US evaluation in differential diagnosis of painful hip

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Purpose

The aim of this presentation is to review all the imaging and especially ultrasound criteria which establish acute transient synovitis, septic arthritis of the hip or other causes of hip pain including Legg-Calvé-Perthes disease and slipped capital femoral epiphyses.

*Transient synovitis (TS) is the most common cause of acute hip pain in the pediatric age group, excluding infections and trauma with an incidence of 76.2 per 100,000 person-years. Transient synovitis most frequently occurs in children aged 4-10 years; however, transient synovitis has been reported in infants and in adults. Nonetheless, children outside the typical age group are unlikely to have transient synovitis.*

*Transient synovitis affects boys twice as often as girls.*

*The disease causes arthralgia and arthritis secondary to a transient inflammation of the synovium of the hip. Biopsy reveals only nonspecific inflammation and hypertrophy of the synovial membrane. Ultrasonography demonstrates an effusion that causes bulging of the anterior joint capsule. Synovial fluid has increased proteoglycans.*

*The possible etiologic relationship between transient synovitis and Legg-Calvé-Perthes disease (LCP) is controversial. Although some children with transient synovitis may develop LCP, whether persistence of increased intraarticular pressure eventually causes avascular necrosis or whether patients may have a synovitis that occurs before detection of femoral head collapse is not well determinated.*
Fig. 1: Axial CT image of the hips shows acute epiphysiolysis capitis femoris of the left femoral head (preslip phase).

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Fig. 2: MPR of the axial CT images (same patient as above) shows acute epiphysiolysis capitis femoris of the left femoral head (preslip phase).

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Fig. 3: 3D CT (same patient as above) shows acute epiphysiolyis capitis femoris of the left femoral head (preslip phase).

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Methods and Materials

It is a retrospective 1 year study including children consulting for nontraumatic hip pain (n=211), 134 boys and 77 girls, aged from 5 months to 12 years (median 5.16 yrs). These children had a clinical examination (n=211), pelvis x-rays (n=173), initial ultrasound examination (Doppler US) of the hip (211 children, 218 hips) and follow-up sonograph of the hip (n=129 hips). 7 children had bilateral hip symptoms and bilateral US examination. One child had a complementary Computed tomography scan (CT) of the hips.

Ultrasound (US) examination is characterized by effusion in the hip joint, as described in the literature. Our experience confirms the importance of the technique with which the US examination is performed. In order to obtain the best diagnostic information the hip must be examined with the patient in the supine position and the hip joint in a neutral position by means of an anterior approach along the long axis of the femoral neck in the parasagittal plane. US is performed for suspicion of transient synovitis of the hip is aimed at identifying effusion in the hip joint anterior recess. It may be useful to compare the image with that of the contralateral normal hip. At US examination, the anterior joint capsule can be seen as a tissue band between the anterior surface of the femoral neck and the fascial layer of the iliopsoas muscle. It consists of two layers: anterior and posterior. In the absence of joint effusion, a linear reflection (“stripe sign”) can be observed in the center; it is the interface between the two layers indicating the absence of effusion.

A significant variation in thickness or echogenicity of the two layers of the anterior joint capsule in children with transient synovitis of the hip and the increased vascularity of the soft tissue of the affected region have not been demonstrated as compared to asymptomatic patients. This can be explained by the fact that the thickness of these layers, measured at histological examination, is approximately 0.025 mm, which exceeds the spatial resolution of US. A US sign that is always present in patients affected by this pathology is joint effusion in the hip joint anterior recess.

Although extremely accurate for detecting an intracapsular effusion, ultrasonography does not assist in determining the cause and is also used to guide hip aspiration. Perform aspiration with ultrasonographic guidance in all individuals in whom ultrasonography has exhibited evidence of an effusion and fever or increased CRP levels and severe hip pain and spasm with movement. The aspirate should assist the physician in differentiating transient synovitis from septic arthritis.

Radiographs exclude bony lesions (eg, fracture, epiphysiolysis capitis femoris, Legg-Calvé-Perthes disease) unless the child had onset of symptoms within 3 days, has no fever, appears well, and has only mildly restricted abduction without guarding against
movement in other planes. Plain films may be normal for months after onset of symptoms. Medial joint space may be slightly wider in the affected hip.

If excess fluid is present or the patient has early Legg-Calvé-Perthes (LCP) disease, plain radiography may reveal an increase in the teardrop distance (ie, distance between the medial acetabulum and ossified part of the femoral head). Compared with the other side, this distance should be the same or within 1 mm. One half to two thirds of patients with transient synovitis may have an accentuated pericapsular shadow.

