DCMC Emergency Department Radiology Case of the Month

These cases have been removed of identifying information. These cases are intended for peer review and educational purposes only.

Welcome to the DCMC Emergency Department Radiology Case of the Month!

In conjunction with our Pediatric Radiology specialists from ARA, we hope you enjoy these monthly radiological highlights from the case files of the Emergency Department at DCMC. These cases are meant to highlight important chief complaints, cases, and radiology findings that we all encounter every day.

If you enjoy these reviews, we invite you to check out Pediatric Emergency Medicine Fellowship Radiology rounds, which are offered quarterly and are held with the outstanding support of the Pediatric Radiology specialists at Austin Radiologic Association.

If you have any questions or feedback regarding the Case of the Month format, feel free to email Robert Vezzetti, MD at rmvezzetti@ascension.org.

This Month: Bumps on the head. Usually the cause of such a physical exam finding is minor trauma. In this case, the cause was most surprising. Thanks to Dr Paul Schunk (PEM Fellow) and Dr Ada Earp (PEM Attending) for this extremely interesting case!
Case History

Things are kind of picking up in the Pediatric Emergency Department. Lots of sports related injuries are the norm right now, primarily head and extremity injuries from football (after all, the season is in full swing) with the scattered viral respiratory stuff beginning to sneak into the mix. So, it's no surprise that the next chart you pick up is a 13 year old male with forehead swelling after football practice. Here we go again....

Apparently this patient noted swelling to his forehead 6 days ago. He had football practice the next day (5 days prior to presentation in the Pediatric Emergency Department) but states he wore his helmet and had no injury that he could recall. He went to see his primary care provider the next day (3 days prior to his presentation) and was given a “steroid shot and antibiotics”; the patient and the child both do not know why he was given the injection nor what the prescribed antibiotics were for. He states that the swelling has gotten considerably worse over the past few days. While he does not complain of baseline pain, he states that it is tender when it is touched. He has not had fever, vomiting, diarrhea, cough, congestion, or recent illness. He denies vision changes, numbness, weakness, facial pain, neck pain, back pain, or incontinence. He has had nasal congestion for the past several weeks. He strenuously denies being the recipient of any trauma.

On physical examination, you note his vital signs: Temp - 97.3  HR - 88  BP - 138/73  RR - 18  Sats - 100% (RA). Ok, nothing too remarkable here. He is alert and pleasantly conversing; he does not appear to be in any distress. Notably, he has a rather large area of edema to his front portion of his scalp, which is exquisitely tender to palpation. There is mild warmth, but no erythema, step-off, crepitus, deformity, or fluctuance. The HEENT examination is benign and his vision is grossly normal. He has no neck pain. His cardiopulmonary examination is normal. He has no abdominal tenderness or organomegaly. His entire spine shows no signs of trauma and is nontender, without warmth, erythema, fluctuance, step-off, or deformity. He is able to ambulate well and his neurological examination is completely normal.

Why does this patient have frontal edema and tenderness? There are no outward signs of infection, but is the fact that he is currently on oral antibiotics and had a dose of steroids compounding the clinical picture? Can imaging be helpful for this child? If so, what should it be? Are plain films useful in this setting? What about CT or MRI?

Imaging the ‘Ol Nogging: A Primer

When it comes to imaging the head, there are multiple options available to today's practitioner. The trick to picking which imaging modality to employ really depends on what you are obtaining imaging for in the first place:

Head CT - Typically done without IV contrast, this modality will detect fractures, and more importantly, hemorrhage and is the imaging test of choice in the context of trauma (NOT plain films). CT is also useful to visualize the sinuses, bony destruction, lytic lesions (such as those found in osteomyelitis), auditory/inner ear structures (with temporal cuts), and is quick (sedation is not needed) in addition to being readily available. Yes it’s ionizing radiation, but today’s scanners are crazy fast and with appropriate protocols, exposure can be minimized.

