Magnetic Resonance Imaging in Evaluation of Hip Pain

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head changes, early avascular necrosis (AVN), bony infarcts, and early degenerative changes. Its superior soft tissue contrast also helps in detecting anatomical details, articular cartilage injury, synovial pathologies joint effusion, surrounding periarticular soft tissue abscess, and tumors.

Thus, MRI is the modality of choice for evaluation of hip pain as it has a profound impact on the subsequent treatment and is useful tool for the clinicians. Hence, the aim of our study was to study the spectrum of imaging findings depicted on MRI in patients with hip pain.

MATERIALS AND METHODS

The study is a prospective study on 50 patients with hip pain referred to the Department of Radiodiagnosis, Gandhi Medical College and Hamidia Hospital, Bhopal. The study was undertaken over a period of 1 year after taking written informed consents from all patients.

INTRODUCTION

Hip pain is very common in all age groups with wide spectrum of differential diagnosis. Magnetic resonance imaging (MRI) plays an important role in the delineation of hip pathologies, as it provides excellent soft tissue resolution, multiplanar imaging and is non-invasive without the risk of ionizing radiation.

MRI provides valuable information regarding occult bony pathologies such as bone marrow edema, subtle femoral
Inclusion Criteria
The following criteria were included in the study:
• Patients presenting with unilateral or bilateral hip pain
• Patients of all age groups and both sexes.

Exclusion Criteria
The following criteria were excluded from the study:
• Patients with contraindication for MRI such as metallic implants, cardiac pacemakers, aneurysmal clips, and cochlear implants
• Patients with claustrophobia
• Patients with recent trauma.

MRI hip was performed on 1.5 Tesla MRI Hitachi ECHELON SMART 523 machines with the help of dedicated surface coil. Patients were asked to lie in a supine position and both hips were scanned simultaneously using hip protocol. The sequences obtained were T1 weighted, T2 weighted, short-tau inversion recovery (STIR), proton-density fat saturation (PDFS) coronal images, and T1-weighted and T2-weighted axial images with PDFS sagittal images. Intravenous contrast (Gadolinium at 0.1 mmol/kg) was administered when thought necessary (infective, inflammatory, and neoplastic cases) and scans were taken in axial, sagittal, and coronal planes. Final diagnosis was based on clinical, laboratory, and imaging findings and further confirmed by histopathology wherever indicated.

RESULTS
In our studies of 50 patients with hip pain, we observed the following results:
• The age range of patients was from 5 to 72 years (mean = 29.6 years).
• The maximum number of cases, i.e., 15 was in the age group of 21–30 years [Table 1].
• There was a male predominance with 35 cases (70%) and females were 15 (%).
• Unilateral hip pathologies were seen in 30 cases, the common causes were post-traumatic AVN, infective arthritis (tubercular and pyogenic arthritis), transient synovitis, Perthes disease, slipped capital femoral epiphysis (SCFE), and tumors.
• Bilateral hip pathologies were seen in 20 cases, the common causes were non-traumatic cases of AVN,
osteoarthritis, sacroiliitis, metastasis, and multiple myeloma.

- Most common cause of hip pain was AVN of femoral head, i.e., 25 cases (50%) [Table 2].
- Infective arthritis was the second most common hip pathology seen in 6 patients (12%), four patients had a history of fever. All six cases had joint effusion, thickened enhancing synovium, signal alteration in bone marrow and soft tissues, and multiloculated periarticular abscess formation. Joint effusion aspiration finally diagnosed four cases as tubercular and two cases as pyogenic arthritis.
- Seven cases (14%) were diagnosed as tumors based on MRI findings which were then histopathologically confirmed.
- Common hip pathologies seen in children were transient synovitis, SCFE, Legg-Calve-Perthes disease, aneurysmal bone cyst, and rhabdomyosarcoma.
- Common hip pathologies seen in adults were osteoarthritis, sacroiliitis, metastasis, multiple myeloma, and chondrosarcoma. Cases of AVN were usually seen in middle age group.
- Infective arthritis was observed in all age groups.

DISCUSSION

In our prospective study of 50 patients with hip pain, the common causes with their MRI findings are as follows:

AVN

In this study, AVN was seen in half of our cases as the most common hip pathology, with prevalence in age group

<table>
<thead>
<tr>
<th>Number of patients diagnosed as having AVN of the femoral head</th>
<th>Number of femoral heads affected by AVN</th>
<th>Unilateral AVN</th>
<th>Percentage of unilateral AVN</th>
<th>Bilateral AVN</th>
<th>Percentage of bilateral AVN</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>37</td>
<td>13</td>
<td>52%</td>
<td>12</td>
<td>48%</td>
</tr>
</tbody>
</table>

AVN: Avascular necrosis
from 16 to 60 years (mean 30.3 years) and a male:female ratio of 2.1:1, i.e., 17 (68%) patients were male and 8 (32%) patients were female. In the study conducted by Ito et al.,[1] sex ratio was 4–8:1.

