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Spinal Angiolipomas: MR Features

James M. Provenzale and Roger E. McLendon

PURPOSE: To determine the MR features of spinal angiolipomas and to compare these findings with their histologic appearance. **METHODS:** The MR examinations of three patients with surgically proved angiolipomas were reviewed for tumor location and extent, signal characteristics, and pattern of contrast enhancement, and were then compared with the histologic findings. **RESULTS:** Four tumors were found in the three patients, all located in the posterior epidural compartment, averaging about 2.5 vertebral bodies in length. On noncontrast T1-weighted images, all lesions were inhomogeneous and hypointense relative to epidural fat. Inhomogeneous enhancement was seen in three lesions on postcontrast T1-weighted images obtained with fat-saturation techniques. Angiolipomas were least conspicuous on T2-weighted images. A high vascular content correlated with the presence of large hypointense regions on T1-weighted images. **CONCLUSION:** Spinal angiolipomas are typically hyperintense on noncontrast T1-weighted images relative to other tumors. Angiolipomas that contain large hypointense foci on noncontrast T1-weighted images can be expected to have a high degree of vascularity.

Index terms: Lipoma; Spine, neoplasms

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Angiolipomas are uncommon, benign neoplasms that consist primarily of adipose and vascular elements. They are usually found in the soft tissues of the extremities, trunk, or neck (1). Spinal angiolipomas are rare lesions, accounting for between 0.14% and 1.2% of spinal axis tumors (1). Previous reports of the magnetic resonance (MR) imaging appearance of spinal angiolipomas have noted that these lesions are typically hyperintense on T1-weighted images (because of their lipomatous content) and often inhomogeneous (1-5). We report the MR imaging and histologic findings in three cases of spinal angiolipoma.

Materials and Methods

A review of our neuropathologic records over a period of 3 years revealed three patients (all women; average age, 47 years) in whom histologic findings prompted a diagnosis of spinal angiolipoma. All three patients had

undergone preoperative MR imaging examinations. In addition, in one patient, axial computed tomography (CT) was performed before and after administration of intravenous contrast material, and contiguous 3-mm sections were obtained. Pulse sequences used included noncontrast T1-weighted (three patients), T2-weighted (three patients), noncontrast T1-weighted with fat saturation (one patient), postcontrast T1-weighted with fat saturation (two patients), and postcontrast T1-weighted without fat saturation (one patient). T1-weighted images were obtained with parameters of 500-749/11-18/2 (repetition time/echo time/excitations). Precontrast and postcontrast T1-weighted images were obtained in all three cases. T2-weighted images were obtained using a fast spin-echo technique with parameters of 3000-4000/34-38, 102-108 (effective)/2. Fat-suppression T1-weighted images acquired with a frequency-selective pulse followed by gradient dephasing were obtained in two patients.

MR images were examined to determine the number and rostrocaudal length of the lesions, the presence of hyperintense signal within the tumor on T1-weighted images, presence of inhomogeneous signal within the tumor, and degree of contrast enhancement. The histologic findings of each tumor were reviewed for degree of vascularity and compared with the MR findings in each case.

Results

Four lesions were found in the three patients. Three of the lesions were proved histologically

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at surgery and the fourth (a second lesion in patient 2) was presumed to be an angioliipoma on the basis of nearly identical signal characteristics as the first lesion. The lesions ranged from 1.6 to 4.0 vertebral bodies in length (average, 2.6 vertebral bodies). One lesion extended into adjacent neural foramina, resulting in foraminal widening.

Imaging Appearance

All lesions were predominantly hyperintense on noncontrast T1-weighted images but were slightly or moderately hypointense relative to epidural fat. All lesions were inhomogeneous on each of the pulse sequences, but this feature was most pronounced on noncontrast T1-weighted images, in which focal regions of hypointense signal relative to the overall signal of the tumors were seen (Figs 1A and 2A). These regions varied in size; they were small and had a mottled appearance (Fig 1A) in two cases, and occupied a relatively large volume of the tumor in one case (Fig 3A).

