

Acute Hip Pain in the Nonambulatory Infant

Salter-Harris Type I Fracture in the Capital Femoral Epiphysis Without a Traumatic History

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Abstract: An otherwise healthy 11-month-old girl was brought to the hospital after her parents noted the acute onset of right hip pain and refusal to bear weight. No abnormalities were seen in the initial radiographs, laboratory values were within reference range, and noninvasive workup was negative for septic arthritis. The parents reported a recent minor fall from a standing position, but stated that the child seemed to return to normal without pain after a few minutes of crying. A hemarthrosis without purulence was found upon joint aspiration, and the patient improved significantly after administration of anti-inflammatory medication. Follow-up radiographs 13 days after initial presentation showed an extremely rare Salter-Harris type I proximal femoral fracture well into the healing process.

Key Words: non-ambulatory, fracture, proximal femoral physis

CASE

An 11-month-old girl was brought to the hospital at 10:30 PM with acute onset of right hip pain and cessation of weight bearing. Her parents gave no history of trauma and also denied any history of fever, chills, night sweats, or increased lethargy. The patient's only known sick contact had been her father, who had an episode of conjunctivitis during the previous week. Up until approximately 8 PM on the night they arrived at the hospital, the patient appeared perfectly normal according to the parents. They did note that she had been fussy when she was picked up from day care that evening, but this was believed to be related to teething.

The patient had been healthy before this admission. She was a product of a full-term, uncomplicated, single vaginal delivery and had met all of her developmental milestones thus far. She was able to stand with support before tonight's episode of hip pain but not yet ambulatory. The child was raised by both parents and a part-time babysitter, who had been with the family for 10 months. The mother worked as a manager in a nearby nursing facility, and the father was an accountant. The home was properly child-proofed, and the family seemed appropriately concerned about their child's discomfort. There was no delay in presentation to our emergency department; the story was consistent and seemed believable.

On physical examination, the patient was noted to have a flexed and abducted right hip which allowed her to be resting comfortably. She appeared alert and oriented appropriately for her age, and she was afebrile with normal vital signs. The patient had no skin lesions or bruising and exhibited a normal affect. There was no tenderness upon palpation of the spine or the other extremities, and the patient's right hip was mobile upon careful rotation. She did, however, become extremely fussy with flexion and extension of the right lower extremity at the hip. Adduction and abduction elicited the same response, and axial compression of the right hip with the knee flexed 90 degrees was noted to make the child slightly uncomfortable too. Although the patient was unable to pinpoint the area of maximum tenderness, the groin area was most tender upon palpation and during motion testing of the right hip. The greater trochanter was not painful upon palpation, and the patient had full range of motion of her right knee and ankle. Her sensation appeared to be intact to light touch, and reflexes were bilaterally brisk and symmetrical without evidence for pathological reflexes. Examination on her left lower extremity showed normal findings.

Initial laboratory evaluation showed a serum white blood cell count of 15,400 cells/ μ L, a hematocrit of 39.4%, platelet count of 507,000 cells/ μ L, an erythrocyte sedimentation rate (ESR) of 1 mm/h, and a C-reactive protein of less than 0.1 mg/dL. Radiographs of both entire lower extremities taken on the evening of presentation showed some slight widening of the right proximal femoral physis but were otherwise interpreted as normal by both orthopedics and radiology (Fig. 1). The patient was admitted for observation and



FIGURE 1. Frog-leg lateral view of the right hip at initial presentation. No abnormalities other than slight widening of the proximal physis of the right femur were found.

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pain control, and decision was made to aspirate the hip on the next morning because her clinical examination, the lack of fevers, normal sedimentation rate, and only mildly elevated peripheral white blood cell count placed septic arthritis low on our list of possible etiologies of her hip pain. We also decided to admit the patient to perform arthrocentesis immediately in the morning and enable further consultation with our social services about the possibility of abuse while the child was kept safe.

In the morning after admission earlier that night (~3:00 AM), the patient underwent aspiration of her right hip under general anesthesia and fluoroscopic guidance. A bloody tap was noted, showing a white blood cell count of 390 cells/ μ L with 68% segments, 17% lymphocytes, 14% monocytes, and 1% eosinophil and no crystals seen. The Gram stain was negative, and uric acid level was not elevated. A total protein of 0.3 g/dL and glucose of less than 10 mg/dL were determined (serum level, 78 mg/dL). The fluid was also submitted for pathological examination and showed no bacterial growth over 5 days.

