

# “Differentiating Spine Hemangiomas: Role of Fat-Suppressed MRI”

Dr. M. V. Madhusudhan Rao<sup>1</sup>, Dr. Kamireddy Krishna Chaitanya Reddy<sup>2</sup>, Dr. G. Divya Chandana<sup>3</sup>, Dr. Kona Venkata Surya Ashok Kumar<sup>4</sup>, Dr. G. S. Kejiriwal<sup>5</sup>

<sup>1,2,3,4</sup>Junior Resident, <sup>5</sup>Professor & HOD

Department of Radio Diagnosis, Maharajah's Institute of Medical Sciences (MIMS), Nellimarla, Vizianagaram, Andhra Pradesh, India

**Abstract:** Fat-suppressed MRI sequences showed promise in differentiating aggressive from typical asymptomatic vertebral hemangiomas (100% accuracy in this study).

**Methods:** MRI and CT scans of aggressive (n=8) patients and typical hemangiomas (n=11) were analyzed. Signal intensity on fat-suppressed MRI sequences was compared between groups.

**Results:** Aggressive hemangiomas showed significantly higher signal intensity on fat-suppressed MRI than normal bone and typical hemangiomas. A threshold value achieved 100% accuracy in differentiating the two groups.

**Conclusion:** Fat-suppressed MRI may be a valuable tool for identifying aggressive vertebral hemangiomas, but larger studies are needed for confirmation.

**Keywords:** Atypical hemangioma, Fat Suppressed MRI, Aggressive hemangioma, Vertebral hemangioma

## Introduction

Vertebral hemangiomas are frequent vascular abnormalities found in the spine, affecting up to 11% of the population<sup>1</sup>. Often unnoticed by patients, these lesions are discovered incidentally during various imaging procedures. However, in some cases, they can become aggressive, causing pain or neurological problems. This can happen due to the expansion of the vertebral bone or the soft tissues around the spine, compressing the spinal cord or nerve roots<sup>2,3,4</sup>.

Under a microscope, hemangiomas mainly consist of spaces lined with blood vessels and non-vascular components like fat tissue, muscle, fibrous tissue, bone, and blood breakdown products<sup>2</sup>. There are two main histological types: cavernous hemangiomas, the most common kind with large blood spaces, and capillary hemangiomas with smaller channels<sup>5,6</sup>.

Regular X-rays typically show a coarse, vertical pattern of bone trabeculae in vertebral hemangiomas. CT scans reveal these as dotted areas of increased bone density on axial images, resembling a "polka-dot" pattern, or as stripes resembling "jail bars" or "corduroy cloth" on side-view and front-view reconstructions<sup>7</sup>.

MRI scans of typical, non-problematic hemangiomas usually show increased signal intensity on both T1 and T2 sequences<sup>8</sup>. However, aggressive hemangiomas may have lower T1 signal intensity due to a lack of fat tissue. The presence of fat tissue within hemangiomas has been suggested by some studies as an indicator of a benign nature<sup>7</sup>. Based on this idea, our study investigated the usefulness of MRI sequences that suppress fat signals to differentiate between typical asymptomatic and aggressive vertebral hemangiomas.

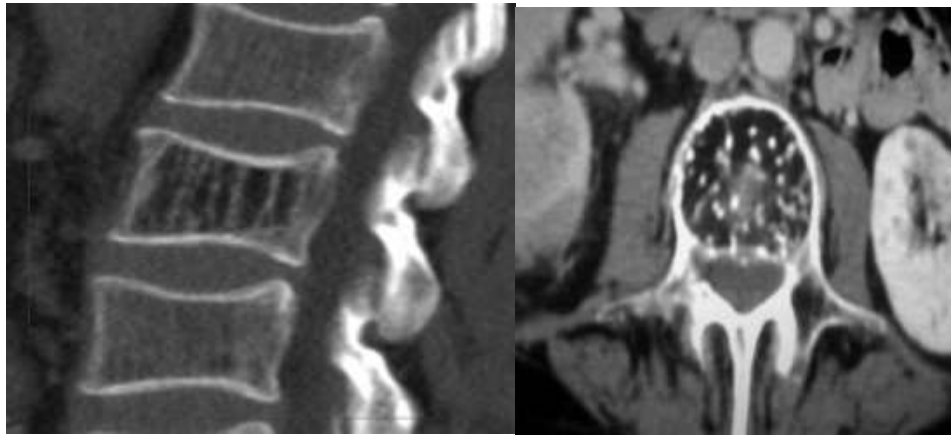


Figure 1: Showing "Corduroy" appearance and "Polka Dot sign"

### Study Design and Selection Process

The MRI and CT scans of the spine performed within the past 20 months, specifically looking for patients diagnosed with aggressive vertebral hemangiomas were investigated. Medical records were reviewed to gather information on patient demographics.

