**Original article:**

**Role of MRI in evaluation of bone marrow changes in non-traumatic spine in various diseases**

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**Abstract:**

Introduction: Magnetic resonance imaging (MRI) is a widely used non-invasive imaging modality for the evaluation of various spinal pathologies. The purpose of this retrospective study is to describe the distribution and signal characteristics of different spinal pathologies on MRI.

Methods: A retrospective study was conducted on 100 patients with various spinal pathologies who underwent MRI at our institution. The patients were divided into five age groups (0-20, 21-40, 41-60, 61-80, and >80), and the distribution of lesions was recorded. Signal intensity and enhancement pattern of different spinal pathologies were also evaluated.

Results: The most common spinal pathology seen on MRI was degenerative changes of the spine, accounting for 60% of cases. Disc degeneration was the predominant finding (68.3%), followed by disc bulge causing anterior thecal sac indentation (66.7%) and disc herniation (28%). In terms of reconversion disorders, most of the cases showed diffuse involvement of bone marrow. The most common focal disorder of bone marrow was focal edema (60%). Depletion disorders were rare in our study, with only three cases identified.

Conclusion: MRI is a valuable tool for the evaluation of various spinal pathologies. Degenerative changes of the spine were the most common pathology seen in our study, followed by reconversion disorders and focal disorders of bone marrow. The signal characteristics and enhancement patterns of different spinal pathologies on MRI can help to improve the accuracy of diagnosis and guide appropriate treatment.

**Keywords:** Magnetic Resonance Imaging , bone marrow , clinical implications

**Introduction:**

Magnetic Resonance Imaging (MRI) is a non-invasive diagnostic imaging modality that plays a vital role in the evaluation of bone marrow changes in non-traumatic spine in various diseases. MRI provides detailed imaging of the bone marrow, allowing clinicians to visualize the morphology and signal intensity of the bone marrow. Bone marrow changes can occur in a variety of diseases, including hematologic malignancies, metabolic bone diseases, infectious diseases, and inflammatory disorders.

In the context of the spine, bone marrow changes can have significant clinical implications. These changes can be indicative of disease progression, treatment response, or can help differentiate between various diseases with similar clinical presentations. For example, bone marrow changes in the spine can be seen in multiple myeloma, which is a hematologic malignancy characterized by clonal proliferation of plasma cells in the bone marrow. On the other hand, vertebral body changes in the spine can also be seen in osteoporosis, a metabolic bone disease characterized by low bone density and increased risk of fractures.

Therefore, the role of MRI in the evaluation of bone marrow changes in non-traumatic spine in various diseases is of great importance. It enables accurate diagnosis, appropriate management, and monitoring of disease progression. In this essay, we will discuss the specific role of MRI in evaluating bone marrow changes in non-traumatic spine in various diseases.

**Material and methods:**

A cross-sectional observational study was conducted at Bapuji Hospital/Chigateri General Hospital to assess the role of MRI in the evaluation of non-traumatic bone marrow changes in the axial skeleton. The study was approved by the institutional ethics committee, and informed consent was obtained from all the participants.

A total of 100 patients were recruited for the study from the surgery, medicine, emergency, and pediatrics departments of the hospital. The inclusion criteria for the study were patients with suspected marrow pathology involving the axial skeleton, biochemical examination suggestive of deranged hematological profile or ineffective hematopoiesis/metabolic disorders, patients with known primary malignancy presented with backache, and patients with backache radiating to extremities without any significant past history. Patients who did not consent to participate in the study or were claustrophobic were excluded.

Routine assessments, including history taking, physical examination, and related blood tests, were performed on all patients. Additional imaging methods such as x-ray spine or x-ray/CT chest and abdomen were performed in patients with primary pathology identified at other locations using a risk-benefit-based management algorithm.

All patients underwent MRI of the spine on an elective basis. The imaging was performed using a 1.5 Tesla MRI machine, and T1-weighted, T2-weighted, and STIR sequences were acquired. For patients who required contrast, gadolinium-based contrast agents were used, but lactating women, patients with moderate to severe renal insufficiency, and patients with an allergy to gadolinium were excluded.

The MR images were analyzed by two radiologists independently. The qualitative data were presented as a percentage, and the Z-test was used wherever required for statistical analysis. The results of the study were reported in a descriptive style. The study findings were used to assess the role of MRI in the evaluation of non-traumatic bone marrow changes in the axial skeleton.

**Results:**

Out of n=100 cases studied for various spinal pathologies, maximum cases (n=60) were degenerative followed by infiltration disorders (n=16), next was reconversion disorders (n=11). There were only 3 cases of depletion disorder and was no case with deposition disorder.

In our study, out of n=100 patients of various spinal pathologies 48 patients were male and 52 were female. There was no significant sex predilection noted with an almost equal male to female distribution was seen in our study group.

Disc degeneration was the predominant finding accounting for 68.3%(n=41) suggesting possibility of earliest change. Disc bulge causing anterior thecal sac indentation was the next common finding seen in 66.7%(n=40) followed by this was disc gerniation seen in 46(n=28) cases.

In our study of various spinal pathologies, there were n=60 cases of degenerative changes of spine on MRI.

