PedsCases Podcast Scripts

This is a text version of a podcast from Pedscases.com on "Pediatric complicated pneumonia: Diagnosis and management of empyema." These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedcases.com/podcasts.

Pediatric complicated pneumonia: Diagnosis and management of empyema – CPS Podcast

Developed by Colleen O'Connor, Dr. Tania Wong and Dr. Thea Chibuk for PedsCases.com.
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Introduction:

Hi everyone, my name is Colleen O'Connor, I'm a third year medical student at Dalhousie University in Halifax, Nova Scotia. This podcast was produced together with PedsCases and the Canadian Paediatric Society (CPS), with the goal of summarizing the 2011 CPS statement on the management of complicated pneumonia in children and youth. This podcast was developed with support from Dr. Tania Wong, a General Paediatrician at the IWK Health Centre in Halifax as well as Dr. Thea Chibuk, a General Paediatrician at the Stollery Children's Hospital in Edmonton and the lead author of this position statement.

Clinical Case:

Let's begin the podcast with a case to put this topic in context:
You are working in the Emergency Department at a local children's hospital. You grab the next chart and see that the patient is Nicholas, a 7-year-old boy with a 5-day history of cough, fever, and increased work of breathing. In speaking with the family, you learn that prior to this he had been healthy, and had received all of his immunizations. Nicholas was seen by his family doctor 3 days ago and started on a course of oral amoxicillin to treat community-acquired pneumonia. They tell you that despite 3 days of antibiotics, he hasn't gotten any better and has still been having fevers at home. You consider the possible causes for persistent symptoms in this patient, and wonder he could have developed a complicated pneumonia.

Objectives:

The objectives of this podcast are to summarize the CPS guidelines on the diagnosis and management of complicated pneumonia and specifically to:
1. Outline the common bacterial causes and pathophysiology of complicated pneumonia
2. Review the diagnosis of complicated pneumonia
3. Describe the approach to management of complicated pneumonia in hospital
4. Understand the follow-up required for children with complicated pneumonia after discharge

Definitions:

To start, when discussing the topic of pneumonia, it is important to make the distinction between uncomplicated and complicated pneumonia. Uncomplicated pneumonia is an acute inflammation of the lung parenchyma in the lower respiratory tract typically caused by bacteria, that leads to clinical evidence of respiratory symptoms and may also include a small parapneumonic effusion[1,2]. *You can find a podcast on the CPS Guidelines for the diagnosis and management of uncomplicated pneumonia on PedsCases.com.*

Complicated pneumonia refers to when pneumonia occurs with the development of an empyema, lung abscess formation, or lung parenchyma necrosis[3]. This CPS guideline focuses solely on the management of the first of these, empyema, which is defined as a collection of pus in the intrapleural space[1].

There are three stages of empyema:
At the beginning, the lung parenchyma is inflamed and becomes leaky, which allows fluid, proteins, and leukocytes to escape into the pleural space. This first stage is called the exudative stage, where a moderate to large exudative parapneumonic effusion can develop. The second stage is called the fibropurulent stage, where invasion of bacteria ensues and loculations develop within the collection. Loculations are pockets of pleural fluid contained by fibrinous pleural adhesions. In the third stage, called the organizational stage, the collection becomes more organized and may form a pleural fibrinous peel[1,4]. In simpler terms, in the first stage, fluid is freely flowing around the lung and is easier to drain. As the pneumonia evolves into the later stages, the fluid forms organized pockets, which are much more difficult to drain.

Causative organisms and pathophysiology:

The most common causative bacteria in complicated pneumonia in an immunized child is Streptococcus pneumoniae, but may also be caused by Staphylococcus aureus, and Streptococcus pyogenes. MRSA should also be considered as a potential pathogen as this pathogen has been increasingly reported[3]. Since children have been receiving the pneumococcal conjugate vaccine there have been increasing numbers of complicated pneumonia cases due to serotypes of pneumococcus that are not covered by the immunization[5,6].

Diagnosis:

Let's return to our case.

You check the patient's vitals and find that Nicholas has a temperature of 38.6 degrees Celsius, his respiratory rate is 40 breaths per minute, his heart rate is 120 bpm, his blood pressure is 90/68, and his oxygen saturation is 89% on room air, so he is given supplemental oxygen by nasal prongs.

Nicholas appears irritable and is laying supine in the emergency room bed with his mom and dad at the bedside, and he has a wet sounding cough. You are able to gain his cooperation for a physical examination. A thorough respiratory examination beginning

with inspection shows that he has mild subcostal and intercostal retractions, but no nasal flaring. He does not have any peripheral or central cyanosis. He has no tenderness to palpation of the chest wall, but he has decreased chest expansion, with reduced movement on the left side. He also has dullness to percussion at the left lung base. On auscultation, there are normal vesicular breath sounds on the right, but they are reduced on the left and absent at the left lung base.

His cardiac examination reveals normal S1 and S2 with no evidence of a murmur. There is no evidence of peripheral edema on examination of the hands and feet. His abdominal exam is normal with no hepatosplenomegaly.

What imaging and lab tests you would like to order to get a better understanding of what is going on in this patient's lungs?

The first imaging test this patient should receive is a chest radiograph[4,7]. This test is fast, non-invasive, and low-cost, and will allow us to see the extent of the area of involvement in the lungs. X-ray findings indicative of complicated pneumonia include: evidence of a fluid meniscus in the lung space, loss of the costophrenic angle, and when large amounts of fluid are present you may notice opacification of the hemithorax or mediastinal shift from the fluid accumulation[4]. An ultrasound is also a non-invasive modality which can provide more detailed information on the presence of pleural fluid and detect whether it has loculations[4]. A CT scan should **not** be routinely performed because of the significant amount of associated radiation, and the lack of evidence to show that it changes clinical management or predicts outcomes[7]. A CT may be indicated if chest x-ray and ultrasound are inconclusive[4].

