FAT SUPPRESSION MR IMAGING OF VERTEBRAL HEMANGIOMAS *

İ. KOVANLIKAYA MD H. ÇAKMAKÇI MD D. ÖZAKSOY MD Y. GÖKTAY MD
C. KÜÇÜKLER MD E. İĞCİ MD M. MANİSALI MD

ABSTRACT:

Vertebral hemangiomas include a wide range of signal characteristics of MRI. All vertebral hemangiomas do not have pathognomonic signal properties and it's aften difficult to distinguish them from various processes affecting bone marrow, such as hemorrhage, trombosis, radiation therapy, degenerative disk diseases and even some metastasis. Fat suppression magnetic resonance imaging is performed to investigate the additional advantage of the technique, to diagnose atypical vertebral hemangiomas. Eighteen patients with a total of 21 vertebral hemangiomas were studied with conventional and fat suppressed MRI. Fat suppressed T1 weighted images revealed signal decrease within the lesions, having atypical signal properties on conventional MR images. Athough nonfat suppressed images allowed to diagnoose 84% of vertebral hemangiomas, this ratio for fat saturation images was increased to 96%. Fat suppression MRI is found as a valuable technique in evaluation of atypical forms of vertebral hemangiomas and differentiate lesions, having similar signal properties.

Key Words: *Fat suppression magnetic resonance imaging - vertebral hemangiomas - fat saturation.*

INTRODUCTION

Vertebral hemangiomas benign vascular tumors of origin, encompass a wide range of signal properties on MR Imaging. While most of them come into view with high signal n T1 and T2 weighted images with mottled appearance that emerges to be characteristic, a further collection of vertebral hemangiomas show a varying signal intensities on T1 weighted images (1, 2). Due to their fat content, additional work is needed to ascertain the identity of the distinctive signal changes contrived by vertebral hemangiomas, frm various processes affecting vertebral bne marrow with imitative appearance of hemangiomas.

On the basis of discriminating vertebral hemangiomas having atypical signal properties, we stressed the role of fat suppression MR imaging.

MATERIALS AND METHODS

MR imaging was performed on 18 patients with a total of 21 vertebral hemangiomas, which were already diagnsed oon the basis of characteristic radiological findings (Plain radiography, CT, Nuclear Medicine) except one which had undergne biopsy for diagnosis. A patient with Paget disease was also examined, as conventional MR findings were similar with hemangiomas. MR imaging was performed with SIEMENS Magnetom 1 T superconductive magnet. All images were obtained on sagittal plane with spine coil. After routine T1 and T2 weighted sequences, fat suppression was performed by transmitting a chemically selective RF pulse centered on the frequency of lipid resonance with subsequent dispersion of the signal with a slice selective gradient pulse. The spin echo T1 weighted sequence was then performed with signal centered on the frequency of water. After nonenhanced images, Gd-DTPA (0.01 mmol per kg) was injected as bolus and enhanced sagittal fat suppressed images were obtained.

Image analysis

Hemangiomas, depicted on conventional T1 and T2 weighted and fat saturation images were evaluated by two radiologists; based on comparison and correlation of the signal intensity within the hemangiomas before and after fat suppression, presence of mottled appearance, compression, partial or total involvement of the vertebra and also contrast enhancement, which could only be detectable on fat suppressed images.

RESULTS

The results of conventional and fat suppression MR imaging are summarized on Table 1. Based on criteria of increased signal on conventional T1 and T2 weighted images, with or without mottled appearance, 17 vertebral hemangiomas were detected on conventional imaging (84 %) (Figure 1). In addition, 3 of 4 vertebral hemangiomas with atypical signal pattern on

* Dokuz Eylül University, School of Medicine Department of Radiology 35340 İzmir - TURKEY

