



JOHNS HOPKINS ALL CHILDREN'S HOSPITAL

Troponin in Pediatric Patients with Chest Pain Clinical Pathway

Johns Hopkins All Children's Hospital

Troponin Clinical Pathway

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Owners: J. Johnson, J. Laks

This pathway is intended as a guide for physicians, physician assistants, nurse practitioners and other healthcare providers. It should be adapted to the care of specific patient based on the patient's individualized circumstances and the practitioner's professional judgment.

Johns Hopkins All Children's Hospital

Troponin/Biomarker Clinical Pathway

Rationale

This clinical pathway was developed by a consensus group of JHACH physicians, advanced practice providers, nurses, and pharmacists to standardize the management of the assessment and treatment of patients with chest pain and inform them when to check cardiac biomarkers. It addresses the following clinical questions or problems:

- When it is appropriate to evaluate serum troponin in medical (non-trauma) pediatric patients
- What to do with elevated troponin levels
- When should elevated troponin levels require cardiology consultation and/or hospital admission

Background

Serum troponin is the most widely used biomarker for myocardial injury and is commonly used to help determine acute myocardial ischemia secondary to acute coronary syndrome in adults. However, multiple studies have proven that most children presenting to the ER with chest pain do not have a cardiac etiology, and when they do it is rarely as a result of coronary-related ischemia. For this reason, it is likely unnecessary to use troponin as a screening biomarker for children presenting to the ER with chest pain

Troponin, or the troponin complex, is a complex of three regulatory proteins, Troponin C, Troponin I, and Troponin T that are integral to muscle contraction in skeletal and cardiac muscles. Cardiac troponin I and T are specific and sensitive biomarkers of myocardial injury and the preferred serologic tests for evaluating patients with suspected myocardial infarction.

In the pediatric population, however, myocardial infarction and acute coronary syndrome are extremely rare events. Troponin I levels can help diagnose myo/pericarditis in patients presenting with chest pain and a history of infectious symptoms. They can also be helpful in patients presenting with exertional chest pain that may have congenital abnormalities of the coronary arteries, severe aortic stenosis, or abnormal myocardium such as those with hypertrophic cardiomyopathy.

Diagnosis

- A. The first step in evaluating pediatric patients with chest pain is obtaining a thorough history.

Red Flag” questions and etiologies to consider:

1. Does the chest pain occur with physical exertion? (Coronary artery problem, aortic stenosis, hypertrophic cardiomyopathy)
2. Recent history of fever or viral illness (including COVID-19 or influenza)? (MISC/myocarditis)
3. Is the pain associated with shortness of breath? (Hypertrophic cardiomyopathy)
4. Is the pain or SOB worse with lying supine? (pericarditis)
5. Is the pain associated with syncope? (Arrhythmia, hypertrophic cardiomyopathy)

Additional questions and etiologies to consider:

1. Recent history of chest wall trauma? (musculoskeletal)
2. Is the pain worse with deep inspiration or movement? (musculoskeletal)
3. Is the chest pain worse following meals? (reflux)
4. Does the patient frequently wake up at night with chest pain? (reflux)
5. What is the severity, duration, and frequency of chest pain episodes?

Chest pain that is at rest and worse with deep inspiration and movement is most often musculoskeletal chest pain (such as costochondritis or Precordial Catch syndrome). Chest pain following chest wall trauma would also most likely be musculoskeletal but further evaluation may be needed to rule out any possible rib fracture or muscular injury. Traumatic chest wall injury, such as from a motor vehicle accident, can also lead to pericardial effusion, so this should also be considered. Chest pain following meals or that causes the patient to wake up at night is often secondary to gastric reflux.

Chest pain and Myocarditis

Red flags for myocarditis would include chest pain occurring with or preceded by a viral illness including fevers, cough, congestion, etc. Pericarditis is often associated with chest pain and shortness of breath made worse with laying supine, and improved with sitting forward. Most often, these symptoms occur 2-4 weeks after the viral illness, and often abnormal vital signs or physical exam findings will accompany the chest pain. Additionally, the ECG in a patient with myocarditis and/or pericarditis is abnormal.

Chest pain and Congenital abnormalities

Red flags for congenital abnormalities of the coronary arteries include frequent episodes of chest pain with high levels of physical exertion. This is also noted in patients with aortic stenosis, but usually, a high-pitched systolic murmur is noted by primary care physicians prior to them presenting with clinical symptoms (but not always in patients with limited care).

Patients with hypertrophic cardiomyopathy will also have exertional chest pain associated with shortness of breath, but may also experience episodes of palpitations or syncope both with and without physical activity.

