Novel imaging strategies in venous thromboembolism

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8

CHAPTER

Magnetic resonance thrombus imaging for the differentiation of chronic versus (sub)acute cerebral vein thrombosis: a Case Report

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ABSTRACT

The diagnosis of cerebral vein thrombosis (CVT) can be difficult. Patients with suspected CVT, in whom venous sinuses are affected by intracranial tumours or after intracranial surgery constitutes a particular challenging setting. Magnetic resonance non-contrast thrombus imaging (MR-NCTI) is a new magnetic resonance imaging (MRI) technique that has previously been shown to be accurate in the diagnosis of a first CVT and difficult-to-diagnose venous thrombosis in other anatomical locations. In this case report, a patient with a medical history of craniotomy for parieto-occipital meningioma was suspected of an acute CVT but had an inconclusive computed tomography (CT) and MRI venography. MR-NCTI showed no abnormalities diagnostic for (sub)acute CVT and thus cerebral sinus occlusion was most likely a chronic thrombus or a result of residual meningioma tissue. Anticoagulant treatment was discontinued, and she was discharged from hospital in good health. This case shows that MR-NCTI may be a valuable additional imaging test in complex cases in whom CT and MRI venography could not exclude acute CVT.

BACKGROUND

Cerebral vein thrombosis (CVT) includes thrombosis of the dural sinuses and cerebral veins and is an uncommon presentation of venous thrombosis.[1] The imaging test of choice for diagnosing CVT is computed tomography (CT) or magnetic resonance imaging (MRI) venography.[2] Even though CT and MRI venography have a high sensitivity and specificity for CVT [3], the diagnosis can be challenging due to complex anatomic variation of cerebral veins and sinuses [2] and also in patients in whom venous sinuses are affected by brain tumours or after intracranial surgery. Magnetic resonance non-contrast thrombus imaging (MR-NCTI) has been shown to be sensitive and specific for the diagnosis of CVT [4,5] as well as difficult-to-diagnose venous thrombosis in other locations, including suspected recurrent ipsilateral deep vein thrombosis (DVT) of the leg or isolated pelvic vein thrombosis in pregnant patients.[6-10] In our view, MR-NCTI therefore has potential added value in the diagnostic management of suspected CVT.

CASE PRESENTATION

We present a 52-year-old patient in whom acute CVT could not be excluded on CT and MRI venography due to post-surgical changes of venous sinuses and in whom the final treatment decision was based on MR-NCTI. She presented at the emergency department with a mild, pressing headache with concomitant nausea that had started three weeks before presentation. In the week before presentation, she had experienced three episodes of acute and intense worsening of the headache, all of which occurred during exercise. Except for blurry vison, she reported no other symptoms. Her medical history included a craniotomy for right sided parieto-occipital meningioma five years ago. She smoked 30 cigarettes per day and was treated with simvastatin because of hypercholesteremia. She did not use oral contraceptives. On physical examination, her blood pressure was 149/87 mmHg, and the heartrate was 84 bpm. The Glasgow Coma Scale was 15/15. Further neurologic examination revealed no abnormalities, in particular no papilledema.

Non-contrast brain CT showed a tissue defect in the right parieto-occipital region, compatible with the postoperative status. CT venography showed no opacification of the posterior part of the superior sagittal sinus and both transverse sinuses

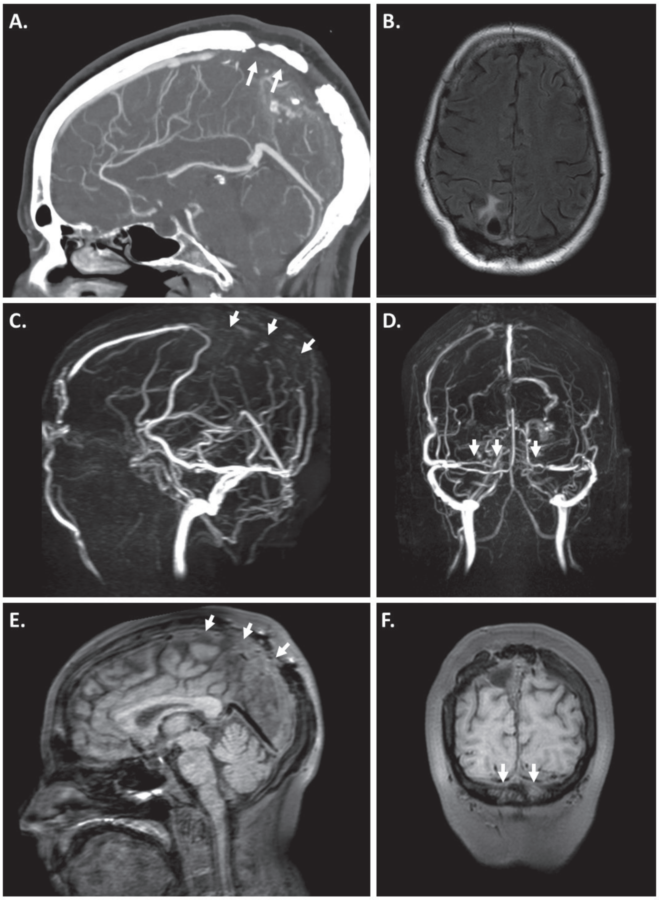
(**Figure 1A**). As prior MRI scans already showed increased signal intensities on fluid-attenuated inversion recovery (FLAIR) and restricted diffusion on diffusion weighted MR images at the same anatomical location, it was initially concluded that the lack of opacification of these sinuses on CT venography could well represent post-surgical changes or chronic thrombosis (**Figure 1B**). Even so, acute CVT could not be excluded with certainty and anticoagulant treatment was therefore started empirically. The next day, a MRI scan was performed including MR-NCTI sequences to evaluate these sinuses in more detail. MR-NCTI scan included three dimensional (3D) T1 weighted turbo field-echo (T1 TFE) and 3D Turbo Spin-echo Spectral Attenuated Inversion Recovery (TSE-SPAIR) sequences performed on a 3.0 Tesla unit (**Table 1**).

