

A Case of Spinal Epidural Extramedullary Hematopoiesis Diagnosed Using Indium-111 Bone Marrow Scintigraphy

Haruka Tanaka ¹, Masashi Nakadate ¹, Hiroyuki Inose ², Kazunori Kubota ¹

¹. Department of Radiology, Dokkyo Medical University Saitama Medical Center, Saitama, JPN ². Department of Orthopaedics, Dokkyo Medical University Saitama Medical Center, Saitama, JPN

Corresponding author: Haruka Tanaka, h.tanaka.nuro@gmail.com

Review began 05/17/2025

Review ended 05/27/2025

Published 05/28/2025

© Copyright 2025

Tanaka et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.84940

Abstract

Although indium-111 (¹¹¹In) bone marrow scintigraphy is commonly used to assess bone marrow function, it plays a significant role in diagnosing extramedullary hematopoiesis (EMH) due to isotope accumulation in hematopoietic bone marrow. In our case, a 67-year-old man with polycythemia vera presented with an epidural tumor, for which EMH was considered a differential diagnosis. The diagnosis was subsequently confirmed by ¹¹¹In bone marrow scintigraphy. The tumors exhibited a reduction in size following radiation therapy. We report this case to highlight the utility of ¹¹¹In bone marrow scintigraphy in diagnosing EMH. This imaging modality can confirm epidural EMH and help avoid unnecessary surgeries.

Categories: Radiology, Neurosurgery, Nuclear Medicine

Keywords: extramedullary hematopoiesis, in-111 bone marrow scintigraphy, nuclear medicine, radiotherapy, spinal epidural tumor

Introduction

Although indium-111 (¹¹¹In) bone marrow scintigraphy is primarily used to evaluate bone marrow function, it is also useful for diagnosing extramedullary hematopoiesis (EMH) because the isotope accumulates in the hematopoietic bone marrow [1]. EMH typically occurs in the liver or spleen but can also arise in various other locations [2]. Previous reports have documented the use of bone marrow scintigraphy to diagnose EMH in the intrathoracic space [3], paravertebral region [4], presacral area [5], intracranial space [6], and lungs [7]. However, there have been no reports on its use in spinal canal imaging.

We report a case of spinal epidural EMH diagnosed using ¹¹¹In bone marrow scintigraphy, highlighting its potential as a noninvasive diagnostic tool that may guide appropriate treatment and help avoid unnecessary surgery.

Case Presentation

The patient was a 67-year-old man with a history of polycythemia vera, hypertension, and gout. He was referred to our hospital after experiencing back pain for six months.

Initial laboratory tests revealed elevated white and red blood cell counts (Table 1). Neurological symptoms were limited to increased bilateral patellar tendon reflexes. No muscle weakness was observed in the lower limbs during the initial visit.

How to cite this article

Tanaka H, Nakadate M, Inose H, et al. (May 28, 2025) A Case of Spinal Epidural Extramedullary Hematopoiesis Diagnosed Using Indium-111 Bone Marrow Scintigraphy. *Cureus* 17(5): e84940. DOI 10.7759/cureus.84940

Laboratory test	Result	Units	Reference range
White blood cell (WBC)	10100	/ μ L	3300–8600
Red blood cell (RBC)	7.96	million/ μ L	4.35–5.55
Platelet	159000	/ μ L	15800–348000
Hemoglobin	19.4	g/dL	13.7–16.8
Hematocrit	63.6	%	40.7–50.1
Mean corpuscular volume (MCV)	79.9	fL	83.6–98.2
Lactate dehydrogenase (LDH)	260	U/L	124–222
C-reactive protein (CRP)	0.24	mg/dL	<0.14

TABLE 1: Initial laboratory test results with reference ranges

Magnetic resonance imaging (MRI) revealed extradural masses at the Th5-7 and L3-4 levels, showing low signal intensity on T1-weighted imaging (T1WI) and slightly higher signal intensity than that of the spinal cord on T2-weighted imaging (T2WI), accompanied by contrast enhancement (Figure *1A-1C*). High signal intensity was observed on diffusion-weighted imaging, along with a slight decrease in the apparent diffusion coefficient. The dural sac was compressed by the mass. The spine demonstrated diffuse low signal intensity on T1WI, suggesting hyperhematopoietic activity and fibrosis.

