



Overlooked early CT signs of cerebral venous thrombosis with lethal outcome

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Abstract

The aim of this report is to emphasize the consequences of overlooked initial CT signs of cerebral venous thrombosis. Brain CT was ordered in an afebrile patient with neck pain and occipital headache. Since no abnormalities were noted on non-contrast CT study, the patient was discharged with recommendation for routine laboratory tests and plain X-ray of the cervical spine. Right hemiparesis developed the next day with persistent headache and the patient was sent back to the Neurology Clinic where he developed myoclonic seizures compatible with focal motor status epilepticus. Neuroimaging, performed two days later, revealed a huge hemorrhagic venous infarct in the left posterior cerebral hemisphere associated with typical signs of dural sinus thrombosis. Subtle curvilinear hyperdensities were detected within the left parietal cortico-subcortical border zone on reevaluation of the initial brain CT. A posteriori these were thought to be compatible with a developing venous infarct, associated with subtle signs most consistent with combined cortical vein and sinus thrombosis. No improvement was noted after administration of anticoagulant treatment and the patient died 11 days after the initial CT scan. Detection of early CT signs of cerebral venous thrombosis is extremely important, since delaying adequate treatment may have catastrophic consequences.

Introduction

Thrombosis of the cerebral veins and sinuses (TCVS) is an emergency condition resulting from venous congestion that may lead to regional ischemia and cortical infarction. Distinction between two mechanisms of this disorder is important: cortical vein thrombosis (CVT) produces local effects due to venous obstruction while thrombosis of the major dural sinuses (DST) causes intracranial hypertension (Stam, 2005). While in majority of occasions both entities occur together, isolated forms have been reported. Animal studies using experimentally produced cerebral venous thrombosis have shown that

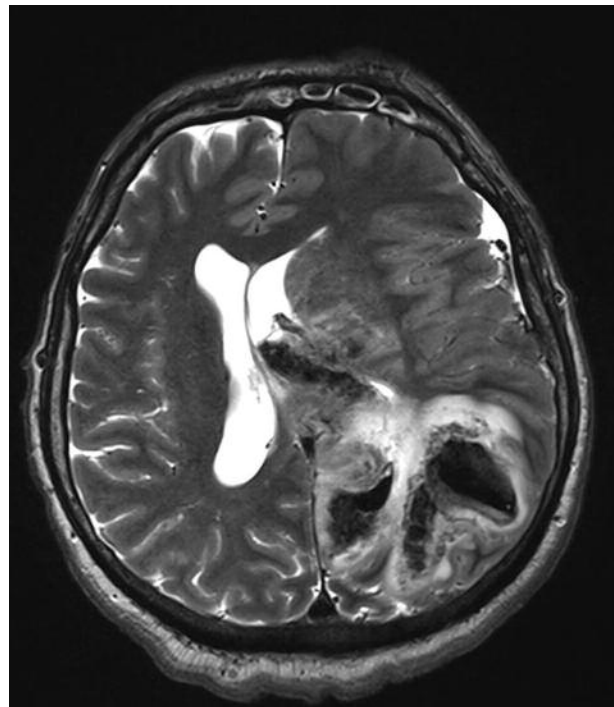


FIG. 1. — Brain MRI showing massive left parietal hemorrhagic infarct on T2W axial images associated with intraventricular hemorrhage.

parenchymal involvement is associated with the thrombosis of the cortical veins and does not occur with isolated sinus obstruction (Rother, 1996). Clinical presentation of this disorder is variable, markedly different from typical arterial stroke (Grotta, 1996; Grover, 2004). The purpose of this report is to increase the awareness of TCVS both in clinical and radiological practise in order to minimize the mortality rate.

