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ID CONSULT

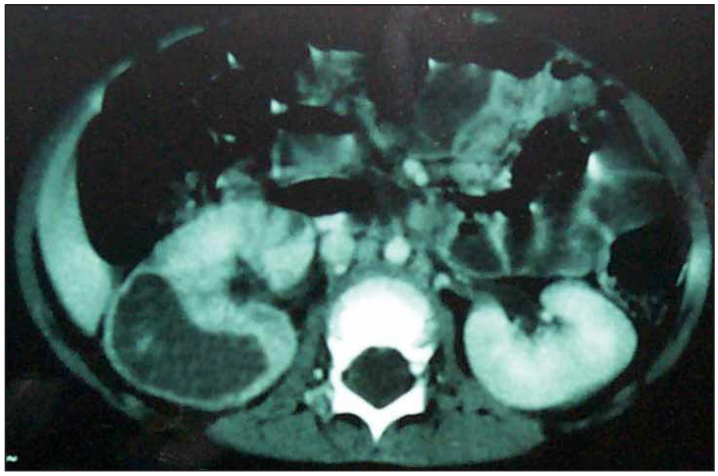
Sometimes, Big-Gun Imaging Is Necessary

When it comes to imaging studies for suspected infections in children, sometimes you have to pull out bigger guns. CT and MRI are expensive, stressful to the child, and may require sedation, so we don't use them as first-line tools. But three recent cases illustrate that these modalities may be needed when your suspicions are not borne out by routine imaging.

Case 1: An 8-year-old girl with 3 days of abdominal pain was initially diagnosed via ultrasound (US) at an outlying hospital as having constipation and was treated with an enema. Her pain resolved, but she then returned 5 days later with more intensity, low grade fever, and flank tenderness.

Complete blood count showed 18,300 white blood cells/μL with 70% neutrophils and 412,000 platelets/μL. In the prior year, she'd had three culture-confirmed urinary tract infections due to *Escherichia coli* that was susceptible to trimethoprim/sulfamethoxazole and cephalexin, with normal renal US and vesicoureterogram. Pyelonephritis was considered, but this time the only urinalysis abnormality was 11 WBC. The urine culture was negative, as was a second US.

She was referred to our hospital. Because US has a nearly 40% false-negative rate for renal abscesses, we obtained an abdominal CT scan. In many cases, abscesses are too small (2 cm or less) to be seen on US. In this child, however, the abscess was large (most of the upper half of her kidney).



Abdominal CT of an 8-year-old girl shows a large, uniform abscess filling most of the upper half of her kidney. Because its density was so uniform and similar to kidney tissue, ultrasound had missed it.

The success of US depends upon differences in density creating an echo. Because the uniform consistency of this abscess closely matched that of the kidney, it didn't reflect echoes needed to "see" the abscess.

Ultrasound can be ideal when screening for renal abscesses because of ease of performance: When it's positive, you're done. But if it's negative and you remain suspicious, you need a CT scan with contrast (> 90% sensitive) because US can't definitively rule out a renal or perinephric abscess.

Case 2: Neither routine radiographs (which were normal) nor bone scan (with questionable signal in knee joint area) revealed the cause for a swollen knee and failure to bear weight in a 13-month-old boy.

Joint fluid glucose was normal, and his cell count was 3,800 WBC/μL, less than you'd expect with pyarthrosis. Culture of knee joint fluid was negative. He was diagnosed as having tenosynovitis and treated with ibuprofen.

The swelling was reduced after the tap, but the boy returned 5 days later with a limp. Another plain x-ray was read as normal. Vancomycin was started for "culture-negative" pyarthrosis, fearing methicillin-resistant *Staphylococcus aureus*. The swelling only marginally improved in the next 4 days, so he was referred to us.

We obtained an MRI. Sure enough, his bone marrow lit up, and there was a defect in his distal femur. He had osteomyelitis with a sympathetic effusion in the knee joint, explaining the negative joint fluid culture.

Plain x-rays often miss early bone infection because prepubertal children have uncalcified areas in their distal long bones. An x-ray "sees" infection as changes in calcium density via defects in already calcified bone or new reactive bone formation around infected but previously uncalcified areas.

Thus, children with incompletely calcified long bones can have osteomyelitis for 10-14 days without visible bony changes on x-ray.

Bone scan findings also had been falsely negative, possibly because the technetium used to localize the infection couldn't enter the infected area due to the expanding pressure of the infection, thus limiting local blood supply.

Plain x-ray and bone scan for osteomyelitis are indeed easier and cheaper than MRI, and in most cases, they are sufficient. However, in this case there were signals that could have triggered an MRI sooner, including a negative joint fluid culture (but this may be true in 30% of septic arthritis cases, so it's only a partial clue) and the relatively normal joint fluid findings. While acute tenosynovitis may be a logical initial diagnosis, the ibuprofen failure points in another direction, i.e., MRI to rule out bone or other soft tissue focus.

An MRI also will pinpoint the focus to allow culture by bone aspiration. Cultures before or early in the antibiotic course can direct antibiotics based on susceptibilities, thereby allowing for intravenous therapy for 5-7 days and then use of oral drug with the same activity to finish the 4- to 6-week regimen.

An early MRI, although expensive, can end up being cost effective by showing where to culture and potentially reducing overall antibiotic costs. Without a cultured pathogen, patients "responding" to broad antibiotics such as vancomycin are necessarily kept on this intravenous drug for the whole course.

Case 3: Our third case was a 13-month-old boy with 2 days of abdominal pain and fever, plus elevated WBC count, sedimentation rate, and C-reactive protein. The child lay rigidly in bed, not allowing anyone to roll him over, move his right leg, or touch his lower right abdomen. His examination initially suggested appendicitis. However, both abdominal x-ray and CT scans were normal.

Our differential diagnosis expanded to include pelvic osteomyelitis, diskitis, or an iliopsoas abscess with referred pain to the hip and abdomen.

A bone scan revealed no abnormality of the iliopsoas area, the sacroiliac joint, or the disks. But we were surprised to see an enhanced signal in the soft tissues near the right side of the pelvis.

An MRI (pelvis to thighs) clearly showed a large abscess in his adductor muscle group. The CT, it turned out, had cut off just above the abscess. He dramatically improved within 48 hours after incision and drainage followed by intravenous antibiotics.

An MRI reveals osteomyelitis in the distal femur of a 13-month-old limping boy with sympathetic effusion in his knee joint, which had confused the clinical picture.

PHOTOS COURTESY DR. CHRISTOPHER J. HARRISON

In a 13-month-old boy with abdominal pain, lower-body MRI captured what a bone scan had helped localize: A large abscess in the adductor muscle group, below the point where a prior abdominal CT scan had cut off.

Infections of the lower pelvis (pubis or ischium) or nearby soft tissues are difficult to diagnose in children, who have a hard time localizing the pain. In this child's case, the bone scan, which can image the whole body, helped us locate an area of increased vascularity, so we could confidently order the MRI of the correct part of the abscess.

Probably less than 5% of osteomyelitis or soft tissue abscesses are located in the lower pelvis area. With our patient, a key finding was his refusal to allow lateral movement of his right leg. We assumed that meant a problem was in his sacroiliac joint or muscle groups in his back. We didn't think about the muscles right there in his thigh. This was a reminder to us to think outside the "box," including the lower pelvic bones and the muscles that attach to those bones. ■

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