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MRI of a Vertebral Hemangioma Causing Myelopathy

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脊髄圧迫症状をきたした脊椎血管腫のMRI

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脊椎圧迫症状を呈した脊椎血管腫1例のMR所見を報告する．T1，T2，強調画像いずれにおいても血管腫は隣接する椎体に比し高いシグナルを示した．このパターンは他の病変では報告されておらず，血管腫に特徴的なパターンである可能性がある．

Case Material

A 61-year-old white female presented with a six month history of progressive bilateral leg numbness and weakness. The patient also complained of a "tight feeling" around the abdomen with prolonged walking or sitting. Admission to Presbyterian-University Hospital was preceeded by dull, non-radiating, mid-thoracic back pain. The patient denied constipation, urinary incontinence or retention, but ademitted to a sense of urgency prior to urination.

On physical examination there was focal, moderate tenderness over the fifth and sixth thoracic vertebrae. Pertinent aspects of the neurologic exam were as follws. There was mild calf atrophy on the right. Muscle strength was 5/5 in all groups tested except the left extensor hallucis longus which was 4+/5. Muscle tone was moderately increased in the lower extremities in a claspknife fashion. There was bilateral hypesthesia and hypalgesia to approximately the T-7 level. Proprioception was mildly reduced bilaterally. Moderate gait ataxia was present. Deep tendon reflexes were 2+ in the upper extremities and 3+ in the lower extremities. There was left ankle clonus. Bilateral Babinski's were present.

Thoracic spine films revealed a mottled "honeycomb" pattern involving the T-1 vertebral body. This was associated with ill defined pedicles on the AP view. There was no evidence of compression fracture or disc space narrowing. Iohexol myelography revealed a complete extradural block at the inferior aspect of the T-1 vertebral body (Fig. 1).

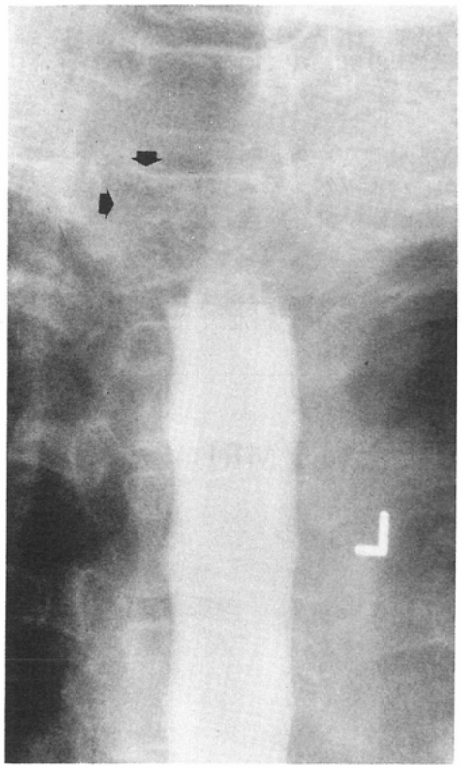

Fig. 1 Iohexol myelogram demonstrates a complete block inferior to T_1 with feathered margins characteristic of an extradural process. Note the mottled appearance of T_1 and the indistinct right pedicle (arrows).

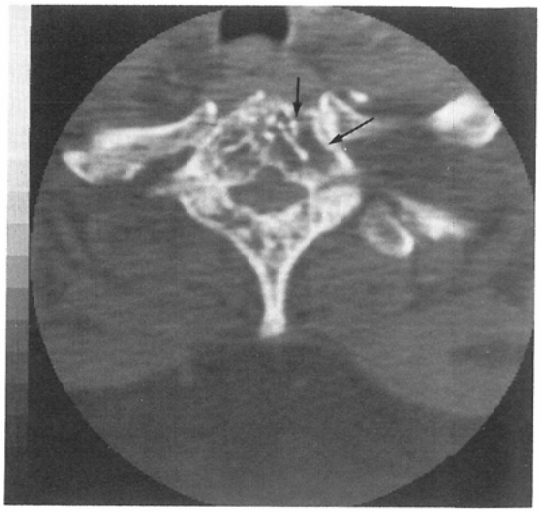

Fig. 2 Axial CT through T_1 demonstrates medullary architecture consistent with hemangioma. The lucent areas (arrows) represent the dilated venous channels (venous basins). The remaining trabeculae are thickened.

CT myelography was performed on a GE 9800 scanner utilizing a 256 × 256 matrix. The T_1 vertebral body, pedicles and laminae demonstrated a reduced number of trabeculae with thickening of those remaining. This pattern is consistent with hemangioma. In addition, bony hypertrophy of the body and posterior elements resulted in concentric spinal canal narrowing (Fig. 2).

MRI of the thoracic spine was performed on a GE Signa system operating at 1.5 Tesla, utilizing a 14.6 cm round surface coil. There was increased signal intensity, relative to normal bone marrow, in the first thoracic vertebra on T1 and T2 weighted images. Sagittal MRI further delineated the narrowed spinal canal and the resultant anterior and posterior compression of the spinal cord (Fig. 3A & B). A decompressive laminectomy and unilateral pediculectomy of T1 was performed. The lamina of T_1 was thickened with coarse trabeculae. The bone was quite porous and moderately vascular. No extradural mass was identified. Histology confirmed the diagnosis of capillary hemangioma. Radiation therapy was considered, but deferred. Follow-up examination two month later revealed the patient to be neurologically normal.