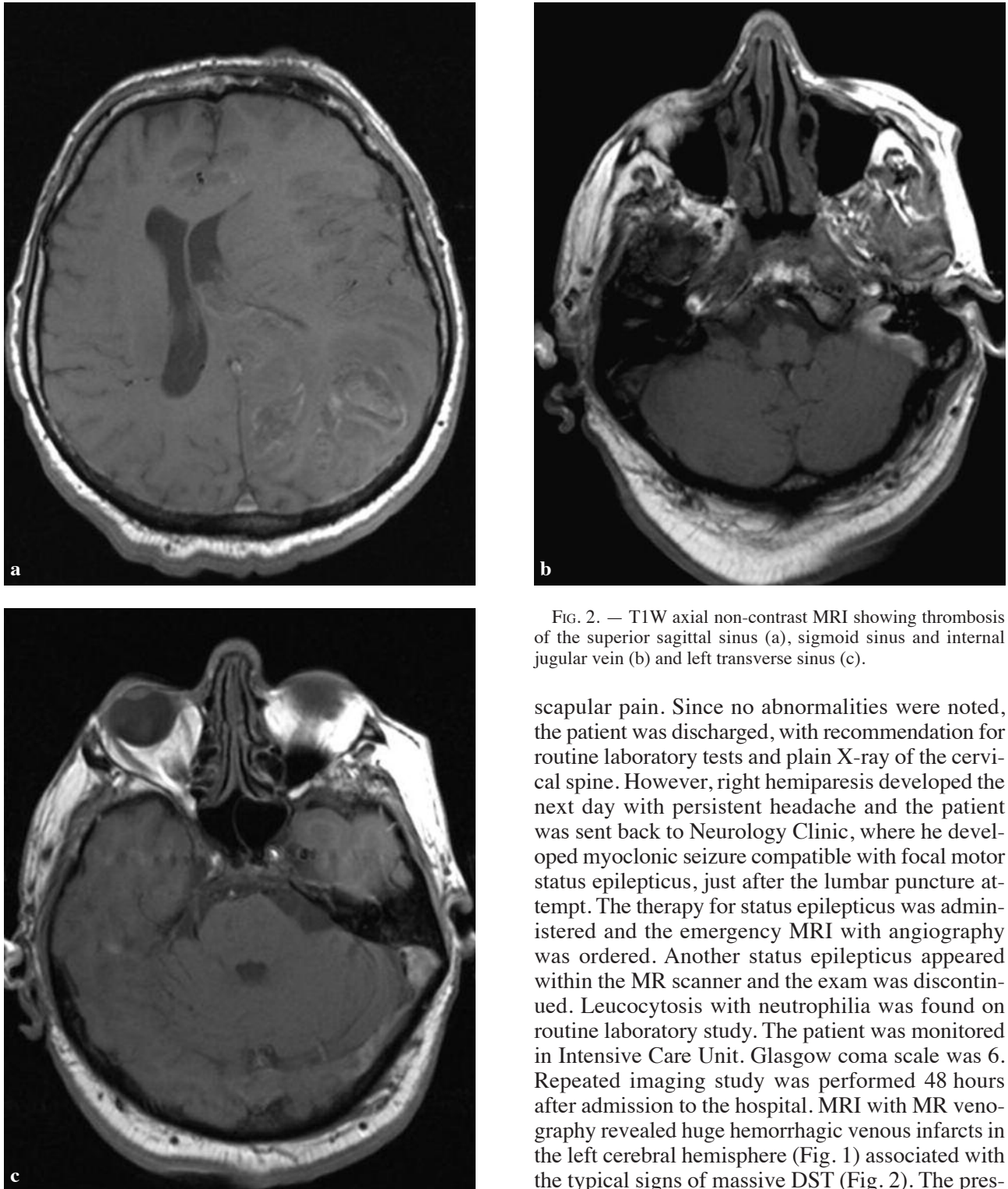


FIG. 2. — T1W axial non-contrast MRI showing thrombosis of the superior sagittal sinus (a), sigmoid sinus and internal jugular vein (b) and left transverse sinus (c).

scapular pain. Since no abnormalities were noted, the patient was discharged, with recommendation for routine laboratory tests and plain X-ray of the cervical spine. However, right hemiparesis developed the next day with persistent headache and the patient was sent back to Neurology Clinic, where he developed myoclonic seizure compatible with focal motor status epilepticus, just after the lumbar puncture attempt. The therapy for status epilepticus was administered and the emergency MRI with angiography was ordered. Another status epilepticus appeared within the MR scanner and the exam was discontinued. Leucocytosis with neutrophilia was found on routine laboratory study. The patient was monitored in Intensive Care Unit. Glasgow coma scale was 6. Repeated imaging study was performed 48 hours after admission to the hospital. MRI with MR venography revealed huge hemorrhagic venous infarcts in the left cerebral hemisphere (Fig. 1) associated with the typical signs of massive DST (Fig. 2). The presence of combined CVT and DST with subtle curvilinear hyperdensity in the left parietal cortical-subcortical border was detected during the reevaluation of initial brain CT, associated with slight flattening of the sulci, most compatible with developing hemorrhagic venous infarct (Fig. 3). Detailed hematologic evaluation showed depressed

