

PedsCases Podcast Scripts

This is a text version of a podcast from PedsCases.com on “**Septic Arthritis.**” 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.pedscases.com/podcasts.

Acute Monoarthritis: A Case of Septic Arthritis

Developed by Dr. Brienne Rogers, Dr. Janet Ellsworth, Dr. Sukhdeep Dulai, and Dr. Peter Gil for PedsCases.com.

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Introduction

Hi everyone, my name is Dr. Peter Gill, a pediatric resident at the Hospital for Sick Children at the University of Toronto. This podcast was developed by Brienne Rogers, a pediatric resident at Alberta Children’s Hospital at the University of Calgary in conjunction with Dr. Janet Ellsworth, a Pediatric Rheumatologist and Dr. Sukhdeep Dulai, a Pediatric Orthopedic Surgeon, both at the Stollery Children’s Hospital, Edmonton, AB, CAN.

This is the first podcast in a two part series discussing septic arthritis as an acute monoarthritis presentation in children.

Specifically, in this first episode, we will:

1. Review an approach to and differential diagnosis for acute monoarthritis,
2. Discuss key considerations for history and physical examination for acute monoarthritis, and
3. List the key investigations for a child that presents with acute monoarthritis.

In the second podcast of this series, our main objectives will be:

1. To recognize septic arthritis as a pediatric emergency,
2. To learn how to rapidly diagnose and treat septic arthritis to prevent complications,
3. To learn the preventable complications of septic arthritis, and
4. To provide families with prognostic information on septic arthritis.

We recommend that you listen to the PedsCases podcast on evaluation of a limp for a broader approach joint problems in children.

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Let's get started with a case. You are a third year medical student completing a pediatric emergency rotation. You are asked to see Ethan, a previously healthy 6 year old boy who presented to the ER with 24-36 hours of right leg pain. He is limping and has a subjective fever, but his parents did not measure his temperature at home. Ethan is now unable to weight bear which is why his parents brought him to ER. How do you approach this?

This case is an example of an acute monoarthritis. What exactly does that mean? Arthritis refers to inflammation of a joint, characterized by pain, swelling, warmth, redness, and/or limitation of movement. Monoarthritis means only one joint is affected by arthritis. You may also hear the term oligoarthritis, such as in a case of oligoarthritic juvenile idiopathic arthritis or JIA, meaning 4 or less joints, or polyarthritis meaning 5 or more joints being affected. Arthritis is called acute if the symptom onset is less than 3 weeks, subacute if 3-6 weeks and chronic if greater than 6 weeks.

A figure outlining an approach to acute monoarthritis is included in the supplementary materials at PedsCases.com. The figure breaks down the differential diagnosis into categories of infection, inflammation, trauma, neoplasm, and vascular or blood related. For the rest of the podcast, we will first go over the approach to acute monoarthritis and then focus on septic arthritis.

History

Initially, you want to take a focused acute monoarthritis history and then a more broad, general pediatric history to make sure you aren't missing any other important clues!

1. First ask yourself, is the child 'well', 'unwell' or 'sick'? In any pediatric presentation, this is always the first question that you should yourself when you walk into the patient room. Sick could mean a medical emergency. Remember, if you feel in over your head, you probably are – do not be afraid to get help! In our case, the child looks “unwell.”

Ethan is febrile, looks irritable and gets upset whenever his Mom points toward his right leg.

2. What is the nature of the pain (OLDCARTPO)? Use whatever pain mnemonic you like to help guide your pain questions and to ensure you do not miss any questions regarding pain. One approach is OLDCARTPO - onset, location, duration, characterization, alleviating/aggravating, radiation, timing (when during day, how often), had previously? and other associated symptoms.

From an acute monoarthritis perspective, there are certain things from history that can help point you in the direction of a certain diagnosis. For example,

- Night pain can be a feature of growing pains or malignancy. Malignancy-associated pain is persistent, present during the day but worse at night (and may

wake the child up because of the pain) and may be unilateral or bilateral. On the other hand, growing pains are brief, episodic and typically bilateral.

