

MAGNETIC RESONANCE IMAGING(MRI) IN EVALUATION OF AVASCULAR NECROSIS OF HIP

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Abstract

Background: Avascular osteonecrosis of the femoral head (AVNFH) is an ischemic condition characterized by local disruption of intraosseous blood supply, affecting predominantly young and middle-aged adults. If left untreated, AVNFH often progresses and often leads to complications at a relatively young age. Conventional radiography is the first line investigation performed, followed by magnetic resonance imaging (MRI), which is the gold standard of imaging. **Materials and Methods:** A prospective observational study was conducted in adult patients of both sexes who were evaluated by MRI hip in the Department of Radiodiagnosis, PES Institute of Medical Sciences, Kuppam, Andhra Pradesh, from March 2022 to December 2023. Adult patients who came to the orthopedic department with unilateral or bilateral hip pain were evaluated. **Results:** Out of 30 patients, most were between 20 and 50 years old, of which 29 are males. Bilateral involvement is seen in 60% and unilateral in 30% of patients. The most common etiology was found to be steroid use, seen in 14 cases (46%), followed by alcohol, seen in 8 cases (26%), and trauma, seen in 8 cases (26%). The double line sign was the most common finding and was seen in 28 cases (93.3%); joint effusion was seen in 25 patients (83%); subchondral fracture was seen in 7 cases (23%); and secondary osteoarthritis was seen in 8 patients (26%). **Conclusion:** MR imaging helps in early detection of avascular necrosis of hip, which is not possible in conventional radiographs or CT imaging. Early diagnosis helps in early intervention to medical and surgical management which can significantly improve the prognosis for the patient.

INTRODUCTION

Avascular osteonecrosis of the femoral head (AVNFH) is an ischemic condition characterized by local disruption of intraosseous blood supply, affecting predominantly young and middle-aged adults.^[4] If left untreated, AVNFH often progresses and often leads to femoral head collapse, early osteoarthritis, and total hip arthroplasty (THA) at a relatively young age. The most common predisposing factors for osteonecrosis are trauma, corticosteroids, and alcoholism. The etiology of the ischemic process of the femoral head is still unclear, and different and multifactorial etiologies have been proposed, such as traumatic vascular disruption of the vascular network of the femoral head, intravascular occlusions, and increased intraosseous pressure caused by fatty infiltration of the bone marrow leading to vascular compression. Conventional radiography is the first line investigation performed, followed by much

advanced magnetic resonance imaging (MRI), which is the gold standard of imaging with over 99% reliability for AVNFH.^[3] MR imaging is an important tool in the assessment of hip related pathologies because it helps in the evaluation of articular structures, extraarticular soft tissues, and the osseous structures that can be affected by hip disease.^[2] A CT scan can demonstrate bony pathology well, but not as beforehand as an MRI. A CT scan also has the disadvantage of radiation. Coronal MR images give good visualization of femoral head and neck and the intertrochanteric regions. Axial MR images give good visualization of the articular space, hip musculature, and supporting ligaments. Early diagnosis and treatment are crucial so as to reduce the disease progression and subsequent morbidity.^[3] The pathway for hip imaging has evolved vastly with the arrival of MRI, which is non-invasive and very sensitive in the early detection of bone marrow edema and other hip joint pathologies. A close correlation between clinical

symptoms and MRI findings is thus necessary for the accurate diagnosis and staging of avascular necrosis of the hip joint.^[1]

MATERIALS AND METHODS

A prospective observational study was conducted in adult patients of both sexes who were evaluated by MRI hip in the Department of Radiodiagnosis, PES Institute of Medical Sciences, Kuppam, Andhra Pradesh, from March 2022 to December 2023. A detailed history and associated risk factors were taken from all the patients. Adult patients who came to the orthopedic department with unilateral or bilateral hip pain and were sent for an MRI evaluation were included in the study, and patients who didn't give consent, had known contraindications (metallic prosthesis, prosthetic valves), or were claustrophobic were excluded from the study. After clinical evaluation, once a patient satisfied the inclusion and exclusion criteria for this study, he or she was taken for an MRI of the hip joint, which was then evaluated.

