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TEACHING CASE STUDIES
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Incremental Value of SPECT/CT in the Detection of Viable Femoral Head in Slipped Upper Femoral Epiphysis (S.U.F.E)

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Running Title: SPECT/CT in Slipped Upper Femoral Epiphysis.

ABSTRACT:

In these teaching case studies we discuss two cases of slipped upper femoral epiphysis and role of Tc99m MDP Scintigraphy with SPECT/CT. We have described incremental value of SPECT/CT in detection of viability of the femoral head and implications in management of patients with slipped epiphysis.

INTRODUCTION

Avascular necrosis in the region of femoral epiphysis is a disease in which there is ischemic death of the cellular elements of bone and marrow. The predisposing causes include dislocation of the hip, femoral neck fracture, corticosteroid usage, alcoholism, collagen vascular disease, haemoglobinopathies, Gaucher's disease, Caisson's disease and some skeletal dysplasias. The purpose of the current study is to evaluate the role of SPECT/CT imaging in the detection of viability of the femoral heads following surgery for SUFE.

CASE REPORTS

CASE 1

A 14-years-old male presented with left hip pain. X-rays showed a slip of the left femoral head epiphysis which was further confirmed, on the MRI Scan (Fig.1A). The patient underwent surgical fixation (pinning) of the femoral heads bilaterally. Post-operatively Tc99m MDP Bone Scan (550MBq i.v) and SPECT CT showed tracer uptake at the femoral heads bilaterally (Fig.1B). There was satisfactory alignment of the epiphysis and screws. Blood pool and osteoblastic activity at the affected side was suggestive of perfused and viable femoral head post surgery. A follow-up X-ray performed 2 years after the operation showed smooth outline of the femoral head and satisfactory alignment of the epiphysis bilaterally. (Fig. 1C)

CASE 2:

An 8 years old girl presented with history of left hip pain. X ray showed moderate posteromedial slip of the left capital femoral epiphysis. MRI hips, in addition to the slip demonstrated associated inflammatory changes with a small left hip joint effusion and marrow oedema at the physeal surface of the left capital femoral epiphysis (Fig 2A). The patient underwent screw fixation of the hips. Post operatively early blood pool static images following injection of 525MBq Tc99m MDP i.v showed absent distribution of tracer in the region of the left femoral head. Three hours post injection, static images showed photopenia in the left femoral head. 3D SPECT/CT images confirmed absent uptake in the left femoral head epiphysis (Fig 2B). X-ray 2 years following screw fixation showed avascular necrosis of the left femoral head with irregularity,flattening and sclerosis of femoral head (Fig 2C).

DISCUSSION

SUFE is defined as a posterior and inferior slippage of the proximal femoral epiphysis [1].

We have utilised SPECT/CT for the detection of viable femoral head in young patients and presented two cases where SPECT/CT helped detection of viable and non viable femoral heads. There are many advantages of SPECT/CT in such clinical situation. MRI is the investigation of choice in young patients however in the presence of metal internal fixation devices and screws, MRI is contraindicated. SPECT/CT is the valid alternative. SPECT/CT can demonstrated the photopenic femoral head and overcome the artefacts on planar images caused by superimposition of the overlying structures. SPECT/CT helps to correlate the functional abnormality seen on bone scan and helps to localise it anatomically. In a study by Krishan etal [2], diagnostic accuracy of bone scan was 67% , SPECT 78% while SPECT/CT had a diagnostic accuracy of 95%. AUC for SPECT/CT was (0.919), SPECT (0.76) and planar images (0.56).CT component of the SPECT/CT improves the detection of subtle collapse which can be easily missed on planar images. Alternative diagnosis of hip pain can also be demonstrated such as impingement and nail protrusion post operatively.

Three patterns of uptake on bone scan related to SUFE have been described by Glenfand [3]

a) Increased uptake in the physis and adjacent proximal metaphysis

b) Decreased uptake in the femoral head

c) Change in the scintigraphic appearances following internal fixation due to post surgical changes. The activity may approach the level of radiopharmaceutical uptake found in the adjacent femoral neck and head.

Loder [4] introduced the concept of instability and recognised two types of slips which have clinical, radiological and functional significance. In a series of 55 patients with SUFE, Loder showed that avascular necrosis developed in 47% of unstable slips but none of stable slips.

SPECT/CT helps in achieving the main goals of treatment of SUFE which are [1]

(i) Prevent further epiphyseal displacement until physeal closure

(ii) Avoid complications such as AVN and chondrolysis

(iii) Maintain adequate hip function.

