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Pediatric Pearls: Tachycardia Out of Proportion

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Take Home Points

- **Tachycardia out of proportion may be a sign of myocarditis.**
- **Viral myocarditis may present with subtle findings and over half of cases are missed on their first presentation.**
- **Patients with myocarditis should be dispositioned to the PICU as they are at risk of dysrhythmias and rapid decompensation.**

CASE

A 5 month old female presented with respiratory distress for a day. The mother reported the baby had decreased wet diapers and decreased oral intake over the previous two weeks. The mother had noticed blue lips, increased work of breathing and fever during the last two days. She took the child to the pediatrician the day before presentation and received a diagnosis of viral syndrome.

- The patient had been seen by her primary care provider two weeks prior with similar symptoms. She was given a 5 day course of azithromycin.
- She had no past medical history. She was a full-term child. Her vaccinations were all up-to-date.
- Vital signs. Her heart rate was 185. The blood pressure was 90/60. Respiratory rate was 48. The temperature was 99 F and the oxygen saturation was 100% on room air. The lung exam was unremarkable.

- The majority of these cases are bronchiolitis. What features of this case suggest something else? The patient had disproportionate tachycardia. The child had been ill for two weeks but had only been febrile for two days. With most viruses, fevers are seen early in the disease course. In this situation, the fever developed later.
  - As a general rule of thumb, for every degree above normal, the heart rate should increase by about 7-10 beats. In this case, the child was afebrile but was very tachycardic.
  - Normal vital signs in pediatric patients.

Age	Heart Rate (bpm)	Blood Pressure (mmHg)		Respiratory Rate (breath/min)
		Systolic	Diastolic	
Premature	120-170	55-75	35-45	40-70
0-3 mo.	100-150	65-85	45-55	35-55
3-6 mo.	90-120	70-90	50-65	30-45
6-12 mo.	80-120	80-100	55-65	25-40
1-3 yr.	70-110	90-105	55-70	20-30
3-6 yr.	65-110	95-110	60-75	20-25
6-12 yr.	60-95	100-120	60-75	14-22
12+ yr.	55-85	110-135	65-85	12-18

- **A chest x-ray showed cardiomegaly but no effusions or vascular congestion.**
- **The patient was given two fluid boluses due to the tachycardia.** The patient then developed increased work of breathing, worsening crackles and had color change to the lips. You might consider sepsis and pneumonia due to the tachycardia and administration of a fluid bolus is reasonable.
- **What are you worried about now?** Heart failure or underlying cardiac pathology. Sepsis. ARDS.
- **When the patient doesn't respond to your interventions as expected, it is important to take a step back and reassess.**
- **Based on the worsening respiratory status, the patient was intubated with ketamine and atropine pretreatment.** A repeat chest x-ray showed worsening pulmonary edema.
- **Ketamine is a reasonable choice for intubation.** It releases extra catecholamines which will help cardiac output. However, ketamine is a direct myocardial suppressant. They intubated the child while she still had some reserve. Had they waited until the child was in extremis, she likely would have had depletion of her catecholamines and the myocardial depressant effect of ketamine may have been more pronounced. These are the children that crash with intubation.
- **The evidence behind the use of atropine is suspect and it may not be necessary.**
- **A bedside echocardiogram could be used to determine global cardiac function.** Is the heart big and floppy or restricted and tight? Is there tamponade?
- **Obtain an EKG.** There is not a huge differential for heart failure in a 5 month old. The child could have a late presentation of congenital heart disease but also viral myocarditis. ALCAPA, an abnormality of the left main coronary artery, can predispose children to early MI. Most congenital heart defects present around 6 weeks of age, but a child may be tipped over the edge by a viral illness. A congenital heart defect is less likely if you do not hear a murmur, but you may not hear a murmur with a very large VSD. Significant tachycardia may limit your cardiac exam.
- **In addition to the EKG and bedside echo, you can send a CBC, BNP, venous gas with a lactate and troponin.** You should also send a TSH as high output cardiac failure can result from severe hyperthyroidism.
- **Only about 40% of chest x-rays in myocarditis will show cardiomegaly.** Only about 60% of myocarditis patients have an abnormal chest x-ray.
- **The patient had an EKG which showed a fast narrow regular complex with P waves consistent with sinus tachycardia.** There were some questionable ST elevations in the precordial leads without evidence of reciprocal changes. SVT may be a cause of heart failure in infants.
- **95% of patients with myocarditis will have an abnormal EKG and sinus tachycardia is considered an abnormal finding.** If the patient has a completely normal EKG, it makes myocarditis unlikely. Myocarditis remains on the differential with any EKG abnormality.
- **The labs demonstrated anemia, anion gap of 16, troponin of 2 and a markedly elevated BNP.** An echo was obtained and showed a severely dilated left ventricle with depressed contractility and EF of about 20%. There were normal proximal coronary arteries. There was no evidence of tamponade.
- **The picture was most consistent with myocarditis.**
- **How do you manage the child?** Depending on the perfusion and blood pressure, you may consider some inotropic support such as dopamine or milrinone to reduce the afterload. You could start these through a peripheral line but given how sick the child is, you should consider obtaining central access such as a femoral or internal jugular line. If the peripheral access is tenuous (such as a questionable 24-gauge line in the hand), you may not want to start pressors through it. You can also consider intraosseous placement.
    - **If the blood pressure is good, you can start with dobutamine which will improve cardiac function and vasodilate the periphery.** Dobutamine can be started at a dose of 5 mcg/kg/min but you can increase the dose for more inotropy.
    - **If the pressure is low or you are worried about developing hypotension, epinephrine may be a better choice.** You can start anywhere from 0.1-0.5 mcg/kg/min and titrate up.

