

Various presentations of multiple myeloma MRI review: A Case series**Mary Hazarika Bhuyan***Department of Radio-Diagnosis, Assam Medical College, Dibrugarh, India****Correspondence Info:**

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Abstract

We present the MRI findings in four cases of multiple myeloma involving the musculo-skeletal system. The diagnosis is made by combination of imaging and histopathologic findings. Radiologists should be aware of the imaging findings of this condition to ensure early diagnosis and treatment.

Keywords: Multiple myeloma, magnetic resonance imaging (MRI).

1. Introduction

Multiple myeloma is the most common primary malignant neoplasm of bone. It usually originates from the hematopoietic element of the bone marrow but occasionally arises in extraskelatal sites. Bone deposits have been shown by MRI in about 50% of asymptomatic myeloma patients with normal plain radiographs. The imaging patterns in multiple myeloma can be classified as normal, focal, diffuse and variegated [2].

The focal pattern consists of localised areas of decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted images[1]. Myelomatous deposits are generally sharply demarcated on a background of an otherwise normal appearing bone marrow. Homogeneous enhancement occurs on T1-weighted images following intravenous contrast injection.[6]

2. Case reports

The present cases were studied at Assam Medical College, in the department of Radiodiagnosis, Dibrugarh, Assam. All studies were performed using Siemens magnetom avanto 1.5 T whole body MR system. Scanning was done in axial, coronal and sagittal planes. Post contrast fat saturated T1 weighted images were obtained after giving 10ml of IV Gadolinium in all cases. Biopsy confirmation

(ultrasound guided/CT guided FNAC, /or direct FNAC by a pathologist) or pathological correlation was done in all cases.

2.1 Case 1

A 51 -year old male presented with backache and chest pain since one month. His general condition was fine and was healthy otherwise. Clinician did not suspect anything like multiple myeloma. Plain X-ray of lumbar spine revealed a normal study. Magnetic resonance imaging (MRI) showed involvement of D4-L3 vertebrae (figure 1 A, C, D), both iliac bones (figure 1 B), affection of posterior vertebral elements (figure 1C) which shows low-intermediate signal on TIWI (figure 1 A,) intermediate, slightly high to high signal on coronal and sagittal FST2WI (Figure 1B, C). The tumor also showed prominent heterogeneous Gd-contrast enhancement on FS TIWI (figure 3 b).

In phase and opposed phase images (Figure 2 a,b) showed SIR=1.8 (SIR >0.8). Splenomegaly was present (figure 1E).

Serum electrophoresis showed a normal pattern, no M-band or spike was detected. Bone marrow biopsy from sternum showed 46% plasma cells few of them showed bi-nucleation.(Figure 3a). A conclusion of non-secretory myeloma was made.

Figure 1 (A-E): Multiple Myeloma involving the spine that has a pathologic fracture of D8 causing spinal cord compression hypo -isointense on TIWI(A), involvement of body and posterior vertebral elements of D4 which is hyperintense on T2WI (C) and the marrow of the pelvis-Right iliac bone(arrow), ala and body of sacrum which has high signal on coronal FST2WI(B), T2WIFS Sagittal shows hyperintense lesions in D12,L3(D)(arrows)



Figure 2 (a,b): In-phase (a) and opposed phase(b) Opposed-phase image (echo time [TE] = 2.4 ms). Marrow replaced by tumor does not suppress (arrows), whereas the normal fatty marrow appears dark.