Table 1: Conventional and Fat Suppressed MR Imaging Findings

PATIENT NO	LOCATION	MOTTLED APPEARANCE	COMPRESSION	VERTEBRAL INVOLVEMENT		CONVENTIONAL IMAGES		FAT SAT IMAGES	
				PARTIAL	TOTAL	T1	T2	T1	C + T1
1	L2, T1	+	+	+	+	hyperintense	hyperintense	hypointense	punctuate increased signal
2	T12	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
3	T10	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
4	T7 - 10	+	–	+	+	hyperintense	hyperintense	hypointense	punctuate increased signal
5	L5	+	–	+		isointense	hyperintense	hypointense	punctuate increased signal
6	T12	+	–		+	isointense	hyperintense	hypointense	atypical increased signal
7	L1 - L2	+	–	+	+	isointense	hyperintense	hypointense	punctuate increased signal
8	L2	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
9	T12	+	+	+		hyperintense	hyperintense	hypointense	punctuate increased signal
10	T2	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
11	L5	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
12	T11	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
13	L3	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
14	L1	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
15	C3	+	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
16	T11	–	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
17	L4	–	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
18	L1	–	–	+		hyperintense	hyperintense	hypointense	punctuate increased signal
TOTAL	21	15	2	17	4	hyperintense 18 isointense 3	hyperintense 21	hypointense 20 isointense 1	punc. hypertintense 20 atyp. hyperintense 1

conventional MR images, 17 hemangiomas with pathognomonic signal characteristics allowing to be diagnosed with conventional MR technique showed signal decrease on non-enhanced fat suppressed images owing to fatty stroma and punctuate increased signal on contrast enhanced fat suppressed images which were due to vascular pool (Figure 3). Those findings made it possible to diagnose additional 3 cases of vertebral hemangiomas with fat suppression technique (96%) on MRI basis. On of the 21 hemangiomas, did not have the diagnostic criteria on both conventional and fat suppression images which was diagnosed by biopsy. The signal intensity of vertebral involvement in the patient with Paget disease was hyperintense on T2 weighted and slightly increased atypical signal on contrast enhanced fat suppressed images. In this patient, fat suppression technique was successful in differentiating hemangiomas from changes due to Paget disease (Figure 4).

DISCUSSION

Vertebral hemangiomas (VH) are slowly growing hamartomas, which in bones are most commonly found in the calvarium and the vertebral bodies. Within spinal column, the thoracic vertebrae are most frequently involved. Histopathologically, they consist of thin-walled, blood-filled vessels and sinuses lined by endothelium and interspersed among the longitudinal oriented trabeculae of bones. The dilated vascular channels are set in a substratum of fattly marrow (1, 2).

VH can be divided into two categories as asymptomatic and symptomatic. Laredo et al, has previously found that fatty vertebral hemangiomas mostly present inactive forms of VH while low signal intensity at MR