Complications of SUFE include chondrolysis, avascular necrosis, premature osteoarthritis (OA), slip progression despite surgery, loosening, infection, fracture, and migration of metal implants, femoral head rotation, sub-trochanteric fractures and joint infection [5]

CONCLUSION:

Triple phase scintigraphy and SPECT-CT is a valuable tool to detect viability of the femoral head following surgery. Patients with reduced viability are offered calcium supplements (bisphosphonates) to enhance bone healing. Bone Scan coupled with

SPECT/CT facilitates triage of patients who benefit from medical treatment post surgery for SUFE.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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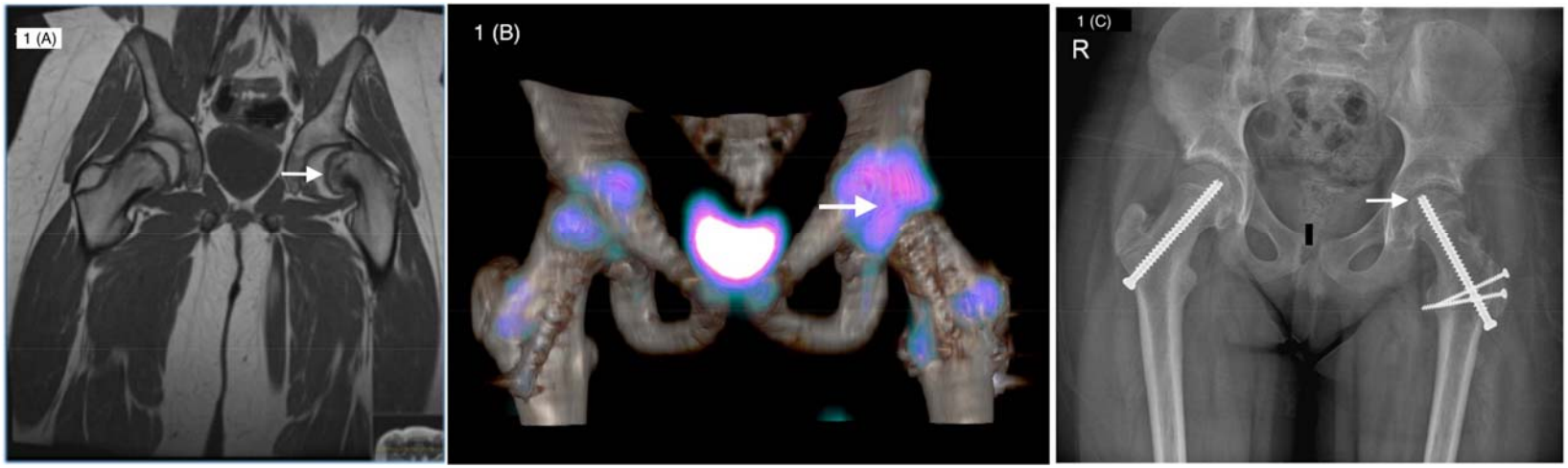
Figures Annotation

Fig 1 (A-C)

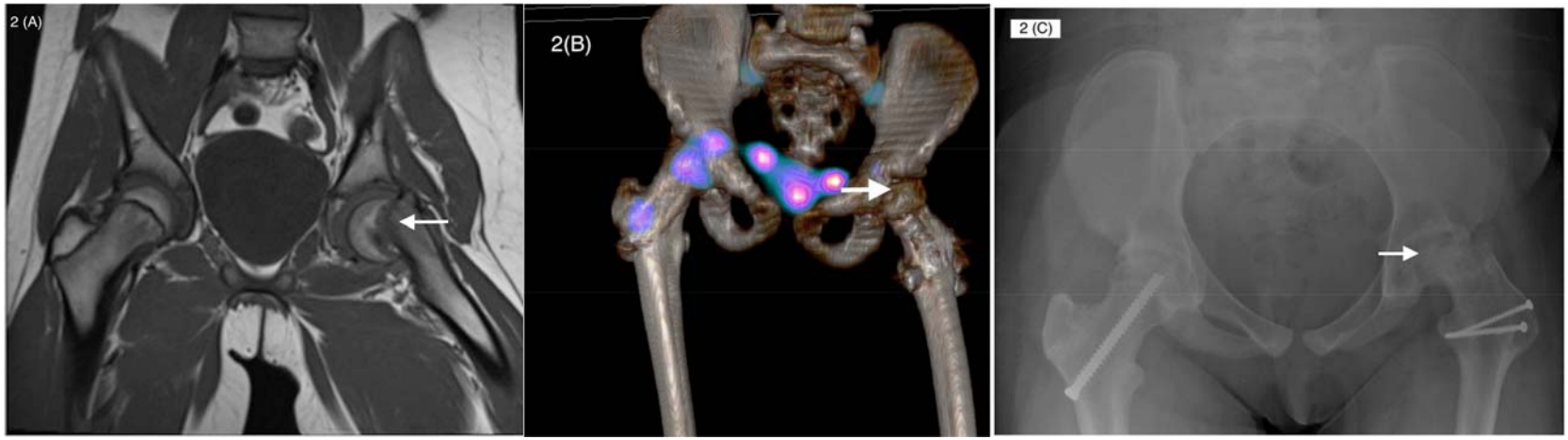


(A) Coronal T1W MRI showing left slipped upper femoral epiphysis

(B) Axial fused 3D SPECT/CT with uptake in the femoral head with satisfactory appearances of the articular surface

(C) X-Rays obtained at 2 years follow up showing smooth outline of the left femoral head.

Fig 2 (A-C)



(A) Coronal T1W MRI showing left slipped upper femoral epiphysis

(B) Post operative axial fused 3D SPECT/CT with absent uptake in the left femoral head in keeping with non-viable region.

(C) X-rays at 2 years follow up showing collapse of the left femoral head at same site where 3D SPECT/CT showed non-viable femoral head