ORIGINAL RESEARCH PAPER

Radiology

ROLE OF MRI IN THE EVALUATION OF AVASCULAR NECROSIS OF FEMORAL HEAD

KEY WORDS:

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ABSTRACT

Aim – to describe the role of MRI in evaluation of AVN of femoral head.

Materials and Methods – 50 patients with clinical suspicion of AVN were evaluated by 1.5T MRI using T1W1, T2W1 and STIR sequence in axial, coronal and sagittal planes.

Results- Study comprised of 50 patients suffering from AVN of the hip (82 HIP JOINT). The maximum patients belonged to the age group of 31-40 years. 32 patients were male and 18 patients female. Bilateral AVN were detected in 32 patients and unilateral AVN in 18 patients. Bone marrow conversion , neck widening , marrow oedema, joint effusion, abnormal signal like band pattern, ring pattern, homogenous and inhomogenous pattern are MRI characteristics of AVN .

CONCLUSION: MRI is sensitive for detection of AVN of the femoral head and can be used as a guidance for follow up of conservative and surgical management of the disease.

INTRODUCTION

Avascular Necrosis of the femoral head is a progressive, debilitating and challenging clinical problem affecting mostly the middle aged population. Avascular necrosis (AVN) of the femoral head, also known as osteonecrosis is a condition caused by decreased vascular supply to the subchondral bone of the femoral head[1]. It is a leading cause of muscular skeletal disability and common in young individuals mainly men between the third and fifth decade of life. Due to the high occurrence in young individuals, early diagnosis and treatment is of utmost importance as delayed diagnosis and treatment increases the chances of morbidity. Following ischemic insult, there is death of osteocytes and marrow cells followed by a repair process with osteoclastic resorption of the dead trabeculae and apposition of new bone[2] . This results in subsequent fracture and collapse of subchondral bone.

OBJECTIVE

To Assess The Role of MRI In The Evaluation and Early Diagnosis Of Avascular Necrosis Of Femoral Head

MATERIALS AND METHODS

A total of 50 patients who presented in the Orthopedic Department with complaints of pain in one or both hip joints who were suspected clinically and or on conventional radiography of AVN of femoral head were referred for MRI of the Hip to the Department Of Radiology at MGM Medical College And Hospital over a period of 1 year.

INCLUSION CRITERIA
• Patients of age group 20-60 years
• Patients suspicious on clinical examination and/or conventional radiography

EXCLUSION CRITERIA
• Less than 20 years and over 60 years of age
• Patients with history of acute trauma, suspicious infective arthritis, rheumatoid arthritis

MRI scan was performed in a 1.5 Tesla Toshiba MRI scanner. The scan was performed after palpating the greater trochanter and obtaining the images at that level. Full examination was done in axial, coronal, sagittal planes using T1 weighted, T2 weighted and STIR sequences.

RESULTS

Based on our study of 50 patients it was observed that all 50 patients had positive findings on MRI for a diagnosis of AVN.

Unilateral involvement was observed in 18 patients and bilateral involvement was observed in 32 patients. A total of 64% of our cases were male and 18% were female.
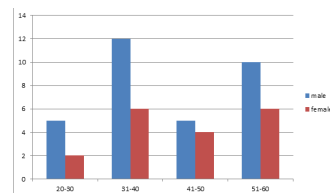
Table 1- Gender

GENDER	CASES	PERCENTAGE
MALE	32	64%
FEMALE	18	36%
TOTAL	50	100%

Table 2- side involved

SIDE	CASES	PERCENTAGE
UNILATERAL	18	36%
BILATERAL	32	64%
TOTAL	50	100%

Table 3- age-wise distribution

Based on our study, maximum patients affected belonged to the age group 31 to 40 years and were male patients.

According to the Ficat And Arlet system(modified 1985) 30 hip joints were categorized Stage 4, 26 hip joints categorized stage 3, 18 hip joints were categorized stage 2 and 8 hip joints were categorized stage 1.

