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: Incidental findings...or not. Sometimes (often, actually) an imaging study is obtained in the workup of one chief complaint, only to reveal another disease process. Take this month's case, for example. He is a young man involved in an MVC whose images reveal something unexpected. Enjoy!
Case History

It's a typical late November night in the Pediatric Emergency Department: BUSY! Lots of cough, rhinorrhea, fevers, bronchiolitis. The weather, though, has been unusual so there are lots of extremity injuries as well. Warm weather also means people are out and about and the next chart you pick up is a 12 year old male who was involved in an MVC...2 days ago. He was a restrained backseat passenger then the car, which was driven by his grandmother, struck the car in front of them at approximately 60 MPH. Luckily, no one appeared injured at the time of the accident, and the child was ambulatory at the scene. There was airbag deployment and significant front end damage to the child’s car. Over the course of the past 2 days, the child has developed abdominal pain, more of an achy feeling, without emesis, obvious hematuria, difficulty urinating, or obvious abdominal ecchymoses. He also has complained of chest pain without difficulty breathing, cough, or hemoptysis. The pain is also described as achy and generalized.

On his physical exam, you find a well-appearing child who is conversing and seems to be in no distress. His vital signs are unremarkable: Afebrile, HR - 84 RR - 18 BP - 110/63 Pulse Ox - 100%. He is, on first glance, completely fine. He is ambulatory and asking to eat. He has no obvious injury to his head, neck, chest, or back. He has equal and clear breath sounds but he does complain of chest pain with deep inspiration. There is no chest ecchymoses. His abdominal examination reveals no hepatosplenomegaly or ecchymoses; palpation, though, causes the patient to complain of generalized tenderness. There is no guarding or rebound. He has no tenderness or edema of his extremities; there is no crepitus and he has full range of motion throughout.

What is going on with this child? He does not appear to be significantly injured but he does complain of chest pain and abdominal pain. The accident, though, was 2 days ago. Does this impact your decision whether to work this patient up or not? Does he need imaging? If so, plain films? Ultrasound? CT? Will lab work be helpful for this child? If so, what studies should you obtain? If you find an injury, does it matter at this point? Maybe you should just put the chart back....

First published in October of 1957, in an issue of Redbook, as well as a book, the story was adapted twice as a visual presentation once in an animated 1966 TV special and again in a 2000 feature film.

At one point Geisel’s car bore a license plate reading “GRINCH”.
The main question to answer with this patient is whether or not he has a significant injury. He is complaining of chest pain and, on exam, abdominal pain. While he doesn’t appear to be in overall distress, given the history of an MVC, he certainly could have an injury.

Imaging Options in Pediatric Trauma

Imaging is often used in pediatric trauma to screen and confirm injuries.

Plain Radiography – the most readily available and probably most utilized imaging modality. Plain films can detect fractures, air (pneumothorax, pneumomediastinum, pneumoperitoneum), and blood (hemothorax) but may miss subtle injury and often are difficult to interpret in younger children (think cervical spine images). But they are quick and, if abnormal, can indicate the need for immediate intervention of further studies.

CT – also very commonly utilized, an excellent modality to detect common as well as life-threatening injuries. But remember, the radiation exposure is higher.

Ultrasound – becoming more and more utilized in children, available, no radiation utilization, and painless. BUT, not completely as reliable in children for detecting injury as in adults (but getting better). Still, history and clinical examination trumps ultrasound findings (ie a negative FAST exam does not necessarily rule out injury).

MRI – not commonly used in the acute trauma period, but often used in spinal injuries to look for both cord involvement as well as ligamentous injury.

Consider chest radiography in children who have sustained blunt chest trauma and have the following:

1. Abnormal respiratory rate.
2. Tenderness over the chest wall.
3. Abnormal physical exam findings.
4. Concerning mechanism (ie high speed MVC).

Blunt abdominal trauma is the third most common cause of pediatric trauma deaths, but is the most common cause of unrecognized fatal injury. The spleen and liver are the most commonly injured organs, followed by the kidney, small bowel, and pancreas. MVC’s are the most common mechanism of blunt abdominal trauma in children. Consider imaging in the following scenarios:

1. Evidence of abdominal wall injury (seat belt sign).
2. GCS < 13.
3. Abdominal tenderness.
4. Thoracic wall trauma.
5. Complaint of abdominal pain.
6. Vomiting.

