Demonstration of Dural Sinus Occlusion by the Use of MR Angiography

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Thrombosis involving the dural venous sinuses is a well-known clinical entity. Patients present with a variety of symptoms, which can include headache, nausea, vomiting, seizures, and focal neurologic deficits [1]. Before the advent of antibiotics, dural sinus thrombosis was commonly seen in conjunction with mastoiditis or uncontrolled facial infections [2]. Other recognized causes of dural sinus thrombosis include pregnancy (or oral contraceptives), malignancies, and head injuries [1–3]. Rarely, dural sinus thrombosis may be associated with systemic lupus erythematosus [1], homocystinuria [4], or Behçet disease [5]. Traditional radiologic diagnosis of dural sinus thrombosis has relied heavily on the use of cerebral angiography. Other useful imaging methods include digital subtraction angiography [5], scintigraphy [6, 7], sonography [8], CT [9], and MR imaging [10, 11]. With MR, the diagnosis of sinus thrombosis is made by the demonstration of a lack of flow void normally present within these structures. Routine spin-echo imaging uses signal information predominantly from stationary spins. By tailoring MR pulse sequences, images consisting of information only from moving spins can be formed. This technique has been referred to as MR angiography [12]. We demonstrate the application of this new process in the diagnosis of dural venous thrombosis.

Materials and Methods

MR images were obtained with a GE Signa superconductive magnet operating at 1.5 T. Using a spin-echo technique, we obtained T1-weighted, 500/20 (TR/TE), and multiecho T2-weighted, 2824/20,80 cardiac-gated images in the coronal and axial planes. Slice thickness was 5–7 mm. Enhanced T1-weighted MR scans were obtained after IV infusion of gadopentate dimeglumine at a dosage of 0.1 mmol/kg (0.2 ml/kg). Gadolinium-enhanced images were obtained immediately after the infusion. MR angiography was accomplished with the use of the GE bipolar pulse sequence for phase-contrast angiography, 31/17 (TR/TE) [12]. With this pulse sequence, phase shifts are imparted to moving spins proportional to their velocity [12]. A subtraction image (angiogram) is then formed from separate flow-encoding sequences [13].

CT was performed on a GE 9800 scanner with axial 5-mm-thick cuts. Contrast-enhanced images were obtained with a split bolus-drip IV infusion of Isovue-300 (Squibb) at a dosage of 2 ml/kg (150 ml maximum).

Case Report

A 38-year-old man with acute myelogenous leukemia presented with a 2-week history of headaches, neck pain, nausea, and vomiting. Additional symptoms included scotoma and gait disturbances.

Laboratory Studies

Admitting CSF studies revealed protein and glucose levels of 72 and 61 mg/dl, respectively. Abundant blast forms within the CSF were present.

Radiologic Studies

Contrast-enhanced CT scans showed high-density extraaxial mass lesions near the peripheral tentorial incisura bilaterally. The patency of the dural sinuses could not be reliably determined (Fig. 1). MR images obtained the same day confirmed leptomeningeal spread of tumor involving the inferior aspects of both occipital lobes (Fig. 2A). In addition, there was abnormal signal (absence of normal flow void on both T1- and T2-weighted images) within the left transverse and sigmoid sinuses that extended into the left internal jugular vein (Figs. 2B–2D). The abnormality was consistent with dural sinus thrombosis. MR angiography confirmed the absence of normal flow within these structures (Fig. 3).