It is important to ask a detailed family history that includes:

1. History of cardiomyopathy
2. History of congenital heart disease
3. History of early acute MI, before the age of 55
4. History of sudden cardiac death, or sudden unexplained death including drowning
5. History of arrhythmias or need for pacemaker or defibrillator

B. The next step includes the evaluation of vital signs and physical examination.

Concerning physical exam findings that may be suspicious for a cardiac cause include:

1. Fever
2. Tachycardia
3. Hypotension
4. Worsening symptoms when supine
5. Murmur, rub, or gallop on auscultation

Reassuring findings include:

1. Normal vital signs
2. Tenderness to palpation, or tenderness with movement of the shoulders, chest, or back

C. Chest X-ray should be ordered for patients presenting with chest pain that have:

1. Fever, SOB, desaturations, or abnormal lung exam
2. History of chest wall trauma

D. An EKG should be ordered for patients presenting with chest pain who have:

1. Fever
2. Tachycardia
3. Hypotension
4. Abnormal cardiac exam findings
5. Exertional chest pain
6. Chest pain in the setting of syncopal episodes or palpitations

Typically, NO additional specific laboratory tests are needed, unless the history, physical, ECG, or CXR suggests a specific etiology for the chest pain that requires further workup.

Clinical Management - Emergency Center

A. When to send troponin levels

1. Serum troponin levels **SHOULD BE SENT** when the suspicion for myocarditis or pericarditis is high, which would include patients with:
 - Concurrent or preceding viral illness or fever
 - Abnormal exam findings (pulsus paradoxus, murmur/gallop/rub, tachycardia, hypotension, crackles)
 - Abnormal EKG findings (diffuse ST elevation, diffuse low voltage QRS complex, electrical alternans, and/or any form of heart block)
 - Enlarged cardiac silhouette or diffuse pulmonary edema on CXR
2. Serum troponin levels **MAY BE SENT** for older patients with a history of drug use (especially methamphetamine or cocaine) presenting with acute chest pain to evaluate for myocardial ischemia caused by coronary arterial spasm. Troponin levels **SHOULD BE SENT** if an abnormal EKG is showing ST elevation or pathologic Q waves. If the ECG is normal, it may be reasonable to clinically monitor without checking troponins, particularly if the symptoms are improving.

B. Other scenarios

Serum troponin levels in the vast majority of other pediatric scenarios are **unlikely** to be clinically useful, and as such, should not be sent. If there are any specific concerns, please discuss them with the cardiology attending **prior** to sending serum troponin.

C. Persistent/Recurrent Chest Pain

If the patient presents with persistent and recurrent exertional chest pain an EKG should be performed and if normal, they can be referred to outpatient cardiology. If the EKG is abnormal, cardiology should be notified to determine the need for further laboratory testing, echocardiogram, and/or Holter monitor.

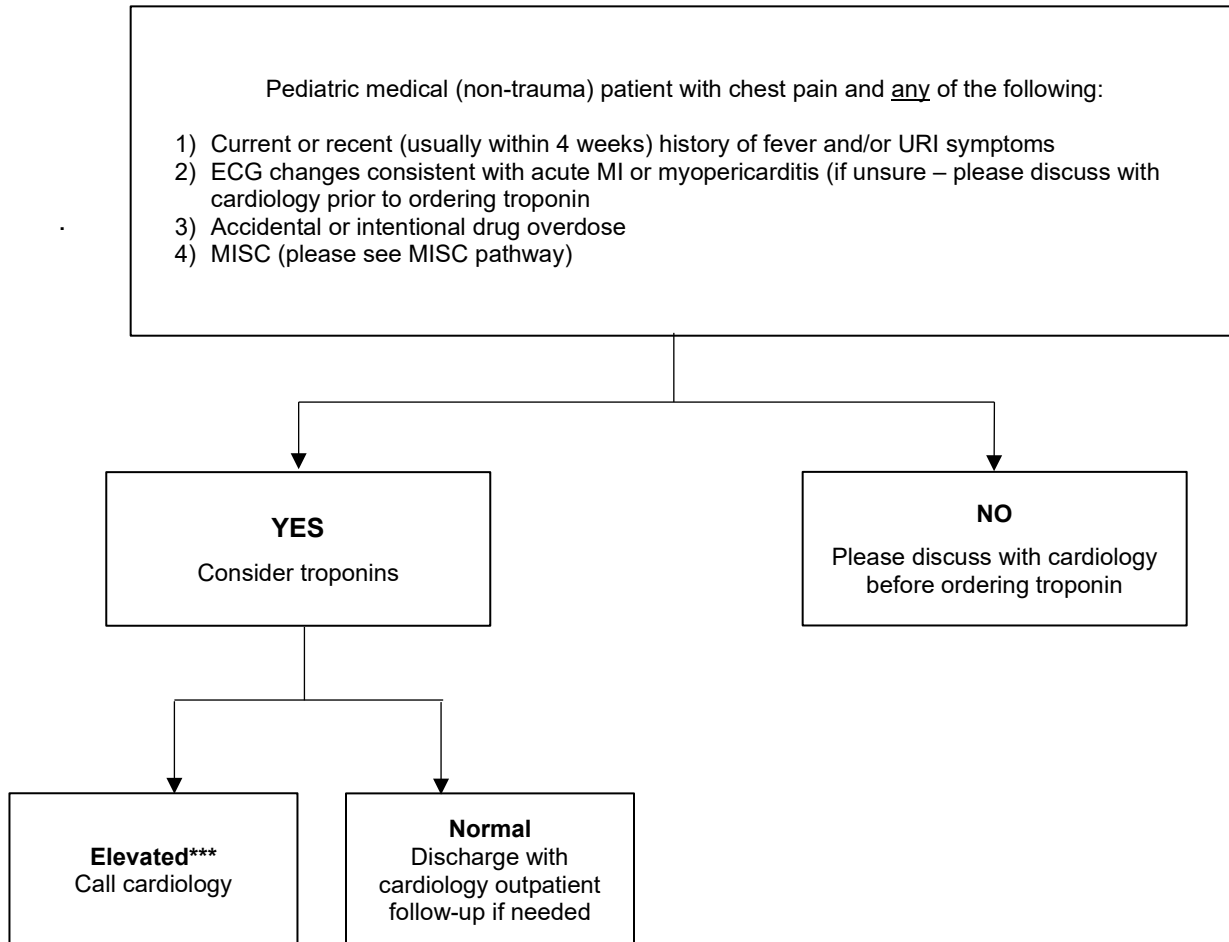
D. Elevated troponin levels at outside hospital