- Morning stiffness, improvement in pain/stiffness with gentle mobility and mild pain could be more suggestive of JIA, especially if sub-acute or chronic.
- Pain in the evenings/end of the day and worse after movement/activity suggests mechanical pain.
- Lastly, migrating arthritis, or arthritis which begins in one joint, then resolves in that joint and moves to the next joint, is suggestive of Acute Rheumatic Fever.

For our case, Ethan's mom tells you that the pain started approximately 24-36 hours ago and is steadily getting worse. The pain is only in his right leg, and he localizes to his right knee. He says it is painful all day and night, with no relief. Ethan describes the pain as a throbbing and stabbing. There are no specific aggravating or alleviating factors. The pain does not radiate anywhere and has never happened before. Associated signs and symptoms include a tactile fever, inability to weight bear on the right lower extremity and decreased range of motion of the lower extremity, especially when he moves his right knee.

3. What is the onset of pain? Specifically, is it acute, sub-acute, or chronic? This is important for classification and differential diagnosis. This podcast is focused on acute:

- Sudden onset of swelling/pain over minutes to hours is suggestive of trauma. Always keep non-accidental injury in mind so that you don't miss it!
- Acute onset of a single joint swelling over hours to days is suggestive of septic joint, reactive arthritis, osteomyelitis, acute rheumatic fever or hemarthrosis, or bleeding into a joint.

In our case, the presentation is acute but not sudden onset.

4. Is there a history of trauma? Specifically, ask if there has been any traumatic event or injury. But remember, a history of trauma does not exclude septic arthritis since trauma can pre-dispose to septic arthritis, for example via inoculation. Pain due to trauma should occur immediately after the incident, with rapid development of swelling or an effusion. Delayed pain, or swelling hours-to-days after the injury could be due to secondary infection such as cellulitis or septic arthritis.

In our case, when you ask about trauma or any injuries surrounding the events mom replies, "Injuries? He's a 6-year-old boy with an 8-year-old brother! He has injuries and bruises daily!" But, there was not one clear incident that brought on any sudden pain or swelling.

5. Are there constitutional features or signs of infection, either localized or systemic? These include fever, sore throat, weight loss, decreased intake, reduced appetite, nausea/vomiting/diarrhea, lethargy, urethral discharge, rash, etc. which are all clues to diagnoses.

Ethan had a subjective fever, and maybe some slightly decreased appetite recently.

6. Is there a personal or family history of bleeding disorders? Here you are asking specifically if this could be a hemarthrosis from hemophilia or a vaso-occlusive pain crisis from sickle cell disease.

In our case, there is no personal or family history of bleeding disorders or sickle cell disease.

7. Is there a history of medications? Medications can be an important clue. Prolonged use of steroids can cause avascular necrosis and osteoporosis with a predisposition to fractures. Retinoids, such as isotretinoin used for acne, are associated with monoarthritis while some anticonvulsants can unmask lupus.

The boy in our case is not on any medications except Flintstone multivitamins and the occasional Tylenol or Advil.

8. Lastly, complete a full pediatric history and review of systems. For our current case, no other clues were elicited from this history or ROS.

Physical Exam

Next, let's move onto the physical exam. Always start with vital signs. The vitals are HR 120, RR 16, BP 96/55 and oral Temp 38.9°C. On general appearance, Ethan appears unwell, is alert and interactive but irritable. There are no obvious skin rashes, evidence of psoriasis, such as dactylitis or nail pitting, or evidence of erythema or trauma over joints, such as bruises, abrasions, lacerations.

His pupils are equal and reactive to light. He does not have erythematous tonsils or pharynx, lymphadenopathy, or bulging tympanic membranes. Cardiovascular exam reveals a normal S1 and S2 with physiological splitting of S2 on inspiration and a grade II/VI systolic murmur heard loudest at left lower sternal border radiating to the left axilla. He has good air entry to bases bilaterally, with no adventitious sounds. His abdomen is soft, non-distended and non-tender with no hepatosplenomegaly or masses.

