ORIGINAL ARTICLE
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J Turk Spinal Surg 2025;36(3):98-102
DOI: 10.4274/jtss.galenos.2025.87587

THORACIC ATYPICAL HEMANGIOMAS: DIAGNOSIS AND MANAGEMENT-A SINGLE CENTER EXPERIENCE

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ABSTRACT

Objective: Vertebral hemangiomas (VH) are common benign vascular tumors, often discovered incidentally. However, the clinical significance and optimal management of atypical VH, particularly in the thoracic region, remain unclear due to their variable radiological appearances and overlapping features with malignant lesions. This study aims to investigate the diagnosis, radiological characteristics, and management strategies of atypical thoracic VH.

Materials and Methods: A retrospective review was conducted on 3,175 spinal magnetic resonance imaging (MRI) reports performed at our center between January 2019 and September 2023. Patients with radiological findings suggestive of atypical thoracic VH were identified, and imaging was re-evaluated by two experienced neuroradiologists. Patients were included if radiological criteria for atypical VH were met and follow-up data were available. Demographic data, lesion characteristics, imaging findings, and clinical outcomes were recorded.

Results: A total of 41 patients (26 female, 15 male; mean age: 47.7 years) with atypical thoracic VH were included. Most lesions showed hypointensity on T1-weighted images and hyperintensity on T2-weighted and short tau inversion recovery sequences. Lesions were most commonly located at T7, and 71% were solitary. Additional imaging, including computed tomography (CT), contrast-enhanced MRI, and positron emission tomography-CT, was performed in select cases to exclude malignancy. No cases exhibited extraosseous extension or radiological progression during a mean follow-up of 49 months. Of 13 patients presenting with back pain, 69% improved with conservative management. No patients developed neurological deficits or required surgical intervention.

Conclusion: Atypical thoracic VH may present with imaging characteristics that mimic malignancy but often remain clinically silent and stable over time. Accurate radiological assessment and close follow-up are essential to avoid unnecessary interventions. Observation appears to be a safe and appropriate strategy for managing asymptomatic atypical VH.

Keywords: Atypical, spinal, thoracic, vertebral hemangioma

INTRODUCTION

Vertebral hemangiomas (VH) are incidental findings and relatively common radiological entities. As a benign vascular tumor, VH is one of the most common spinal tumors, with an estimated incidence in the general population ranging from 1% to 30%[1-4]. The male-to-female ratio varies between 1:1.2 and 1:2.25[5-7]. Multiple perspectives exist regarding the symptomatic evolution of atypical hemangiomas. While some studies suggest that atypical hemangiomas are merely a radiological diagnosis and do not exhibit aggressive features, others emphasize that the atypical form is a significant factor for progression to the aggressive type[2,5,8]. Similarly, conflicting findings are observed in terms of hormonal effects, diagnosis, treatment, symptomatic presentation, and neurological deficits[9-12]. Almost every aspect of VH reported in the literature shows widely varying rates, leading to significant uncertainty. Consequently, the management of atypical thoracic hemangiomas remains incompletely understood. In our study, we retrospectively analyzed patients diagnosed and followed up with atypical thoracic hemangiomas in our clinic. The aim of this study is to determine the diagnosis and management of thoracic hemangiomas with atypical features on magnetic resonance imaging (MRI).

MATERIALS AND METHODS

All records of spinal MRI performed at our center between January 2019 and September 2023 were retrospectively

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Received: 25.03.2025 **Accepted:** 17.06.2025 **Publication Date:** 08.07.2025
Cite this article as: Bozyiğit B, Kına H. Thoracic atypical hemangiomas: diagnosis and management-a single center experience. J Turk Spinal Surg. 2025;36(3):98-102

reviewed. A text search was conducted in the reports using the keywords "atypical hemangioma(s)" and "atypical VH(s)." All spinal MRI studies performed at our center were initially reported as part of routine clinical practice by two neuroradiologists with over 10 years of experience in neuroradiology. The images of patients suspected of having atypical VH were independently re-evaluated by the same two radiologists, and the final diagnosis was established by mutual consensus. This standardized evaluation process minimized interobserver variability and ensured that only lesions meeting the accepted radiological criteria for atypical hemangiomas were included in the study.

Inclusion criteria were: (1) availability of thoracic spinal MRI with a prospective or suspected diagnosis of atypical hemangioma; (2) confirmation of radiological features consistent with atypical hemangiomas upon expert re-evaluation; and (3) availability of follow-up imaging or clinical documentation.