If JHACH ER is notified by an outside hospital of a patient with elevated troponin levels, please contact cardiology to discuss the need for transfer. In many cases of mild myocarditis/pericarditis, a slight elevation in troponin (between 0.5 - 1.5 ng/mL or 500-1500 ng/mL for high-sensitivity troponin) with mild clinical symptoms can be treated with around-the-clock (scheduled) ibuprofen with outpatient cardiology follow up within 1-2 weeks. The severity of the symptoms, the degree of troponin elevation, and the comfort of the referring facility should be discussed between the ER attending and Cardiology attending to determine the need for transfer.

Admission

Indications for admission will be discussed between ER attending, cardiology attending and CVICU attending if appropriate. Serial elevated and increasing troponin levels, persistent symptoms of chest pain, persistent abnormalities of vital signs, and physical examination will all be considered as indications for likely admission.

Emergency Center Troponin (Suspected Myocarditis/Pericarditis) Clinical Pathway



***For patients who present to an outside hospital and are found to have minor elevations of troponin (between 0.5 - 1.5 ng/mL or 500-1500 ng/mL for high sensitivity troponin) without other concerns – please include cardiology in the discussion prior to transfer. Most of these patients can be followed as an outpatient without further EC or inpatient monitoring or testing.

Red Flags for Pediatric Patients with Chest Pain

History of present illness	Family history (first degree relative)	Physical exam	ECG / Chest X-ray
CP with exertion	Cardiomyopathy	Pulsus paradoxus	Diffuse ST elevation
Recent/current fever or viral symptoms	Congenital heart disease	Murmur, gallop or rub	Diffuse low voltage QRS complexes
CP with SOB	MI before age 55y	Tachycardia not responsive to fluids	Electrical alternans
CP/SOB worse when supine	Sudden cardiac or unexplained death incl. drowning	Hypotension not responsive to fluids	Heart Block
CP with syncope	Arrhythmias, pacemaker, defib.	Crackles	Enlarged cardiac silhouette
CP with drug use	---	---	---

