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Original Research Paper

Radiodiagnosis

IMAGING PATHWAY OF CHILD WITH HIP PAIN AND LIMPING

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ABSTRACT

Objective : Hip pain and limping remained one of the major causes of children presenting to casualty , which if not diagnosed leads to permanent morbidity and mortality. The purpose of this study is to determine the best imaging pathway for particular hip pathology among children aged between newborn to 15 years.

Materials and methods: This is a prospective observational study involving 67 children in our institute .Children of age group from newborn to 15 years(Table 1) ,presenting with complaints of hip pain , limping with /without swelling ,during a period of 3 years were selected for this study from January 2015-December 2017 . Statistical analysis done by Chi-Square test. Mode of investigations done for these children are USG ,X RAY,MRI depending on the age and symptoms .

Results : The most common cause in age group less than 1 year is Developmental Dysplasia of the Hip . Ultrasonogram is found to be most sensitive if presentation is less than 6 months compared to X-RAY ,MRI . Septic and inflammatory arthritis is most common in 1-5 years age group ,Ultrasonogram is sensitive but MRI is more specific . The most common cause in age group 5-10 years is toxic synovitis ,perthes disease although X RAY is sensitive , MRI is specific., Slipped Capital Femoral Epiphysis,perthes, Idiopathic Chondrolysis of Hip is common in 10-15 years , MRI is more specific .MRI is superior to USG ,X RAY in diagnosing other causes of hip pathology.

Conclusion: Different imaging modality can be used appropriately depending up on the age and symptom of the child and the imaging pathway as defined.

KEYWORDS : limping ,hip pain

Introduction

The hip is a stable, major weight-bearing joint with significant mobility .(1)

Hip pathology may cause groin pain, referred thigh or knee pain, refusal to bear weight or altered gait in the absence of pain. Evaluation and management requires a thorough history and physical exam, and understanding of the paediatric skeleton.(2)

Hip pain in a child can arise from the hip itself or from remote sites including the spine, abdomen, pelvis, or knee. This, in addition to the barriers to communication in childhood, poses a diagnostic challenge to the clinician. Meticulous history taking, careful clinical examination, and laboratory tests may narrow the differential, but imaging is usually required to locate the cause and guide management. (3)

In children, common causes of hip pathology include developmental dysplasia of the hip (DDH), transient synovitis, septic arthritis, Legg-Calvé-Perthes disease, and slipped capital femoral epiphysis (SCFE). Less common hip disorders include proximal femoral focal deficiency, developmental coxa vara, neuromuscular hip dysplasia, injuries about the hip, arthritides, and tumors. Accurate diagnosis and treatment of pediatric hip disorders are important because of the potential complications, which may lead to degenerative joint disease in adult life. (4)Our aim is to identify the best imaging pathway for particular hip pathology among children aged neworn-15 years.

Materials and methods

This prospective observational study was conducted on 67 children***(Table 1)*** with painful hip joint presenting with limping , with /without swelling of joint during a period of 3 years from January 2015-December 2017 . All patients underwent complete history taking, local examination of the diseased hip and laboratory investigations followed by X RAY USG , ,MRI

Inclusion criteria are children presenting with limping , with /without swelling of joint, painful hip . Exclusion criteria includes sequel of toxic synovitis.

Ultrasonogram was performed for children less than 6months presenting with acute hip . The examination is performed with a high-frequency linear array transducer. The infant is placed with the side of interest slightly elevated or in a lateral decubitus position. We measured the alpha angle when the hip is pathological. The normal angle is 60º or greater. In the newborn, angles of approximately 55º are still considered normal

Anteroposterior pelvis and frog leg lateral radiographs are the initial investigation of choice with hip pain .Both hips are involved in approximately 15% of patients and it is therefore important to include both hips on radiographs .

We evaluate the shape of the acetabular roof (normal hip: concave, dysplasia hip: straight), the acetabular sclerosis (normal hip: central, dysplasia hip: lateral), the femoral ossification center (dysplasia hip: small) the proximal femur (dysplasia hip: superolateral displacement) and various lines. M**RI** examinations of the both hips were performed for all the patients using a 1.5 Tesla MRI machine Siemens aera(Germany) scanner whose radiograph and history didn't match .