MRI - The Cadillac of imaging! Obtained both with and without IV contrast, this modality will effective image the brain and surrounding structures. Great for inflammatory processes as well as vascular pathology when dedicated MRV/MRA imaging is used. But, sedation is often required, since a brain MRI with and without Gadolinium can be 15 to 20 minutes in duration and most pediatric patients will not hold still that long. Older patients also can feel claustrophobic, so sometimes a little Versed helps as well. Availability can be another issue too.

Plain Xrays - Sometimes useful, but limited. True dedicated sinus films can be useful if one is concerned about sinusitis, but unless the patient has had this for a while, potential complications (ie bony destruction, osteo) will not be readily apparent. Also, plain images are not helpful in determining if there is hemorrhage in the patient with trauma.

Ultrasound - if one is considering a superficial abscess, then go for it! No radiation and easy to obtain. However, if there are associated complications (again with the osteo) or a deep brain mass, US will not be terribly useful.
In ancient times, the apple was viewed as a sacred fruit that could be used to predict the future. Bobbing for apples is one of the traditional games used for fortune-telling on Halloween night. It was believed that the first person to pluck an apple from the water-filled bucket without using their hands would be the first to marry.

Head Trauma: How to Image:

Basically there are two imaging modalities that one can use when evaluating pediatric head trauma:

1. **Plain skull radiographs** - the time-honored modality! Plain imaging of the skull can detect skull fractures in many instances, but will tell you nothing about the underlying brain (i.e., is there a contusion) or associated hemorrhage. Most clinicians are steering away from skull X-rays as a first imaging modality in the setting of pediatric head trauma and obtaining a non-contrast head CT scan instead (pretty much the standard practice in Pediatric Emergency Departments). Remember, though, that plain imaging of the skull is still used in pediatric skeletal surveys! (we’re working on that).

2. **CT** - the gold standard in pediatric head trauma. CT is excellent for visualizing fractures as well as hemorrhage or cerebral contusions. The scan itself is very rapid - about 1-3 seconds. Of course, as low a radiation dose possible is used. No sedation is typically required for this study. CT has been proven to be superior in the evaluation of skull fractures and one has to wonder why anyone would do a plain skull X-ray in the setting of pediatric trauma these days. Three D reconstruction is a neat feature!

Other Modalities:

1. **MRI** - used as a tertiary study. MRI is not sensitive for fractures but can be used to further define hemorrhage.

2. **Ultrasound** - no primary role yet, but potential use to identify skull fractures in infants.

Happy Halloween indeed! So the plain images above show fractures, but these could easily be picked up on CT as well. The other images show the frontal bone fractures and they are impressive. Plain imaging most likely would have picked these injuries up but CT can’t be beat for delineating the extent of the injury, orbital muscle entrapment for orbital injuries, and any hemorrhage. That’s gotta hurt!

If you hear footsteps behind you on Halloween night don’t look back. It may be the dead following you. Turning back could mean that you will soon join ‘em!
So back to our patient....

The edema and tenderness to this patient’s forehead is, well, weird. You think that an imaging test is called for and you think about your options. Plain films? Well, as we’ve seen, not so helpful in any setting really. Ultrasound? Might be useful, but there are no clinical signs of an abscess at this point. Head CT? That might be useful. If there is trauma, you’ll identify it. If there is an infectious process (abscess, sinusitis) that can be seen too. Sounds pretty good.

Selected images are noted to the left and below.

There is impressive right maxillary/ethmoid/sphenoid sinus disease (green arrow); there is a hyper dense area (red arrow) that is encroaching on the right orbit; there is cortical breakthrough along the anterior front wall with a fluid collection that is subgaleal in location (yellow arrow). This may represent an abscess. Check out the 3D reconstruction view!

What is the etiology of these findings and what to do next?

Pott’s Puffy Tumor: More Than a Bump

This is an osteomyelitis of the frontal bone associated with a subperiosteal abscess. This produces, clinically, edema of the forehead. This is a complication of sinusitis but can also be seen associated with trauma. It has also been described in association with dental infections. It is primarily seen in adolescents.

Symptoms include headache, fever, vomiting, and facial edema. Complications from this infection include meningitis, encephalitis, epidural/subdural abscesses, and sinus venous thrombosis. Typically this infection is polymicrobial.