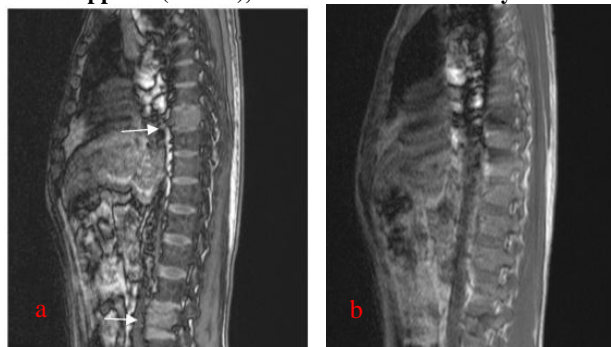
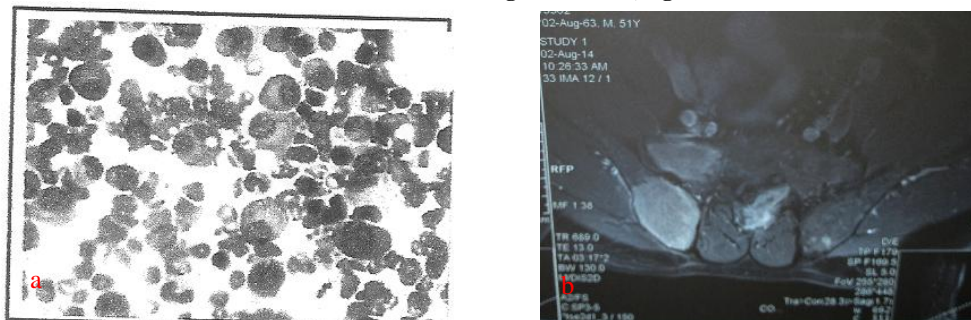


Figure 3 (a,b)Bone marrow examination(a)shows 46% plasma cells with occasional binucleation, consistent with multiple myeloma. Post contrast Gd-TIWFs (b) enhancement in the right iliac bone, right sacral ala and soft tissue involvement.



2.2 Case 2

A 35 year old female presented with low back ache since one and a half month. It was sudden in onset and was gradually progressing. Pain was radiating to both the lower limbs. Presently she is unable to walk; clinically traumatic paraparesis. There was mild weight loss. Blood picture revealed a normal study. Magnetic resonance imaging (MRI) showed complete collapse of D1 vertebra with posterior vertebral convexity with retropulsion into spinal canal causing marked spinal canal stenosis and

changes of chronic cord myelopathy.(fig 4a).Associated expansion of posterior elements, extension into the adjacent soft tissue(fig 4 b,c)(fig5a-arrow). Multiple tiny TIWI hypo,T2WI hyperintense lesion, showing diffusion restriction(figure 5 d) and post contrast enhancement in C3,C4,D2,D4 vertebrae (Figure 5 c) .In phase and opposed phase sequences showed SIR of 0.9.Histological study from D1 showed multiple myeloma (Fig 6).

Figure 4(a-c): TIWI shows iso intense lesion in D1 with complete collapse(a),T2WIFS shows hyperintense area(b) with adjacent soft tissue extension in post contrast (arrow)(c)

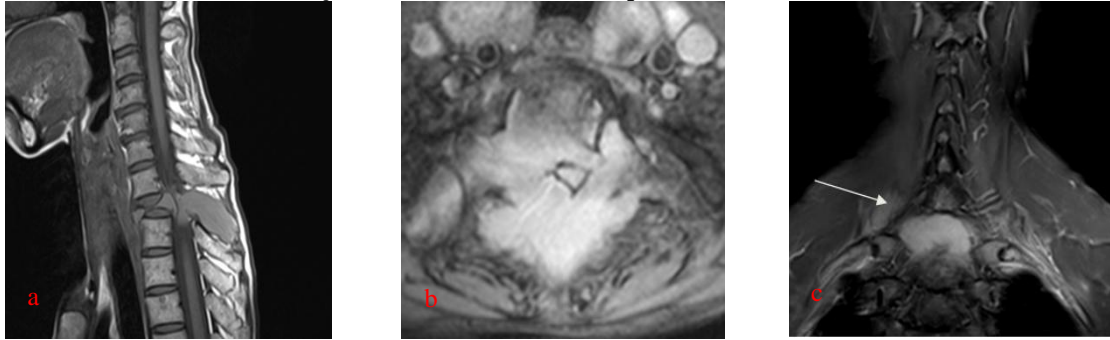


Figure 5(a,b,c,d): Post contrast TIWI , T2WI axial images shows contrast enhancement of the involved soft tissue(a)which is subtle in the T2WI (b). Coronal TIWI FS post Gd shows enhancement of C3,C4,D2 vertebrae (c), diffusion restriction(d)