Protocol of the MR Scan of the Hip Joint:

Patients were typically positioned supine on the examination table. The feet were internally rotated and gently immobilized with tape if

necessary with slight flexion at the knees. Both hips were examined for suspected bilateral abnormalities using the body coil with a large field of view to determine the extent of the lesions and to allow for comparison between the normal and abnormal sides. The slice thicknesses were adjusted to be 4-8mm and thinner slices were used when more details were required. - Images were taken in the following sequences:

Scout view of the hip: coronal TI WI image was performed for all cases for localization of subsequent slices of different planes and delineate the anatomy, coronal T1 and T2 weighted images, axial T1 and T2 weighted images, sagittal TI weighted images, coronal STIR weighted images and post contrast TI weighted images in sagittal , axial and coronal planes were performed (as per the institutuional protocol) by using Intravenous bolus injection of Gadolinium DTPA in dose of 0.1mmoll/kg in the inflammatory and neoplastic cases.(7)

Statistical Analysis:

Statistical analysis was done by, Chi-Square test. To analyse the data SPSS (IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY: IBM Corp. Released 2013) is used. Significance level is fixed as 5% ($p<0.05$). ***(Table 4a,b,c).***

Results

Based on the findings obtained by imaging ,clinical and pathological modality , the final diagnoses were as the following: Developmental Dysplasia of the Hip(14.9%) , ICH (10.4%) , transient synovitis (10.4%), septic arthritis (3%), Perthe's disease (31%), tumor (7.5 %) , intramuscular inflammatory lesions (3%) and slipped femoral capital epiphysis (13.5%) Stress fractures(1.5%).In 4.5% children the cause for hip pain and limping was localised to lower limb and spine***.(Table 2 & 3)***

Discussion:

In our study DDH incidence was found to be 14.9%, Ultra sonogram was considered sensitive if the presentation was (less than 6 months age). Many MRI studies are ordered in the postoperative period, usually after reduction and spica cast placement.(8)MRI has the ability to delineate soft-tissue structures as well as osseous structures without ionizing radiation. American College of Radiology recommends Ultrasound is the reference standard for evaluating the hip in an infant before 6 months, when capital femoral epiphyseal ossification usually occurs. It is a nonionizing, quick, and portable examination that furthermore offers the advantage of dynamic imaging in addition to standard static views (9) and lack of ossification of the femoral epiphyses. MRI is generally reserved for abnormal hips that do not respond to first-line treatment with Pavlik harness abduction splinting.(10***)(figure 1)***

LCPD is idiopathic osteonecrosis (osteochondrosis) of the immature capital femoral epiphysis. It occurs in children 2–14 years old, with a peak incidence at 5–6 years old. Boys are 5 times as likely as girls to be affected, and 85–90% of cases are unilateral. Presenting symptoms include limp and pain in the hip, thigh, or knee. (11)

In our study perthe's disease(***figure 2a &b)*** incidence was found to be 31%. Changes of Perthe's disease can take 3-4 months to become apparent on radiographs .AP and frog leg or lateral radiographs are the first investigation of choice .(12)

Most common cause of limping among children aged 5-15 years is perthe's ,incidence is found to be 21%,of which only 2% showed positive in x-ray, the remaining was diagnosed by MRI, and was considered most specific as said in study conducted by N Egund, and H Wing strand et al (13) .

MRI also facilitates early detection, showing low T1 and high T2 signal intensity in the femoral epiphysis and no enhancement on dynamic gadolinium-enhanced subtraction images. As LCPD heals, the bone marrow exhibits increasingly normal signal intensity (14)

In our study the incidence of septic arthritis***(figure 3)*** was found to be 3% among 1-5 years age group which is best diagnosed by Ultra sonogram and MRI on comparing to X-RAY which coincided with a study conducted by Lourdes Nunez-Atahualpa, MD (15)

Ultrasonography (US) is a low-cost, widely available, non-invasive technique that allows side-to-side characterization of joints, differentiation between intra- and extra-articular disease, [17] and guided relief of tension due to effusion in a painful joint. [18] . It is an extremely sensitive method [19] that can detect as little as 1-2 ml of fluid in a joint. Capsular distension in the hip, noted as convexity of the anterior recess when compared to the contra lateral, can be easily identified. [17]Effusions in septic arthritis tend to be hypo echoic, rather than echo-free, [16,17] and it has been suggested that an ultrasound that fails to show a fluid collection may virtually exclude the diagnosis. [16]

Synovial hypertrophy has been observed in patients with tuberculosis, brucellosis, lyme disease, and fungal infections. [17] MRI shows large complex effusions, synovial thickening and enhancement, bone marrow oedema, and bone erosions; however, these findings may also be seen in non-infectious inflammatory arthropathy. MRI is helpful for assessing an infectious process (such as myositis) adjacent to the infected hip joint.

