Pericardial Effusion, Sepsis, and Administration of General Anesthesia
Causing Cardiovascular Collapse in a 16 Month Old: A Triple Threat
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Introduction
Pericardial effusion and tamponade in the setting of sepsis is a frequently life-threatening combination associated with severe diastolic dysfunction. Dangerous hemodynamic compromise can occur following induction of general anesthesia in children. We discuss a case of a patient with methicillin sensitive Staphylococcus aureus (MSSA) sepsis and a small pericardial effusion who received general anesthesia for the placement of a peripherally inserted central catheter (PICC) line and subsequently suffered severe hypotension and bradycardia requiring intense fluid administration and pressor support. Despite a pre-operative echocardiogram suggesting that the effusion was minimal and causing no significant hemodynamic compromise on the day before surgery, the effusion likely had enlarged since the echo was completed and in combination with general anesthesia proved to be dangerous.

Pericardial effusions frequently present with hypotension and tachycardia, elevated central venous pressures, and most notably, an audible friction rub on cardiac auscultation which is a loud, machine-like murmur throughout systole and diastole. Occasionally respiratory compromise may be seen with tachypnea and hypoxia. Imaging may reveal an enlarged cardiac silhouette and laboratory studies may reveal deranged biochemical markers of myocardial integrity and function.

Cardiac tamponade is a pericardial fluid accumulation causing hemodynamically significant cardiac compression. The rapid development for acute tamponade is a pericardioscintesis, though a thoracotomy or more invasive approach may be required in the case of cardiac trauma or recent cardiac or thoracic surgery. A palpable cardiac apex is generally left in place for drainage of further fluid accumulation until the underlying etiology is determined and corrected.

Background
Cocoon pericardial effusion and the subsequent administration of general anesthesia appears rare in a search for related case reports. In one retrospective study examining 79 general anesthetic administrations in a pediatric population with known pericardial effusions, one third of the patients had an adverse outcome or complicating event. Pre-operative hypoxia was the most significant predictor of adverse outcome. Major complications were most often predicted by pre-operative tamponade as demonstrated on echocardiogram, and tachycardia.

Disseminated staphylococcal sepsis (DSD) has an annual incidence of about 10 in 100,000 and a median age in children of 2 years, and is associated with a soft tissue infection in nearly 40% of cases. Most immunocompetent children who develop a skin or soft tissue infection will not demonstrate clinically significant bacteremia and can be managed as outpatients with an incision and drainage and oral antibiotics. Those that continue to deteriorate despite antimicrobial therapy and surgical drainage with debridement have a high mortality rate. Approximately 50% of those who survive are not discharged home in stable condition on hospital day 30.

An 11 kg previously healthy 16 month old female presented with a one day history of decreased oral intake and fever and an erythematous, edematous, painful right index finger which had been slammed in a door several days previously. The patient was mildly tachycardic, tachypneic, and hypotensive. She was admitted and started on broad spectrum antibiotic coverage. Blood cultures revealed MSSA bacteremia. A bedside incision and drainage of the finger was performed.

A slightly enlarged cardiacomedialsternal silhouette was noted on admission chest x-ray. Echocardiography showed globally normal right and left ventricular function and a small global pericardial effusion without tamponade; an initial EKG showed sinus tachycardia. She did have a friction rub on auscultation per physical exam notes.

Within two days of admission, she remained febrile despite buprofen and acetylsalicylic antipyretic therapy. She had tachypnea and persistent hypoxia which improved with 50% FiO2 High Flow Nasal Cannula and hypotension and oliguria which responded to crystalloid and minoxide infusion. A repeat echocardiogram showed no tamponade and a persistent but small pericardial effusion.

The patient was diagnosed with SIRS and acute pancreatitis of the finger and for a PICC line placement for extended antibiotic regimen on hospital day 4. Her examination notes from the pre-operative assessment did not mention an auscultated friction rub, but noted that the patient was hypotensive with wheezing and coarse breath sounds. She received an intravenous induction with propofol (2 mg/kg), fentanyl (2 mcg/kg), and rocuronium which revealed and 300 ml of blood which was easily drawn.

On induction, her blood pressure dropped and she became severely hypotensive with unresponsive pulses. The patient received 5 mcg epinephrine intravenously as well as 10 mg of ephedrine with return of spontaneous circulation. A blood gas was drawn which revealed severe acidosis. She was treated with crystalloid and colloid infusions along with a tamping dose of sodium bicarbonate. An arterial line was placed. A subsequent arterial blood gas showed resolution of her acidosis.

A post-procedure echocardiogram showed significant enlargement of the pericardial effusion. She was taken emergently to the cardiac catheterization laboratory and a drain was placed after 90 cc of serous pericardial fluid was removed. She tolerated the procedure well. She received low-dose isoflurane and a fentanyl infusion for anesthesia and continued minoxide infusion for hemodynamic support and tolerated the procedure well. The patient was weaned off hemodynamic support then extubated on hospital day 12. She was eventually discharged home in stable condition on hospital day 30.

Discussion
Pericardial effusion and tamponade are known complications associated with staphylococcal sepsis in children. Induction of general anesthesia in this setting is at high risk to cause significant hemodynamic compromise. In non-emergent or elective cases in patients with pericardial effusion and sepsis, surgery should be delayed if at all possible. If not, the sepsis should be drained prior to induction of anesthesia.

If general anesthesia is necessary emergently, or if effusion is suspected but not known, ketamine or etomidate may be used as more hemodynamically stable induction agents. Maintenance with opioids such as fentanyl may lead to a more stable course than use of halogenated inhalational agents. Overall anesthetic goals are based on the pathophysiology of tamponade, which demonstrates a fixed stroke volume, impaired diastolic filling, and rate dependent output. Therefore, maintenance of preload and avoidance of agents which depress cardiac contractility and decrease heart rate is ideal. In addition, maintenance of spontaneous ventilation and avoidance of positive pressure ventilation, which further decreases preload, is advisable.

Pericardiocentesis under local anesthesia is recommended in patients with cardiac tamponade to avoid general anesthesia as opposed to a pericardial window or other approach. Additional tools to improve diagnosis and management of pericardial effusion and tamponade may include the more routine use of peri-operative imaging in patients who are at high risk for these conditions.

References