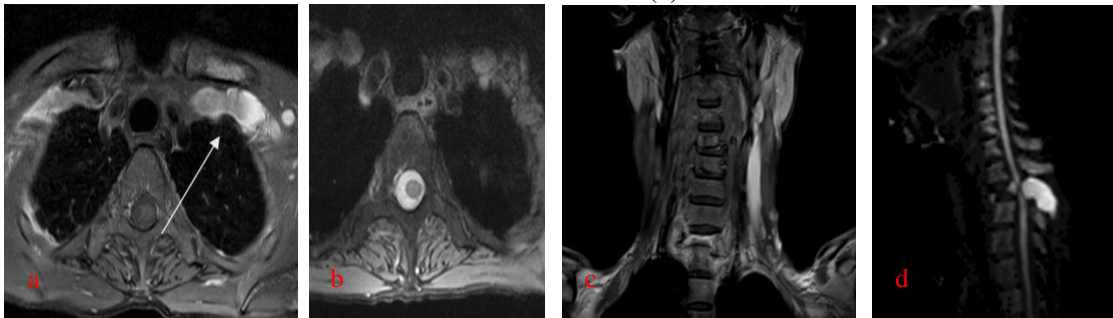


Figure 6: Biopsy report from D1 vertebra consistent with multiple myeloma

Biopsy tissue from collapsed D1 vertebral body.
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Section shows small fragments of highly cellular compact groups of mononuclear round cells with mild nuclear atypia, eccentric nuclei in some cells and eosinophilic cytoplasm. Picture suggestive of multiple myeloma.

2.3 Case 3

A 54 year old male presenting with pain in the right upper limb from shoulder since 15 days. He was unable to hold things with the right hand with tingling sensation. Clinically right brachial plexopathy was suspected. The blood picture showed raised ESR (120mmAEFH) and was anaemic; TC

was low. He underwent MRI of cervical spine. The lesions were scattered in multiple cervical, lumbar, sacral vertebrae, sternum (figure 7c), ribs. It was hypo to isointense on TIWI (figure 7a), intermediate on T2WI (fig7 b) and homogeneously hyperintense on T2FS(c).

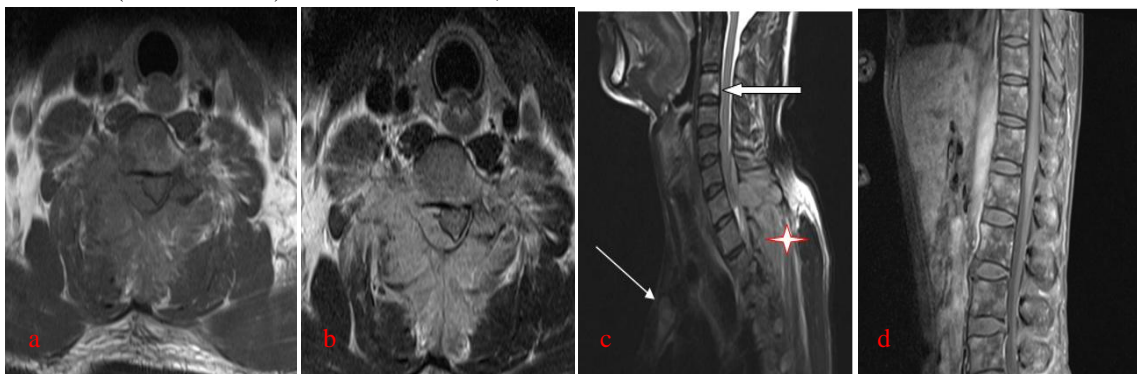


Figure 7 (a-d): lesions shows hypo-iso signal on axial TIWI (a) intermediate –high on T2WI; (b) sagittal T2FS; (c) Moderate Gd-contrast enhancement seen in C3, sternum (arrows), posterior elements of C6-D1(asterisks)(c). Multiple myeloma involving multiple thoracic and lumbar vertebrae; (d) inset shows report of serum electrophoresis and bone marrow cytology