Next you completed a focused MSK exam. Ethan is observed holding his right lower extremity in slight flexion. He has a right knee effusion with ballottement of knee with much difficulty due to pain. He has painful and reduced active and passive range of motion. His right knee is warm to touch. All other joints examined normally with no effusions, pain, reduced range of motion, erythema or warm. Gait assessment was not possible as Ethan was unable to weight bear.

After you complete the history and physical exam, you go over the case in your head and prepare a differential diagnosis. You prepare a list of investigations to rule in or rule

out certain diagnoses under your acute monoarthritis differential. Based on your history and exam, you are worried about septic arthritis. You present these to your preceptor.

Investigations

If you suspect septic arthritis, what investigations should be ordered or considered? Investigations can be broadly divided into bloodwork, imaging and procedures.

The most important initial bloodwork includes a complete blood count and differential (CBC-diff), blood culture, and inflammatory markers, including ESR and CRP. A CBC-diff looks for signs of infection (e.g. increase in WBC) and signs of inflammation (e.g. increased platelets). A reduced hemoglobin may point towards inflammatory bowel disease or another chronic disease.

If you suspect a septic joint, you must get a blood culture. Septic arthritis in children is often due to hematogenous spread, and blood cultures help identify the responsible organism as synovial culture may be negative. CRP is a useful inflammatory marker because it peaks within 36-50hrs of onset and resolves 1 week after appropriate treatment while ESR can remain elevated for 30 days. If you suspect a bleeding disorder, include coagulation studies. Depending on the situation, an Anti-streptolysin O test or ASOT may be useful to look for evidence of Group A strep infection.

However, if you highly suspect a septic joint, the most important investigation is synovial fluid analysis, which usually is done by a pediatric orthopedic surgeon. Synovial fluid analysis should include cell count (WBC-d), gram stain and culture & sensitivity. When doing a synovial fluid analysis on adults you also look for inflammation and crystals but this is not the case in children. There are a few possible radiological evaluation modalities. An x-ray may show joint space widening suggestive of an effusion. X-rays are helpful if you suspect a fracture, neoplasm or chronic osteomyelitis, the latter revealing cortical erosion, periosteal reaction, mixed lucency and sclerosis. Ultrasound can be helpful to evaluate for effusions, and can guide aspiration in older, cooperative children. MRI can be used to diagnose joint effusion when the diagnosis is unclear, as can be the case with septic arthritis and osteomyelitis of adjacent bones, but waiting for an MRI should not delay treatment. Lastly, a bone scan can be useful to diagnose osteomyelitis because areas with more cell turnover are metabolically active, take up more tracer and light up on the scan.

It is important to note that all investigations and imaging are not completed on every patient with septic arthritis, but rather narrowed to the most appropriate top differential diagnoses for that patient.

*The (expedited) results of the investigations completed for this case are reported as follows. Bloodwork showed a hemoglobin of 120, **WBC of 17 with 14.5 neutrophils**, platelets of 350, **ESR 55mm/hr, CRP 135 mg/L** and normal coagulation studies. Blood culture results were pending. X-ray of the bilateral knees and right hip were normal.*

Given your strong suspicion of septic arthritis, you convinced the orthopedic surgeon on call to complete a joint arthrocentesis. The synovial fluid analysis revealed an elevated WBC of 30×10^9 , 95% polymorphonuclear leukocytes and the gram stain showed gram positive cocci in clumps. Later culture was positive for Staph aureus susceptible to all antibiotics tested.

Your preceptor is impressed with your approach and summary of the case. She asks you how you would diagnose septic arthritis, if that is what you think is the most likely diagnosis.

This concludes our first podcast of a two part series on an approach to septic arthritis in children. In this episode, we discussed the clinical presentation of acute monoarthritis, reviewed the differential diagnosis, an approach to history and physical exam, and listed the key investigations.