- **Milrinone is often preferred by pediatric intensivists but is rarely used in the ED.** This drug needs to be loaded 50-70 mcg/kg over 20 minutes and then a drip can be started at 0.75 mcg/kg/min. Your intensivists can help you with it as we don't use this drug often.

- **The patient was started on a milrinone drip and a furosemide drip after a bolus.** Fluid management is difficult in these children. You want to be sure they have enough in the tank to perfuse but their heart has such poor performance that it is easy to fluid overload them. This child had a blood pressure of 90 and had some leeway.

- **Most myocarditis is caused by viruses including HHV6, enterovirus and parvovirus.** Also consider treatable causes. Worldwide, the most common cause of myocarditis is Chagas. We are seeing more of this in the US. It is mostly in adults but there are about 300 cases of congenital Chagas in the US each year.
  - **If Kawasaki's disease is the cause of the myocarditis, IVIG is useful.**
  - **Immunosuppressants have not been shown to be beneficial for viral myocarditis.** A Cochrane review of myocarditis found that steroids do not reduce mortality. There is questionable benefit to left ventricular ejection fraction. The current recommendation is to not give steroids, especially if you think the patient is in the acute phase. The acute phase is associated with a high viral load and immunosuppressants may worsen the status.
    - *Chen, HS et al. Corticosteroids for viral myocarditis. Cochrane Database Syst Rev. 2013 Oct 18;(1):CD004471.*
  - **A Cochrane review on IVIG found no mortality benefit or improvement of left ventricular ejection fraction.**
    - *Robinson, J et al. Intravenous immunoglobulin for presumed viral myocarditis in children and adults. Cochrane Database Syst Rev. 2015 May 20;(5):CD004370.*

- **One of the scary complications of myocarditis is life-threatening dysrhythmia.**
  - For pulseless ventricular tachycardia and ventricular fibrillation, defibrillate at 2 J/kg followed by 4 J/kg. Epinephrine at 0.01 mg/kg. If needed, amiodarone at 5 mg/kg.

- **What is your disposition?** Even if the patient is well-appearing, they should be dispositioned to the PICU as they are prone to dysrhythmias and rapid decompensation. If you do not have a PICU, they should be sent to a hospital with ECMO and transplant capabilities. These patients can become very sick, very quickly.