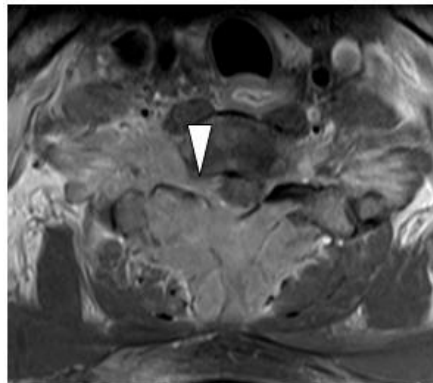
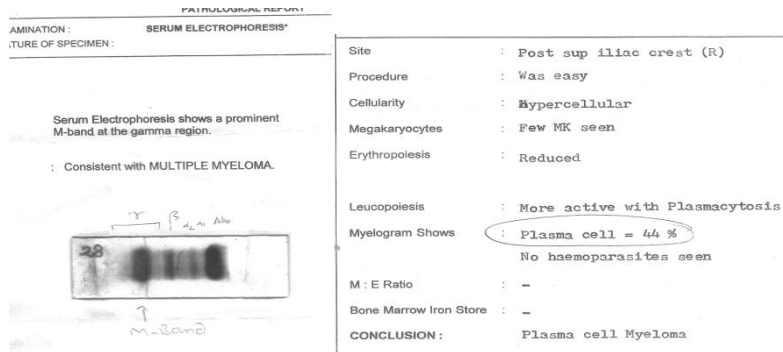


Figure 8: The tumor shows heterogeneous Gd-contrast enhancement on axial T1WIFS. Tumor extension into adjacent extraosseous soft tissues, into posterior epidural space, right neural exit foramina (arrowhead)

On post contrast scans the affected vertebrae shows moderate homogeneous enhancement (figure8). The soft tissue component is noted to extend into the posterior epidural space and right neural exit foramina (figure 8-arrow head). Spinal cord is pushed to the left (figure7a,b). The soft tissue component is noted to extend into the right neural exit foramina of C5/C6,C6/C7 and C7/D1 which corresponds to brachial plexopathy clinically. Serum electrophoresis and bone marrow cytology from posterior superior iliac crest (right) (figure 7 d inset).

2.4 Case 4

A 60 year old female with low back ache since one and a half month. It was sudden in onset. She also had a history of fall. She had pain and swelling of left arm after a very subtle injury which showed pathological fracture of left shaft humerus(9f). Her blood urea was high 42mg/dl.

However blood picture did not reveal any abnormality. Partial collapse of D12 with mild posterior vertebral convexity with retropulsion into spinal canal was seen. Abnormal TIWI hypointense (figure 9b), heterogeneously hyperintense in T2WI(9 a), T2WI FS (figure 9 c) involving L1,L4,D5,D6,C6 vertebral bodies and posterior elements of D5 and C6 (figure 11, 9a) vertebrae. Post contrast Gd-enhancement TIWIFS shows heterogeneous enhancement (figure 9 d). Soft tissue epidural component which shows enhancement (figure 10 a,b). Pleural effusion, tiny paraaortic, aortocaval nodes were seen. Epidural soft tissue extension is from D11 to L1 level (figure 8,10 b). Secondary spinal canal stenosis seen (figure 10 a). Chemical shift imaging, in-phase and out of phase sequences shows replacement of normal fat by myelomatous infiltrations (figure 10 c,d).