One of the common cause of limping among children aged 5-10 years is transient synovitis, incidence is found to be 6%, which was diagnosed by MRI. Ultrasound (U/S) is a non-invasive diagnostic imaging study, which is particularly useful to safely confirm the presence of joint effusion. Nevertheless false-negative results, when performed in the early course of the disease, may be recorded [21]. Therefore, negative sonograms cannot exclude SA, and do not safely differentiate between SA and TS. MRI was considered most sensitive as said in study conducted b Kim EY, Kwack KS, Cho JH, Lee DH, Yoon SH(20)

In our study the incidence of transient synovitis was found to be 10.4% Magnetic Resonance Imaging (MRI) reveals signal intensity alterations in bone marrow in the presence of septic arthritis. Based on these findings this diagnostic modality has been proved useful in differentiating between hip SA and TS, with the limitations established by the high cost and the difficult cooperation, especially of the younger children.

Toxic (transient) synovitis results from inflammation of the synovial lining that has no known cause. Allergic, traumatic, and viral causes have been suggested. Patients are generally 5–10 years old and present with a waxing and waning limp. Hip pain (usually minimal) or stiffness also may be reported. Transient synovitis typically produces fewer acute symptoms than does its more serious mimic, septic arthritis MRI is reliable for excluding septic arthritis, although the presence of concurrent osteomyelitis raises suspicion

Another common cause of limping among children aged 10-15 years is Slipped capital femoral epiphysis***(figure 4)*** incidence is found to be 9%, although XRAY is sensitive, standard X-ray requested is AP and frog's-leg view. In potentially unstable slip, care should be taken not to exacerbate the slip by placing the limb in frog's-leg position, more sensitive was MRI which is proven by a study conducted by Sanjay M Khaladkar et al.(22)

In our study the incidence of Slipped capital femoral epiphysis was found to be 13.4% The earliest way to detect Slipped capital femoral epiphysis is by using MRI. One of the risk factors for the incidence of Slipped capital femoral epiphysis in children of the age group of 10 years and more is the change of shape of proximal femoral growth plate from pleated to more spherical. MRI detects early physeal changes of both preslip and Slipped capital femoral epiphysis even when radiographs and computed tomography are normal.(23) With MRI early marrow oedema, physeal widening and slippage can be demonstrated. Diagnosis of Slipped capital femoral epiphysis can be done with MRI with high clinical suspicion of Slipped capital

femoral epiphysis in preslip stage when X-ray is inconclusive.

Salter-Harris type I fracture through the proximal femoral physis. The disorder is most often idiopathic, although a trauma history is reported in 50% of cases. It occurs most commonly among overweight African American male adolescents. As many as one third of cases are bilateral. Patients present with chronic hip or referred knee pain and limp.(24)

Another common cause of limping among children aged 5-10-years is Idiopathic chondrolysis of the hip***(figure 5).*** Incidence is found to be 7%, although XRAY demonstrated joint space narrowing specific diagnosis by MRI(25)
In our study the incidence of Idiopathic chondrolysis of the hip was found to be 10.4%

Idiopathic chondrolysis of the hip is a disorder characterized by extensive loss of articular cartilage of the proximal femoral epiphysis and acetabulum, with resultant joint space narrowing and restriction of motion. It can be seen in association with slipped capital femoral epiphysis (SCFE), trauma, infection, arthritis and immobilization. Girls are affected more than boys and the symptoms are often unilateral. Patients present with a painful, stiff hip.

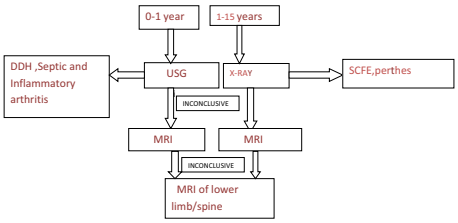
One rare but most important cause for limping among children aged 10-15years is Ewing sarcoma **(figure 6),** incidence is found to be 2%, although XRAY demonstrated aggressive lesion, specific diagnosis by MRI(26)

Owing to its superior contrast resolution, MR imaging is the optimal radiologic modality in evaluation of bone and soft-tissue tumours, including Ewing sarcoma. MR imaging of Ewing sarcoma of bone reveals marrow replacement (100%) and cortical destruction (92%), with an associated soft-tissue mass in 96% of cases (26, 27). The soft-tissue mass is commonly circumferential but asymmetric about the osseous involvement

The moth-eaten or permeative osseous destruction typically seen in Ewing sarcoma of bone may be subtle at radiography, and a soft tissue mass may be the predominant abnormality. Saucerisation or extrinsic erosion of the bone outer cortex is more often seen in cases extending from the medullary canal. However, this medullary origin may be difficult to detect at radiography (28) and is more optimally seen with MR imaging.