Postcontrast T1-weighted imaging with fat saturation was the best pulse sequence for demonstrating the tumor. All three lesions imaged using this sequence diffusely enhanced in an inhomogeneous manner and were brighter than epidural fat (Figs 1B and 2D). On proton density-weighted images, angioliipomas appeared much brighter than cerebrospinal fluid but were nearly isointense with fat. The lesions were least conspicuous on T2-weighted images, on which they were only mildly hypointense relative to CSF and nearly isointense or slightly hypointense compared with epidural fat (Fig 3C).

Noncontrast CT scans showed the mass in patient 1 to be slightly hyperdense relative to epidural fat (Fig 1C). Contrast-enhanced CT in the same patient showed the mass to enhance diffusely and to become relatively isodense with the thecal sac (Fig 1D).

Histologic Appearance

In patients 1 and 2 the lesions had the normal whitish yellow histologic appearance of benign epidural fat. A gross specimen was not available for the lesion from patient 3. Microscopically, the lesions from patients 1 and 2 showed sheets of mature adipocytes densely interspersed with numerous small vascular channels (Fig 1E). In addition, the specimen from patient 2 also fo-

cally exhibited dilated vascular channels enmeshed within dense fibrous connective tissue containing little fat. In contrast, the histologic appearance of the lesion from patient 3 was marked by intense vascularity with cavernous vascular channels that appeared to fold upon themselves in tortuous knots, coursing between islands of mature adipocytes (Fig 3D).

Radiologic-Pathologic Correlation

In the three lesions that were resected, there was good correlation between the degree of hyperintense signal on noncontrast T1-weighted images and the degree of lipomatous content. The lesions in patients 1 and 2 were diffusely hyperintense and had the highest ratios of fat to vascular content. The lesion in patient 3 had relatively large foci of hypointense signal (relative to the rest of the tumor) and had the highest degree of vascularity.

Discussion

Angioliipomas are benign tumors composed of varying proportions of mature fat cells and angiomatous proliferation of blood vessels (6, 7). They are considered a subgroup of lipomas and have been referred to by various terms, including *vascular lipoma*, *hemangioliipoma*, and *fibromyoliipoma* (1). Mitoses and pleomorphism are not features of these lesions (6). Angioliipomas may be composed predominantly of vascular and stromal elements, with only a small lipomatous component and blood vessels varying in size from capillaries to arteries (1, 7). Alternatively, they may be predominantly lipomatous and contain only a few small angiomatous regions. In the latter instance, they can be distinguished from lipoma by the presence of capillaries with a complex branching pattern and abnormal pericytic proliferation (7). Sparsely vascularized angioliipomas can be distinguished from lipomas by the presence of microthrombi and fibrous scarring in angioliipomas but not in lipomas. Angioliipomas can be distinguished from liposarcomas by the typical presence of mitotically active, pleomorphic lipoblasts associated with an arcuate, or "chicken track," vascular appearance in liposarcomas, features not found in angioliipomas (6). Furthermore, angioliipomas often contain a greater number of mature, thick-walled vessels than do liposarcomas (6). Distinction from well-differ-

