

MR of Venous Sinus Thrombosis: A Case Report

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The frequency of aseptic venous sinus thrombosis (VST) is underestimated according to many authors [1–4]. One of the reasons is that until now the correct diagnosis of VST could only be established by cerebral angiography. As pathologic changes can be demonstrated by MR in a patient with angiographically proven VST, MR may become an important non-invasive method for its primary diagnosis. To our knowledge, this is the first report of the diagnosis of VST by MR.

Materials and Methods

MR images were obtained with a 1.5-T superconductive magnet (Magnetom, Siemens AG, Erlangen), which is now operated at 0.35 T. A multislice T2-weighted double-echo spin-echo (SE) technique (TR/TE = 1600/35,70 and 1600/60,120) was used as well as a more T1-weighted SE sequence (TR/TE = 400/35,70 and 400/60,120). The spin-echo images were obtained in transverse, coronal, and sagittal planes with a slice thickness of 10 mm.

Bilateral carotid angiography was performed using a transfemoral catheter technique in frontal and lateral projections with films taken every second up to 15 sec.

Case Report

A 44-year-old woman with a 10-year history of migraine, who had taken contraceptives for 15 years and had a history of labile hypertension, suffered from an increasingly severe headache for several days after a common cold. Five days after the onset of the symptoms a grand mal seizure precipitated hospital admission, where she presented with mild disorientation and right occipital headache.

EEG

EEG indicated a focal lesion in the right occiput as well as discontinuous delta waves of low amplitude. The CSF was xanthochromic with 3300 red blood cells/mm³ but with no other abnormalities.

Radiologic Studies

CT on the 10th day showed a small hyperdense area in the left parietal region without enhancement, which was thought to be a

hypertensive hemorrhage. A second CT study on the 11th day showed narrow ventricles; the basal cisterns were not well defined but the gyri were still discernible. After enhancement, the empty delta sign was seen (Fig. 1A), as was enhancement of the right transverse sinus.

Carotid angiography showed thrombosis of the superior sagittal sinus. The ascending cerebral veins were congested and without connection to the superior sagittal sinus (Figs. 1B and 1C).

On MR, the superior sagittal, right transverse, and sigmoid sinuses displayed high signal intensities on the T1- and T2-weighted SE images (Figs. 1D–1G). Additionally, an area of high signal intensity could be seen in the right parasagittal region, which was interpreted as a hemorrhagically infarcted area of cortex (Fig. 1G).

Discussion

Indirect signs, which are mostly nonspecific, can be obtained by CT. Consequently, CT is an important noninvasive method in the early diagnostic work-up of VST. The only specific CT sign is the empty delta sign [5–8] first reported by Buonanno et al. [5]. The sinus rectus sign [9, 10], the falx sign [11], and the gyral or tentorial enhancement [5, 7, 12–14] are found not only with VST. Other signs, such as intracerebral hemorrhage [5, 7, 15–18], hypodense areas [5, 9, 18], or increased cerebral volume [19], are more frequently seen in other cerebral diseases and are less indicative of VST [20].

Although digital subtraction angiography has been able to show signs of sinus occlusion in some cases [15], its reliability for the majority of cases is not yet proven. MR signal intensity and contrast not only depend on T1- and T2-values and proton density, but also on flow velocity. Thus, information about blood flow in vessels can be obtained. This is true not only for big arteries but also for the large cerebral venous sinuses such as the superior sagittal sinus, the transverse sinus, and the sigmoid sinus, which can be well assessed, if adequately examined.

In a group of 60 patients comprising healthy persons as well as patients with nonvascular cerebral diseases, the superior sagittal sinus could be seen without exception as a