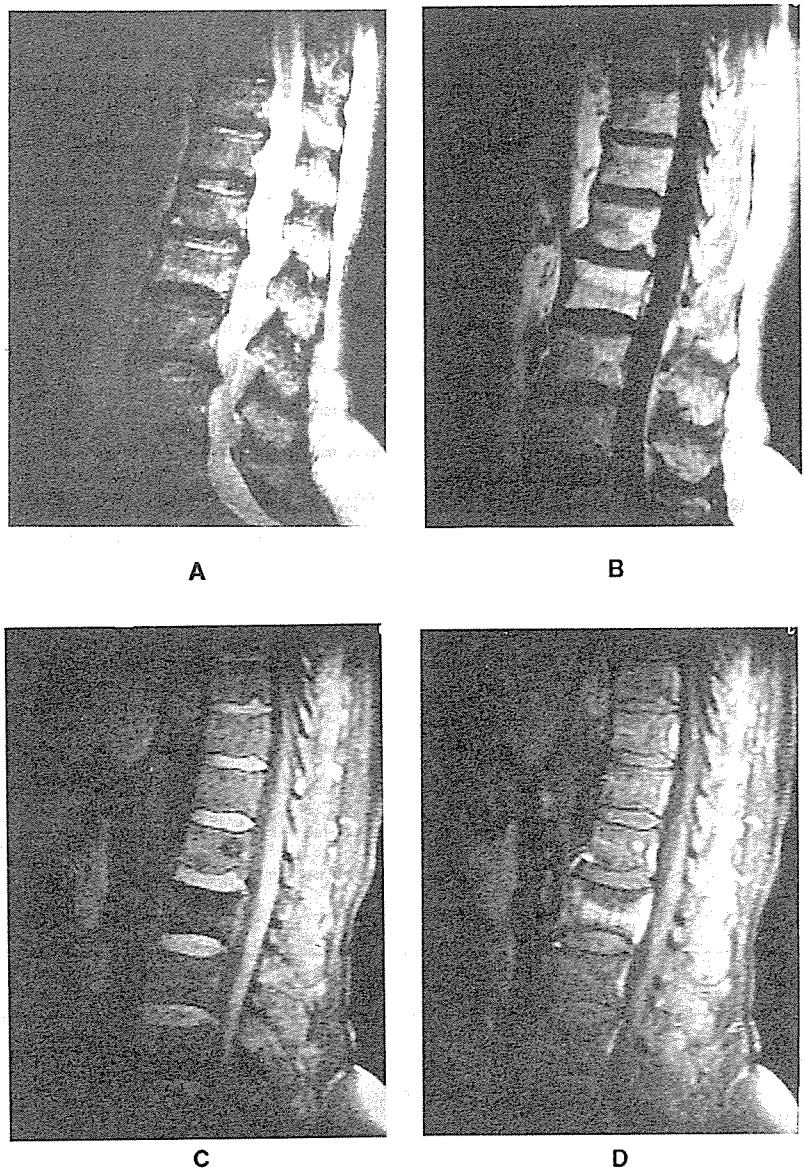


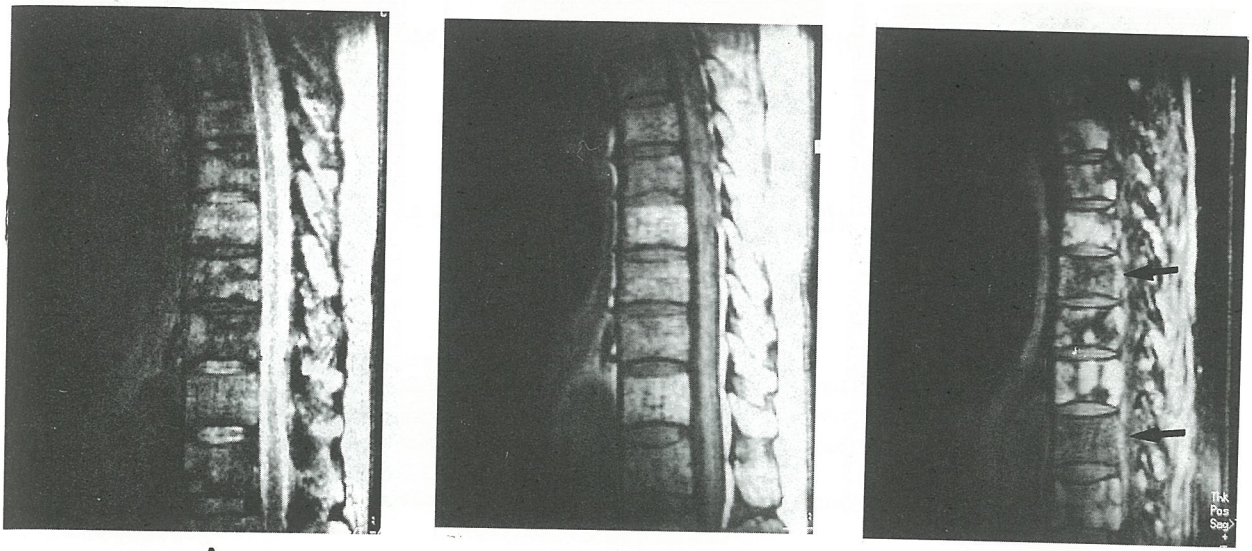
Figure 1:
A Sagittal T2 weighted (SE 2200/80) MR image shows high signal intensity of the L2 body and a focal area in the L1 body.
B Sagittal T1 weighted (SE 5600/15) image of the same areas demonstrates increased signal.
C Fat suppressed T1 weighted image shows decreased signal which is due to fatty stroma of the hemangiomas. The central linear pat in the L2 body shows less prominent signal decrease than the rest of the vertebra.
D Contrast enhanced fat suppressed sagittal image is revealed the vascular component with mottled increased signal pattern within the hemangiomas. The central linear pat of the L2 body which has less prominent signal decrease on non-enhanced fat suppressed image, shows much more enhancement than the rest of the body.