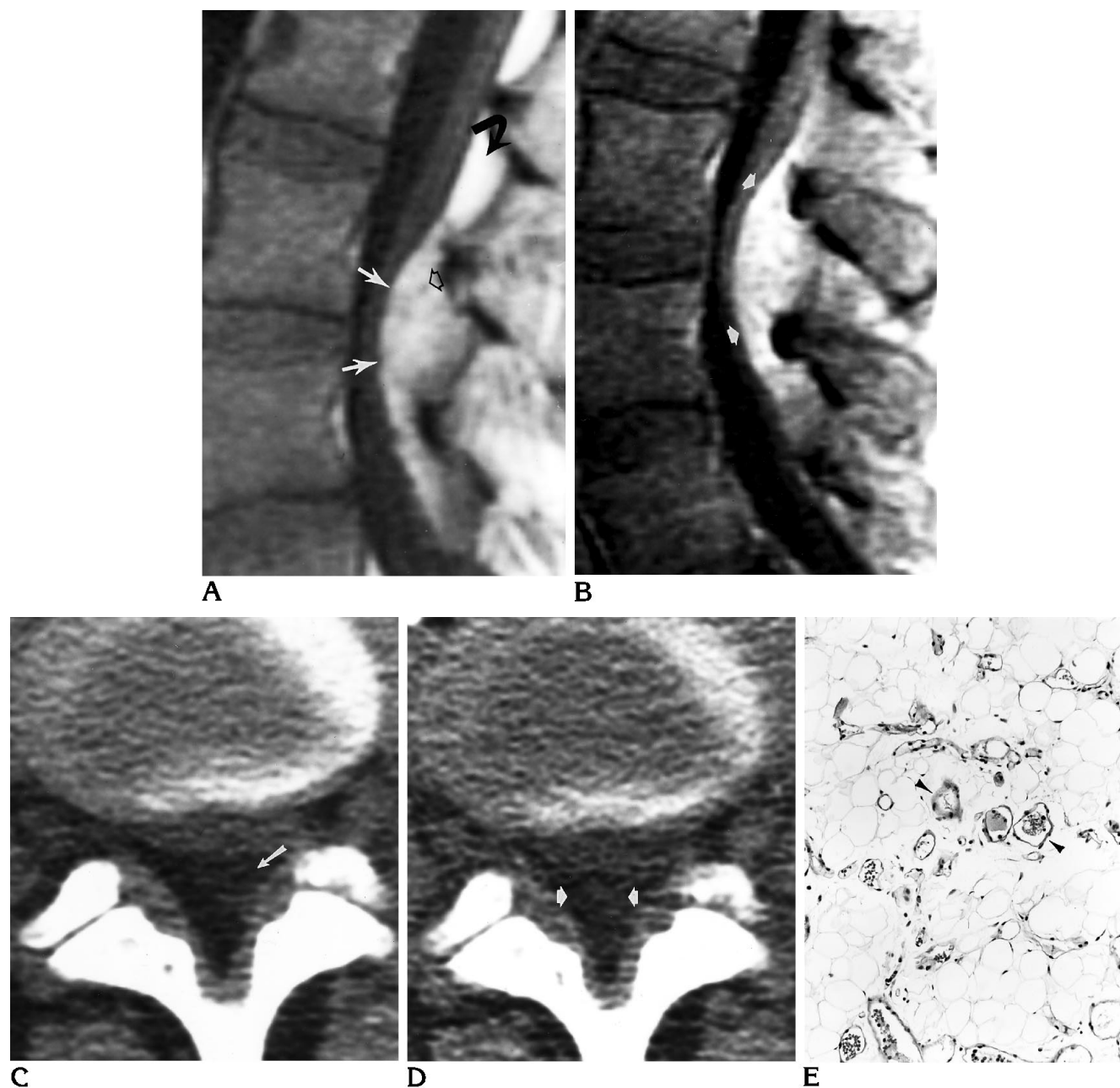


Fig 1. Patient 1: 38-year-old woman with lower back pain of 3 years' duration.

A, Noncontrast T1-weighted sagittal MR image (500/11/2) of the lumbar spine shows a slightly inhomogeneous posterior epidural mass (*white arrows*), which is moderately hypointense relative to normal epidural fat (*curved arrow*) and that contains small foci that are even more hypointense (*open arrow*). The lesion was nearly isointense with epidural fat on T2-weighted images (not shown).

B, Postcontrast T1-weighted sagittal MR image (600/11/2) obtained with fat saturation technique shows dense, slightly inhomogeneous enhancement of the mass (*arrows*).

C, Noncontrast axial CT scan shows anterior displacement of the thecal sac by a slightly inhomogeneous mass (*arrow*), which is mildly hyperdense relative to fat. The mass measured between -59 and -112 Hounsfield units.

D, Contrast-enhanced axial CT scan shows moderate enhancement of the mass (*arrows*), which is now relatively isodense with the thecal sac. The mass now measured between -24 and -31 Hounsfield units.