### Inclusion Criteria:

- MRI must include fat-suppressed sequences (STIR or T2 fat saturation).
- CT scan must show the classic "polka-dot" appearance of coarsened trabeculae.
- Both CT and MRI must confirm the presence of soft tissue outside the bone (extra-osseous).

### Control Group Selection:

Eleven patients with typical, non-aggressive vertebral hemangiomas were chosen as the control group. They met the following criteria:

- Fat-suppressed sequences (STIR or T2 fat saturation) were included in their routine MRI.
- MRI findings were typical for hemangiomas, including high signal intensity on T1 and T2 sequences, without signs of aggression like bone expansion or soft tissue components around the spine or epidural space.
- CT scan displayed the classic "polka-dot" appearance of coarsened trabeculae.
- Prior or follow-up scans (CT or MRI) confirmed hemangioma stability.
- No symptoms directly linked to the hemangioma were reported.

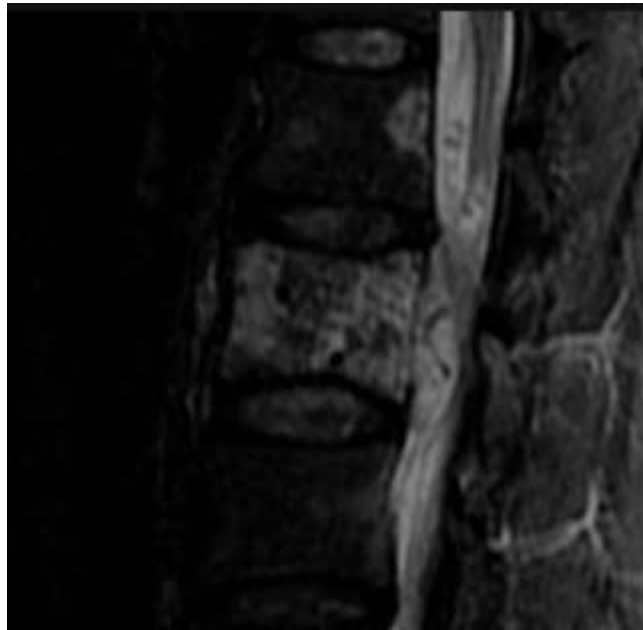


Fig 2: STIR sequence showing aggressive spinal hemangioma with epidural extension .

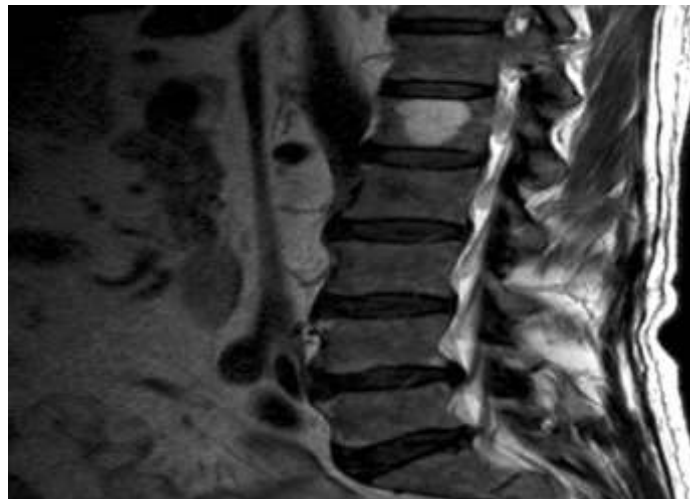


Fig 3: Showing typical hemangioma, which is hyperintense on T2W imaging

#### **Underlying Conditions in Control Group:**

The control group included patients with various underlying conditions that did not cause symptoms related to the hemangioma. These conditions included:

- Degenerative disc disease (5 patients)
- Discitis-osteomyelitis at a different spinal level (1 patient)
- Prostate cancer (2 patients)
- Previous acute vertebral body fracture (2 patients)
- Asthenia (1 patient)

#### **Exclusion Criteria:**

- Patients with a history of radiation therapy, systemic chemotherapy, or anti-angiogenic medications.
- Patients without fat-suppressed sequences in their MRI scans.
- Patients who had undergone surgery, biopsy, or any intervention on the affected vertebra.

## Image Analysis

- Both MRI and CT scans were used to determine the location and size of the hemangioma. Signal intensity (SI) was measured within the hemangioma on fat-suppressed sequences. An additional measurement was taken from a healthy vertebral body for normalization. The regions of interest (ROIs) for measurement are selected

## Statistical Analysis

- Statistical software was used to analyze the data. Agreement between the two radiologists was assessed. Differences in SI between the groups were evaluated, and a threshold for distinguishing aggressive from non-aggressive hemangiomas was established. This threshold was then used to calculate sensitivity, specificity, and other performance metrics.