32 patients had bilateral AVN, 18 patients had unilateral AVN
Total hip joints evaluated = 82

Table 4 - Ficat and Arlet staging

STAGE	HIPS	PERCENTAGE
Stage 0	-	-
Stage I	8	9.7%

Stage II	18	21.95%
Stage III	26	31.7%
Stage IV	30	36.5%
Total Hips	82	100

Table 5- pre collapse and collapse staging

| STAGES	HIPS	PERCENTAGE
Pre collapse(I,II)	30	36.5%
Collapse(III,IV)	52	63.5%
Total	82	100%

MRI FINDINGS IN AVN

100% of patients had peripheral low intensity rim on T1W sequences, 87.7% of patients had synovial effusion, 82.9% patients had peri-articular muscle atrophy, 63.41% had contour flattening/articular cartilage, 54.8% had a double line sign on T2W sequences, 48.7% had bone marrow edema and 43.9% had joint space narrowing.

Table 6 – MRI findings

MRI FINDING	Total No (82)	Percentage
Synovial effusion	78/82	87.8%
Peripheral low intensity rim in T1W	82/82	100%
Double line sign on T2W	45/82	54.8%
Contour flattening/articular cartilage	52/82	63.41%
Joint space narrowing	36/82	43.9%
Bone marrow edema	40/82	48.7%
Periarticular muscle atrophy	68/82	82.9%

Case 1
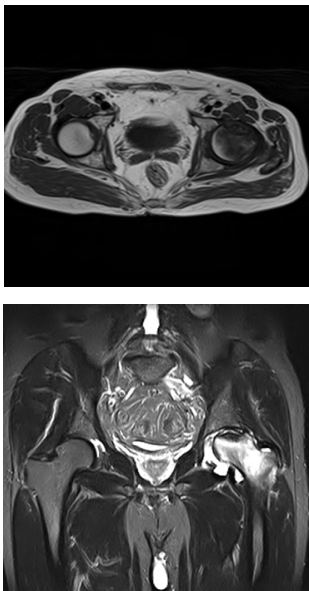
In the above axial T1W image and coronal T2W image the findings of bone marrow edema, subchondral collapse of femoral head with cortical irregularity and joint effusion is suggestive of Avascular Necrosis of Femoral Head (Grade 2-3) of the left hip joint.

CASE 2

In the above Coronal T1 image we can appreciate bilateral avascular necrosis of differing age in bilateral hip joints.

DISCUSSION

The common causes of AVN in upto 90% of cases are chronic steroid use, alcoholism, smoking, hip trauma including femoral neck fractures and hip dislocations, and prior hip surgery. Other etiologies include childhood history of slipped capital femoral epiphysis, Caissons disease, systemic lupus erythematosus, vasculitis, sickle cell anemia, coagulopathies, fat embolus syndrome, Gaucher's disease, chemotherapy and/or radiation, organ transplantation, chronic liver disease, etc[2, 3].

Patients present with a combination of hip, groin, thigh or knee pain, usually ongoing for months, with a limited range of motion on examination. Symptoms increase with weight bearing and relieved with rest. On radiograph, osteopenia is demonstrated in 2 to 5 months.

Arlet and Ficat have developed a staging system of AVN on radiograph[4]. Stage I shows normal radiograph findings, Stage II shows femoral head osteoporosis with areas of cystic lucency and sclerosis, Stage III shows subchondral collapse ("crescent sign"), Stage IV shows segmental progressive femoral head collapse with normal hip joint space and acetabulum and Stage V shows osteoarthritic changes with joint space narrowing.

MRI due to its better soft tissue resolution and multiplanar ability has become the imaging modality of choice for Avascular necrosis of the femoral head. T1-weighted images shows serpiginous "band-like" lesion with low signal intensity in the anterosuperior femoral head [5].The "double-line" sign is seen on T2-weighted images and consists of a low signal intensity outer rim and a high signal intensity inner rim. This sign was introduced by Mitchell et al.[5] and considered pathognomonic for AVN since the outer rim represents the reactive bone and the inner rim the vascular and repair tissue at the necrotic-viable osseous interface. The region within the "double-line" sign can demonstrate hypo-, iso- and hyperintensity relative to the normal marrow. Transient osteoporosis can also be seen and is almost always unilateral and the subchondral lesions that might exist are thin and short, probably representing trabecular insufficiency fractures which never proceed to form a circumscribed band [6].

Computed tomography (CT) is less sensitive than MRI in detecting osteonecrosis. Ultrasound may sometimes demonstrate synovial swelling and increased joint space in acute stage with inter-observer variability .

CONCLUSION

MRI due to its high sensitivity, specificity and multiplanar soft tissue resolution is a highly accurate method both for early diagnosis and for staging of AVN. It can be used as a guidance tool for deciding conservative and surgical management of the disease as well as for follow-up and for detecting disease progression.

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