In one study, >50% of patients with transient synovitis had the Waldenström sign (lateral displacement of the femoral epiphyses with surface flattening). Other studies have reported a positive obturator sign in established incidents of transient synovitis. This is a prominent shadow caused by the soft tissues that overlie the interpelvic aspect of the acetabulum. Radiography may reveal diminution of the definition of soft tissue planes around the hip joint or slight demineralization of the bone of the proximal femur, particularly in the metaphyseal region.

In settings in which routine aspirations of effusions is not performed, an MRI may help physicians differentiate transient synovitis from septic arthritis. The statistically significant findings in the patients with transient synovitis included contralateral (asymptomatic) joint effusions and the absence of signal intensities in the bone marrow. Both diseases showed ipsilateral effusions with synovial thickening and enhancement. Dynamic contrast-enhanced MRI findings can be used to differentiate septic arthritis from transient synovitis in the joint.

A CT scan can be used to give more details in cases of Legg-Calvé-Perthes disease or slipped capital femoral epiphyses.
**Fig. 4:** Joint effusion and synovial thickening (TS).

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Fig. 5: US imaging of the hips: 7 yrs old boy with left joint effusion (TS).

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Fig. 6: US imaging of the hips: 3,5 yrs old boy with left TS and negative US findings (stripe sign).

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Results

Both US and x-rays were normal in 89 children.

Pelvis x-rays had positive findings in 42 children.

One child had epiphysiolyis capitis femoris - preslip phase (CT confirmation).

In 129 hips we had a positive sonograph with joint effusion and 89 a negative sonograph.

7 children with bilateral US hip symptoms also had positive sonograph in both hips.

Increased echogenity of the joint fluid was found in 7 cases.

In 129 hips with joint effusion the follow-up after two weeks showed no fluid (transient synovitis).

We had 2 cases with transient synovitis and negative US.

In 7 cases the diagnosis retained was septic arthritis and the follow-up examination was positive.

In the most studies, the children with a clinical diagnosis of transient synovitis all had a joint effusion by ultrasound, the mean age of the patient population was 6 years, the average size of the effusions was 9 mm, the distribution between the sides affected was equal and 2 weeks postdiagnosis, all patients were pain and limp free. The effusions, although still present in some, were decreasing in size.

If significant symptoms persist for 7-10 days after the initial presentation, consider other diagnoses.

Patients with transient synovitis usually experience marked improvement within 1-2 days. 65-75% of patients with transient synovitis have complete resolution within 2 weeks. The remainder may have less severe symptoms for several weeks. The recurrence rate is 4-17%, most recurrences develop within 6 months. A slightly increased risk for later
development of osteoarthritis may be noted. It is recommended that all patients with transient synovitis should have repeat radiography within 6 months to exclude Legg-Calvé-Perthes (LCP) disease.
Fig. 7: US: increased echogenity of joint fluid was found in one case of left hip septic arthritis - confirmation after fluid aspiration (2.5 yrs old boy).

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Fig. 8: A 6 yrs old boy with bilateral hip symptoms also had positive sonogram in both hips (bilateral TS).

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Fig. 9: 11 yrs old boy with bilateral positive sonograph (bilateral TS).

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**Fig. 10:** Left hip joint effusion and synovial thickening (TS).

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Fig. 11: A 5 yrs old girl with bilateral hip symptoms also had fluid effusion with increased echogenity in both hips (bilateral TS).

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Conclusion

**US examination is a safe and effective imaging method for the evaluation and the follow-up of the painful hip.**

Ultrasound is the best imaging method in the diagnosis of transient synovitis because the patient is not exposed to ionizing radiation, is widely available, examination time is short and it is appreciated by parents. It may be useful to compare the image of the painful hip with that of the controlateral normal hip. Two weeks after the acute onset of the pain, an ultrasound follow-up is necessary to verify disappearance of joint effusion and definitely exclude other diagnostic hypotheses. US is also useful for guided fluid aspiration, in case it is necessary. If the symptoms do not regress, further imaging such as magnetic resonance imaging with ivc may be required to reach a differential diagnosis.
Fig. 12: US imaging of the hips: 7 yrs old boy with right joint effusion (TS).

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Fig. 15: 6 months after TS diagnosis the previous 5 yrs old male patient develops LCP disease (VRT 3D CT image).
Fig. 14: 6 months after TS diagnosis the previous 5 yrs old male patient develops LCP disease (MPR of axial CT images).

Fig. 13: 5 yrs old boy with left hip pain: Sagittal US image shows left hip effusion and local thickening of the layers of the joint capsule (TS).
References