In evaluation of the limping and painful hip of children from newborn to 15 years , the sensitivity of Ultrasound is higher in children less than 1 year. Sensitivity of x-ray in diagnosis is very less compared to the ultrasound and MRI. MRI appear to be most sensitive and specific in early diagnosis of the disease***.(Table 4a,b,c).***

Imaging pathways :



Conclusion

MRI provides increased soft tissue contrast and more detailed evaluation of articular and physeal cartilage, subchondral bone, periosteum, synovium and bone marrow elements. The results from a study of fifty consecutive children presenting with acute non-traumatic hip pain indicate good sensitivity and specificity for MRI in the investigation of acute hip pain in children and suggest it is a more accurate method than ultrasonography and radiography.

Table 1: Age wise distribution of population

		Frequency	Percent
Valid	< 1 yr	6	9.0
	1 - 5 yrs	10	14.9
	6 - 10 yrs	31	46.3
	11 - 15 yrs	20	29.9
	Total	67	100.0

Table 2: Frequency of disease identified in our study.

Disease	Frequency	Percent
DDH	10	14.9
ICH	7	10.4
Septic arthritis	2	3.0
Muscle avulsion	2	3.0
others	3	4.5
Perthes	21	31.3
SCFE	9	13.4
Stress fractures	1	1.5
Toxic synovitis	7	10.4
Tumors	5	7.5
Total	67	100.0

Table 3 : Distribution of the diseases age wise.

		DIAGNOSIS										
		DDH	ICH	Septic arthritis	Muscle avulsion	others	Perthes	SCFE	Stress fractures	Toxic synovitis	Tumors	Total
AGE < 1 yr	Count	6	0	0	0	0	0	0	0	0	0	6
	% within AGE	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
1 - 5 yrs	Count	4	0	2	0	0	2	0	0	0	2	10
	% within AGE	40.0%	0.0%	20.0%	0.0%	0.0%	20.0%	0.0%	0.0%	0.0%	20.0%	100.0%
6 - 10 yrs	Count	0	2	0	0	0	19	5	1	4	0	31
	% within AGE	0.0%	6.5%	0.0%	0.0%	0.0%	61.3%	16.1%	3.2%	12.9%	0.0%	100.0%
11 - 15 yrs	Count	0	5	0	2	3	0	4	0	3	3	20
	% within AGE	0.0%	25.0%	0.0%	10.0%	15.0%	0.0%	20.0%	0.0%	15.0%	15.0%	100.0%
Total	10	7	2	2	3	21	9	1	7	5	67	
Count	% within AGE	14.9%	10.4%	3.0%	3.0%	4.5%	31.3%	13.4%	1.5%	10.4%	7.5%	100.0%

Table 4A: Disease diagnosed using Ultrasonogram

Disease diagnosed	Frequency	Percent
No	64	95.5
Yes	3	4.5
Total	67	100.0

Table 4B: Disease diagnosed using X-Ray

Disease diagnosed	Frequency	Percent
No	55	82.1
Not done	3	4.5
Yes	9	13.4
Total	67	100.0

Table 4C: Disease diagnosed using MRI

Disease diagnosed	Frequency	Percent
Not done	12	17.9
Yes	55	82.1
Total	67	100.0

Table 5: Chi-Square test

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	100.457a	27	.0005
P - Value	** Highly Significant at P ≤ .01		

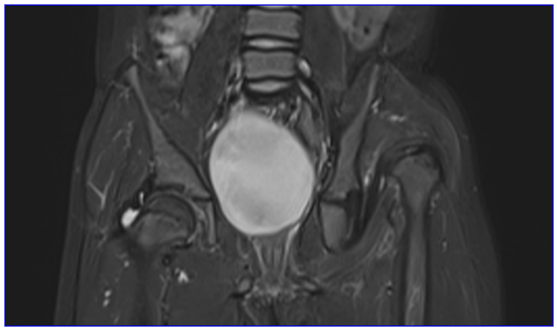


Figure 1: Coronal FS T2WI MRI of a male child shows left DDH.