Exclusion criteria included: (1) inconclusive imaging findings; (2) absence of follow-up records; and (3) contraindications to MRI or patient refusal of follow-up evaluation.

If the patients' MRIs were consistent with the radiological findings of atypical thoracic hemangiomas, further investigations, including computed tomography (CT), contrast-enhanced thoracic MRI, and positron emission tomography-CT (PET-CT), as well as clinical follow-up notes, were examined.

Demographic characteristics of the patients, lesion location and appearance, number of lesions, compression of neural elements, neurological examination findings, and follow-up results were recorded. Neurological examination findings were retrospectively obtained from electronic medical records and included in the analysis only if they were systematically documented during initial or follow-up visits. The study was approved by İstinye University Faculty of Medicine Human Research Ethics Committee (decision number: 24-213, date: 22.12.2024).

Statistical Analysis

Statistical analyses were performed using SPSS (version 22.0, IBM Corp., Armonk, NY). Descriptive statistics were presented as mean ± standard deviation or median (minimum-maximum), depending on the data distribution.

RESULTS

A text search of 3175 MRI examinations conducted at İstinye University Hospital Medical Park Gaziosmanpaşa between January 2019 and September 2023 identified 93 records with relevant keywords. Fourteen cases with lumbar and eleven with cervical atypical hemangiomas were excluded from the study. Among the remaining 68 cases, 19 were found to have thoracic metastases upon further evaluation. Six cases initially reported as atypical hemangiomas were excluded because their radiological findings did not meet the criteria for atypical hemangiomas. Two patients who did not continue follow-up after diagnosis were also excluded. A total of 41 patients met the inclusion criteria and were included in the study. The mean age of the patients was 47.68 years, ranging from 26 to 78 years. The study population included 26 (63%) female and 15 male patients (Table 1). Nineteen patients had no neurosurgical complaints, while 14 (34%) reported back pain, 5 had lower back pain, and 3 had neck pain. Lesions located at the T1 or T12 vertebrae were incidentally detected in cervical or lumbar MRI scans of 6 patients. In these cases, the adjacent thoracic vertebral levels (T1 or T12) were partially included in the imaging field, allowing for lesion identification, which was later confirmed with dedicated thoracic imaging. On T1-weighted images, 32 (78%) cases showed low signal intensity, and 9 exhibited mixed signals, while high signal intensity was observed on T2-weighted and short tau inversion recovery sequences in 39 (95%) cases (Figure 1). Upon repeated radiological evaluation, an additional atypical hemangioma was detected in 4 patients. Twenty-nine patients (71%) presented with a single lesion, while six patients had two lesions, five patients had three lesions, and one patient exhibited four atypical hemangiomas. The most frequently affected vertebra was T7, observed in 9 (22%) patients. The least affected vertebrae were T3, T5 and T9 with two cases each (Figure 2). Among patients with a single lesion, neither the T3 nor the T5 vertebra was solely affected. Additionally, 15 (37%) patients had typical hemangiomas in the thoracic region. The size of atypical hemangiomas ranged from 2 to 26 mm in maximum diameter, and in 8 (20%) cases, the lesion size exceeded 1 cm. Only 1 case showed involvement of more than 50% of the vertebral body (VB). In 39 (95%) cases, the lesions were confined to the VB. One case had a lesion in the left pedicle, and another with multiple atypical hemangiomas exhibited a lesion extending from the VB to the left pedicle. No extraosseous extension was observed in any case. To confirm the radiological diagnosis, thoracic CT was performed in 26 patients, contrast-enhanced thoracic MRI in 29 patients, and PET-CT in 2 patients. Radiological findings of atypical hemangiomas were observed in 11 patients on CT (Figure 3). On contrast-enhanced thoracic MRI, contrast enhancement was detected in 4 patients (Figure 4). PET-CT revealed cold lesions in 2 patients, ruling out metastasis. Patients with a history of cancer, symptomatic presentation, or contrast enhancement underwent their first follow-up at 6 months, which included both CT and MRI. For other patients, annual follow-ups were conducted with thoracic MRI alone. The mean follow-up duration was 49 months (17-68 months). No progression was observed in any patient. Among the 13 patients with back pain, 9 (69%) experienced pain resolution following conservative treatment. The remaining 4 reported pain unrelated to the lesion's localization. In a patient diagnosed with endometrial cancer, pathological fractures were identified in the lumbar 3, 4, and 5 VB during follow-up, leading to vertebroplasty.