MRI venography confirmed the absence of flow in the posterior part of the superior sagittal sinus and in both transversal sinuses (**Figure 1C** and **D**), with concomitant (heterogenous) increased signal intensity on T2 weighted MR images. However, on MR-NCTI images no increased signal intensity was present at these locations, making the diagnosis of an (sub)acute CVT highly unlikely (**Figure 1E** and **F**). The final diagnosis therefore was changed into a cerebral sinus occlusion either due to chronic CVT or as a result of residual meningioma tissue. Anticoagulant treatment was discontinued, and she was discharged from hospital in good health. She was kept under outpatient surveillance at the department of Neurosurgery for regular follow-up after the meningioma resection. She had persistent headache which was diagnosed as tension type- and medication overuse headache. A 12-months follow-up MRI showed no new abnormalities and no new adverse events.

DISCUSSION AND CONCLUSIONS

The diagnosis of CVT is based on the positive findings of intraluminal thrombus on either CT or MRI, or a filling defect in a cerebral vein or sinus.[2,11] Excluding acute CVT with non-invasive conventional imaging techniques can be challenging.[2] MR-NCTI is a new technique based on the visualization of methemoglobin in a fresh thrombus which appears as a high signal intensity (bright signal).[12] This allows for the direct visualization of (sub)acute thrombi and the differentiation between acute and chronic thrombosis.[6,13,14] MR-NCTI has previously been shown to be accurate in the diagnosis of a first CVT and is likely to be valuable in the diagnostic management of complex cases in whom CT and MRI venography could not exclude acute CVT, such as patients with changes in venous sinuses due to brain tumours or after intracranial surgery. Application of this technique may avoid overdiagnosis and subsequently potential bleeding events. Larger diagnostic studies are needed to confirm the value of MR-NCTI in the diagnostic management of suspected CVT.

Figure 1. Computed tomography (CT) (A) and magnetic resonance images (MRI) (B-F) in a patient with suspected acute cerebral vein thrombosis: A. Sagittal CT venography image showing no opacification of the posterior part of the superior sagittal sinus (arrows) B. Transverse FLAIR MR image showing a parenchymal defect in the right parietal region, surrounded by increased signal intensity (indicative of gliosis), adjacent to the falx cerebri at the location of the superior sagittal sinus. C. and D. Sagittal and coronal MRI venography images showing absence of flow in posterior and caudal part of the superior sagittal sinus and both transversal sinuses (arrows). E. and F. Sagittal and coronal magnetic resonance non-contrast thrombus images (3D T1 TSE SPAIR sequence) showing no high signal intensity at the location of superior sagittal sinus or both transversal sinuses (arrows), making the diagnosis of (sub)acute thrombosis highly unlikely.



8

Table 1. Three dimensional T1 weighted turbo field-echo (3D T1 TFE) and three dimensional Turbo Spin-echo Spectral Attenuated Inversion Recovery (3D TSE-SPAIR) MRI scan parameters

	3D T1 TFE	**3D TSE-SPAIR**
Technique	T1 TFE	TSE
Orientation	Coronal	Coronal
Slices	160	209
Slice thickness (mm)	3	1.1
Slice distance (mm)	1.5	0
FOV	250 x 200	250 x 180
Voxel size (mm)	1.0 x 1.0 x 1.5	1.1 x 1.1 x 1.1
Scan time (min)	4.23	5.46
Echo time (ms)	Shortest (5.2)	Shortest (30)
Repetition time (ms)	Shortest (10)	400
Flip angle	15	90

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