Discussion

Vertebral hemangioma is a benign, slow growing tumor occurring most commonly in the lower thoracic or upper lumbar spine[5]. Middle aged females are most frequently affected[6]. The majority of hemangiomas are asymptomatic. Spinal cord or cauda equina compression is uncommon. However, when

Fig. 3A T_1 weighted image, (repetition time (TR) of 800 ms, echo time (TE) of 25 ms, 5 mm slice thickness, 2 excitations) demonstrates increased signal intensity in the first thoracic vertebral body and neural arch. Note the thickened vertical striations (arrow) representing the prominent trabeculae. Also note the posterior encroachment on the spinal cord secondary to laminar hypertrophy.

Fig. 3B T_2 weighted image, (repetition time (TR) of 3500 ms, echo time (TE) of 100 ms, 5 mm slice thickness, 2 excitations) again demonstrates increased signal intensity of the body and neural arch of the first thoracic vertebrae. Note the anterior as well as posterior narrowing of the spinal canal secondary to vertebral body and laminar hypertrophy.

present it occurs most frequently in the thoracic area[12]. Causes of neural compression include: 1) expansion of the involved vertebrae; 2) extension of tumor into the extradural space; 3) compression fracture; 4) hemorrhage resulting in extradural hematoma[16]. Of these mechanisms, the first two are more common.

The plain film radiographic characteristics of vertebral hemangioma are well established. There are two distinct patterns: 1) indistinct parallel vertical linear streaks resulting in a "corduroy cloth" appearance, which is best demonstrated in the lateral projection or 2) a mottled honeycomb pattern[13]. The vertebral body is most frequently involved but there can be extention into the neural arch. With posterior element involvement, symptomatology related to neural compression is more frequent[12].

On axial CT the thickned vertical trabeculae are demonstrated in cross-section. This results in a polkadot pattern[10]. Since there are technical limitations in lateral plain film examination of the upper thoracic spine, axial CT is supperior in evaluating this region. In addition to demonstrating the characteristic coarse trabecular pattern, CT delineates epidural and paraspinal extension[10]. These plain film radiographic and CT findings are characteristic but not pathognomonic. They can be seen in other lesions such as multiple myeloma, metastases, lymphoma, Paget's disease or blood dyscrasias. Thus, an apparent hemangioma in a symptomatic patient should be carefully evaluated.

The current case exhibits increased signal intensity on T_1 and T_2 weighted MR images. In contrast, Zimmer et al, reported a hemangioma, site unspecified, where measured T_1 and T_2 values were longer than normal bone marrow. Resultant images had decreased signal intensity with T1 weighting and increased signal intensity with T2 weighting[17].

The inconsistency with T_1 weighting may be explained by structural and hemodynamic differences in

vertebral hemangiomas. These differences were elucidated in a comparative CT and angiographic study by Stojanovic et al[15]. They noted that some hemangiomas manifested prominent dilated venous channels which they termed "venous basins". When such basins were present there was a consequent decrease in the number of bony trabeculae visualized on CT. Angiographic evaluation of these hemangiomas demonstrated a shortened arterial phase associated with a lengthened venous phase. This relative venous stasis resulted in a protracted tumor blush.

The currently reported case demonstrates "venous basins". Thus, the increased signal with T_1 weighting may be a manifestation of paradoxic enhancement seen with slowly flowing blood[7]. The decreased signal with T_1 weighting in the case reported by Zimmer may be secondary to two factors: 1) relative faster flow in smaller channels, therefore less stasis; 2) a relative increased number of trabeculae, therefore more calcified bone mass.

Thus far, most skeletal lesions reported have exhibited a decreased signal intensity, relative to normal bone marrow, on T1 weighted images. Presumably this is secondary to replacement of marrow fat by the lesion. This pattern has been reported with metastases[2][3][4][10], myeloma[3], lymphoma[17], leukemia[2], eosinophilic granuloma[4], primary malignant bone tumors[2][17], giant cell tumors[1], and osteomyelitis[9].

However, increased signal within bone on T_1 weighted sequences has been reported after radiation therapy[12] and with aplastic anemia[2]. In each instance, the cited mechanism was replacement of fat-containing marrow by more homogeneous fat. This fatty replacement dose not result in increased signal on T_2 weighted images.

Paget's disease is another entity in which T_1 weighted images can demonstrate increased signal intensity. This has been reported in relationship to the calvarium[16]. Currently there are no reports of MRI findings in Paget's disease involving vertebrae.

With neoplastic replacement of bone marrow by non-hemangiomatous lesions, the distribution of T2 signal intensity relative to normal marrow is more diverse than the T_1 signal intensity spectrum. As previously noted, T_1 signal intensity is generally decreased. With T_2 weighted images, signal intensity, although increased in the majority of cases, may be isointense or decreased. Zimmer et al. in an analysis of 52 bone tumors noted isointense or decreased signal in seven cases[17]. Daffner et al. in an evaluation of 80 patients with malignant infiltration of bone marrow did not attempt differentiation of abnormalities at T_2 weighting, because of the variable appearance of lesions on T_2 weighting[3].

In general, when marrow is replaced by tissue of increased water content, whether this tissue be neoplastic, inflammatory, vascular or necrotic, there will be a concomitant increase in T_2 values. This results in increased signal on T_2 weighted images. If marrow is replaced by fibrous tissue, calcification, osteoid or cartilage, the resultant signal after T_2 weighting will be decreased. With the currently reported hemangioma, the increased signal on the T_2 weighted images may be related to two factors: 1) the increased water content of the venous basins relative to marrow; and 2) venous stasis manifested by paradoxic enhancement.

Since increased signal intensity with T_1 and T_2 weighting is unreported with other vertebral body lesions, this pattern may be suggestive of hemangioma. However, further experience is necessary to establish the spectrum of MRI patterns in vertebral hemangiomas and to determine the diagnostic significance of increased signal intensity when present on both T_1 and T_2 weighted vertebral body images.

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