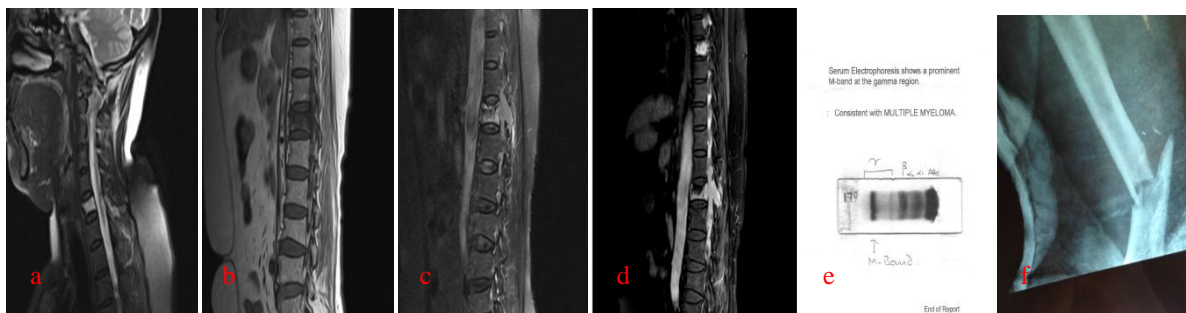


Figure 9(a-f) sagittal T2WI hyperintensity in C6 and posterior elements(a), TIWI hypointensity with partial collapse of D12 (b), T2WIFS heterogeneous hyperintensity in body and posterior elements of D12 (c), Gd-enhancement seen in D12, D6, D5 with epidural soft tissue component extending from D11-L1(d), serum electrophoresis(e) fracture left humerus(f)

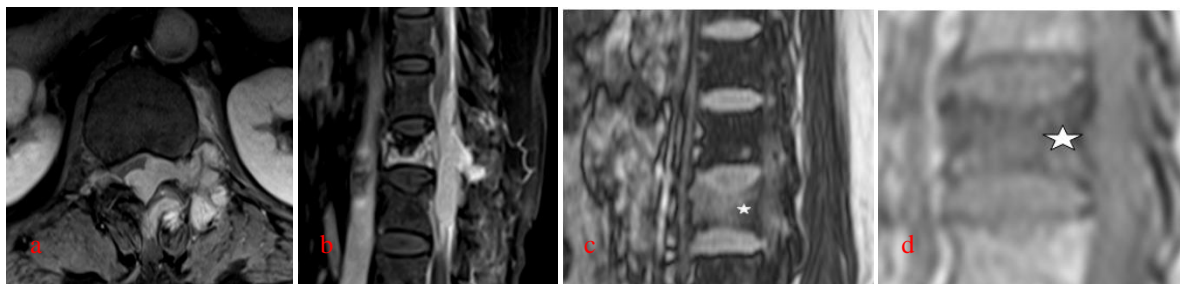


Figure 10 (a,b,c,d) T1WIFS Gd (a,b) shows epidural soft tissue component(arrows) causing severe spinal canal stenosis D12vertebra. In-phase(c), opposed phase (d) shows no signal loss in D12 vertebra (asterisks)



Figure 11: T2WIFS sagittal, lesions in D5, D6

3. Discussion

Multiple myeloma is a common malignancy of older patients (70% of cases are diagnosed between 50 and 70 years of age) and it is the most common primary malignancy of bone.[6] Our studies too show three cases within this range; only one (case no.2) is of 35 years old. It has a male predilection (M: F 2:1). The exact pathogenesis of multiple myeloma is unknown, but environmental factors such as exposure to herbicides, insecticides, benzene, and ionizing radiation may contribute to its occurrence.[3]

On MRI Multiple myeloma typically appears as multiple intramedullary zones with low – intermediate signal on T1WI; and intermediate, slightly high to high signal on T2WI[1] and slightly high to high signal on FST2WI. FST2WI is important for detecting myeloma because intermediate and high signal heterogeneity on T1WI from red and yellow marrow respectively, can be seen in normal vertebral marrow in elderly patients. Zones of cortical destruction may occur associated with extraosseous soft tissue lesion, as seen in case 3,4 in our series.