MRI hip was performed on a SIGNA Explorer 1.5 Tesla MRI scanning machine with the help of a dedicated surface coil. Patients were asked to lie in a supine position, and both hips were scanned simultaneously using the hip protocol. The sequences obtained were: T1 weighted in axial and coronal, T2 weighted in axial and coronal, proton-density fat saturation sequences in axial and coronal, and T2 weighted sequence in sagittal.

RESULTS

Out of 30 patients, most were between 20 and 50 years old, of which 29 are males. Bilateral involvement is seen in 60% and unilateral in 30% of patients. The most common etiology was found to be steroid use, seen in 14 cases (46%), followed by alcohol, seen in 8 cases (26%), and trauma, seen in 8 cases (26%). The double line sign was the most common finding and was seen in 28 cases (93.3%); joint effusion was seen in 25 patients (83%); subchondral fracture was seen in 7 cases (23%); and secondary osteoarthritis was seen in 8 patients (26%).

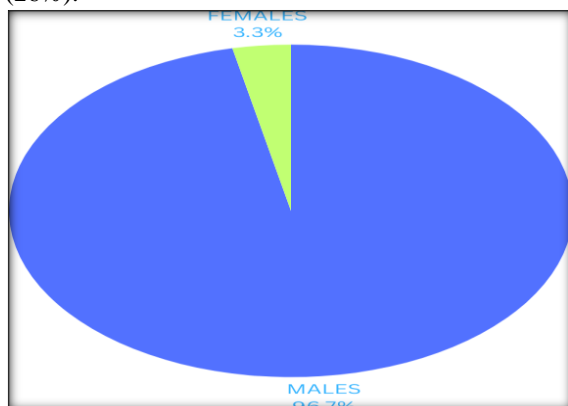


Figure 1: Males and Females

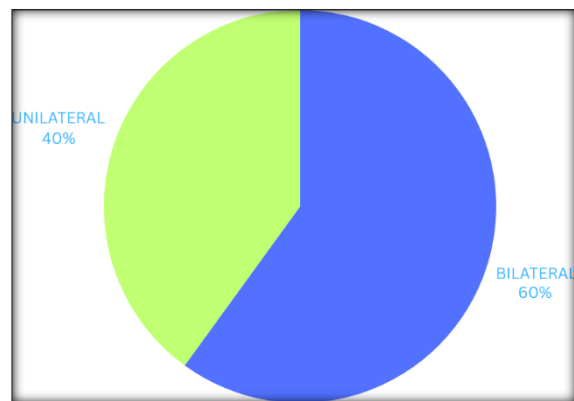


Figure 2: Unilateral/Bilateral

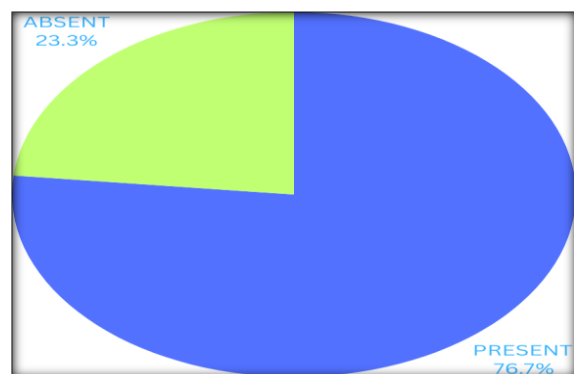


Figure 3: Subchondral Fracture

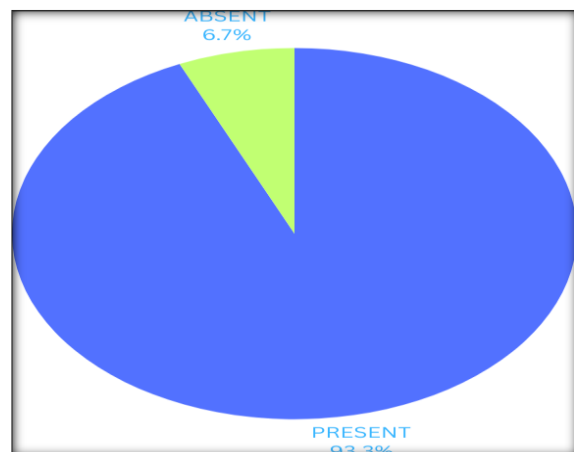


Figure 4: Double Line Sign

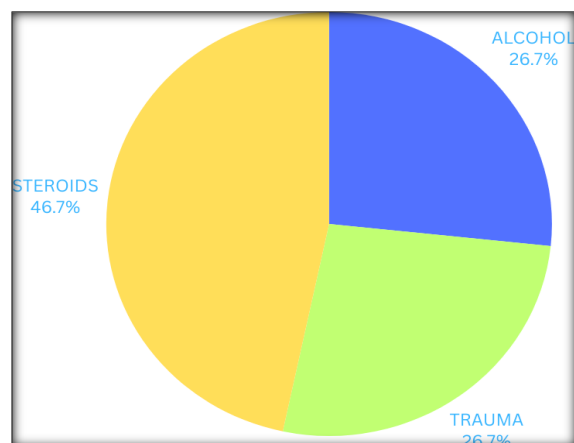


Figure 5

DISCUSSION

Avascular necrosis of the hip is a painful, disabling condition affecting unilateral or bilateral femoral heads. The wide usage of steroids and the wide prevalence of alcoholism in our Indian population are the major etiologies behind the avascular necrosis of the hip. The role of MRI in the evaluation of hip joints in relation to AVN is well documented. MRI hip help in the very early detection of AVN, even when the radiographs of hip joints are normal. The normal femoral head marrow signal is T1 hyperintense in adults. In AVN hip, the femoral head marrow signal turns into a T1 hypointense signal with a corresponding STIR hyperintense signal abnormality.