Table 1. Demographic and radiological characteristics of the patients

Number of patients	**41**
Age	47.68
Female	26 (63%)
Asymptomatic	19 (46%)
Hypointense on T1-weighted MRI	32 (78%)
Hyperintense on T2-weighted MRI	39 (95%)
Single lesion	29 (71%)
Coexisting typical vertebral hemangioma	15 (37%)
Lesion larger than 1 cm	8 (20%)
Pedicle involvement	2 (5%)
Contrast enhancement	8 (28%)
Typical CT findings	11 (42%)

MRI: Magnetic resonance imaging, CT: Computed tomography

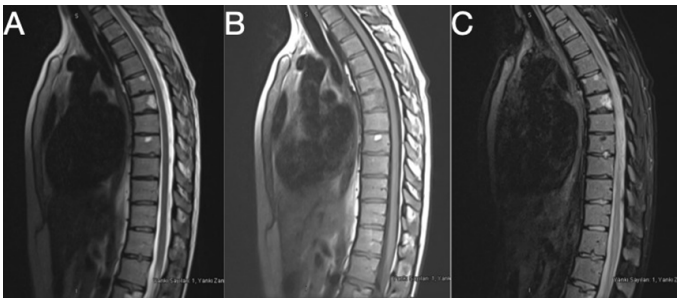

Figure 1. High signal intensity on T2-weighted imaging (A), low signal intensity on T1-weighted imaging (B), and high signal intensity on STIR sequences (C). STIR: Short tau inversion recovery

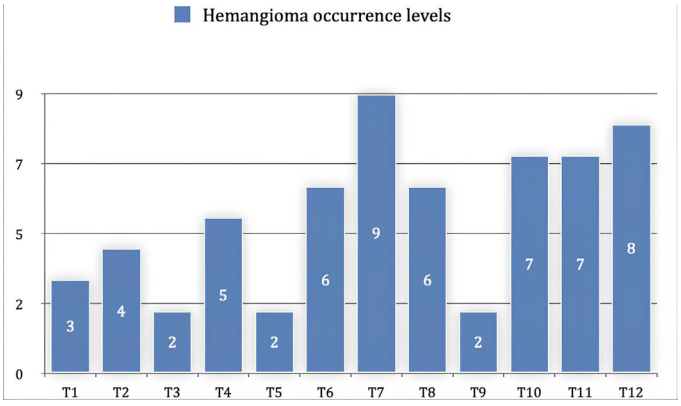

Figure 2. Frequency of vertebral hemangiomas at different vertebral levels

Figure 3. Thoracic CT scan illustrating an atypical hemangioma extending from the vertebral body to the left pedicle. CT: Computed tomograpy

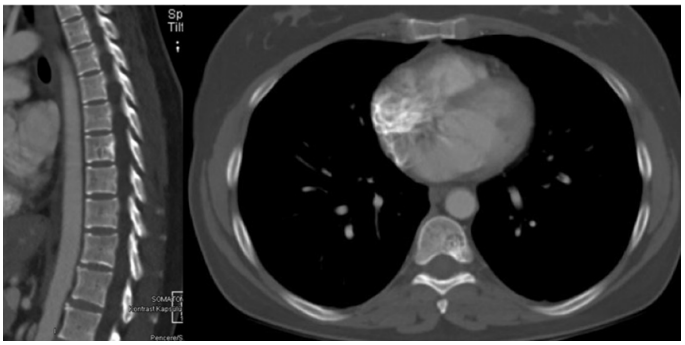

Figure 4. Demonstration of peripheral contrast enhancement in a case with both typical and atypical hemangiomas

DISCUSSION

In this retrospective single-center study, 41 cases of atypical VH were identified, corresponding to an incidence of 1.3%. Reassessment of available imaging revealed additional lesions in four patients, suggesting that smaller or less conspicuous VH may be underrecognized in routine radiological or autopsy studies. This finding supports the hypothesis that the increasing use of advanced imaging techniques contributes to higher detection rates[4,7,13,14]. Most lesions were located in the thoracic spine, followed by the lumbar and cervical regions, while no lesions were observed in the sacrum. Approximately 15% of thoracic VH located at T1 or T12 were incidentally detected on cervical or lumbar spine MRI, emphasizing the importance of thoroughly evaluating all visible vertebral levels, even when not the primary focus of imaging[11,12]. The anatomical distribution observed in this cohort is consistent with prior reports indicating a predilection for the mid-and lower thoracic segments[15,16]. The mean age of patients was