Be sure to check out the second PedsCases podcast in this series for more information on septic arthritis, including how to diagnose and treat septic arthritis. Thanks for listening!

PART 2

Welcome back to our two part series on an approach septic arthritis as an acute monoarthritis presentation in children. My name is Dr. Peter Gill, a pediatric resident at the Hospital for Sick Children at the University of Toronto. This podcast was developed by Brienne Rogers, a pediatric resident at Alberta Children's Hospital at the University of Calgary in conjunction with Dr. Janet Ellsworth, a Pediatric Rheumatologist and Dr. Sukhdeep Dulai, a Pediatric Orthopedic Surgeon, both at the Stollery Children's Hospital, Edmonton, AB, CAN.

In the previous podcast, we discussed an approach to and the differential diagnosis for acute monoarthritis, key considerations on history and physical examination and important investigations.

We were also introduced to the clinical case of Ethan, a 6-year old boy who presented to the emergency department with 24-36 hours of right leg pain. He was febrile, tachycardic and irritable. Ethan had a painful and warm right knee effusion with reduced range of motion and was unable to weight bear. His bloodwork showed an elevated WBC of 17 with 14.5 neutrophils, ESR 55mm/hr and CRP 135 mg/L. X-ray of the bilateral knees and right hip were normal. Synovial fluid analysis revealed an elevated WBC of 30×10^9 , 95% polymorphonuclear leukocytes and the gram stain showed gram positive cocci in clumps.

We will continue to use Ethan's case throughout this podcast to illustrate the learning objectives. In this second episode, we will discuss the importance of recognizing septic arthritis as a pediatric emergency and how to rapidly diagnose and treat septic arthritis to prevent complications. We will also touch on the preventable complications and outline prognostic information for families.

Septic Arthritis is a **MEDICAL EMERGENCY** where the joint is inseminated with bacteria via direct entry of bacteria into the joint by inoculation, hematogenous seeding of bacteria into the joint space, or spread from adjacent infections (osteomyelitis or cellulitis). Bacteria cause inflammation and erosion of the synovial membrane. Overall, hematogenous spread is the most common mechanism in all age groups, especially in neonates and infants because a network of blood vessels called transepiphyseal vessels traverse from the metaphysis to the epiphysis, allowing bacteria and purulent material to cross into the joint space. Further, the synovial membrane is highly vascular and lacks a limiting basement membrane during this age, which allows bacteria to seed and damage the synovial membrane. Keep this in mind because neonates can present with multiple septic joints, and you need to look for the source. After the first year of life, the transepiphyseal vessels become gradually obliterated by the epiphysis formation, which reduces the chance of infection spreading into the joints in older children. Therefore, in older children, inoculation or spread from adjacent infections is more common.

From an organism perspective, *Staph aureus* is the most common bug among all age groups. Other organisms that are prevalent to different age groups are:

- Under 12 months: *Staph aureus*, Group B Strep and gram negative bacilli
- 1-5 years: *Staph aureus*, *Haemophilus influenzae*, Group A strep and *Strep pneumoniae*
- 5-12 years: *Staph aureus* and Group A strep
- 12-18 years: *Staph aureus* and *Neisseria gonorrhoea*

If septic arthritis is suspected based on history and physical exam, the diagnosis should be confirmed with joint aspiration for synovial fluid analysis, including cell count (WBC-d), gram stain, and culture and sensitivity. Typical findings in synovial fluid of septic arthritis are cloudy/turbid synovial fluid with a WBC greater than 50,000 cells/microl, predominantly >90% polymorphonuclear leukocytes. Gram stain is positive in only 30-50% while culture and sensitivity of causative organism is positive in 70% of cases. Even if a gram stain and culture are negative, if you have a high index of suspicion from your history, physical and other investigations, treatment for septic arthritis should be considered.

Blood cultures should also be done as they are positive in 40-50% of cases, even in cases where the synovial cultures are negative.

Use other investigations to help you!