Discussion

CT has provided an important noninvasive method for diagnosing dural sinus thrombosis. The presence of the empty delta sign is highly suggestive of this disease [14]. Other findings include thrombosed cortical veins [15], the sinus rectus sign, and the falx sign. Recently, conventional MR imaging has been shown to be an effective noninvasive

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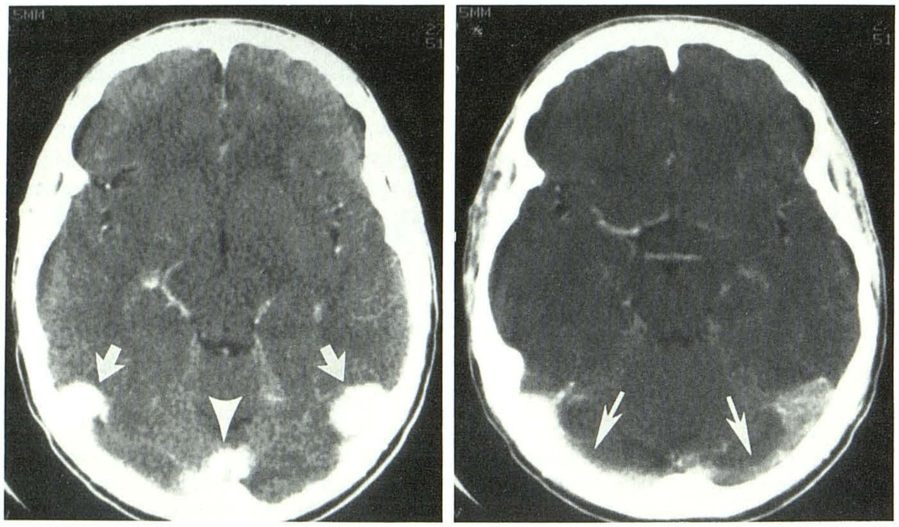
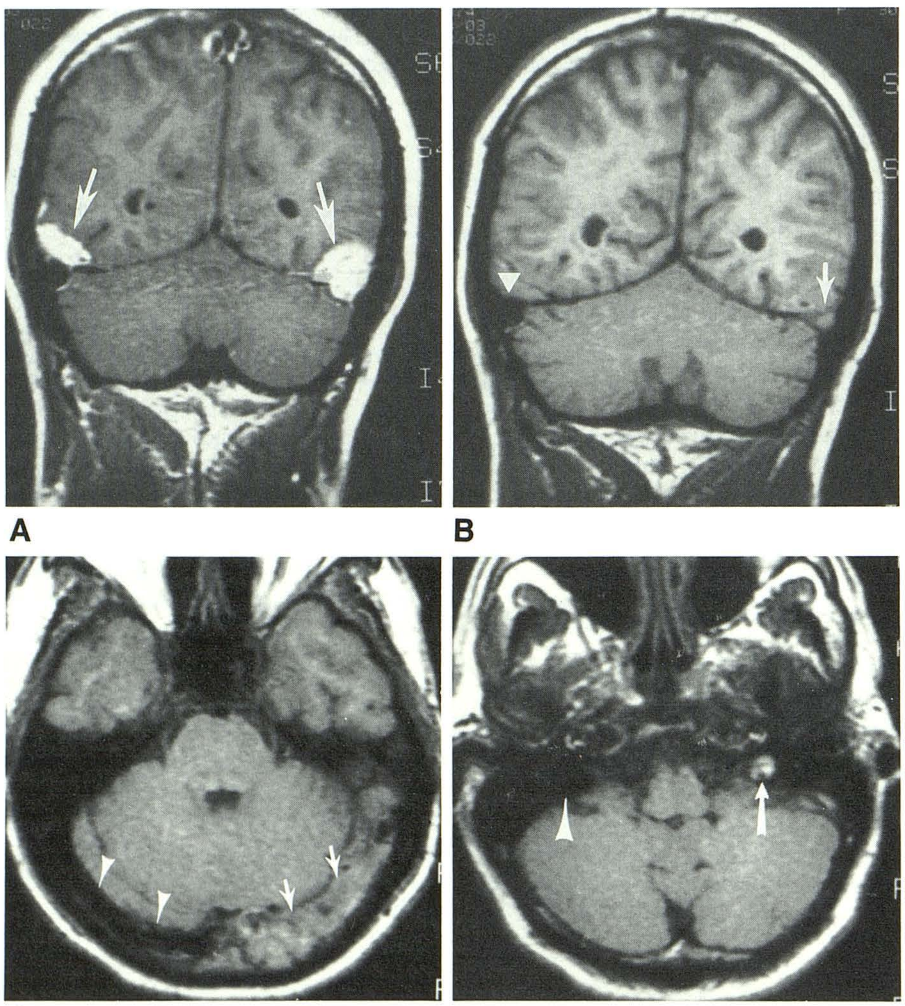


A B

Fig. 1.—*A*, Axial enhanced CT scan shows nodular densities bilaterally near tentorial insertion (*arrows*). Ill-defined density centrally also was present (*arrowhead*).