In terms of laboratory investigations, you may consider sending a sputum culture if it is possible to obtain a high quality sample, although often not possible in young children. A blood culture should be sent in any patient who has not yet received antibiotics as it can be positive 10-20% of the time and may help with the selection of antibiotic treatment[8]. In patients who receive a chest tube, you should send the pleural fluid for culture, although it may be negative if collected after the initiation of antibiotics[8].

Management:

The management of empyema is often controversial[9], and the CPS guideline suggests that treatment decisions should be made in consultation with the specialists available at your children's hospital, which could include a paediatric surgeon or interventional radiologist.

For patients with moderate to severe respiratory distress with persistent or worsening symptoms of tachypnea, hypoxia or signs of increased work of breathing including nasal flaring, suprasternal, intercostal, or subcostal in-drawing, a two-pronged approach using antibiotic management and procedural intervention is required.

Antibiotic therapy:

There is currently a lack of high quality evidence to guide the choice of specific antibiotics and the duration of treatment[7]. However, now that you know that the top 3 bacterial causes of pneumonia are Streptococcus pneumoniae, Staphylococcus aureus, and Group A Strep, you should pick antibiotics that cover these and take into account local patterns and susceptibilities[7]. An example of appropriate antibiotics would be IV Ceftriaxone to cover most pathogens, and IV Clindamycin if you suspect community-acquired MRSA. Given the nature of the infection, the antibiotics should always be initially delivered intravenously, until the drainage is complete, the child's symptoms have improved and they are no longer requiring supplemental oxygen. At this point the antibiotics can be switched to PO. The total duration of antibiotics is typically 3 to 4 weeks and is stopped when there has been clinical improvement and no signs of further pulmonary complications.

Procedural intervention:
Likewise, there is also currently a lack of randomized trials to provide clear evidence on the best procedural intervention for empyema. Currently the existing evidence supports one of two options: video-assisted thoracoscopic surgery, also known as VATS, or either early chest tube placement with instillation of fibrinolytics[7]. VATS is a surgical procedure where instruments are introduced into the chest cavity through small ports, and guided by a video camera to complete a procedure called decortication. A thoracostomy is the placement of a chest tube between the ribs to allow for drainage of pleural fluids. Depending on the center, chest tubes can be placed either by surgeons or interventional radiology. Fibrinolytics such as alteplase (tPA) can be helpful for a loculated empyema, and work to break down pockets of fluid to allow for better drainage. It is important to be aware of the contraindications to fibrinolytic use which include bleeding disorders, necrotizing pneumonia, or air in the pleural space. The decision between these two options will depend on many factors including the types of specialist expertise available at your children's hospital, the consideration of cost, anesthesia, and also importantly, the child and family's wishes.

Clinical Course:

To conclude, let's return to our clinical case. You decided to order a chest x-ray and ultrasound which showed an empyema with loculations. You identify that this patient will need to be admitted to hospital for further management so you prepare admission orders. You place the patient NPO anticipating the need for procedural intervention. He will need supplemental oxygen by nasal prongs to keep his oxygen saturations above 91%. A CBC with differential, blood culture electrolytes, creatinine, albumin and a venous blood gas would be helpful investigations. Upon his admission, you consulted paediatric surgery, interventional radiology, and infectious disease. Nicholas was started on IV ceftriaxone, and clindamycin to cover potential anaerobic or CA-MRSA infection. The decision was made to proceed with chest tube insertion and instillation of tissue plasminogen activator, also known as alteplase, daily for 3 days. His fever persisted for 3 more days, which is not unexpected and does not indicate incorrect treatment choice.

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You continue to follow his daily progress on morning rounds. Later in the week, he is looking much happier and playful, and breathing comfortably on room air. The drainage from the tube has started to resolve and the tube is ready to be removed. The family is now wondering what they should expect for follow up.

You are happy to tell them that Nicholas is very likely to have a very good outcome and should not have long-term sequelae from this illness[10]. Some patients have minimal changes that persist on chest x-ray, such as minor thickening of pleura, but his chest x-ray will likely return to near normal in a few months[10]. You recommend that they should be seen in follow up to ensure that the symptoms from his complicated pneumonia have fully resolved[10]. He will require continued oral antibiotics for a total of 3 to 4 weeks at home. You also provide them with a requisition to have a final chest radiograph again in 2-3 months to ensure it has returned back almost all the way to his baseline.

Summary:

To wrap up the podcast, let's review the main learning points for the management of complicated pneumonia in children:

1. Community acquired pneumonia can be complicated by an empyema and the rates of reported cases have recently been increasing[5]. The most common causative organisms are Streptococcus pneumoniae, Staphylococcus aureus, and Streptococcus pyogenes.
2. Diagnosis of complicated pneumonia relies on a chest x-ray to identify the presence and extent of fluid, and a chest ultrasound to assess for loculations.
3. Current management involves both IV antibiotic treatment and procedural intervention, either through VATS or chest tube placement with or without fibrinolytics depending on available expertise at your facility. Antibiotics should be given for a total of 3-4 weeks.
4. Most children with complicated pneumonia regain their full lung function and their CXR is normalized within 2-3 months.

Thanks for listening!

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