## Results

A total of 8 patients with aggressive vertebral hemangiomas and 11 patients with typical hemangiomas for this study are identified

### Patient Characteristics:

- Aggressive Hemangioma Group (n=8):
  - Age: Average 46.6 years (range 14-67)
  - Gender: 5 female, 3 male
  - Location: 4 thoracic, 4 lumbar
  - Symptoms:
    - 4 patients with radicular symptoms (nerve pain)
    - 1 patient with myelopathic symptoms (spinal cord dysfunction)
    - 2 patients with non-specific back pain
    - 1 patient asymptomatic (hemangioma found incidentally)
  - Treatment:
    - 4 patients received ethanol ablation (alcohol injection)
    - 1 patient received embolization (blocking blood flow) followed by surgery
    - 3 patients received no treatment
- Typical Hemangioma Group (n=11):
  - Age: Average 61.7 years (range 37-85)
  - Gender: 8 female, 3 male
  - Location: 6 thoracic, 5 lumbar
  - Symptoms: None (asymptomatic)
  - Treatment: None (all remained stable on follow-up imaging)

### MRI Signal Intensity Analysis:

- Aggressive hemangiomas showed significantly higher signal intensity on all measured parameters compared to normal vertebral bone and typical hemangiomas.
- The brightest normalized mean SI ratio provided the highest accuracy in distinguishing aggressive hemangiomas (AUC=1).

### Threshold Analysis:

- Using a brightest normalized mean SI ratio threshold of 2.92 achieved:
  - 100% sensitivity (correctly identified all aggressive cases)
  - 100% specificity (correctly identified all typical cases)
  - 100% positive predictive value (all positive tests were true positives)
  - 100% negative predictive value (all negative tests were true negatives)

This study investigated using fat-suppressed MRI sequences to differentiate between aggressive and typical asymptomatic vertebral hemangiomas.

- Aggressive hemangiomas showed significantly different signal intensity ratios than typical hemangiomas on fat-suppressed sequences.
- Unlike typical hemangiomas, which appear bright on T1 and T2 weighted images, aggressive hemangiomas can have variable T1 signal intensity (bright or low).
- The brightest normalized mean SI ratio provided the best accuracy in distinguishing aggressive hemangiomas.
- A threshold value of 2.92 on the brightest normalized mean SI ratio achieved 100% accuracy in differentiating between the two groups in this study.

#### Comparison to prior research:

- Our findings on T1 signal intensity are partially consistent with previous studies, which reported lower T1 signal in aggressive hemangiomas.
- However, some aggressive hemangiomas in our study were also T1 hyperintense.
- The absence of fat on CT scans of aggressive hemangiomas reported by others may explain the high signal intensity on fat-suppressed MRI sequences in our study.

#### Limitations:

- Small sample size due to the rarity of aggressive hemangiomas and strict inclusion criteria.
- Lack of fat-suppressed sequences in some patients.
- No long-term follow-up imaging for untreated aggressive hemangiomas.
- Lack of tissue samples for histological examination due to non-surgical treatment in most cases.

#### Conclusion

- This study suggests that fat-suppressed MRI sequences and standard imaging signs can help distinguish aggressive vertebral hemangiomas from typical asymptomatic types. However, further research with larger groups is needed to confirm this finding and determine if it can be used to identify potentially aggressive hemangiomas early on.

#### References

1. Huvos AG. *Hemangioma, lymphangioma, angiomatosis, lymphangiomatosis, glomus tumor*. In: Huvos AG, ed. *Bone tumors: diagnosis, treatment and prognosis*. 2nd ed. Philadelphia, PA: Saunders, 1991; 553-578.
2. Murphey MD, Fairbairn KJ, Parman LM, Baxter KG, Parsa MB, Smith WS. *From the archives of the AFIP. Musculoskeletal angiomatous lesions: radiologic-pathologic correlation*. *Radiographics* 1995; 15(4):893-917.
3. Rodallec MH, Feydy A, Larousserie F, Anract P, Campagna R, Babinet A, et al. *Diagnostic imaging of solitary tumors of the spine: what to do and say*. *Radiographics* 2008; 28(4):1019-41.
4. Siemund R, Thurnher M, Sundgren PC. *How to image patients with spine pain*. *Eur J Radiol*. 2014 Jul 2. [Epub ahead of print]
5. Acosta FL Jr, Sanai N, Chi JH, Dowd CF, Chin C, Tihan T, et al. *Comprehensive management of symptomatic and aggressive vertebral hemangiomas*. *Neurosurg Clin N Am* 2008; 19(1):17-29.
6. Pastushyn AI, Slin'ko EI, Mirzoyeva GM. *Vertebral hemangiomas: diagnosis, management, natural history and clinicopathological correlates in 86 patients*. *Surg Neurol* 1998; 50(6):535-4
7. Gaudino S, Martucci M, Colantonio R, Lozupone E, Visconti E, Leone A, et al. *A systematic approach to vertebral hemangioma*. *Skeletal Radiol* 2014 Oct 28. [Epub ahead of print]
8. Laredo JD, Assouline E, Gelbert F, Wybier M, Merland JJ, Tubiana JM. *Vertebral hemangiomas: fat content as a sign of aggressiveness*. *Radiology* 1990; 177(2):467-72.

