How to Best Treat Pediatric Vascular Injuries

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Disclosure
• Nothing to disclose

Background: Pediatric Trauma
1. Center for Disease Control and Prevention
   http://www.cdc.gov/injury/wisqars/leadingcauses.html

Background: Vascular Trauma
• Vascular injuries are infrequent, occurring in 0.6-1.0% of all pediatric trauma cases
  – But a major contributor to mortality
• Iatrogenic arterial injuries → PVI
• Non-iatrogenic arterial injuries with complex bony and arterial injuries in war zones

Type and Mechanism of Isolated Pediatric Vascular Injury in the US*

Results: Factors Associated with Mortality in Children with Pediatric Vascular Injury

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Adjusted Odds Ratio</th>
<th>95% Confidence Intervals</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetrating vs. Blunt</td>
<td>1.97</td>
<td>1.081-1.27</td>
<td>0.006</td>
</tr>
<tr>
<td>ISS</td>
<td>1.07</td>
<td>1.060-1.093</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>GCS&lt;9</td>
<td>11.206</td>
<td>7.180-17.489</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Shock: SBP&lt;90</td>
<td>5.48</td>
<td>3.555-8.461</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Variables that were not independently significant:
Age, gender, race, regions of country, anatomical location

*National Trauma Data Bank 2002-2012
Anatomic and Physiologic Consideration

• Similar to adults, PVIs may lead to disruption, obstruction or spasm of artery
• For vasoapam or minimal intimal disruption, conservative therapy after removal of the offending agent(s) is adequate
  – Adjuncts such as papervine or NTG is helpful in PVI
• Of significant concern is traumatic AVF in children
  – Limb size discrepancy or heart failure

Diagnostic Evaluation

• Hard signs of injuries include bleeding, expanding hematomas suggest arterial injury
• With no hard signs, such as blunt injuries, diagnosis depends on physical exams (cap refill, skin color, and pulse) and diagnostic tests

Diagnostic Tests

• Doppler to document signals and perform an Injured Extremity Index (IEI)
  – Doppler occlusion of injured limb/non-affected limb: Poor perfusion: IEI<0.88 in children <2 and <0.90 in older
• Pulse Oximetry
• Duplex ultrasound
• CTA- useful for truncal and abdominal injuries
• DSA- Very risky in children but may be necessary
• Surgical Exploration

Generalities: Management of Pediatric Vascular Injuries

• Similar to adult trauma:
  – Exposure of injured vessel, control of hemorrhage, restoration of circulation to end organ
  1. Use of temporary shunts to reduce ischemia
     Pediatric feeding tube or argyle shunts
  2. Heparin if no contraindication
  3. Liberal use of fasciotomy decreases morbidities
  4. Endovascular techniques when indicated

Management of Iatrogenic Pediatric Vascular Injuries

• Perhaps the most common cause of PVI in children <6 in developed countries
• Minimal intimal injuries can be watched
• 20-50% of ECMO cannulation is a common cause of carotid/femoral injury
  – Limb ischemia → limb size discrepancy
  – Cognitive issues with carotid injuries

Management of Non-iatrogenic Pediatric Vascular Injuries

• Follows the same principal as adult trauma except:
  – Very spastic vessels in the young
  – Interposition graft must accommodate the axial growth of the injured extremity
  – Primary repair often required interrupted sutures in very young
  – Contralateral GSV is a reasonable conduit in most
Results: Prevalence of Vascular Injuries by Anatomical Locations*

Blunt Brachial Injury

- Most common of PVIs
- Brachial artery stretch
- Can lead to Volkmann ischemic contracture
- In patients with no pulse,
  - exploration is indicated if extremity is cold or neurosensory deficit
  - If pulseless pink hand, expectant treatment is reasonable

Truncal Vascular Injuries

- Mechanism, severity and the location dictates treatment
- Blunt aortic injuries are uncommon in children
  - Endovascular options are limited
  - If endo, long-term results are unknown

Summary

- Many tenets of adult vascular trauma applies to children
- Special considerations for repair of injured vessels among children:
  - smaller spastic artery in limbs that grow longitudinally and radially
  - Limited endovascular options
  - Long lasting devastating outcomes with limited reserve
- Success requires collaborative team work of many specialists