E, On histologic section, the neoplasm was grossly yellow and had a lobulated appearance. The gross appearance was similar to that of normal epidural fat. Microscopically, the tumor was remarkable for a uniform profusion of mature adipocytes intersected by numerous thin-walled vascular channels (*arrowheads*) (hematoxylin-eosin stain; magnification $\times 170$).

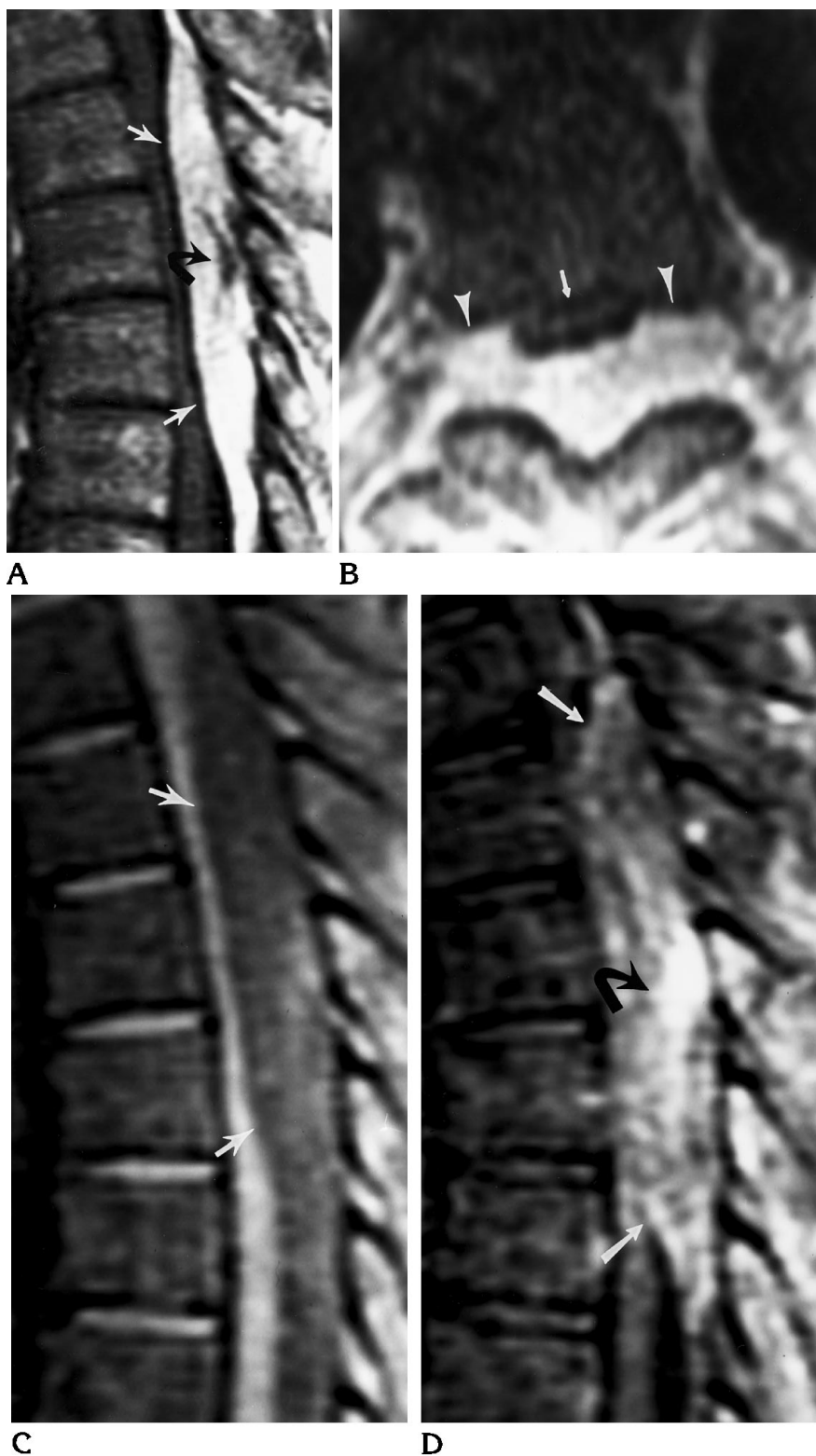
Fig 2. Patient 2: 61-year-old woman with a 2-year history of increasing paraparesis and two thoracic spinal lesions with similar imaging characteristics, one of which is illustrated.