CP: chest pain

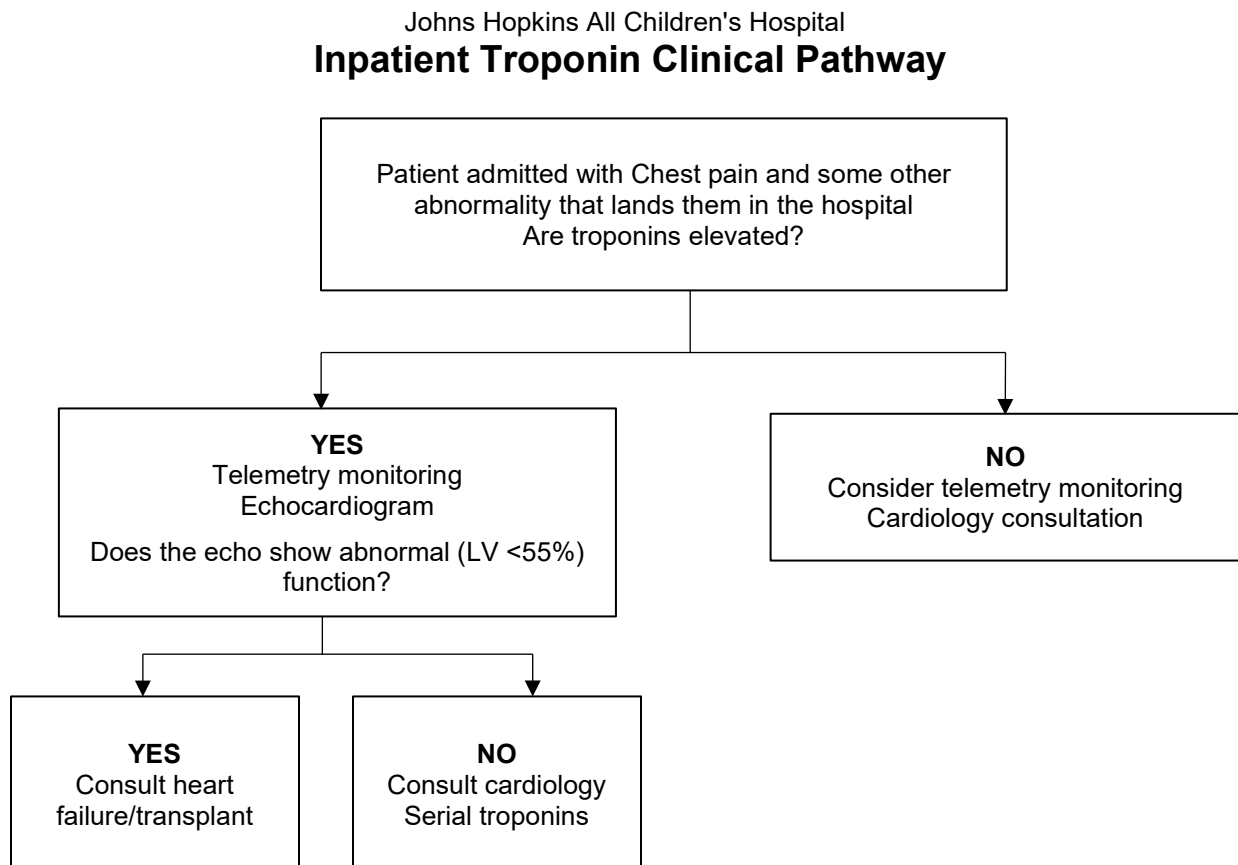
Clinical Management - Inpatient*

- A. Clinical management of admitted patients will:
1. Be at the discretion of the consulting cardiologist
 2. May differ based on the clinical picture of the patient.
- B. Patients admitted with elevated troponin levels should:
1. Be placed on telemetry (Optimal to be in the CVICU, but pending CVICU census and patients clinical history, PICU may be appropriate. Provider requesting admission should begin by discussing with the service cardiologist and CVICU admitting attending)
 2. Have an echocardiogram done **in discussion with cardiology**
 3. If cardiac function is abnormal on echocardiogram (LVEF < 55%), the heart failure and transplant service should be consulted
 4. Have serial troponin levels followed throughout admission

**For patients found to have minor elevations of troponin (between 0.5 - 1.5 ng/mL or 500-1500 ng/mL for high sensitivity troponin) without other concerns – please include cardiology in to discuss disposition. Most of these patients can be followed as an outpatient without further inpatient monitoring or testing.*

Discharge

Patients should be considered for discharge when the cardiology deems it appropriate based on clinical exam and laboratory work. Cardiology will determine outpatient follow-up and testing to be coordinated prior to discharge.



Documentation Reminders

Clinical notes and documentation of troponin level with outpatient follow-up as deemed appropriate.

References

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Outcome Measures:

- Admission rates
- Length of Stay

Clinical Pathway Team
Troponin Clinical Pathway
Johns Hopkins All Children's Hospital

Owner(s): Joy Johnson MD, Jessica Laks MD

Also Reviewed by: Heart Institute Clinical Practice Council

Intensive Care: Zack Coffman MD

Emergency Center: Frank Carnevale MD, Wassam Rahman

Pharmacists: Amy Kiskaddon PharmD

Clinical Pathway Management Team: Courtney Titus, PA-C, Michelle Wade

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Disclaimer

Clinical Pathways are intended to assist physicians, physician assistants, nurse practitioners and other health care providers in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. The ultimate judgment regarding care of a particular patient must be made by the physician in light of the individual circumstances presented by the patient.

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