You can order investigations looking for inflammation, specifically CRP and ESR. Although there is controversy over the usefulness of using CRP vs. ESR, it is more common to use ESR to follow response to treatment. As previously discussed, X-rays may be helpful in ruling out other diagnoses, like fracture, osteomyelitis or neoplasms, but are not that helpful for diagnosis of acute septic arthritis.

Ultrasound can be helpful to find evidence of a joint effusion. If septic arthritis of a hip is suspected, U/S can be used for detecting a hip effusion and is useful for guided aspiration in older children who tolerate procedures without anesthetic. If septic arthritis is suspected, MRI can be used to determine if there is a joint effusion, adjacent osteomyelitis and the vascularity of the adjacent bone. However, MRI is often not available in emergency situations.

Multiple diagnostic algorithms have been studied and described in the literature, producing some common themes and hints to diagnosis! Non-weight bearing is a common factor in many diagnostic algorithms of septic arthritis. If the child you are seeing truly cannot weight bear, always rule out septic arthritis. In contrast, not all children with septic arthritis have fever. Don't rule out septic arthritis just because a child does not have a fever!

Four key clinical predictors are used in the literature for septic arthritis: 1) history of fever; 2) an inability to bear weight; 3) an ESR of 40 mm/hr or more; and 4) serum WBC count greater than 12,000 per milliliter ($12.0 \times 10^9/L$). Using these four predictors, the incidence of septic arthritis was 0.2% for no predictors, 3% for one, 40% for two, 93.1% for three, and 99.6% for all four.

So back to the case, now that you know the diagnostic standard for septic arthritis, as well as other helpful investigations, does this little boy have septic arthritis? Yes! You're right! He does have Septic Arthritis. Now how do we treat it?

Treatment

If you have a high index of suspicion of septic arthritis, or have confirmed septic arthritis, you need to start your patient on empiric IV antibiotics. Broad spectrum IV antibiotics are only started in a patient with septic shock or in a neonate. Empiric IV antibiotics should be chosen to cover the most likely causative organism, and common choices include cefazolin, cloxacillin and clindamycin. Vancomycin should be considered if methicillin resistant *Staph aureus* or MRSA is likely. It is important to collect blood cultures and synovial fluid cultures *BEFORE* initiating antibiotic therapy, with the exception if the patient is in septic shock and needs immediate antibiotics. Once the organism is identified via culture, narrow your IV antibiotic therapy according to sensitivity results. Standard treatment for septic arthritis is 7 days of IV antibiotics (assuming a response to treatment) then 4-6 weeks of appropriate PO antibiotics, such as cephalexin and clindamycin. A response to treatment is usually indicated by a

decreased WBC and CRP/ESR, and should always be accompanied by clinical improvement in range of motion and weight-bearing. You can always consult the Infectious Disease's team for help with antibiotics and treatment duration.

Orthopedics should always be consulted for removal of the purulent material from the joint space. This can be done via needle aspiration but most commonly is completed surgically with arthroscopy or open drainage and washout. Older studies comparing needle aspiration and surgical joint drainage show mixed results, however standard of treatment at many pediatric hospitals continues to be surgical joint drainage. Ultimately, this is a decision that is made by the orthopedic surgeon. Always consult orthopedics if you think your patient has septic arthritis!

Finally, follow-up is extremely important in cases of septic arthritis in order to monitor response to treatment and side effects to antibiotics. Typically, the patient should follow-up with his/her pediatrician or Infectious Disease's team one week after discharge and then at 1-2 week intervals. Typically follow-up will include investigations such as CBC-d, electrolytes, ESR, and CRP to monitor response to treatment and aminotransferases to determine if there are any adverse effects of antibiotics.

Back to our case. The above information was explained to the family, but they still have some questions. Did they get their son into the emergency quick enough? Will he have any long-term damage of his knee?

Let's review the long-term outcomes of septic arthritis by going over some known prognostic factors.

Prognosis

There are 5 main prognostic factors of septic arthritis that can guide us in educating parents about the long-term outcome of their child. The first prognostic factor that we will discuss is patient age. In general, there is a poorer prognosis for younger children under one. This is likely multifactorial related to the difficulty in diagnosis of small children, delay starting treatment, immature immune systems, and easier hematogenous spread.