imaging indicates a more active vascular lesion with a potential to compress the spinal cord (2, 3, 4). Therefore, evaluation of the agressiveness of the lesion which corresponds to vascularity, seems crucial for optimal management and treatment (5).

The VH continued to show a distinctive appearance of increased signal on both T1 and T2 weighted images, at least in the osseous portion of the tumor. The shortened T1 reflects the fatty component of the tumor as evidenced by the chemical shift and histopathological findings (2, 3). Fat suppression MR imaging is particularly beneficial in the detection of fat containing areas in VH. Other processes such as hemorrhage, changes due to radiation therapy, thrombosis, slow blood flow may give increased signal on T1 weighted images within vertebral bodies similar to fat content of VH (1, 2, 3, 6-9). After injection of paramagnetic contrast material, detection of punctuate increased signal in fatty stroma of VH is impossible on conventional T1 weighted images. Fat suppression hechniques with contrast enhancement have also proved to be useful in determining vascularity of VH where conventional MR imaging techniques result in limitations owing to fat (7-9) (Figure 2). Especially, in vertebras with compression, the exact cause of contrast enhancement detected on fat suppressed images, whether due to vascular pools of hemangioma or neoplastic, inflammatory lesions, can not easily be characterized, so as biopsy still remains gold standard for accurate diagnosis.

In our study fat suppression MR imaging increased the diagnostic accuracy for VH to 96% and also estimated the aggressiveness of the lesions.

Fat suppression technique in combination with constrast enhancement may be the definitive study for evaluation of vertebral hemangiomas as well, allowing the diagnosis of the atypical cases to be made, prognosis to be determined, treatment to be decided.