Case report

Brain CT examination was performed in a 58 years-old normotensive, afebrile male patient with three days long history of neck pain and occipital headache that were following two days long inter-

prothrombin complex coagulation factors and the presence of lupus anticoagulant. No improvement was noted after administration of anticoagulant treatment and the lethal outcome appeared 11 days after the initial CT scanning.

Discussion

The International Study on Cerebral Vein Thrombosis group identified that one (48%) or multiple (38%) predisposing conditions were responsible for TCVS, including oral contraceptives (46%), coagulopathies (27%), pregnancy or puerperium (17%), systemic diseases (14%), cancer (8%), ear-nose-throat infections (8%), vasculitis (8%), CNS infections (5%), other CNS disorders (5%). The same group has reported that among the most frequent clinical presentations of TCVS, headache is affecting 89% of patients, followed by paresis (37%), generalized (30%) and focal (27%) seizures. The median delay from onset of symptoms to hospitalization is found to be 4 days (Grover, 2004). However, great majority of patients presenting in clinical practice with headaches, have benign causes of their complaints.

The role of radiologist is becoming crucial in establishing correct diagnosis of TCVS, since, like in our patient, normal imaging study in patients with even severe headaches, may have a strong influence on the decision of neurologist or family doctor with

a busy daily schedule, to postpone the hospitalization of the patient.

MRI combined with MR venography has largely replaced conventional angiography and CT for detecting TCVS. But since the non-contrast CT is still imaging technique of choice in majority of emergency departments, even in developed countries, all radiologists should be educated to recognize both direct and indirect early signs of this life-threatening disorder on CT. The cord sign and hyperattenuated vein sign – direct signs, are defined as a homogenous hyperattenuated appearance of the thrombosed venous sinus or vein, respectively, compatible with elevated attenuation of the thrombotic material in the affected vessel. The direct signs are seen within the first week of disease, while in the second week the thrombus becomes isoattenuated or even hypodense. Indirect signs include cerebral hemorrhage and edema (Linn *et al.*, 2009; Teasdale, 2000 and Vijay, 2006). The false-negative rate for diagnosis by CT was estimated to be up to 25% (Allroggen, Abbott, 2000 and Ameri, Bousser, 1992). Kathikeyan *et al.* in their article focused on the spectrum of CT findings in patients with TCVS, suggest that radiologist plays a key role in detecting this disorder due to variable clinical presentation, but unfortunately imaging findings are, according to the authors, easily overlooked, and in a number of instances, the non-enhanced CT examination serves mainly to depict secondary changes in the brain parenchyma, such as

