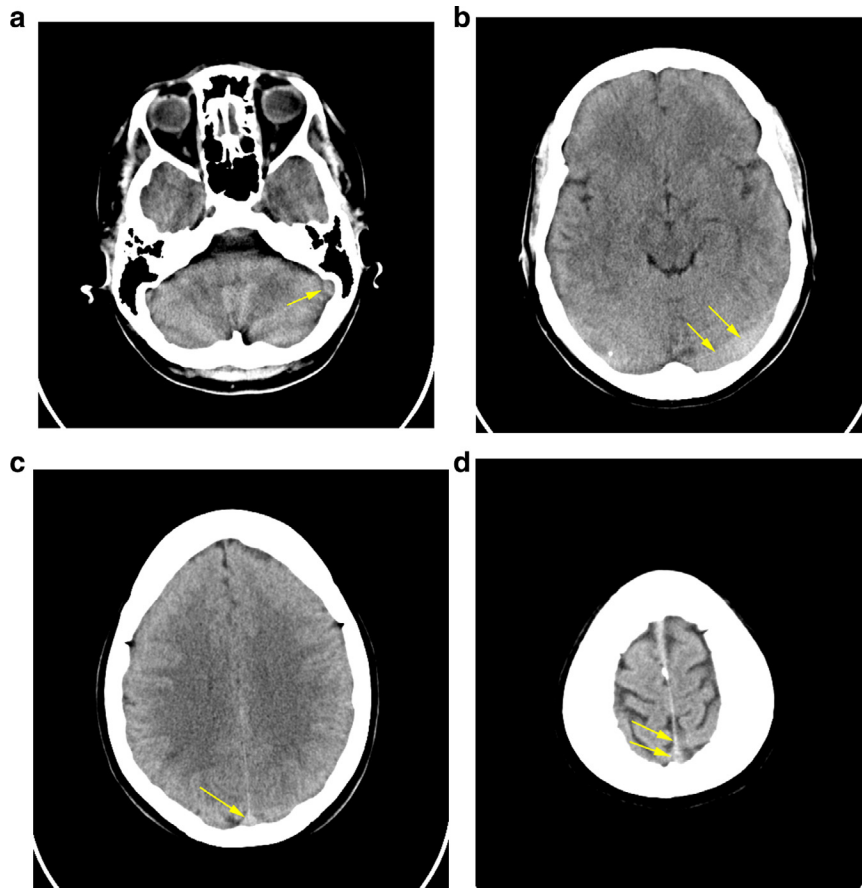


Fig 2 – (a-d) CT 4 years earlier demonstrates normal density of left sigmoid sinus (a), left transverse sinus (b), and sagittal sinus (c,d).

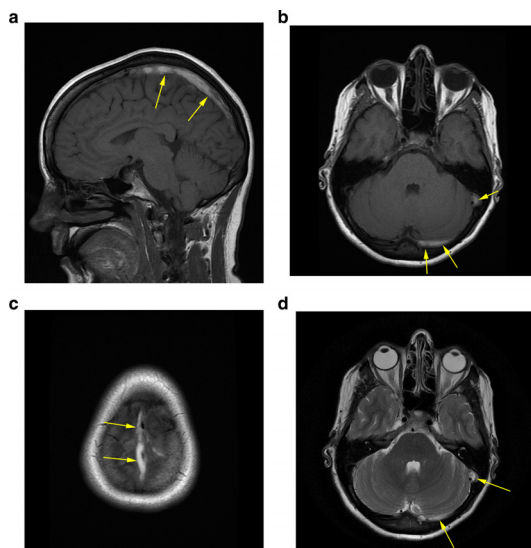


Fig. 3 – T1-weighted MRI shows hyperintense thrombus in the superior sagittal sinus (a), left transverse and sigmoid sinuses (b), and superior sagittal sinus (c). The thrombus is hyperintense on T2-weighted images (d).