A, Noncontrast T1-weighted sagittal MR image (500/11/2) shows an inhomogeneous mass (*white arrows*) compressing the spinal cord. The mass is generally slightly hypointense relative to normal epidural fat but contains a region that is especially hypointense (*black arrow*). This lesion was resected and, on microscopic examination, the degree of vascularity was relatively close to that of the lesion in patient 1.

B, Noncontrast T1-weighted axial MR image (500/11/2) shows the mass displacing the thecal sac (*arrow*) anteriorly and extending through, and widening, the neural foramina bilaterally (*arrowheads*).

C, Noncontrast T1-weighted sagittal MR image (556/10/2) obtained with fat-saturation technique shows a diffuse, nearly homogeneous decrease in the signal intensity of the lesion (*arrows*).

D, Postcontrast T1-weighted sagittal MR image (566/11/2) obtained with fat-saturation technique shows inhomogeneous enhancement of the mass (*white arrows*). The most densely enhancing portion of the mass (*black arrow*) is near the site that was most hypointense on the non-contrast images (Fig 2A).



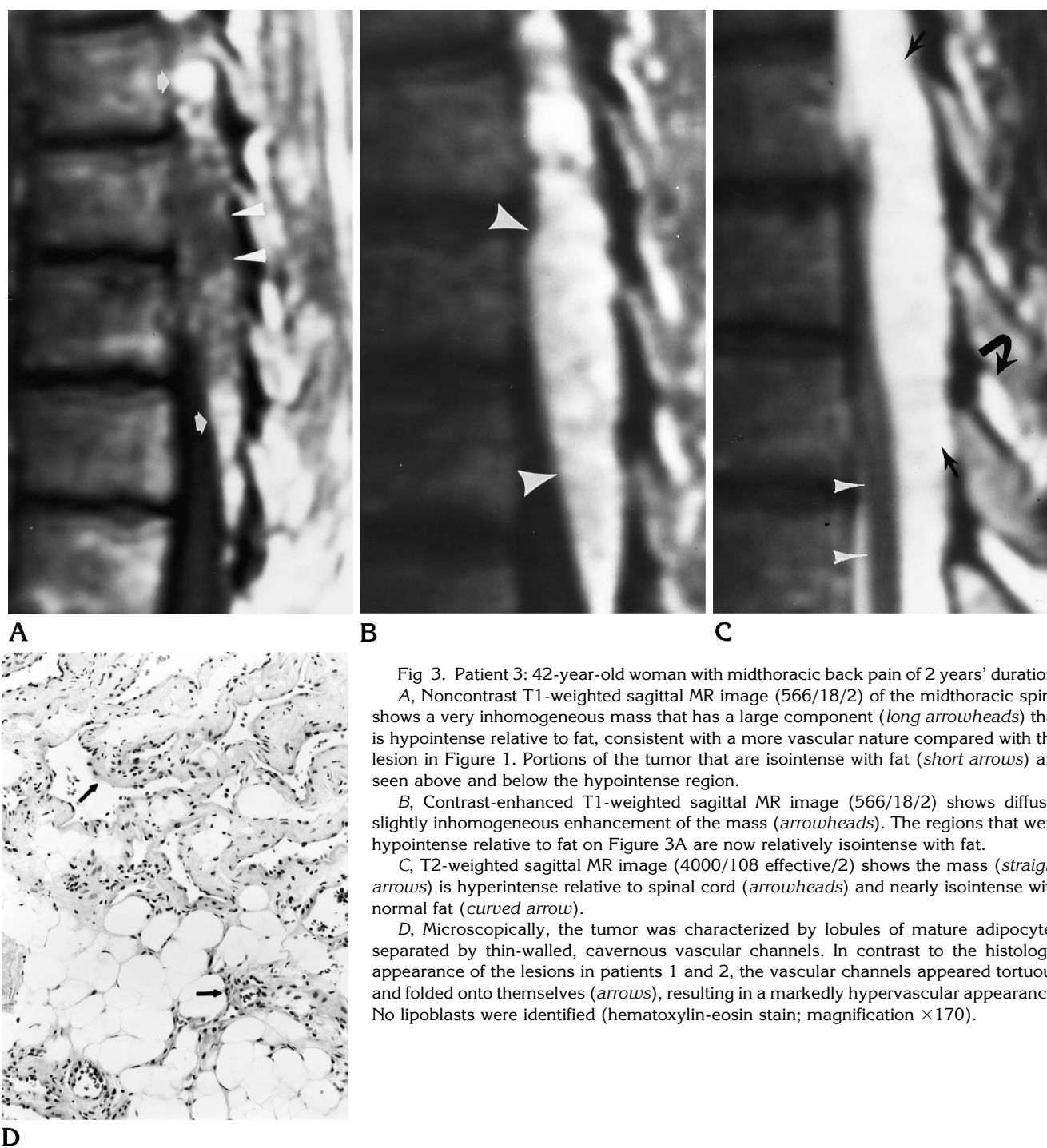


Fig 3. Patient 3: 42-year-old woman with midthoracic back pain of 2 years' duration. A, Noncontrast T1-weighted sagittal MR image (566/18/2) of the midthoracic spine shows a very inhomogeneous mass that has a large component (*long arrowheads*) that is hypointense relative to fat, consistent with a more vascular nature compared with the lesion in Figure 1. Portions of the tumor that are isointense with fat (*short arrows*) are seen above and below the hypointense region.

B, Contrast-enhanced T1-weighted sagittal MR image (566/18/2) shows diffuse, slightly inhomogeneous enhancement of the mass (*arrowheads*). The regions that were hypointense relative to fat on Figure 3A are now relatively isointense with fat.

C, T2-weighted sagittal MR image (4000/108 effective/2) shows the mass (*straight arrows*) is hyperintense relative to spinal cord (*arrowheads*) and nearly isointense with normal fat (*curved arrow*).