Imaging options include:

1. CT - often a non contrast study is done, looking for a reason for the edema. This can show bone erosions, fluid collections, sinusitis. If there is concern for intracranial extension, then a contrast study can be performed.

2. MRI - a great choice for imaging an infectious process like this. This modality can easily detect abscesses, dural venous thrombosis, edema, and osteomyelitis. Of course, sedation is often needed to obtain this study.

Treatment:

Early diagnosis and treatment is critical to avoid further complications. The usual regimen is broad spectrum antibiotics and surgical drainage. Followup imaging is controversial but if obtained, MRI is a reasonable imaging modality to choose.

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Pediatric Sinusitis

So what about pediatric sinusitis? There are guidelines for the diagnosis and treatment of pediatric sinusitis; the majority of the time this disease is viral and will self-resolve in 7-10 days. Bacterial sinusitis may also resolve on its own, but antibiotics are often given to speed recovery. Ethmoid sinuses are present at birth; maxillary sinuses develop by 4 years of age; sphenoid sinuses fully develop by 12 years of age; frontal sinus development is variable, but are usually fully developed by 18 years of age. Diagnosing pediatric sinusitis is controversial! Again, published guidelines are helpful to curtail overuse of antibiotics. Routine imaging to diagnose sinusitis is NOT recommended. Plain radiographs (a sinus series, including Waters & Caldwell views), CT imaging, and even MRI in children often show abnormalities of the sinuses and no not necessarily represent acute infection! Bacterial sinusitis in children should be diagnosed with accepted clinical criteria. Imaging can be obtained, though, when complications are suspected or are a clinical concern.

Case Resolution:

In light of this patient's imaging findings, Pediatric Otolaryngology was consulted. The child was taken to the operating room for functional endoscopic sinus surgery (FESS), septoplasty, and incision/draining of a presumed forehead abscess. During the procedure, extensive sinus disease (as indicated on the CT imaging) was encountered, as well as a large area of debris, which was removed and thoroughly irrigated. The character of the debris as well as the CT imaging suggested a possible fungal cause. Post-operative antibiotics were initiated (Ceftriaxone, Vancomycin, and Metronidazole) and Pediatric Infectious Disease was consulted. A review of his laboratory workup (CBC, CMP) showed an elevated WBC (14) with a mild left shift (Segs 70) but was otherwise unremarkable. Routine cultures were negative; Aspergillus antibodies were sent and are pending. Due to the extensive sinus disease, IgE antibodies were sent and the child, upon discharge, was changed to Augmentin. Zyrtec was added as well as followup with Pediatric Allergy and Immunology to address his likely allergic sinus issues. He also was scheduled to followup with Pediatric Otolaryngology and Pediatric Infectious Disease. He was continued on a Prednisone taper.

Teaching Points

1. Most of the time a good history and physical examination will tease out the cause of forehead swelling in pediatric patients. Sometimes, though, imaging may be indicated.
2. In the setting of head trauma, especially when a skull fracture is a concern, skip plain images of the head. Instead, a non-contrast head CT is the imaging modality of choice. It is superior for fracture identification and will detect intracranial hemorrhage. Don’t forget about non-accidental trauma in any pediatric patient, especially in non-ambulatory children.
3. CT is also a good screen for infectious processes. While most CT imaging of the head is done without contrast, if infection is strongly suspected, a contrast-enhanced study can be utilized. MRI is also useful for identifying and delineating an infectious process, but availability and the possibility of the need for sedation may limit its rapid use.
4. Pott’s Puffy tumor (or Pott Puffy tumor) is a rare complication of a sinus infection and presents with swelling of the involved bone, typically the frontal bone. It is an osteomyelitis of the involved bone. Treatment is broad spectrum antibiotics and surgical drained of the associated abscess.
5. Treat pediatric sinusitis based on published clinical guidelines. Routine imaging is not recommended and should be obtained only in the setting of clinical complications (ie seizure, worsening symptoms) or if the diagnosis is in question.

References