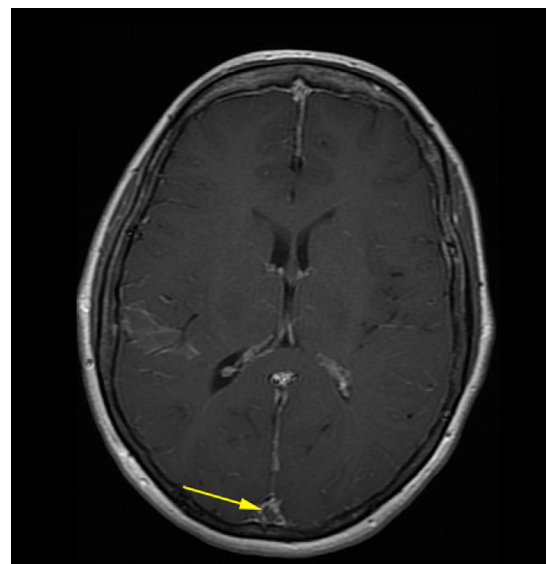


Fig. 4 – T1 post contrast axial MRI demonstrates hypointense thrombus as a filling defect in the superior sagittal sinus.

due to clot retraction with a reduction in water, leading to an increased concentration of hemoglobin and red blood cells. As

the clot ages (7-14 days) the density decreases to a level that can be indistinguishable from the venous sinus blood [7].

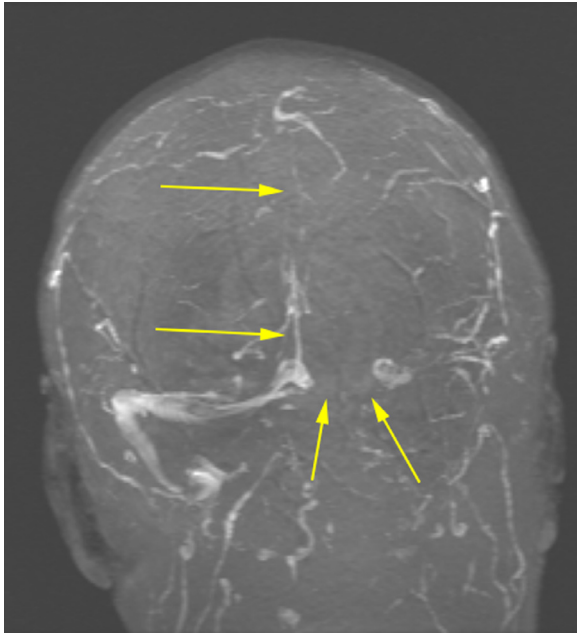


Fig. 5 – Time of flight MRI shows thrombosis of the left sigmoid, left transverse, and superior sagittal sinuses.

Black et al reported the dural venous sinus density in 166 patients without thrombosis ranged from 32 to 69 HU. Eight patients with CVST displayed sinus densities of 46–92 HU with a mean of 77 HU. They suggested a sinus density threshold of 70 HU may warrant further investigation for CVST [8]. Buyck et al report a mean venous sinus density of 52.8 HU in 20 patients without CVST and 73.9 HU in patients with the disease. They suggested that patients with venous sinus density of more than 62 HU, the diagnosis of acute CVST is more likely [7].

False negative cases of CVST on NCCT may be due to a small thrombosed dural venous sinus which can be difficult to assess adjacent to the high density skull. Additionally, volume averaging of a dense sinus with the adjacent brain may be falsely perceived as normal [9].

The most commonly reported reason for a false negative is a clot that is isodense to the normal venous sinus. In this patient, we identified CVST that was hypodense (18–39 HU) relative to the venous sinus (45–61 HU), an unusual appearance that may also result in a false negative interpretation. The differential diagnosis for a hypodense dural sinus on NCCT includes chronic thrombus, arachnoid granulation, dural sinus cyst, and dural sinus adipose tissue [10,11]. The thrombus in this patient was hyperintense on T1-weighted MRI se-

quences suggesting that it was subacute (6–15 days) [3]. We contemplate that the hypodense appearance of the thrombus in this patient is likely due to unusually rapid and intense evolution of the thrombus, manifested as a decreased proportion of high-density red blood cells and increased low-density fibrin [12].

Conclusion

The classic description of CVST on NCCT is that of a hyperdense thrombus within the venous sinus. We have shown that CVST can appear as a hypodense clot on NCCT. It is important for radiologists to recognize this atypical appearance to avoid a delay in diagnosis of this potentially fatal disease.

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