D, Microscopically, the tumor was characterized by lobules of mature adipocytes separated by thin-walled, cavernous vascular channels. In contrast to the histologic appearance of the lesions in patients 1 and 2, the vascular channels appeared tortuous and folded onto themselves (*arrows*), resulting in a markedly hypervascular appearance. No lipoblasts were identified (hematoxylin-eosin stain; magnification $\times 170$).

entiated low-grade liposarcomas lacking pleomorphism can be difficult, if not impossible, and depends on the demonstration of lipoblasts in liposarcomas but not in angioliipomas (6). Angiomyoliipomas, which generally occur in the kidney and are associated with tuberous sclerosis, are distinguished from angioliipomas by the presence of smooth muscle proliferation within

the former. Both encapsulated (ie, noninfiltrating) and nonencapsulated (ie, infiltrating) forms of angioliipomas are recognized. Noninfiltrating angioliipomas typically involve the subcutaneous tissues, are frequently multiple, are usually seen in young adults, present clinically as painful nodules, and usually are easily cured by surgery (8). Infiltrating angioliipomas are rare,

usually involve the extremities, can infiltrate local structures, and have about a 50% recurrence rate (9).

Angiolipomas involving the central nervous system are extremely uncommon, with about 90% located within the spinal canal (10). In rare instances, angiolipomas have been found intracranially (11, 12). The vast majority of spinal angiolipomas are extradural (1, 13). Intramedullary angiolipomas are extremely rare (1). In the spinal canal, noninfiltrating forms of the tumor are much more common (1, 14). Spinal angiolipomas usually extend over three to four vertebral bodies in length. Although angiolipomas are typically located in the posterior epidural space, infiltrating angiolipomas are generally in the anterior epidural compartment (1).

