Penetrating Injuries of the Extremities Clinical Pathway
Johns Hopkins All Children’s Hospital

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Table of Contents
1. Rationale
2. Background
3. Diagnosis
4. Clinical Management
   a. Extremity Penetrating Vascular Injury Clinical Pathway
   b. Extremity Blunt Vascular Injury Clinical Pathway
5. Emergency Center
6. References
7. Outcome Measures
8. Clinical Pathways Team Information

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Owners: Orthopedics

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.
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Rationale:
This clinical pathway was developed by a consensus group of JHACH physicians, advanced practice providers, and nurses to standardize the management of children presenting with penetrating injury to the extremity.

This guideline:
1. Defines suggested diagnostic approaches to penetrating extremity trauma.
2. Defines suggested treatment approaches to penetrating extremity trauma.

Background
Any injured extremity should be thoroughly evaluated for a possible vascular injury. The presence of obvious arterial injury from a blunt and/or penetrating mechanism rarely requires imaging and should not delay emergent operative exploration.

Diagnostics

Radiologic studies: X-ray, CT, IR

Clinical Management
The presence of “hard signs” strongly supports vascular injury and typically necessitates emergent repair. These “hard signs” are:
1. Bruit/Thrill
2. Active/Pulsatile hemorrhage
3. Pulsatile/Expanding hematoma
4. Signs of limb ischemia and or compartment syndrome including the 5 "P's" - pallor, paresthesias, pulse deficit, paralysis, and pain on passive extension of the compartment (pain on passive extension is the earliest and most sensitive physical finding)
5. Diminished or absent pulses with + Doppler signals (this is not a sensitive prognostic finding, as up to 30% of patients with major vascular injuries requiring repair have normal pulses or Doppler signals distal to the injury due to collateral flow) [1]

The Ankle Brachial Index, ABI, or Arterial Perfusion Index, API, is a validated tool for screening for peripheral vascular injury[2]. This is performed by placing a blood pressure cuff above the ankle or on the bicep of the limb of concern. The systolic pressure is determined with a Doppler probe at the dorsalis pedis or brachial artery. Repeat this procedure on the ipsilateral uninjured limb. The API is calculated by dividing the systolic pressure in the injured limb by the systolic pressure in the uninjured limb. An API < 0.9 has a sensitivity of 95% and specificity of 97% for a
major arterial extremity injury. In a study on blunt orthopedic extremity injuries the negative predictive value is 100% for an API > 0.9 to exclude an arterial injury.[3-5]

The purpose of these algorithms is to diagnose the occult injury early before irreversible tissue ischemia is present. In patients where the “hard” signs are NOT present it is imperative to maintain a high suspicion of peripheral vascular injury in the injured extremity [2, 6, 7]. If “hard signs” are not present but peripheral vascular injury is suspected then expedient consultation with Trauma Surgery is indicated and the use of imaging, per Trauma Surgery, should be liberal to avoid missed injuries.
Hard Signs of Vascular Injury:
- Expanding/Pulsatile Hematoma
- Pulseless, pallor, paresthesia, pain, paralysis, poikilothermia
- Bruit/Thrill
- Absent Doppler Signals
- Arterial Pressure Index, API, (<0.9)

Active Hemorrhage?

Direct Pressure

Emergent Vascular Consult

OR vs CTA vs Angio
Hard Signs of Vascular Injury:
- Expanding/Pulsatile Hematoma
- Pulseless, pallor, paresthesia, pain, paralysis, poikilothermia
- Bruit/Thrill
- Absent Doppler Signals
- Arterial Pressure Index, API, (<0.9)

Fracture?

Fracture Reduced?

Normal Pulses

Reduce Fracture +/- Pulses

API Normal? (≥.90)

Serial Exams

Pulse Exam Changes

API ≥.90?

Serial API Exams

Vascular Surgery Consult

OR vs CTA vs Angiogram

Serial Exams
Emergency Center Management

1. Follow the ABC’s.

2. Control exsanguinating hemorrhage by direct pressure or tourniquet if needed.

3. Perform rapid physical exam, noting nature of distal pulses and neurologic findings.

4. Rapidly obtain X-ray of extremity, including entry and exit wounds; use wound markers.

5. Take the patient immediately to surgery for the following findings:
   a. Exsanguinating or uncontrolled hemorrhage from the injury.
   b. Rapidly expanding hematoma.
   c. Rapidly developing compartment syndrome.

6. Obtain angiogram, duplex scan or CT angiogram for:
   a. Diminished or absent distal pulses.
   b. ABI <0.9 (for leg injury).
   c. Difference in upper extremity systolic blood pressure >20 mmHg when upper extremity injury is suspected.
   d. Continued bleeding from wounds.
   e. Major nerve injury.
   f. Bruit or thrill.
   g. Proximity to a major vessel

7. If neurologic deficit is present:
   a. Document level of deficit.
   b. Obtain orthopedic or neurosurgical consult.

8. Penetrating injuries with an absence of vascular injury on diagnostic studies and no neurologic injury can have the wound locally treated and be discharged.

9. Administer one dose of cefazolin intravenously for stab wounds. GSW without clothing contamination do not require antibiotics. NOTE: foreign mater must be debrided. Administer tetanus IM as needed.

10. Debride wound edges and close or treat with dressings depending on clinical conditions.

11. Splint joints above and below with a bulky dressing.

Outcome Measures:

- Need for transfusion
• Unexpected mortality and morbidity

References


Disclaimer

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  Infectious Diseases:
  Hospitalists:
  Intensive Care:
  Emergency Center:
  Resident Physicians:
  Nursing:
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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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