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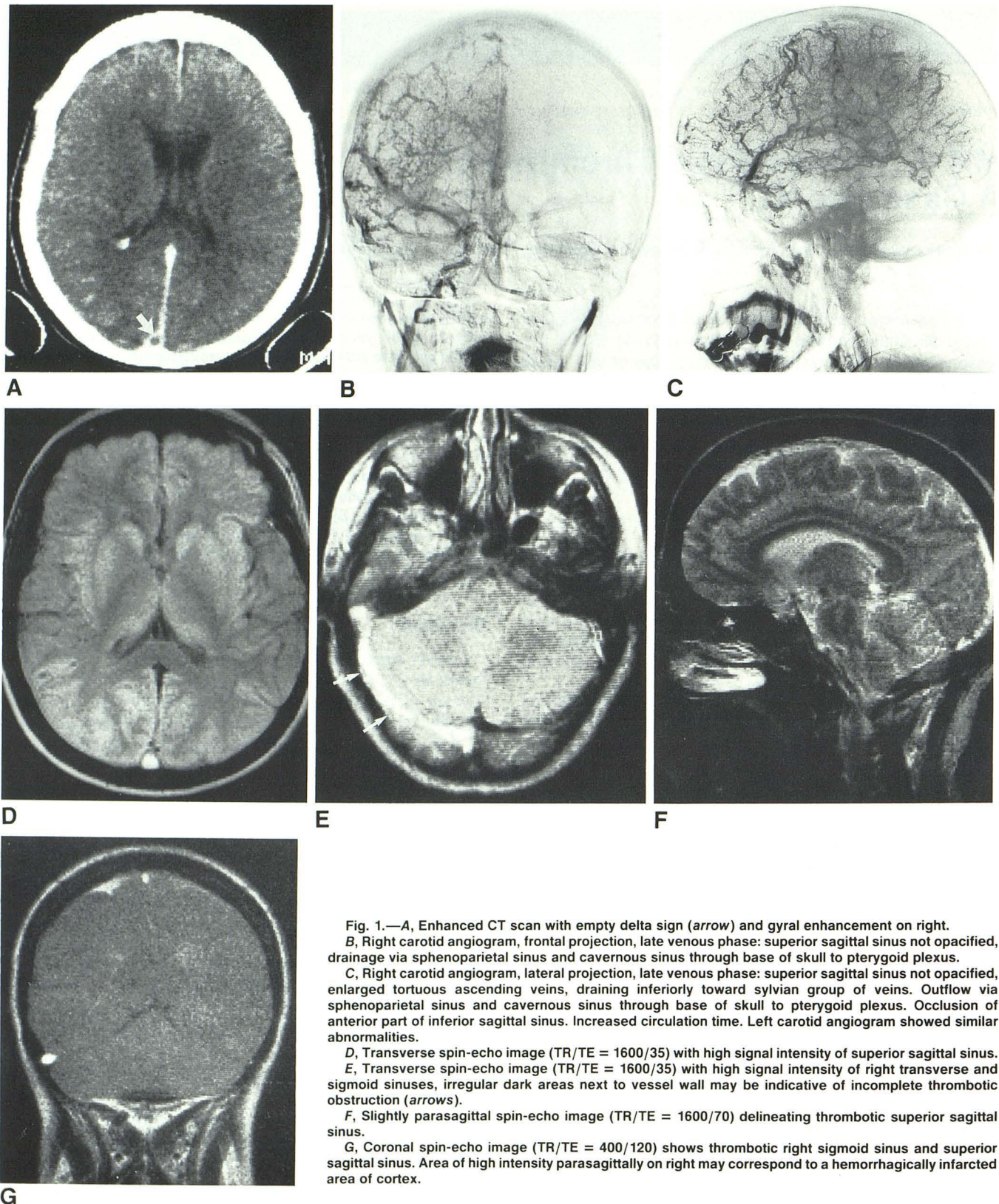


Fig. 1.—A, Enhanced CT scan with empty delta sign (arrow) and gyral enhancement on right.
 B, Right carotid angiogram, frontal projection, late venous phase: superior sagittal sinus not opacified, drainage via sphenoparietal sinus and cavernous sinus through base of skull to pterygoid plexus.
 C, Right carotid angiogram, lateral projection, late venous phase: superior sagittal sinus not opacified, enlarged tortuous ascending veins, draining inferiorly toward sylvian group of veins. Outflow via sphenoparietal sinus and cavernous sinus through base of skull to pterygoid plexus. Occlusion of anterior part of inferior sagittal sinus. Increased circulation time. Left carotid angiogram showed similar abnormalities.
 D, Transverse spin-echo image (TR/TE = 1600/35) with high signal intensity of superior sagittal sinus.
 E, Transverse spin-echo image (TR/TE = 1600/35) with high signal intensity of right transverse and sigmoid sinuses, irregular dark areas next to vessel wall may be indicative of incomplete thrombotic obstruction (arrows).
 F, Slightly parasagittal spin-echo image (TR/TE = 1600/70) delineating thrombotic superior sagittal sinus.
 G, Coronal spin-echo image (TR/TE = 400/120) shows thrombotic right sigmoid sinus and superior sagittal sinus. Area of high intensity parasagittally on right may correspond to a hemorrhagically infarcted area of cortex.

dark area of low signal intensity in T1- and T2-weighted spin-echo images. In the case described above, in which VST had been angiographically confirmed, the area in question displayed high signal intensity (Figs. 1D-1G). As mentioned by Mills et al. [21], these MR findings are characteristic of stationary blood or thrombosis, although very slowly flowing blood may also show increased signal intensity due to "paradoxical" enhancement.

According to Mills et al. [21], vascular occlusion results in a high signal intensity on the first echo and decreased signal intensity on the second echo, whereas in conditions of slowly flowing blood the second echo-delay signal may be equal to or even higher than the first. In our patient the measurement of signal intensities in the superior sagittal sinus of the first (35,60 msec) and second (70,120 msec) echoes showed significant decrease of signal intensity between the first and second echoes. The results demonstrate the capabilities of MR. This new method provides the possibility of differentiating between flowing and stationary blood without being invasive and without application of contrast material. This may finally lead to a change in diagnostic procedure.

MR may contribute to an earlier diagnosis of VST, as it provides an indication for carotid angiography in suspected or uncertain cases. And while it is not yet possible to eliminate carotid angiography in the primary diagnosis of VST, total substitution of carotid angiography by MR in patients with VST in the future does seem possible. However, more experience and further investigations are necessary.

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