The second prognostic factor is timing of diagnosis and treatment. The best prognosis occurs when treatment is initiated within 4 days of symptom onset. One study found that prognosis is significantly poorer after 4 days of no treatment, with 75% of patients having a good outcome when diagnosed within 4 days of symptom onset, to 15% of patients with a good outcome when diagnosed after 4 days, where good outcomes were measured in terms of joint deformities and range of motion.

The third prognostic factor is adequacy of joint drainage. The better drainage and removal of organisms and purulent material from the joint space, means less destruction of the synovial membrane and therefore better outcomes and prognosis.

The fourth prognostic factor is the organism involved. Studies have demonstrated a worse prognosis with *Staph aureus*, due to the increased virulence. There is an increase in destruction of certain collagen receptors of the synovial membrane with *Staph aureus* more so than other bacteria.

The fifth and last prognostic factor is site of septic arthritis. The hip has the worst prognosis of all joints due to increased intracapsular pressure from inflammation/effusion due to synovial membrane destruction, which can cause occlusion or thrombosis of transphyseal vessels, resulting in avascular necrosis.

Overall, prompt recognition of septic arthritis and initiation of therapy are essential in preventing complications such as damage of the articular cartilage and growth plate. Long-term adverse outcomes in children with septic arthritis include leg length discrepancies, joint destruction and dislocation, decreased range of movement, and other morbidities.

Therefore, you tell the parents that they did a great job bringing their son into the emergency department as soon as they recognized he was unwell and could no longer weight bear. As it is hard to give an extremely accurate prognosis of any child with septic arthritis, given the prognostic factors we have discussed, this little boy has a fairly good prognosis. He is an older child, his parent's brought him in for medical treatment which was initiated within 4 days of onset of signs and symptoms of septic arthritis, he will have adequate drainage of his joint and is already started on appropriate antibiotics, and his knee is the site of involvement, which has a good prognosis. While he is infected with Staph aureus, given that he was brought in right away and started on appropriate therapy immediately, he should have minimal morbidity.

The parents thank you for all your information and time, and you head off to see your next patient!

Key Points

Before you go, let's review the key points of this Septic Arthritis PedsCases podcast!

1. **Emergency:** Septic arthritis is an **EMERGENCY**. You need to exclude septic arthritis in all presentations of acute monoarthritis as it leads to joint destruction within hours. Complications from delays in diagnosis include joint destruction, loss of the growth plate, and joint dislocation.
2. **Key Findings:** The best clinical predictors of septic arthritis are: an unwell child with fever and unable to weight bear on a painful joint, with elevated ESR and WBC. But remember, up to 50% of kids with septic arthritis do not have a fever and appear well so always have septic arthritis on the differential, especially for immunocompromised patients!

3. **Diagnosis:** The diagnosis of septic arthritis is made by joint aspiration and synovial fluid analysis for WBC (>50,000), gram stain and C&S for diagnosis. Always make sure you draw blood cultures, CBC-diff and inflammatory markers, including ESR and CRP.

4. **Treatment:** Empiric IV antibiotics are started immediately AFTER blood cultures and synovial fluid cultures are drawn. Orthopedics should be urgently consulted for joint drainage with potential washout of the infected joint. Upon culture results, IV antibiotics can be narrowed according to sensitivities. IV antibiotics are stepped down to PO antibiotics after 7 days of response to treatment, and PO antibiotics can be continued for 4-6 weeks. ID should also be consulted. Appropriate follow-up is every 1-2 weeks until discontinuation of treatment, to monitor response to treatment and side effects.

5. **Prognosis:** Age of patient, length of untreated symptomatic period, adequacy of joint drainage, organism, and site of infection are all factors affecting the prognosis of a patient.

That's it for the PedsCases podcast on Septic Arthritis! Thanks for listening and stay tuned for more PedsCases podcasts!

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