After obtaining the bloody tap, the family was further questioned. They reported that the day-care teacher had mentioned that the patient had fallen from a standing position earlier on the day the parents first noted her right hip pain. The patient was then uncomfortable but was easily consoled and appeared in no further distress. This was the only known history of trauma. The parents also denied any family history of von Willebrand disease, hemophilia, or sickle cell disease.

The patient was kept in the hospital for further observation, and the family and day-care teachers were questioned further by our social services consult team. The social services consult team concluded that abuse was highly unlikely in this situation. Because both lower extremities were already included on the initial radiographs and failed to show any healed fractures or metaphyseal corner abnormalities, we decided not to proceed with a formal skeletal survey. The right hip seemed to be an isolated problem. On the following morning, she remained afebrile, was eating well, and exhibited no lethargy or illness. The parents felt that she seemed to be moving her hip a little more, but the patient was still distressed by passive motion of the hip. Repeat radiographs on hospital day 2 showed no change from the previous x-rays, and all cultures remained sterile. The patient was cleared by child protective services, and at discharge, it was concluded that she had incurred a transient viral infection (toxic synovitis) and, less likely, an intra-articular fracture.

The patient was seen in the clinic 4 days after discharge from the hospital (day 6 after presentation). At that point, she had improved significantly, did not require any pain medication, and remained afebrile. She had begun crawling again, but still refused to bear weight on her right leg while standing. Physical examination showed symmetric range of motion of her hips in all directions. She was only mildly uncomfortable with manipulation of the hip, but this was significantly improved from the last physical examination in the hospital. Range of motion of the knee and ankle and distal sensation all remained intact. Upon return to the clinic 1 week later, the patient's mother reported that she was now weight bearing and showing distress only upon manipulation of the hip during diapering. Repeat films were taken and showed a small amount of healing periosteal bone in the proximal femoral neck and a minimally displaced femoral head consistent with a Salter-Harris type I fracture of the capital femoral epiphysis on the frog-leg lateral film (Fig. 2).

DISCUSSION

The differential diagnosis for acute hip pain in a child can be extensive; however, in a nonambulatory infant younger

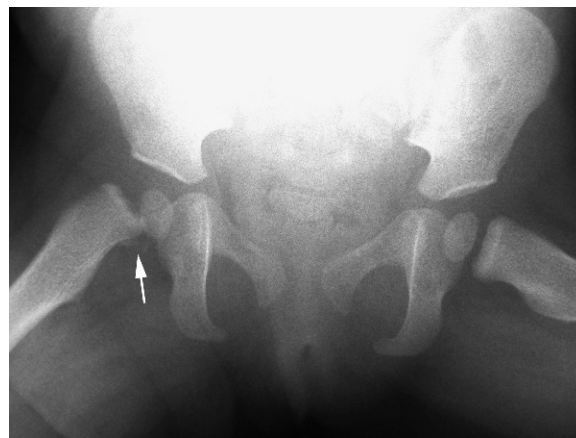


FIGURE 2. Frog-leg lateral view of the pelvis showing new bone formation medial to the femoral neck of the affected right hip (arrow) with minimal displacement of the secondary ossification center of the femoral head 13 days after injury.

than 1 year, this list is quite narrow. Joint sepsis, fracture (through abuse or accidental falls), toxic synovitis, and a malignancy are the 4 most important diagnoses that need consideration. Initially, the evaluation should be focused on ruling out abuse and serious infection (septic arthritis or bacterial osteomyelitis) before investigating more obscure etiologies. The first step in evaluation after performing a thorough history and physical examination should be to obtain anteroposterior and frog-leg lateral views of both hips as these can often suggest a diagnosis, for example, trauma or osteomyelitis.¹ The absence of systemic symptoms decreases the likelihood of inflammatory, infectious, or neoplastic causes of hip pain, but complete blood count with differential, ESR, C-reactive protein, and blood culture are still indicated to rule out septic arthritis when radiological evaluation does not elucidate the etiology of pain. Given the severe morbidity that can result from septic arthritis, arthrocentesis—preferably under fluoroscopic guidance—to obtain synovial fluid for Gram stain, culture, and white blood cell with differential are also strongly indicated.² Hemarthrosis on joint aspiration is strongly suggestive of trauma in the absence of hematologic abnormality.³ Kocher et al¹⁰ developed a criteria for predicting septic arthritis versus transient synovitis of the hip. Their criteria include a child with a painful hip, non-weight bearing on the affected side, an elevated ESR (>40 mm/h), fever, and an elevated serum white blood cell count. They found that, when 1 of 4 criteria is met, there is a 3% chance of septic arthritis; if 2 of 4 criteria, there is a 40% chance of septic arthritis; if 3 of 4 criteria, there is a 93% chance of septic arthritis; and if all 4 criteria are met, there is a 99% chance of septic arthritis in a child.