B, Another cut reveals apparent density within region of torcula and transverse sinuses bilaterally (*arrows*). Empty delta sign was not present.



A B C D

Fig. 2.—*A*, Coronal Gd-DTPA–enhanced MR image (spin echo, 500/20) shows high-signal lesions inferior to occipital lobes bilaterally (*arrows*). These correspond with CT scans (see Fig. 1).

B, Nonenhanced coronal MR image (spin echo, 500/20) reveals signal in left transverse sinus (*arrow*). Normal flow void in right transverse sinus was present (*arrowhead*).

C, Axial MR image (spin echo, 500/20) confirms absence of flow void in left transverse sinus (*arrows*). Normal right transverse sinus shows signal void (*arrowheads*).

D, Abnormal signal extends to left internal jugular vein (*arrow*). Note presence of flow void in right internal jugular vein (*arrowhead*).

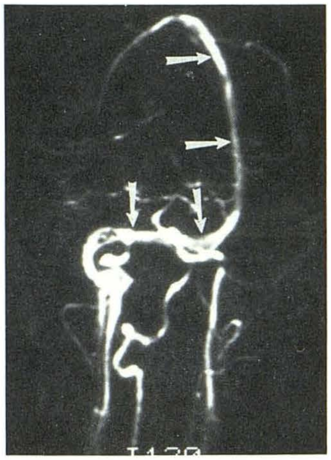


Fig. 3.—MR "angiogram." Image formed from moving spins only. Flow is present within superior sagittal and right transverse sinuses (*arrows*). No moving spins in left transverse sinus. This correlates with abnormal soft-tissue signal within this structure present on conventional axial and coronal MR images (see Figs. 2A–2C). Occlusion of left transverse sinus was confirmed.

method for identification of this disease and its associated complications [10, 11]. In the initial stages of dural sinus thrombosis, an absence of the normal dural sinus flow void is noticed. This finding must persist with a change in scan orientation, thereby excluding flow-related enhancement as a spurious cause of increased signal. Early in the course of the disease the thrombus is isointense on T1-weighted images and hypointense on T2-weighted images. Evolution of the thrombus results in an increase in its signal on T1-weighted images followed by an increase in signal on T2-weighted scans. These changes occur first at the periphery of the thrombus and progress centrally. The above findings are best appreciated in larger vessels [11]. Later there can be recanalization and reappearance of the flow void.

Some reports suggest that MR is the imaging method of choice to diagnose and follow up cerebral venous thrombosis [11]. Others indicate that MR is particularly useful in studying the sigmoid sinus and internal jugular vein, which are difficult to assess by CT owing to the close relationship of these structures to adjacent bone [16]. With specially designed pulse sequences, only selective excitation of moving spins can be achieved. Images formed with this technique consist of pixels whose intensity depends on the velocity of the component spins [12]. Independent "angiograms" (each with a different projection axis) can be combined to provide a single image that is sensitive to flow in all directions [13].

In this case, conventional MR images demonstrated findings consistent with dural sinus thrombosis. Subsequently, MR angiography further substantiated these findings. Patency of the superior sagittal sinus and right transverse sinus was clearly demonstrated. No moving spins within the left transverse sinus were present. This is consistent with thrombotic occlusion. The combination of MR techniques obviated cerebral angiography in this patient.

This case demonstrates the potential clinical significance of this new MR pulse sequence. Possibly, the ability to determine flow noninvasively within dural sinuses may eliminate the need for conventional angiography in certain cases. Further investigation will be required.

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