Bone deposits have been shown by MRI in about 50% of asymptomatic myeloma patients with normal plain radiographs as seen in cases in this series. Sagittal studies of the spine enable screening of a high proportion of hematopoietic marrow and detection of any potential threat to the spinal cord as depicted in our study. [6]

Extraosseous multiple myeloma usually occurs as an extension from intraosseous (as seen in our cases 2,3,4) or less frequently arises from within the soft tissue. Zones of high signal on T2WI peripheral to the Gd-contrast enhancement portion of

the lesion may represent zones of tumor invasion or peripheral oedema.

Multiple myeloma results from monoclonal proliferation of malignant plasma cells which produce immunoglobulins (commonly IgG) and infiltrate haemopoietic locations (i.e. red marrow) [1]. Bone marrow containing more than 15% plasma cells (normally no more than 4% of the cells in the bone marrow are plasma cells). Blood serum and/or urine containing an abnormal protein. This was also the basis of our diagnosis. Renal insufficiency is one of the causes of death.

The focal pattern consists of localised areas of decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted images was also seen in our study. Myelomatous deposits are generally sharply demarcated on a background of an otherwise normal appearing bone marrow. Homogeneous enhancement occurs on T1-weighted images following intravenous contrast injection (Case1 and 2), also detects subtle lesions not seen in pre contrast study (case2).

The diffuse pattern is characterised by a diffuse and homogeneous decrease in marrow signal intensity which becomes identical to or lower than that of adjacent inter-vertebral discs on a T1-weighted image and on a T2-weighted image by a diffuse or patchy increase in signal intensity. Marked enhancement is usually seen on T1-weighted images following intravenous contrast (case 3 figure 8 D).

Distribution of multiple myeloma mirrors that of red marrow in the older individual, and thus this is mostly encountered in the axial skeleton and proximal appendicular skeleton.

Extraosseous epidural tumors causing compression myelopathy without evidence of destruction or collapse of vertebral bodies are

relatively rare; to our knowledge very few cases exist in the literature.(5)

Table 1: Systemic manifestations in our study

Systemic manifestations	Cases
Polyneuropathy	Seen in case 3 of our series.
Pathological fracture	Vertebral compression fracture-seen in case 1,2,4.
Long bone	seen in case 4
Rib	seen in case 3
Pelvis	seen in case 1
Anaemia	in one case –case 3
Backache	present in case 1,2 4.
Renal insufficiency	case 4(mild)
Spinal cord compression	all the cases
Extra skeletal structures (extraosseous myeloma)	rare –but extraosseous extension was found in our series (not extraskkeletal entirely).

4. Conclusion

MRI plays a major role in detecting occult lesions of multiple myeloma. MRI detects myelomatous infiltration early, thus helps in early treatment. Serum electrophoresis is the mainstay of diagnosing multiple myeloma. However its absence does not rule out multiple myeloma especially in non secretory type [3] where bone biopsy is confirmatory. Lack of specificity of the MRI patterns should always be kept in mind. Differentiation between red marrow hyperplasia secondary to anaemia, infection, malignant or treated marrow infiltration can be extremely difficult. MRI is generally more sensitive in detecting multiple lesions compared to the standard plain film skeletal survey[3].

Infiltration and replacement of bone marrow is exquisitely visualised, and newer scanners are able to perform whole body scans for this purpose which has been shown to be superior to both CT and skeletal surveys.[4] The main differential is that of widespread bony metastases, non-hodgkins lymphoma. Contrast study depicts the hidden myelomatous infiltrations.

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