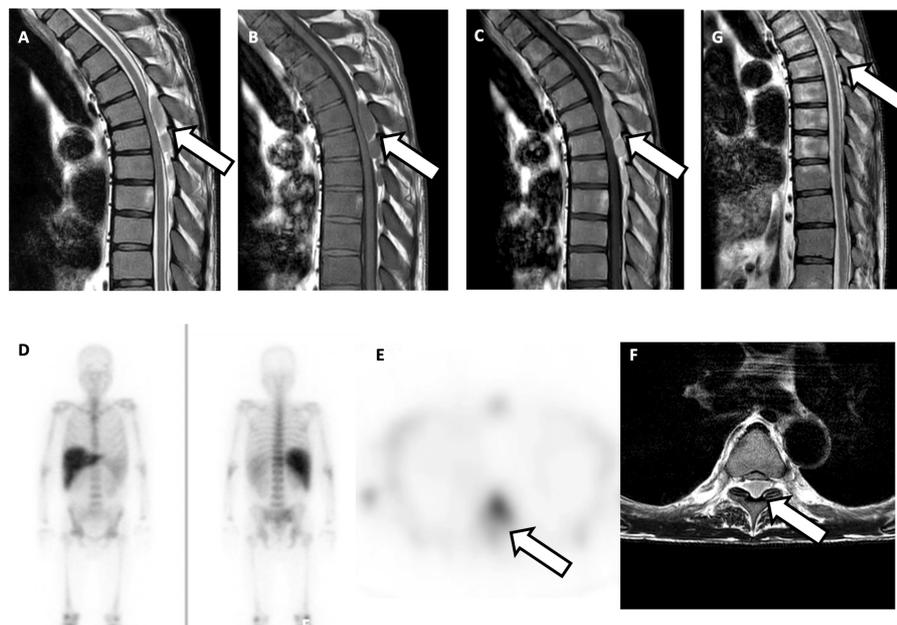


FIGURE 1: A-G: MRI and In-111 bone marrow scintigraphy

A-C: The posterior epidural mass within the spinal canal compresses the dural sac and causes spinal cord compression, as indicated by the arrows.

D-F: Although not visualized on planar bone marrow scintigraphy, faint radiotracer accumulation corresponding to the mass is observed on SPECT imaging, marked by arrows.

G: The epidural mass decreased in size following radiation therapy, as shown by the arrow.

A: T2WI sagittal view, B: T1WI sagittal view, C: Gd-T1WI sagittal view, D: ^{111}In bone marrow scintigraphy planar imaging, E: ^{111}In bone marrow scintigraphy SPECT imaging, F: T2WI axial view, G: Post-treatment T2WI sagittal view.

Abbreviations: Gd-T1WI, gadolinium-enhanced T1-weighted image; T1WI, T1-weighted image; T2WI, T2-weighted image; SPECT, single-photon emission computed tomography

Given the patient's medical history and lack of signal change over a four-month period, EMH was suspected, and ^{111}In bone marrow scintigraphy was performed. In planar imaging, tracer accumulation was not prominently visualized (Figure 1D). However, single-photon emission computed tomography (SPECT) revealed slight accumulation corresponding to the mass (Figure 1 E-F), and EMH was considered highly likely. Approximately two months after the initial visit, the patient began to experience progressive paralysis in both lower limbs, and radiation therapy was administered to alleviate the symptoms. Radiotherapy was administered at a total dose of 20 Gy in 10 fractions of 2.0 Gy.

MRI performed one month after radiation therapy showed a reduction in the mass (Figure 1 G).

The tumor shrank, and symptoms such as lower limb muscle weakness and back pain were alleviated. MRI performed six months post-treatment demonstrated sustained reduction in the mass, with no evidence of symptom progression.

Discussion

EMH most commonly occurs in the liver and spleen but can also develop in various other parts of the body [2-7]. However, occurrences within the spinal canal are uncommon [8], and the underlying cause remains unclear. Several hypotheses have been proposed, including hematogenous spread of hematopoietic cells from the vertebral medulla, embolic deposition of these elements into the intraspinal space, and reactivation of embryonic stem cells originating in the spinal region [8].