Even in patients presenting with a history of trauma, Salter-Harris type I fractures of the capital femoral epiphysis are exceedingly rare in this age group. In most other joints, the epiphysis is a point of attachment for many ligaments, and trauma to the extremity will often transmit to the physis which is biomechanically weaker than the metaphyseal or diaphyseal bone.⁶ In the proximal femur, however, the only

ligament connecting the epiphysis to the acetabulum is the ligamentum teres. All of the other hip joint ligaments attach distal to the physal plate, in effect keeping the proximal physis protected entirely within the articular joint.⁵ Thus, the conjectured mechanism required to produce such a fracture would involve simultaneous traction and external rotation of the femur.⁵ In this combination of forces, the ligamentum teres is more able to withstand stress than the fibrous anchoring ring of the physis, thus resulting in a Salter-Harris type I fracture.⁵

Considering the unique combination of forces required to reproduce a type I fracture, it is no surprise that only a small number of patients have been reported and that cases of this type of fracture in a nonambulatory infant are rarer still. According to Beals and Tufts,⁴ the etiology of fractures in children younger than 4 years can be broken into 4 categories: violent trauma (8.5%), pathological fracture (12.5%), child abuse (30%), and nonviolent trauma (49%). Pathological causes include bone cysts, fibrous dysplasia, or osteogenesis imperfecta. Of the rare nonpathological case reports on nonambulatory infants, causes have been almost exclusively those of extreme child abuse or birth trauma.^{5,6} Of the 4 incidences of non-birth-trauma fractures reported in the literature, 3 of the 4 were reports of egregious abuse and multiple fractures, whereas 1 report did not go into any further details of the patient's history.^{7,8} Furthermore, in reviews of femoral fractures caused by abuse, most cases do not even come close to affecting the neck or epiphysis.^{3,4} More cases of birth trauma epiphysiolysis have been reported, most resulting from breech or footling presentations of large babies experiencing hyperextension, abduction, and rotation while under intense traction.⁸

Treatment for transepiphyseal fractures without dislocation in young infants is generally closed reduction with spica casting.⁵ If reduction is unstable, smooth pins may be required, and unrecognized injury could lead to premature physal closure, avascular necrosis, eventual dysplastic femoral head, coxa vara, and leg length discrepancy.⁵ Initially, radiographs of a nondisplaced capital femoral epiphyseal fracture may not show evidence of a type I fracture, as in the case we present here, and diagnosis must be made upon clinical suspicion.⁹

After the follow-up radiographs were taken on day 13 after initial presentation, we reanalyzed the initial films. On closer inspection, there did seem to be a small chip of possibly detached metaphysis, and had we noticed this from the start, we may have proceeded with magnetic resonance

imaging and subsequent spica casting or application of a Pavlik harness. However, the outcome was unaffected in the follow-up as the same films that revealed the true etiology of the infant's hip pain also revealed that healing was well underway without any undulation or translocation of the femoral head (Fig. 2). Although this appears to be 1 of the first reported cases of type I transepiphyseal injury in a nonambulatory infant without evidence of flagrant abuse or birth trauma, it is crucial to not overlook the possibility that abuse may have occurred. Although it appears odd that no bruising or other indication of injury was found anywhere on the child's body, given the mechanism of the injury, it is hard to fathom a nonpathological cause without some form of extreme trauma.

In conclusion, Salter-Harris type I fractures of the capital femoral epiphysis are extremely rare in nonambulatory infants and even more rare without evidence of flagrant trauma. It is important, however, to keep this fracture in mind when considering a case of acute unilateral hip pain when there is no evidence of toxic synovitis or septic arthritis, especially if hematoma is aspirated from the hip joint. Magnetic resonance imaging may be a useful tool in early identification and subsequent prevention of postfracture sequelae.

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