47.7 years, aligning with previous literature that describes VH as most frequently diagnosed in individuals aged 40-60 years[17]. A predominance of female patients was also noted, consistent with earlier studies suggesting a possible hormonal influence on lesion development[7,15,18,19]. However, due to the retrospective nature of the study, hormonal status could not be assessed. VH are often incidental findings and typically asymptomatic. In this cohort, no patients exhibited neurological deficits or other symptoms directly attributable to VH. Symptomatic cases, although rare, may present with localized pain or signs of neural compression[3]. In our series, 70% of patients presenting with back pain reported symptomatic relief during follow-up, and in four cases, pain localization did not correlate with the location of the VH, suggesting an incidental relationship. VH can be classified as typical, atypical, or aggressive based on radiological and clinical features[1,5,6]. Typical VH exhibit high signal intensity on both T1-and T2-weighted MRI due to their fat-rich composition, whereas atypical VH demonstrate iso- to hypointense T1 signals and markedly hyperintense T2 signals, often lacking classic imaging signs such as the "corduroy" or "polka-dot" appearance[2,6,8,11,20]. The presence of thickened vertical trabeculae remains a key diagnostic criterion, observable on both CT and MRI. CT features characteristic of atypical VH were observed in 35% of patients in this study, aligning with previous estimates indicating that atypical forms constitute approximately one-third of all VH[15]. Aggressive VH may exhibit expansion, cortical destruction, epidural or paravertebral extension, vertebral collapse, or neurological symptoms[9]. Lesions with greater vascularity tend to be more symptomatic and progressive, in contrast to asymptomatic, fat-dominant VH[2,3]. Atypical and aggressive VH may mimic malignant spinal lesions such as metastases or multiple myeloma, complicating the differential diagnosis[9,10,21]. Advanced imaging modalities, including CT, MRI, and PET-CT, are critical for accurate lesion characterization. PET-CT is particularly useful in differentiating VH from metastatic lesions based on metabolic activity[22,23]. In this study, two patients with prior oncological diagnoses underwent PET-CT scans that demonstrated metabolically inactive ("cold") lesions, and subsequent follow-up confirmed the benign nature of these findings[24-27]. The signal characteristics of symptomatic VH-low T1 and high T2 intensity-are often associated with vascular, biologically active lesions, as originally described by Laredo et al.[2] However, previous studies have shown that VH, including atypical and aggressive forms, often remain radiologically stable and asymptomatic over time[16]. Misdiagnosis of atypical VH as malignant lesions has led to unnecessary interventions and patient anxiety. Consequently, some authors have advocated replacing the term "atypical hemangioma" with "lipid-poor hemangioma" to better reflect the radiological rather than clinical behavior of these lesions[8]. In our cohort, no radiological progression or new-onset neurological deficits were observed during follow-up, even in lesions with low fat content. Management strategies for symptomatic VH include conservative measures, percutaneous interventions (e.g., vertebroplasty, sclerotherapy), surgery, radiotherapy, or combined approaches[3,28]. Surgical treatment is typically reserved for cases with neurological compromise, pathologic fractures, or intractable pain. CT-guided biopsy and PET-CT may be considered in diagnostically uncertain or atypical cases[29]. However, biopsy is infrequently performed due to limited diagnostic yield and potential risks such as bleeding or epidural hematoma[4,24]. Therefore, non-invasive imaging modalities remain the cornerstone of diagnosis.

Study Limitations

The primary limitations of this study include its retrospective design and single-center setting, which may introduce selection and observer bias and limit generalizability. Furthermore, the absence of long-term follow-up and the relatively small sample size preclude definitive conclusions regarding the natural history of atypical VH.

CONCLUSION

VH are typically asymptomatic lesions incidentally detected during routine spinal imaging. Our study demonstrates that observation-based management of asymptomatic atypical VH is a safe and appropriate approach. While atypical VH may exhibit different radiological signal characteristics, this does not always necessitate suspicion of malignancy. Proper assessment of the clinical significance of various VH types, despite the radiological diversity in signal changes, can help avoid unnecessary radiological follow-ups, invasive biopsies, and outpatient clinic visits. Moreover, this approach contributes to preventing undue anxiety and stress among patients. In conclusion, careful clinical evaluation is sufficient to prevent unnecessary interventions for asymptomatic VH.

Ethics

Ethics Committee Approval: The study was approved by İstinye University Faculty of Medicine Human Research Ethics Committee (decision number: 24-213, date: 22.12.2024).
Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.K., Concept: B.B., H.K., Design: B.B., H.K., Data Collection or Processing: B.B., H.K., Analysis or Interpretation: B.B., Literature Search: B.B., H.K., Writing: B.B., H.K.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study received no financial support.

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