The differential diagnosis of extramedullary spinal tumors includes not only EMH but also hemangiomas, infections such as abscesses, hematomas, discogenic diseases (e.g., disc herniation, synovial cysts, and post-

surgical epidural fibrosis), and metastatic tumors [9]. Differentiating EMH from other pathologies is essential and typically involves a combination of noninvasive techniques, including computed tomography (CT), MRI, and nuclear medicine imaging, as well as invasive procedures, such as biopsy. On MRI, active EMH lesions typically show intermediate signal intensity on both T1WI and T2WI, higher than that of the bone marrow, and exhibit gadolinium enhancement. By contrast, old inactive lesions may show either high or low signal intensity on both T1WI and T2WI due to fatty infiltration or iron deposition, respectively, and demonstrate reduced contrast enhancement [10].

Nuclear medicine imaging plays a particularly important role in diagnosing EMH, with ^{111}In bone marrow or $^{99\text{m}}\text{Tc}$ Sn colloid scintigraphy commonly performed for this purpose [11]. EMH is usually associated with hematological disorders such as myelofibrosis, myelodysplastic syndromes, thalassemia, polycythemia vera, leukemia, and lymphoma [12]. According to the Mayo Clinic database, approximately 83% of patients with EMH have an underlying myeloproliferative neoplasm [13]. In the present case, the patient had polycythemia vera, making EMH a reasonable differential diagnosis. However, a definitive diagnosis was difficult based on the initial MRI alone; therefore, ^{111}In bone marrow scintigraphy was performed. Using planar imaging alone, it was not easy to determine whether the tumor had tracer uptake distinct from the normal vertebral bone marrow; however, the addition of SPECT imaging enabled differentiation between normal bone marrow and abnormal accumulation, thereby providing valuable diagnostic information.

Spinal cord compression is a significant concern when EMH occurs within the spinal canal. Thoracic spine involvement is particularly problematic because this region has a narrow spinal canal and limited motility, increasing the risk of severe neurological deficits [14]. Currently, no established treatment protocols exist for EMH. Treatment options include surgical decompression or a combination of surgery and postoperative radiation therapy [15]. EMH is highly sensitive to radiation, and tumor shrinkage has been reported following radiation therapy, particularly with low-dose radiation regimens [15,16]. Cailleateau et al. [15] reported a case of spinal canal EMH treated with radiation therapy. They found EMH in a region similar to that in our case and observed that low-dose radiation therapy (18 Gy delivered in 10 fractions of 1.8 Gy) improved neurological symptoms. They suggested a total dose of 16-20 Gy using the classical fractionation regimen (1.8-2 Gy per fraction).

Using bone marrow scintigraphy to confirm the diagnosis of EMH may help avoid the need for invasive surgical procedures, and radiation therapy is expected to reduce tumor size.

Conclusions

This case illustrates the importance of considering EMH as a differential diagnosis for spinal epidural masses, particularly in patients with underlying hematologic disorders. ^{111}In bone marrow scintigraphy enables a non-invasive diagnosis and guides effective treatment. SPECT imaging, in particular, plays an important role in evaluating intraspinal lesions. The use of this imaging modality may reduce the need for invasive biopsy or surgery. Clinicians should include EMH in the diagnostic workup for similar cases.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Haruka Tanaka, Masashi Nakadate

Acquisition, analysis, or interpretation of data: Haruka Tanaka, Masashi Nakadate, Hiroyuki Inose, Kazunori Kubota

Drafting of the manuscript: Haruka Tanaka

Critical review of the manuscript for important intellectual content: Haruka Tanaka, Masashi Nakadate, Hiroyuki Inose, Kazunori Kubota

