Mineralization of the falx cerebri simulating interhemispheric vascular anomalies on MR imaging

Report of three cases

JOHN R. RUGE, M.D., ERIC J. RUSSELL, M.D., AND ROBERT M. LEVY, M.D., PH.D.
Departments of Surgery (Neurosurgery) and Radiology (Neuroradiology), Northwestern University Medical School, Chicago, Illinois

Three cases of ossification of the falx cerebri initially mistaken for vascular lesions based on their magnetic resonance (MR) appearance are reviewed. The MR imaging and computerized tomography characteristics of mineralization of the falx cerebri and their differentiation from interhemispheric vascular lesions are discussed.

KEY WORDS • magnetic resonance imaging • falx cerebri • hemorrhage • ossification

With the advent of magnetic resonance (MR) imaging has come an increased appreciation of a number of intracranial lesions. This increased appreciation has led to the frequent use of this diagnostic modality as the initial neuroradiological study of patients with neurological symptoms. Unfortunately, some processes are more readily distinguished by more conventional imaging studies such as computerized tomography (CT), and the initial use of MR imaging has caused some problems. We present here a case in which the MR appearance of falcine calcification, a normal anatomical variation, was mistaken for that of subacute and chronic hemorrhage, leading to a mistaken diagnosis of anterior interhemispheric dural vascular malformation. The MR images in two similar cases are also reviewed. Although mineralization of the falx cerebri is usually an incidental finding, the recognition of MR intensity patterns observed in cases of falcine ossification are important if they are not to be mistaken for lesions of greater clinical significance.

Case Reports

Case 1
This 39-year-old female nurse presented with a 3-month history of episodic dizziness. The patient complained of five or six episodes of unsteadiness, each lasting only a few seconds. Neurological examination was entirely within normal limits and there was no other significant medical history. The patient's father had died of a malignant glial neoplasm. A cranial MR image was obtained at an outside institution and was interpreted as demonstrating an anterior midline vascular malformation. The patient was then referred for neurosurgical consultation and consideration for angiography and possible intravascular embolization of this presumed malformation.

Upon review of the MR images, intensity patterns characteristic of falcine ossification were identified (Fig. 1 upper left, upper right, and lower left). A confirmatory CT scan was obtained which demonstrated the characteristic mineralization without associated soft-tissue abnormality or other regions of dural calcification (Fig. 1 lower left). The patient was discharged without surgical intervention.

Cases 2 and 3
Two similar cases were referred for our evaluation in which MR imaging was suggestive of vascular lesions (Figs. 2 and 3). Normal falcine ossification was revealed on CT scans in Case 2, and a small area of falcine mineralization was identified in Case 3.

Discussion
The falx cerebri is embryologically derived from mesenchymal cells which are multipotential. These cells may then be stimulated to undergo metaplasia and
differentiate into bone. A fatty central marrow cavity surrounded by dense cortical bone may then develop. Computerized tomography scans demonstrate focal marginal calcific density and occasionally a central noncalcified marrow space. Typically, both $T_1$- and $T_2$-weighted MR images show decreased signal intensity at the periphery, corresponding to dense cortical bone.

The fact that this anatomical variant can be mistaken for interhemispheric vascular lesions or hemorrhage on MR imaging is demonstrated in the three cases presented here. The $T_1$-weighted images show the central fatty marrow space as an area of increased signal intensity compared with adjacent brain (Figs. 1 upper left, 2 left, and 3). Intermediate $T_2$-weighted images may also show this high-intensity signal from central fat (Fig. 2 center). Heavily $T_2$-weighted images do not show this area as brightly, as fat decreases in intensity with increased repetition time (TR) and echo delay time (TE). In Case 2, the area of central fatty marrow appears similar in intensity to surrounding brain, lower in inten-
Mineralization of falx cerebri

Fig. 2. Case 2: normal falcine ossification. Left: T₁-weighted sagittal magnetic resonance (MR) image (spin-echo sequence: TR 450 msec/TE 22 msec/NEX 1 msec) demonstrating scattered areas of increased intensity representing fat within areas of falcine ossification (arrows). These findings may be confused with focal areas of interhemispheric hemorrhage. Center: T₁-weighted axial MR image (same parameters as left). Note the characteristic shape with a flat medial border abutting the falx and a prominent lateral margin (arrows) protruding toward the left. The arrows indicate the interface between fatty material and the more laterally oriented low signal intensity of the dense bone. Right: Second-echo T₂-weighted axial MR image corresponding to the level in the image shown center (spin-echo sequence: TR 2500 msec/TE 90 msec/NEX 1 msec). This image clearly separates the high intensity surrounding the cerebrospinal fluid from the left lateral ossific margin (low signal intensity, small arrows) and a more midline intermediate intensity fat collection (large arrow).

Fig. 3. Case 3: small area of falcine ossification in an elderly woman. Sagittal T₁-weighted magnetic resonance image (spin-echo sequence: TR 500 msec/TE 30 msec/NEX 2 msec) showing a localized area of fat apparently interdigitating with medial frontal cortical gyri (arrow).

mit differentiation of blood from fat. In addition, CT scans may clearly distinguish calcification from areas of vascularity and soft-tissue mass; thus, CT should be performed prior to interventional procedures whenever MR findings are atypical.

Ossification of the falx cerebri not only may be confused with interhemispheric vascular lesions but also may be mimicked by myelometaplasia, ⁸ falcine osteosarcoma, ¹⁴ dural metastases, and leukemic infiltration of the calcified falx. ¹² Parasagittal meningiomas may heavily calcify and therefore may also mimic the decreased intensity seen with normal falcine ossification on T₂-weighted images. While it is unusual to see regions of high signal intensity within these tumors on T₁-weighted images, meningiomas may rarely contain appreciable amounts of fat or hemorrhage ¹¹ and thus may closely resemble falcine ossification.

It is important to recognize that lesions presenting in the interhemispheric fissure which initially appear to be vascular or hemorrhagic on MR imaging may well be normal anatomical variants or other pathological processes. The typical location, anatomical configuration, and characteristic findings of T₁- and T₂-weighted MR images should allow for the specific diagnosis of falcine ossification. In problematic cases, the diagnosis may be confirmed by nonenhanced CT examination which can demonstrate typical calcification.

References

Manuscript received August 9, 1989. Accepted in final form December 22, 1989. Address reprint requests to: Robert M. Levy, M.D., Ph.D., Division of Neurological Surgery, Northwestern University Medical School, Wesley Pavilion 928, 250 East Superior Street, Chicago, Illinois 60611.