The most common age group affected in AVN was 21–30 years. The most common risk factor for AVN was alcohol seen in 10 cases (40%), followed by idiopathic cause 5 patients (20%), sickle cell disease associated with multiple bony infarcts 5 cases (20%), trauma (4 patients, 16%), and one patient had a history of steroids intake [Table 3]. Jacob[2] also found alcohol as the most common cause of AVN in their studies.
Thirteen patients (52%) had unilateral while 12 patients (48%) had bilateral AVN [Table 4]. Thus, a total number of 37 femoral heads were involved. Unilateral AVN was associated with history of trauma and non-traumatic AVN was bilateral [Figure 1].

In our study, the most common MRI findings of AVN were focal subchondral signal abnormality (geographic pattern with sclerosis) and were seen in 24 patients (96%), followed by bone marrow edema (23 patients, 92%), associated with joint effusion (19 cases, 76%), subchondral cysts (9 cases, 36%), double line sign (12 patients, 48%) which is seen on T2-weighted sequence and consists of inner bright line representing granulation tissue and surrounding dark zone representing adjacent sclerotic bone, subarticular collapse of femoral head (5 patients, 20%), and osteophytes formation (4 patients, 16%) [Table 5]. Similar results were found by Kamal et al. [3] Few cases of AVN with a history of sickle cell disease were associated with multiple infarcts [Figure 2].

MRI was found to be highly sensitive and specific in evaluation of AVN and is superior over plain radiographs, which fail to pick up early disease and also helps in diagnosing AVN on contralateral hip. Glickstein et al. [4] in their studies have described the role of magnetic resonance (MR) in evaluation of AVN and compared to the plain radiographs with similar results.

In our study, Grade III was the most common class (Ficat and Arlet classification) seen in 17 femoral heads (46%) out of AVN affected 37 femoral heads followed by Grade II in 10 femoral heads (27%) [Table 6]. In a study done by Kamal et al. [3] 51% of patients were diagnosed as Grade IV and 34.7% were diagnosed as Grade III.

**Table 5: MRI findings in AVN**

<table>
<thead>
<tr>
<th>MRI findings</th>
<th>Number of patients (25)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focal subchondral signal abnormality (geographic pattern)</td>
<td>24</td>
<td>96</td>
</tr>
<tr>
<td>Bone marrow edema</td>
<td>23</td>
<td>92</td>
</tr>
<tr>
<td>Subchondral cyst</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Subarticular collapse of femoral head</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Osteophytes</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Joint effusion</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>Double line sign</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

Infective Arthritis

In our study, there were six cases of infective arthritis. Four cases proved out to be tubercular and two cases were of pyogenic arthritis. The MR features suggestive of tubercular arthritis were joint effusion, subarticular marrow edema, synovial thickening, and soft tissue involvement in the form of periarticular abscess formation. MR features in cases of pyogenic arthritis revealed marrow edema, subchondral bone involvement, joint effusion, and periarticular abscess formation [Figure 3]. After contrast administration, tubercular abscesses had thin and smooth rim enhancement while pyogenic abscesses had thick and irregular rim. Bone erosion was more common in patients with tubercular arthritis seen in three cases than in one.
case of pyogenic [Figure 4 and Table 7]. Hong et al.[5] in their studies also described similar MR imaging features to differentiate tubercular from pyogenic arthritis.

**Transient Synovitis**

Three children (all <10 years) with hip pain were diagnosed as transient synovitis. MR features revealed joint effusion associated with synovial enhancement [Figure 5]. Two cases had unilateral effusion while one case had contralateral effusion. However, there was no evidence of signal alteration in the adjacent marrow [Table 8]. Similar imaging features were seen in the studies done by Yang et al.[6]

**Osteoarthritis**

The most common age group affected was 40–70 years. MRI had role of detecting early changes of osteoarthritis compared with radiographs. The signs on MRI included reduced joint space, joint effusion, marrow edema, articular cartilage defects, subchondral cysts, and osteophytes [Figure 6]. In our study, 3 cases (6%) of osteoarthritis were found with MRI features as tabulated in Table 8. Horii et al.[7] have also studied similar spectrum of MRI findings in osteoarthritis.

