



RADIOLOGICAL EVALUATION OF AVASCULAR NECROSIS OF HIP: A RETROSPECTIVE STUDY

Radiodiagnosis

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ABSTRACT

Introduction: Avascular necrosis of the femoral head (AVN) is a debilitating condition of unclear etiology. An early diagnosis avoids complications. The diagnosis is based on characteristic radiographic findings.

Objective: The aim of study is to evaluate radiological imaging spectrum of avascular necrosis and to study advantages and limitations of different imaging modalities in its evaluation.

Methods: A total of 50 patients who were diagnosed during the study period August 2016 to January 2017 were included. X-ray and MRI findings were reviewed, tabulated and analysed.

Results: The pathology was bilateral in 78%, n=39 with men affected more frequently (60%, n=30). On MRI, 10% (n=05) had loss of joint space, 06% (n=03) had secondary osteoarthritis and 10% (n=05) had destruction of hip joint.

Conclusion. MRI provides information about extent of the necrotic process, soft tissue involvement and allows assessment of lesion size and location.

KEYWORDS

Avascular necrosis, Hip, MRI, X-ray

Introduction

Avascular necrosis (AVN) of the femoral head is a relatively common debilitating condition of unknown etiology.^[1] AVN in adults can be devastating as it typically occurs in a relatively young population (mean age, 35–40 yr). Male affection is more than female. Bilateral hip involvement occurs 80% of the time. The disease is usually progressive and without treatment, AVN frequently results in loss of the joint space, secondary osteoarthritis and destruction of the hip joint.^[2] Hence AVN accounts for a good number of the primary total hip arthroplasties performed in younger population.^[3,4]

AVN commonly occurs after direct trauma, such as hip dislocation or femoral neck fracture.

Although surgical and nonsurgical interventions have been implied, a universal guidelines has yet to be clarified in AVN treatment.^[5] Both the appropriate course of treatment and its degree of success are depend on the etiology and severity of the disease. There is a belief that early diagnosis is important for the beneficial of conservative management.^[6-8]

Methods

This retrospective and descriptive study was conducted at P.D.U. medical college and civil hospital, Rajkot, Gujarat, India. All the radiological investigations x-ray and MRI of all patients diagnosed with avascular necrosis during the study period from August 2016 to January 2017 were reviewed retrospectively. Data was collected during the study period to include patients diagnosed as avascular necrosis of hip including all the lesions, confirmed on imaging studies. We excluded patients who had history of acute trauma, claustrophobia, metallic implants insertion, cardiac pacemakers and metallic foreign body in situ. A total of 50 patients were included in the study. Patients were evaluated by plain radiography and MRI. The analysis of data was done and result is tabulated.

Results

Of the 50 patients included in the study, 30 (60%) of the patients were males and 20 (40%) of the patients were females. The MRI imaging findings of AVN in our patients is tabulated in table 1.

Table 1 MRI imaging features

Imaging feature	No. of patients (%)
Location	11(22%)
• Unilateral	39 (78%)
• Bilateral	
Grade I	20(40%)
IA- <15 % femoral Head involvement	13
IB- < 15-30 %	5
IC- < 30 %	2
Grade II	12 (24%)
IIA- <15 % femoral Head involvement	5
IIB- < 15-30 %	5
IIC- < 30 %	2
Grade III	10 (20%)
Grade IV	6 (12%)
Grade V	2 (4%)

Discussion

Etiology

Direct factors

Traumatic

Hip dislocation
Femoral neck fracture
Surgical exposure of the femoral neck

Nontraumatic

Radiation
Dysbaric phenomena (caisson disease)
Sickle cell crisis

Associated factors

Alcoholism
Pancreatitis
Hypercortisolism
Gout/hyperuricemia
Data from references^[1,9-11].

Cushing's disease
Smoking

CLASSIFICATION

The earliest attempt at classifying avascular necrosis of the femoral head was proposed by Ficat and Arlet in 1964, before the advent of MRI. Ficat modified the classification to include invasive testing procedures and a preclinical, preradiographic stage in 1985^[12,13].

The 1985 Ficat classification system (described below) is currently the most widely accepted and used classification system in the literature.