It is important to differentiate this condition from transient osteoporosis of the hip, which has similar bone marrow signal changes. The differentiating feature between the two is that they are clinically distinguished. Transitive osteoporosis of the hip is a self-limiting condition, but AVN hip progresses if left untreated.

The presence of a double-line sign in AVN is a very characteristic feature. The double line sign indicates central hyperintensity with a peripheral hypointense rim. Central hyperintensity corresponds to granulation tissue, and peripheral hypointensity corresponds to sclerosis. This is only observed in AVN, not in other conditions like transient osteoporosis of the hip or septic arthritis. The flattening of the femoral head along with crescentic subchondral lucency is seen in avascular necrosis of the hip. The geographical shape of the lesion bordered by a double line is very characteristic of avascular necrosis of the hip.

MRI also helps to assess the affected surface area of the femoral head, which determines the prognosis and further management. The true extent of involvement can be underreported if relied only on a plain radiograph. However, the actual involved femoral head is precisely assessed by MR imaging. If the affected area of the femoral head includes the medial 2/3rd of the femoral head and posteroinferior portion, it is more likely associated with a bad prognosis, as has been shown by this study. To assess the area of involvement, we can rely on visual assessment, which does not require any sophisticated software. MR imaging can also assess the extent of femoral head height collapse and secondary osteoarthritic changes like marginal new bone formation, asymmetric joint space narrowing, and acetabular sclerosis.

MRI is helpful in monitoring the outcome of various treatment modalities, which include medical and surgical. The most common surgical procedure performed for AVN is the core decompression procedure. In postoperative follow-up, an MRI scan helps in the assessment of the revascularization of the bone graft and the decrease in bone marrow edema.