**Sacroiliitis**

MR findings commonly observed in sacroiliitis are periarticular marrow edema adjacent to sacroiliac joint, changes in cartilage, and subchondral bone erosions.[8]

In our study, three cases had sacroiliitis, of which two had unilateral and one had bilateral involvement. All were seronegative.

**Perthes Disease**

In our study of 50 patients, one child of age 7 years with bilateral hip pain was diagnosed as Legg-Calve-Perthes disease which is an idiopathic osteonecrosis of the femoral epiphysis in children. MR features revealed hypointensity on T1-weighted image with focal flattening of articular surface of femoral head in anterior-superior region [Figure 7]. Hochbergs et al.[9] on his study on Perthes disease found similar MR findings.

**SCFE**

There was one child of 14 years with clinically suspected case of SCFE. MR findings revealed physeal widening, bone marrow edema, retroversion at epiphyseal-metaphyseal junction (on axial image), joint effusion, and positive Trethowan sign (i.e., a line drawn up the lateral edge of the femoral neck fails to intersect the epiphysis on coronal T2-weighted image) [Figure 8]. Similar findings were seen in a study conducted by Umans et al.[10]

**Tumors**

**Chondrosarcoma**

An elderly patient of 72 years revealed MR findings of altered marrow signal in the right iliac bone with adjacent large heterogeneously enhancing soft tissue, infiltrating surrounding gluteal muscles [Figure 9]. Histopathology revealed chondrosarcoma. Chondrosarcoma is the common primary malignant sarcoma of bone in adults, usually between 40 and 70 years with male predominance. The most common sites are pelvis, femur, and humerus.[11]

**Chondroblastoma**

Chondroblastoma is the rare benign cartilaginous neoplasms that characteristically arise in the epiphysis or apophysis of a long bone in skeletally immature patients. In our study, MRI findings in a female child of 14 years revealed a well-defined lobulated T1 hypointense and T2/STIR intermediate signal intensity lesion in epiphysal region of the right femoral head with adjacent STIR hyperintense marrow edema [Figure 10]. The diagnosis of chondroblastoma was given, which was further confirmed by biopsy.

**Metastasis**

In our studies, two patients were diagnosed as bony metastasis. One female (45 years) with a history of breast
malignancy with hip pain was referred for MRI hip, which revealed expansile altered marrow signal intensity involving left ilium bone associated with multiple areas of cortical breach and adjoining soft tissue component. Multifocal T2/STIR hyperintense lesions were also seen in pelvic bone, bilateral proximal femur, and lower lumbar vertebrae [Figure 11].

Another patient with a history of carcinoma prostate (58 years) also revealed multiple variable sized T1 hypointense and T2 hyperintense lesions in pelvic bone. MRI has high sensitivity and specificity for detection of skeletal metastasis.

**Multiple myeloma**

We had one patient of multiple myeloma associated with hip pain. MR findings depicted multiple discrete and confluent variable sized T1 hypointense and T2 hyperintense lesions showing post-contrast enhancement in bilateral proximal femurs, pelvis, lumbar, and sacral vertebrae [Figure 12].

**Aneurysmal bone cyst**

One 19-year-old male child, with clinically suspected case of tubercular arthritis, was referred for MRI hip, which revealed well-defined expansile lesion in the left acetabulum bone with T1 hypointense and T2/STIR hyperintense signal intensity with multiple blood-fluid levels [Figure 13]. These imaging findings of aneurysmal bone cyst were further confirmed by biopsy.

**Soft tissue sarcoma**

They are a heterogeneous group of malignant tumors of mesenchymal origin, which originates from soft tissues rather than bone. One 5-year-old child, with the left hip pain associated with swelling, was imaged. MRI findings revealed heterogeneously T2 hyperintense soft tissue mass involving surrounding muscles of the left hip joint, underlying bones were spared [Figure 14]. Diagnosis of soft tissue sarcoma was given, biopsy proved it to be rhabdomyosarcoma (subtype of soft tissue sarcoma), which is common in pediatric population.

**CONCLUSION**

MRI of the hip joint is non-invasive, non-ionizing, safe, and accurate imaging modality of choice for diagnosing various causes of hip pain. Due to its excellent soft tissue resolution and multiplanar imaging capability, it can delineate various hip pathologies and help in early diagnosis where radiograph appears normal. We diagnosed wide spectrum of MR findings in patients with all age groups in patients with hip pain. The various underlying conditions included AVN, infective arthritis, transient synovitis, sacroiliitis, osteoarthritis, SCFE, Perthes disease, and tumors.

**REFERENCES**


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