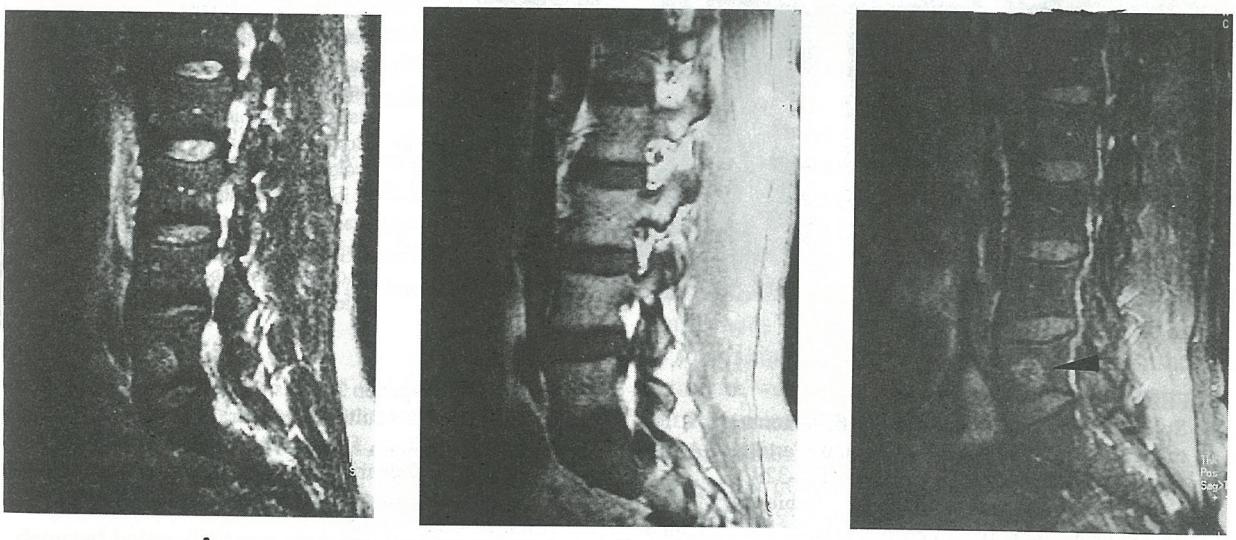
A B C

Figure 2:

A Sagittal T2 weighted (SE 2200/80) thoracic vertebra image of a patient with multiple myeloma shows patchy increased signal within the vertebral bodies.

B On the T1 weighted (SE 500/15) sagittal image high signal of the T7 and T10 vertebral bodies are seen.

C Contrast enhanced fat suppressed T1 weighted image demonstrates mottled increased signal in the same vertebral bodies (arrows), while multiple myeloma deposits are diffusely hyperintense.



A B C

Figure 3:

A T2 weighted (SE 2200/80) sagittal MR image demonstrates focal area of increased signal in L5 vertebral body.

B T1 weighted (SE 500/15) image of the same vertebra shows no altered singal.

C Contrast enhanced fat suppressed T1 weighted image of the hemangioma exhibits punctuate increased signal (arrow head) due to vascular component of the hemangioma