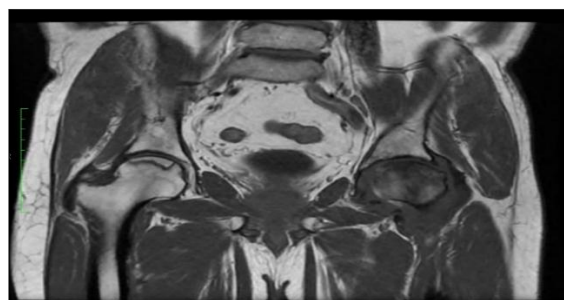


Figure 6: T1 coronal showing an irregular hypointense line seen surrounding the isointense marrow of the anterosuperior portion of the femoral heads. About 70% of the femoral head is involved on the left side and 50% on the right side

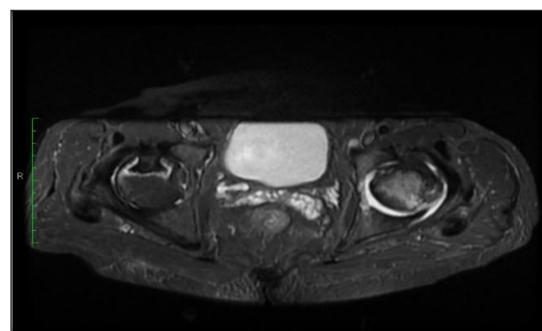


Figure 7: STIR axial sequences showing an irregular STIR hyperintense line seen surrounding the isointense marrow of the femoral head with marrow edema. Moderate joint effusion on the right side and significant effusion seen on the left side

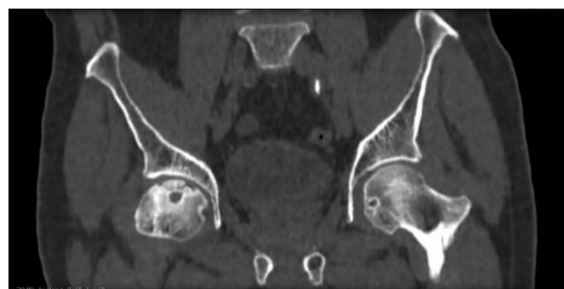


Figure 8: CT-coronal: irregular and flattening of the anterosuperior femoral head contour on the right side

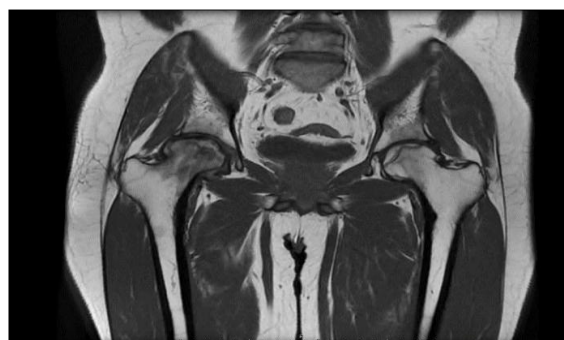


Figure 9: Cor T1 FSE sequence showing an irregular hypointense line seen surrounding the isointense marrow of most of the femoral head. About 80% of the femoral head is involved on the right side, and about 50% is involved on the left side. Marrow edema in the femoral head and moderate joint effusion are noted on the right side

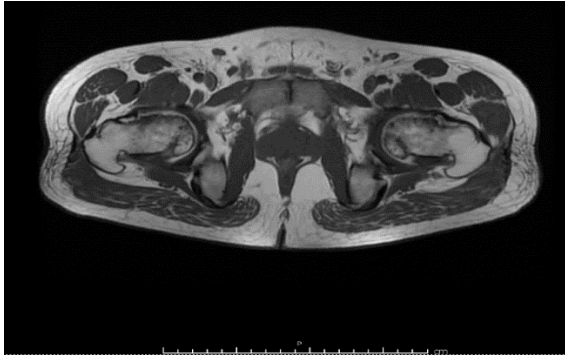


Figure 10: Ax T1 FSE showing an irregular hypointense line surrounding the isointense marrow in the superolateral portion of bilateral femoral heads, about 60% involved on the right side and 50% on the left side with subarticular collapse. Minimal joint effusion is seen on both sides

CONCLUSION

MR imaging helps in early detection of avascular necrosis of hip, which is not possible in conventional radiographs or CT imaging. Early diagnosis helps in early intervention to medical and surgical management which can significantly improve the prognosis for the patient.

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