The typical clinical presentation of extradural angiolipoma is back pain, progressive paraparesis, and lower extremity sensory changes, often occurring over a period of a few years (1). The lesions are more common in females and generally present in the fifth decade, although intramedullary angiolipomas generally present at an earlier age (1, 13, 15). In unusual cases, a relapsing-remitting course has been noted (16). Symptom onset and exacerbations have been noted during pregnancy, possibly in conjunction with an increase in tumor volume (resulting from the generalized rise in blood volume during pregnancy), impaired spinal venous drainage, or hormonal changes resulting in an increase in extravascular fluid volume (1, 17).

The CT appearance of spinal angiolipoma is that of a mass that is typically hypodense relative to the spinal cord and has variable degrees of enhancement after contrast administration (1-3). On rare occasions, portions of angiolipomas within the spinal canal have been reported to be calcified (3). Infiltrating forms of the tumor can destroy adjacent bone and produce a trabeculated appearance within the adjacent vertebral body, simulating hemangioma (1, 14). Vertebral bodies infiltrated by angiolipoma on CT scans have been reported to exhibit little or no contrast enhancement, which, according to some investigators, is a reliable way to distinguish angiolipoma from vertebral hemangioma (14).

Because angiolipomas are mostly hyperintense on T1-weighted images and often nearly isointense with epidural fat, fat-suppression MR imaging is particularly well suited for the investigation of these tumors. Contrast administra-

tion in conjunction with fat saturation in two of our patients served to make the lesions more conspicuous and to define better the borders of the tumor and aid in surgical planning. Almost all reported angiolipomas (and all lesions in our patients) have been predominantly hyperintense on T1-weighted images and inhomogeneous owing to interspersed vascular elements (2, 3, 5). Rarely, angiolipomas have two discrete foci, one that is homogeneously hyperintense and another that is isointense with spinal cord on noncontrast T1-weighted images (1, 2). The lesion in patient 3 differed from this form of angiolipoma because there were a large number of foci (rather than two foci) arrayed in somewhat of a mosaic pattern (Fig 3A). The appearance of angiolipomas differs from that of liposarcoma, another lipomatous (but malignant) lesion in a number of ways. Well-differentiated liposarcomas frequently have irregular, thickened septa on CT and MR studies and contain regions of hyperintense signal (compared with fat) on T2-weighted MR images (18), findings not seen in angiolipoma. Unlike angiolipomas, myxoid and pleomorphic liposarcomas generally are relatively homogeneously isointense with muscle on T1-weighted images and hyperintense relative to fat on T2-weighted images (18).

The MR appearance of angiolipomas correlated well with their observed histologic composition. As expected, the lesions in patients 1 and 2 were composed primarily of fat and the lesion in patient 3 was highly vascular. Unlike some other vascular tumors (eg, glomus jugulare tumors), angiolipomas do not typically contain vascular flow voids on MR images (1, 2). This is probably because of the preponderance of capillaries and venous channels in angiolipomas, which distinguish them from those lesions with predominantly arteriolar circulation and from malformations with arteriovenous shunting, both of which produce fast flow, seen on MR images as flow-void phenomena. The presence of small vascular channels was sufficient to render the angiolipomas inhomogeneous and hypointense relative to epidural fat, which, in conjunction with contrast enhancement, indicated that the lesions were probably some form of vascularized lipomatous tumor. Spinal angiolipomas can, therefore, be distinguished from epidural lipomatosis, which is isointense with epidural fat and homogeneous and would not be expected to show contrast enhancement (19).

The treatment of spinal angiolipoma is surgical extirpation. Total removal of epidural non-infiltrating lesions is possible in about 80% of cases (1, 14). As expected, infiltrating angiolipomas are more difficult to remove, especially if they are anterior in location (1, 14). A staged procedure or only subtotal resection may be necessary. Because these lesions are slow growing and do not undergo malignant transformation, partial resection often provides substantial symptomatic relief (1).

Angiolipomas are rare but should be considered when an inhomogeneous hyperintense mass on T1-weighted MR images is encountered. Our findings indicate that the degree of central hypointensity on T1-weighted images is predictive of the degree of vascularity likely to be encountered at surgery. A preponderance of hypointense regions indicates a very vascular tumor, even though flow voids are not seen.

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