CT with IV contrast is the gold standard; ultrasound is improving but remember that a negative FAST is not sufficient to rule out an intra-abdominal injury. A positive FAST should prompt CT imaging in stable patients. (For a complete discussion, see the August 2015 newsletter).

Don’t forget to recognize Seatbelt Syndrome! This was first described in 1962. It describes abdominal wall bruising, internal abdominal injury, and spinal fractures. Improper restraint use contributes to these injuries.

The song “You’re a Mean One, Mr. Grinch” was sung for specialty by Thurl Ravenscroft, the actor who gave voice to Tony the Tiger in Kellogg’s Frosted Flakes commercials from 1952 until 2005.
The Grinch special was directed by legendary animator Chuck Jones, who worked on dozens of Looney Tunes and Merrie Melodies shorts for Warner Brothers. Jones got the color idea for the Grinch after seeing several rental cars with the same ugly green hue.

Because of the chest pain, you decide to obtain plain radiographs of the chest (a 2 view chest X-ray), which are seen to the left. There is no fracture or pneumothorax but there is a subtle ovoid opacity at the medial left lung base (red arrow). Atelectasis? Infiltrate? Trauma-related? Could another imaging test be helpful?

As luck would have it, you also decided to obtain a CT with IV contrast because of the abdominal pain. While the likelihood of a solid organ injury is somewhat remote, the child does complain of abdominal pain. A selected image is seen on the right. There is a lucency to the posterior left lower lobe (red arrow) with an arterial vessel that is off the aorta (blue arrow). This finding is compatible with pulmonary sequestration. What? Now what do you do?

Pulmonary Sequestration
This is a congenital anomaly of the lower airway that is composed of nonfunctioning pulmonary tissue. It does not have communication with the trachea but does have a systemic blood supply connection. It is thought to originate during weeks 5-7 of development. There are various manifestations: Intralobar sequestration, Extra lobar sequestration, Hybrid/CPAM, Bronchopulmonaryforegut malformation. Patients with extra pulmonary forms often have other associated anomalies, including diaphragmatic hernia, vertebral anomalies, and CHD.

The images to the left show a large intrapulmonary sequestration (red arrow); this patient had recurrent pneumonia. The CT image to the immediate left demonstrated a sequestration (red arrow) with a prominent arterial supply (blue arrow).
**Case Resolution**

The working diagnosis for this child is pulmonary sequestration, given the appearance of his CT scan. The good news is that from a trauma standpoint, he is ok to go. He should, however, be referred to Pediatric Surgery for evaluation. In symptomatic patients, surgical excision is indicated, which is curative. This is urgent in patients with symptoms but can be elective in asymptomatic patients. Symptoms include respiratory distress and recurrent infections (ie pneumonia). With asymptomatic patients, there is debate between observation versus surgical excision. Generally, large lesions (even in asymptomatic patients) that are > 20% of the lobe or patients at risk for pleuropulmonary blastoma (family history or multifocal involvement) should have early excision. Otherwise, some authors recommend observation with plain radiography and/or MRI/CT. In these low risk patients, management is controversial.

The prognosis for children with pulmonary sequestration is generally good, especially in patients who undergo excision.

**Case References**


**Teaching Points**

1. Pediatric trauma is common and in most age groups blunt trauma is the primary mechanism.
2. Pediatric trauma patients can have delayed presentation, sometimes seeking medical care several days after the initial trauma event. A good history and physical examination can help guide if a workup is indicated.
3. Plain radiography is useful in many trauma setting, particularly chest pain after a blunt trauma event. Plain imaging can identify clinically significant injuries in many cases, but in some children more advanced imaging (ie CT) may be indicated.
4. Abdominal pain after trauma is not unusual; if imaging is indicated, then IV contrast enhanced imaging is indicated.
5. Pulmonary sequestration is not common and is the result of a congenital anomaly. It can be associated with other anomalies, including congenital heart disease, diaphragmatic anomalies, and vertebral anomalies. Infections (recurrent pneumonia) can be a complication of this condition.
6. Symptomatic patients with pulmonary sequestration need surgical resection; there is controversy regarding management in asymptomatic patients.