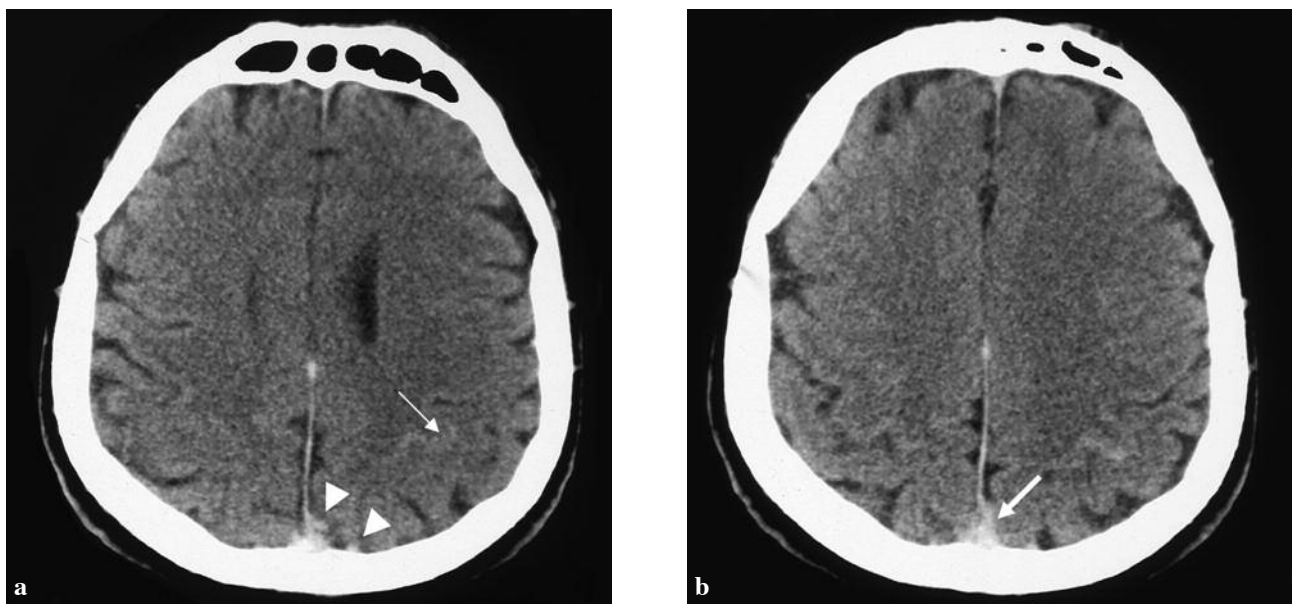


FIG. 3. — Overlooked subtle curvilinear hyperdensity on initial non-contrast CT in the area of left parietal cortical-subcortical border (arrow), associated with slight flattening of the sulci, most compatible with developing hemorrhagic infarct. Note the ill-defined hyperattenuation of superior sagittal sinus associated with two hyperdense foci (a), most compatible with cortical venous thrombosis (arrowheads), while in image (b), a delta sign is more clearly evident (arrow), suggesting the presence of combined cortical vein and sinus thrombosis.

venous infarcts or edema (Kathikeyan *et al.*, 2004). On contrast-enhanced CT, the empty delta sign, or reverse delta sign, can be observed in the superior sagittal sinus, reflecting the opacification of collateral veins in the dural leaves surrounding the less dense thrombosed sinus. This sign can be diagnostic for sinus thrombosis, but it has been reported in only about 20% of patients (Ramenghi *et al.*, 2002). However, increased attenuation in the venous sinuses on non-contrast CT is not a specific sign for thrombosis, but may also be seen in patients with dehydration, an elevated hematocrite level or a subjacent subarachnoid or subdural hemorrhage (Leach *et al.*, 2006). In our patient, two round hyperdense foci were noted adjacent to the ill-defined superior sagittal sinus (Fig. 3a) that is most compatible with CVT, according to the Stam's article that clearly explains the characteristics of thrombosed cortical veins as they join the dura. However, the attenuation differences will likely be detected only in the largest portion of the veins, close to the dural entrance (Stam, 2005).

The administration of intravenous heparin therapy in the acute phase of TCVS is recommended by most authors, even in patients with intracerebral hemorrhage in the era of venous infarction (Fink, McAuley, 2001 and Kimber, 2002). Mortality rate in patients with TCVS is around 20% (Kimber, 2002 and de Bruijn *et al.*, 2001). Also, we need to add that the lumbar puncture that preceded seizures, may have had a role in patient's clinical deterioration.

In conclusion, we want to emphasize that education of both radiology and neurology residents in detecting both direct and indirect signs of TCVS is extremely needed in order to decrease the rate of fatal outcome. The recognition of parenchymal signs, especially in patients with subtle direct signs of CVT is of crucial importance.

Although CT appearances and signs may strongly suggest TCVS, false-positive and false-negative rates are not low, making this diagnostic modality not always conclusively diagnostic. Because of frequently discrete CT findings, physicians in clinical practice should not hesitate to require MR study in patients with progressively worsening headaches and inconclusive CT findings. Recent study of Linn *et al.* showed that T2*w sequence showed the highest sensitivity in the detection of CVT (97.4%), followed by T1w (70%), FLAIR (50%), MRV (41%), whereas the sensitivity of non-contrast CT, proton density sequence, diffusion weighted imaging and multidetector row CT angiography was below 30% (Linn *et al.*, 2010). These results strongly suggest that T2*w sequence, that is frequently not a routine part of brain MR protocols, might be included in MR examination of patients with headaches and seizure attacks.

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