**Table 1) Age wise cases distribution**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr. no | 0-20 | 21-40 | 41-60 | 61-80 | >80 |
| Disc degeneration | 0 | 8 | 36 | 3 | 0 |
| Canal stenosis/nerve  root compression | 0 | 4 | 15 | 2 | 0 |
| Disc Herniation | 0 | 0 | 20 | 2 | 0 |
| Modic changes | 0 | 0 | 11 | 2 | 0 |
| Disc bulge | 0 | 2 | 39 | 3 | 0 |

**Table 2) Focal or diffuse involvement of various reconversion disorders**

|  |  |  |  |
| --- | --- | --- | --- |
| Sr. no | Reconversion disorders | Focal | Diffuse |
| 1 | Chronic anaemia: sickle cell anaemia | 0(0%) | 1(100%) |
| 2 | Chronic anaemia: Thalassemia | 1(25%) | 3(75%) |
| 3 | Hyperparathyroidism | 0(0%) | 2(100%) |
| 4 | Others (Heavy smoking, increase  Oxygen requirements) | 0(0%) | 3(100%) |

**Table 3) Signal characteristic and enhancement pattern**

|  |  |  |  |
| --- | --- | --- | --- |
| Sr no | MRI | | No of patient |
| 1 | T1  Hypointense Isointense hyperintense | | 7  4  0 |
| 2 | T2  Hypointense Isointense hyperintense | | 6  3  2 |
| 3 | STIR  Hypointense | | 4 |
|  | Isointense hyperintense | | 5  2 |
| 4 | Post  enhancement | contrast | 1 |
| 5 | Signal drop on  outphase | | 0 |

**Table 4) Classification of Depletion disorders**

|  |  |  |
| --- | --- | --- |
| Sr no | Depletion disorders | No of patients |
| 1 | Unknown cause | 1(33.33%) |
| 2 | Myelofibrosis | 1(33.33%) |
| 3 | Aplastic anaemia | 1(33.33%) |
| 4 | Secondary to chemo or radiotherapy | 0(0%) |

**Table 5) Distribution of focal disorders of Bone marrow -**

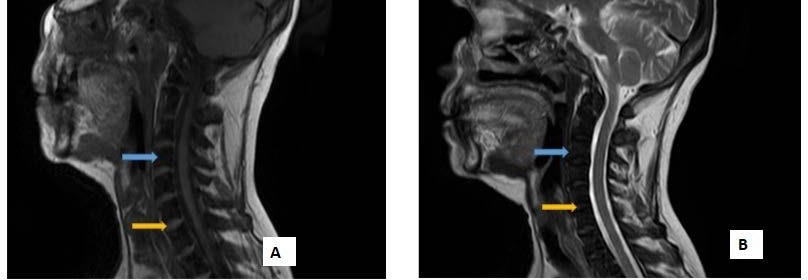
|  |  |  |
| --- | --- | --- |
| Sr no | Focal disorders of bone marrow | No of patients |
| 1 | Focal oedema | 6(60%) |
| 2 | Focal lesions | 4(40%) |

##### 

##### Table 6) Signal characteristic and enhancement pattern

|  |  |  |
| --- | --- | --- |
| Sr no | MRI | No of patient |
| 1 | T1  Hypointense Isointense hyperintense | 5  1  4 |
| 2 | T2  Hypointense Isointense hyperintense | 0  1  9 |
| 3 | STIR  Hypointense Isointense hyperintense | 0  1  9 |
| 4 | Post contrast  enhancement | 4 |
| 5 | Signal drop on out phase | 4 |

**Depletion of myeloid elements with fibrosis: myelofibrosis**



**Image A** : T1 Sagittal Cervical spine, **Image B** : T2 Cervical Dorsal Spine. Vertebral Body

(Blue arrow), Intervertebral disc (Yellow Arrow) ; There is diffuse hypointensity noted involving the vertebral bodies compared to Intervertebral disc resulting in a “black marrow”.

**Discussion:**

The study analyzed 100 cases of various spinal pathologies. Among these cases, the maximum number of cases (60) were degenerative changes, followed by infiltration disorders (16) and reconversion disorders (11). The study showed no significant sex predilection for spinal pathologies with an almost equal distribution of males and females.

Disc degeneration was the most common finding, accounting for 68.3% (41 cases) of the study group, followed by disc bulge causing anterior thecal sac indentation (66.7%) and disc herniation (46 cases). The distribution of these lesions showed a higher prevalence in patients aged between 41-60 years, indicating that these changes may occur early in life.

The reconversion disorders showed diffuse involvement of bone marrow, with chronic anemia due to thalassemia being the most common finding. Signal intensities of bone marrow lesions were compared with those of paraspinal muscles and intervertebral discs, showing various signal intensities and enhancement patterns on MRI.

Depletion disorders were found in only three cases, with unknown cause, myelofibrosis, and aplastic anemia being the causes. The study showed that the most common focal bone marrow disorder in the spine was focal edema (60%), followed by focal lesions (40%). These focal disorders of bone marrow showed various signal intensities and enhancement patterns on MRI.

**Conclusion:**

In conclusion, the study suggests that disc degeneration is the most common finding in spinal pathologies, and it may occur early in life. The study also highlights the importance of MRI in the diagnosis and characterization of various spinal pathologies, including degenerative changes, infiltration disorders, reconversion disorders, and depletion disorders. Further research is needed to investigate the relationship between these findings and the clinical outcomes of patients with spinal pathologies.

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