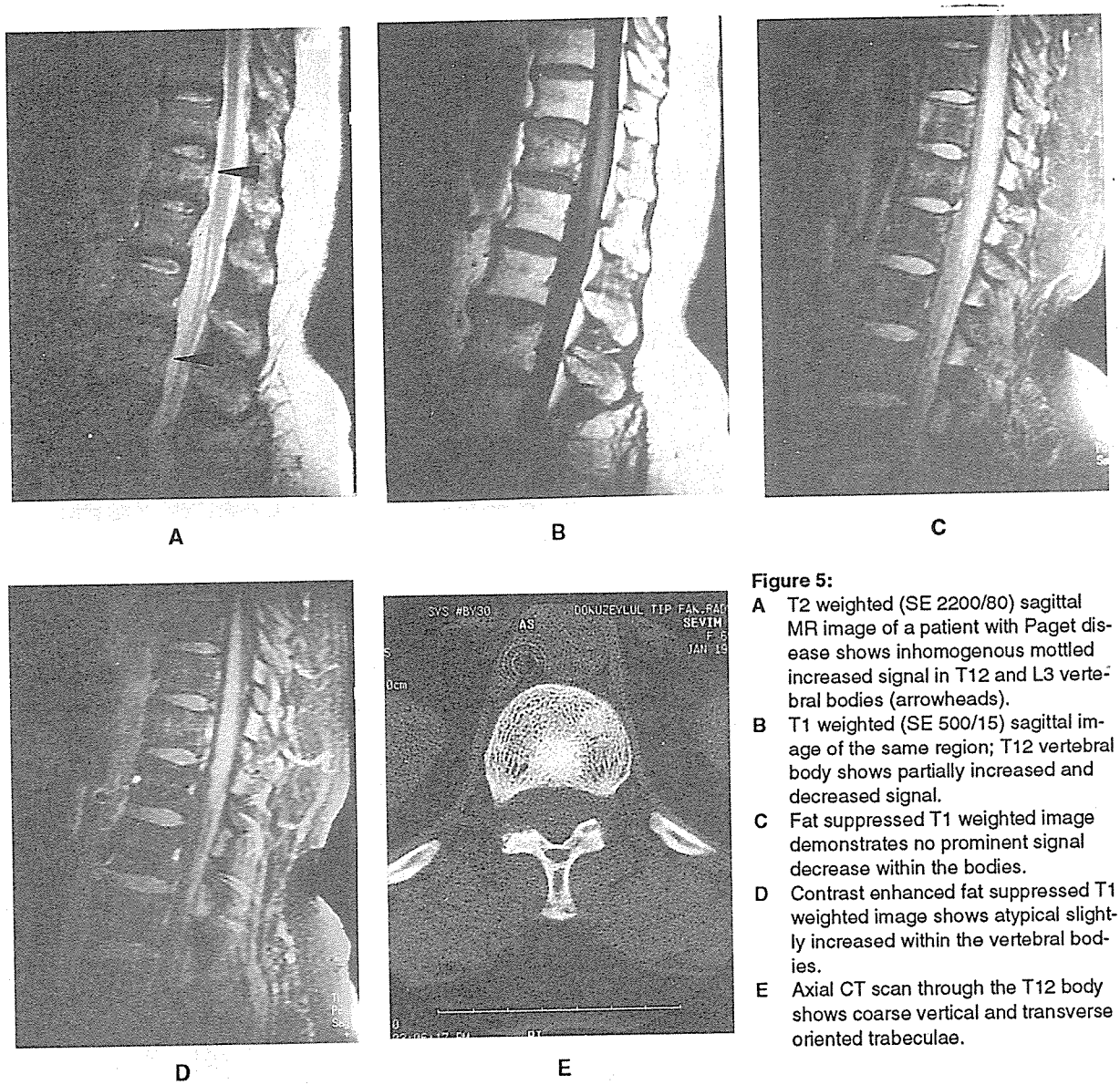


Figure 5:

A T2 weighted (SE 2200/80) sagittal MR image of a patient with Paget disease shows inhomogenous mottled increased signal in T12 and L3 vertebral bodies (arrowheads).

B T1 weighted (SE 500/15) sagittal image of the same region; T12 vertebral body shows partially increased and decreased signal.

C Fat suppressed T1 weighted image demonstrates no prominent signal decrease within the bodies.

D Contrast enhanced fat suppressed T1 weighted image shows atypical slightly increased within the vertebral bodies.

E Axial CT scan through the T12 body shows coarse vertical and transverse oriented trabeculae.

REFERENCES

1. Spjut HJ, Dorfman HD, Fechner RE, Ackerman LV. Hemangioma in: Tumors of Bone and Cartilage. Armed Forces Institute of Pathology; 1983: 327-329.
2. Laredo JD, Assouline E, Gelbert F, Wybier M, Merland JJ, Tubiana JM. Vertebral Hemangiomas: Fat Content as a Sign of Aggressiveness. Radiology 1990; 177: 467-472.
3. Ross JS, Marasyk JT, Modic MT, Carter JR, Mapstone T, Dengel FH. Vertebral Hemangiomas: MR Imaging. Radiology 1987; 165: 165-169.
4. Laredo JD, Reizine D, Bard M, Merland JJ. Vertebral Hemangiomas: Radiological Evaluation. Radiology 1986; 161: 183-189.
5. Djindjian M, Nguyen JP, Gaston A, Pavlovitch JM, Pairier J, Awad IA. Multiple Vertebral Hemangiomas with Neurological Signs. J Neurosurg 1992; 76: 1025-1028.
6. Ramsey RG, Zacharias CH. MR Imaging of Spine after Radiation Therapy: Easily Recognizable Effects. AJR 1985; 144: 1131-1135.
7. Simon JH, Szumowski J. Chemical Shift Imaging with Paramagnetic Contrast Material Enhancement for Improved Lesion Depiction.Radiology 1989;171:539-543.
8. Brateman L. Chemical Shift Imaging: A Review. AJR 1986; 146: 971-980.
9. Tien RD, Olson EM, Zee CS. Disease of the Lumbar Spine: Findings on Fat-Suppression MR Imaging. AJR 1992; 159: 95-99.