- Stage 0 is preclinical and pre radiographic, ie, a “silent hip”.
Stage 1 - patient presents with ischemic pain in the groin with or without radiation down the front of the thigh. X-ray appears normal but positive on MRI.
Stage 2 - radiographic signs of increased density, diffusely increased porosity and/or cystic changes. The radiographs would show flattening of the contour of the head of the femur, the “out-of-round sign”. (Figure A)
Stage 3 -disruption of the normal round contour of the head and accumulation of sequestrum that might increase or maintain the normal joint space and presence of classic crescent sign in the head of the femur as the patient's disorder progresses from the early to late stages. (Figure B)
Stage 4 -complete collapse of the femoral head into a flattened contour and decreased joint space. (Figure C)
Stage 5- presence of osteoarthritis (Acetabular involvement) with decreased joint space. (Figure D)

Diagnosis

Initial Evaluation

The diagnosis of AVN is frequently overlooked because the symptoms are often nonspecific and because the early stages of AVN are not visible on radiographs. A detailed history and complete physical examination with use of magnetic resonance imaging (MRI) are necessary to identify initial onset of AVN. AVN is found bilaterally in up to 80% of patients, so both hips should be carefully examined. MRI is the examination of choice due to its superior contrast resolution, excellent soft tissue delineation and lack of ionizing radiation.

Imaging Studies

Initially X-ray evaluation should be done. Always take a radiograph having pelvis with both hip as it is useful in bilateral condition and also useful in comparison of affected hip with normal hip. On plain radiographs, the most common early findings are alternating areas of sclerosis and lucency. Crescent sign on plain radiograph indicates late stage disease. Sometimes plain radiographs may underestimate the area of articular cartilage damage on the acetabular side. Comparisons of imaging modalities for the diagnosis of AVN hip are tabulated in Table 2.

Conclusion

Imaging techniques play a key role in early diagnosis & follow up. MRI provides excellent anatomic details & accurate information about the extent of the process and grade of the disease. It contraindicated in patients with implant devices and metallic clips. It's not tolerated by all the patients ,claustrophobic, morbidly obese and young children and they may require sedation. Patient motion may be problematic. Availability and cost is the limiting factor. MRI is more specific and sensitive in detection of changes of Avascular necrosis among all the imaging modality.

Table 2 Comparison of imaging modalities for the diagnosis of AVN HIP

Modality	Advantages	Limitations
Plain film radiography	Readily available. Sensitive when infection well established.	Insensitive in acute phase. Poor information about spinal cord and nerve root compression.

MRI	Most sensitive for early detection. No radiation exposure. Excellent soft tissue delineation. Ability to detect bone marrow changes, including inflammatory and reactive hyperaemic changes, Enables early detection of disease. Offers more specific diagnosis in patients with hip pain of uncertain aetiology . Allows assessment of the lesion size and location, which are shown to relate to prognosis and need for treatment. MRI can be used to predict future collapse Offers more specific diagnosis in patients with hip pain of uncertain aetiology.	Contraindications to MR, e.g. claustrophobia, pacemaker, metallic implant etc. Recent studies are evaluating the use of an abbreviated MRI examination for its time and cost saving potential
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Figure A: stage II



Image A X-Ray right hip shows sclerosis in femoral head with central rarefaction and maintenance of femoral head sphericity.

Image B MRI study-The MRI COR T1 FSE image reveals evidence of a focal geographic zone of abnormal subchondral marrow signal intensity involving femoral head. This central osteonecrotic focus demonstrates intermediate signal intensity on images analogous to that of fluid/ oedema.

Figure B: stage III



Image A X-Ray of the femoral head in a stage III osteonecrosis. Note the crescent sign, a hallmark of osteonecrosis caused by the discrepancy in densities of the femoral head due to subchondral bone collapse.

Image B MRI study – COR T1 FSE image shows a crescentic signal change with a well-defined distinct border.

Figure C: stage IV



Image A X-Ray hip joint shows loss of joint space and flattening of the femoral head.

Image B MRI study- COR T1 FSE reveals evidence of focal zone of abnormal subchondral marrow signal intensity involving left femoral head. This central osteonecrotic focus demonstrates isointense signal intensity on T1WI analogous to that of fluid / oedema. The surrounding border remains markedly hypointense with geographic sharp demarcation on T1WI which suggests neovascularity and new bone formation..This is associated with early subchondral collapse and flattening and reduction in joint space at the weight-bearing portion of the femoral head.

Figure D: stage V



Image A X ray -Loss of joint space; advanced arthritic changes

Image B MRI study- COR T2 FSE image reveals moderate joint effusion and diffuse synovial thickening. Right hip joint septic arthritis with grade V avascular necrosis of head of femur.

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