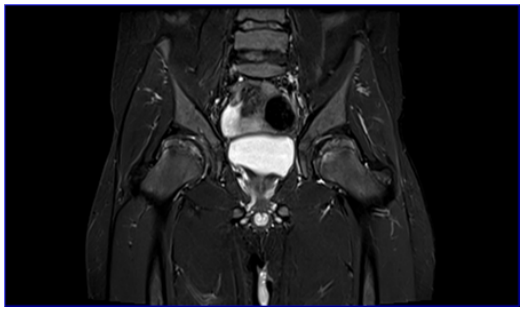


Figure 2a: STIR coronal MRI of a female child showing sclerosis and deformity of bilateral femoral head-Perthes disease.

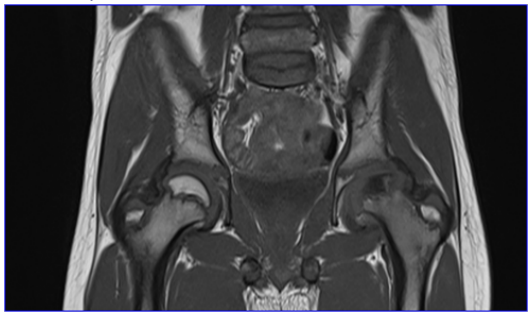


Figure 2b : coronal T1WI MRI of a female child shows unilateral perthes involving the left femoral head. .

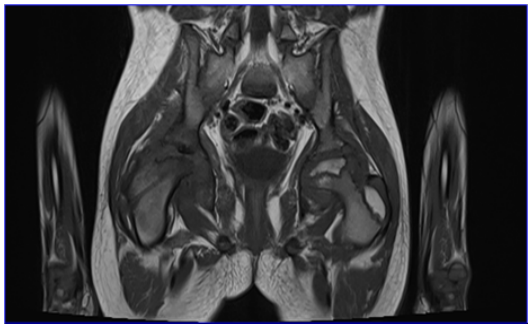


Figure 3: T1WI coronal MRI of a male child showing damage of the cartilage with edema and lysis of the bilateral femoral head-Septic arthritis.

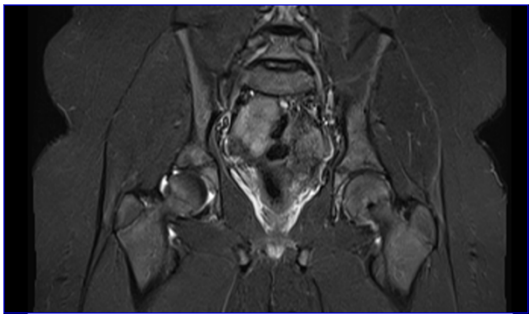


Figure 4 : STIR coronal MRI of a male child shows right early slipped femoral capital Epiphysis

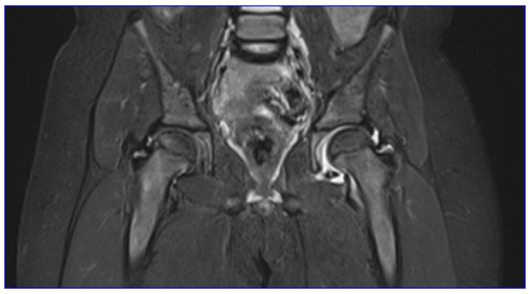


Figure 5 : STIR coronal MRI of a female child shows left idiopathic chondrolysis of hip

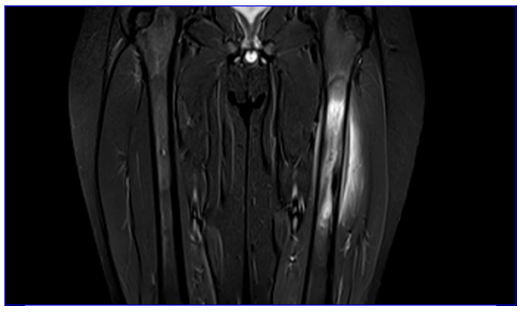


Figure 6: STIR coronal MRI of a female child shows Altered signal in the noted in the left femur with adjacent soft tissue component- Left Ewing's sarcoma

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