Supervision: Hiroyuki Inose, Kazunori Kubota

Disclosures

Human subjects: Consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have

declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Datz FL, Taylor A Jr: The clinical use of radionuclide bone marrow imaging . *Semin Nucl Med.* 1985, 15:239-59. [10.1016/s0001-2998\(85\)80003-9](https://doi.org/10.1016/s0001-2998(85)80003-9)
2. Malla S, Razik A, Das CJ, Naranje P, Kandasamy D, Kumar R: Marrow outside marrow: imaging of extramedullary haematopoiesis. *Clin Radiol.* 2020, 75:565-78. [10.1016/j.crad.2019.12.016](https://doi.org/10.1016/j.crad.2019.12.016)
3. Takeda K, Yato Y, Saito M, Saito G, Nishiyama A, Kasai H, Suzuki T: Diagnostic imaging of intrathoracic extramedullary haematopoiesis. *Respirol Case Rep.* 2023, 11:e01212. [10.1002/rcr2.1212](https://doi.org/10.1002/rcr2.1212)
4. Zade A, Purandare N, Rangarajan V, Shah S, Agrawal A, Ashish J, Kulkarni M: Noninvasive approaches to diagnose intrathoracic extramedullary hematopoiesis: 18F-FLT PET/CT and 99mTc-SC SPECT/CT scintigraphy. *Clin Nucl Med.* 2012, 37:788-9. [10.1097/RLU.0b013e318251e19f](https://doi.org/10.1097/RLU.0b013e318251e19f)
5. Sebes JI, Massie JD, White TJ 3rd, Kraus AP: Pelvic extramedullary hematopoiesis. *J Nucl Med.* 1984, 25:209-10.
6. Urman M, O'Sullivan RA, Nugent RA, Lentle BC: Intracranial extramedullary hematopoiesis. CT and bone marrow scan findings. *Clin Nucl Med.* 1991, 16:431-4. [10.1097/00003072-199106000-00011](https://doi.org/10.1097/00003072-199106000-00011)
7. Yang M, Roarke M: Diffuse pulmonary extramedullary hematopoiesis in myelofibrosis diagnosed with technetium-99m sulfur colloid bone marrow scintigraphy and single photon emission computerized tomography/CT. *Am J Hematol.* 2017, 92:323-4. [10.1002/ajh.24616](https://doi.org/10.1002/ajh.24616)
8. Bai J, Grant K, Hussien A, Kawakyu-O'Connor D: Imaging of metastatic epidural spinal cord compression . *Front Radiol.* 2022, 2:962797. [10.3389/fradi.2022.962797](https://doi.org/10.3389/fradi.2022.962797)
9. Hawkins AN, Breton JM, Bhatnagar A, Paudel N, Voyadzis JM: Spinal extramedullary hematopoiesis mimicking an epidural tumor in a patient with high-risk polycythemia vera: illustrative case. *J Neurosurg Case Lessons.* 2024, 8:10.3171/CASE23659
10. Ghieda U, Elshimy M, El Beltagi AH: Progressive spinal cord compression due to epidural extramedullary hematopoiesis in thalassemia intermedia. A case report and literature review. *Neuroradiol J.* 2013, 26:111-7. [10.1177/197140091302600119](https://doi.org/10.1177/197140091302600119)
11. Kakite S, Tanabe Y, Kinoshita F, Harada H, Ogawa T: Clinical usefulness of In-111 chloride and Tc-99m Sn colloid scintigraphy in the diagnosis of intrathoracic extramedullary hematopoiesis. *Ann Nucl Med.* 2005, 19:317-20. [10.1007/BF02984625](https://doi.org/10.1007/BF02984625)
12. Mattei TA, Higgins M, Joseph F, Mendel E: Ectopic extramedullary hematopoiesis: evaluation and treatment of a rare and benign paraspinal/epidural tumor. *J Neurosurg Spine.* 2013, 18:236-42. [10.3171/2012.12.SPINE12720](https://doi.org/10.3171/2012.12.SPINE12720)
13. Fan N, Lavu S, Hanson CA, Tefferi A: Extramedullary hematopoiesis in the absence of myeloproliferative neoplasm: Mayo Clinic case series of 309 patients. *Blood Cancer J.* 2018, 8:119. [10.1038/s41408-018-0156-6](https://doi.org/10.1038/s41408-018-0156-6)
14. Gupta PP, Shaikh ST, Goyal RP, Gupta DP: Extramedullary hematopoiesis presenting with thoracic spinal cord compression in a young adult with thalassemia major: a case report. *J Pediatr Neurosci.* 2021, 16:303-6. [10.4103/jpn.JPN_183_20](https://doi.org/10.4103/jpn.JPN_183_20)
15. Cailleteau A, Agbetsivi K, Guimas V, Supiot S, Ollivier L: Extramedullary hematopoiesis causing spinal cord compression in polycythemia vera: a case report and literature review. *Clin Transl Radiat Oncol.* 2023, 38:43-6. [10.1016/j.ctro.2022.09.009](https://doi.org/10.1016/j.ctro.2022.09.009)
16. Koch CA, Li CY, Mesa RA, Tefferi A: Nonhepatosplenic extramedullary hematopoiesis: associated diseases, pathology, clinical course, and treatment. *Mayo Clin Proc.* 2003, 78:1223-33. [10.4065/78.10.1223](https://doi.org/10.4065/78.10.1223)