MSCT venography finds cerebral thromboses

October 13, 2004 | Vendors [1]
By Birgit B. Ertl-Qagner, MD [2], Ralf-Thorsten Hoffmann, MD [3], Claudia Rummeny, MD [4], and Maximilian F. Reiser, MD [5]

Dural sinus and cerebral venous thromboses (CVT) are difficult to diagnose. Symptoms are often nonspecific and may evolve slowly, and anatomic variations can further complicate diagnostic decision making. Unilateral aplasias of the transverse or sigmoid sinus, frontal agenesis of the superior sagittal sinus, and high partitions of the transverse sinus are common pitfalls in the diagnosis of CVT.

Dural sinus and cerebral venous thromboses (CVT) are difficult to diagnose. Symptoms are often nonspecific and may evolve slowly, and anatomic variations can further complicate diagnostic decision making. Unilateral aplasias of the transverse or sigmoid sinus, frontal agenesis of the superior sagittal sinus, and high partitions of the transverse sinus are common pitfalls in the diagnosis of CVT.¹

Digital subtraction angiography was traditionally considered the best modality for diagnosing CVT. The procedure's invasive nature, however, coupled with an associated risk of cerebrovascular complications, has led to its increasing replacement by MR imaging, and especially MR venography.² But MR has a number of its own drawbacks. Several studies have reported limited accuracy of MR venography in the diagnosis of CVT.¹,³,⁴ MR scanners are not generally available 24/7, yet a significant proportion of CVT patients will present to the emergency room during on-call hours and require urgent evaluation. Many of these patients are unable to lie motionless for the duration of an MR examination. Reduced access can also become a problem when dealing with critically ill patients suffering from cerebral venous occlusions.³ The optimum diagnostic method for CVT should have high spatial resolution of the cerebral veins, short examination time, and maximum patient access. Advanced CT technology may address these needs.

Multislice CT is becoming more common in clinical practice. It's unrivaled spatial and temporal resolution makes it possible to acquire isotropic voxels and to reformat data sets in any desired plane. Large volumes can be acquired within a short time with no resolution loss.⁵ MSCT has reduced posterior fossa artifacts in brain scans significantly.⁶ Both arteries and veins can be covered intracerebrally with a single-bolus, monophasic protocol.⁷,⁸ The entire supra-aortic, cervicocranial vasculature can be imaged on a 16-slice CT scanner with a single bolus in 12 seconds.⁹ We have found that MSCT angiography of the brain is possible even in uncooperative patients, given scan times of four to 12 seconds. Patient access is almost unlimited during most parts of the imaging protocol.

CEREBRAL CT VENOGRAPHY

Optimal CT venography demands an imaging protocol with carefully chosen parameters. We generally recommend a routine energy setting of 100 to 120 kV. This can, and should, be reduced to 80 kV for pediatric patients and for control examinations of occlusions to the large dural sinuses. A dedicated cavernous sinus examination may warrant an increase to 140 kV. Differentiation between the complex osseous structures of the skull base and the contrast-filled sinus improves with higher kV.¹⁰ MR is generally preferred, however, for imaging occlusions of the cavernous sinus.

We tend to use between 100 and 200 mAs. The higher mAs setting is especially useful in protocols of the entire supra-aortic vasculature that include the region between the shoulders. Nonionic iodinated contrast should be applied with a high flow of 4 to 5 mL/sec, followed by a saline flush, if possible. Iodine concentration of 300 mg/mL should suffice for general venous indications.

Several options exist for determining proper scan time delay between administration of the contrast bolus and initiation of image acquisition. These include semiautomated bolus tracking, use of a test bolus, and a fixed delay.¹¹ We find that a fixed scan time delay of 35 seconds is adequate for...
cerebral venous indications. If both the arterial and the venous cerebrovascular systems are to be assessed, we recommend using a test bolus and adding an additional seven seconds to the predetermined scan delay. This will produce homogeneous arterial and venous contrast. Direction of acquisition should follow the contrast flow, so cranial venous indications require craniocaudal acquisition. We advise using the smallest collimation possible for the type of scanner used. For example, 16 x 0.75 mm for a 16-slice Sensation (Siemens Medical Solutions) and 4 x 1 mm for a four-slice Sensation. Table feed should be adjusted to attain a pitch factor of 1. This corresponds to a 12-mm table feed for a collimation of 16 x 0.75 mm, and a 4-mm table feed for a collimation of 4 x 1 mm.

**CVT ASSESSMENT**

Several studies have demonstrated the value of single-slice spiral CT angiography in the diagnostic evaluation of patients with CVT. These reports generally showed CTA to be a viable alternative to MR venography in the delineation of cerebral veins and dural sinuses as well as in diagnosis of CVT. The comparatively low spatial and temporal resolution of single-slice spiral CT made the assessment of small internal cerebral and bridging veins a challenge, but the introduction of four- and 16-slice CT into clinical practice has largely overcome those limitations. We have found MSCT venography to be an excellent tool in the diagnostic evaluation of patients with a suspected occlusion of the cerebral veins or dural sinuses. Even small veins can be delineated with confidence. As mentioned above, supra-aortic arteries and veins can be imaged simultaneously without compromising spatial resolution.

Sliding thin-slab maximum intensity projection reconstructions of MSCT angiography usually help when assessing pathology in patients whose large dural sinuses are occluded (Figure 1A). Volume rendering techniques can prove useful when judging the degree of venous congestion in CVT (Figure 1B). Quasivenographic volume rendering modes can also assist evaluations of CVT that extend beyond the skull (Figure 1C).

Differentiating between thromboses and hypoplasia of the sinus can prove challenging when the transverse sinus is affected. Volume rendering techniques can assist in such cases (Figure 2). MSCT venography is also an excellent tool for visualizing additional findings in patients with an occlusion or compression of the cerebral veins and dural sinuses. Patients with a thrombotic occlusion of the transverse or sigmoid sinuses should receive particular attention, because they may also have concomitant mastoiditis. This mastoid infection can lead to septic thrombosis in the adjacent dural sinus. Doubts about diagnosis of septic thrombosis can be resolved by viewing MSCT angiographic data in an additional window and level setting appropriate for bone, or reconstructing the data in a bone kernel.

MSCT angiography can delineate neoplasms involving the dural sinuses or cerebral veins with confidence, especially if osseous structures are also involved. Meningiomas are the most common tumors to involve the superior sagittal sinus (Figure 3). MSCT venography will also reveal traumatic fractures to the skull or skull base that may lead to dural sinus lacerations (Figure 4).

In summary, MSCT venography is an excellent diagnostic tool in patients with a suspected occlusion of the cerebral veins or dural sinuses. Optimized protocols make it possible to assess both the arterial and venous cranial vascular systems in a single examination. Short imaging times (between four and 12 seconds) make MSCT angiography viable even in uncooperative patients. High spatial resolution provides confident delineation of even small internal cerebral and bridging veins. Additional findings, such as venous congestion, neoplasms, mastoiditis, or fractures, can be appreciated reliably. Isotopic or near-isotropic resolution means that practitioners can apply image reconstructions in any desired plane and/or volume rendering techniques, with minimal or no artifacts in the z-axis.

PROF. DR. ERTL-WAGNER, DR. HOFFMANN, and DR. RUMMENY are radiologists, and PROF. DR. REISER is department head, all at the Institute of Clinical Radiology, Grosshadern Clinic, in Munich, Germany. Assisting in the preparation of this manuscript were DOMINIK MORHARD and ROLAND BRUENING.

**References**


Disclosures:

Source URL:
http://www.diagnosticimaging.com/articles/msct-venography-finds-cerebral-thromboses

Links: