Penetrating thoracic trauma is the major cause of morbidity and mortality in children. Recently, we have seen a number of penetrating thoracic trauma cases. Penetrating thoracic trauma accounts for only 10–20% of all pediatric thoracic trauma admissions. Thoracic trauma accounts for only 4–12% of pediatric trauma admissions. May cause 6–10% of fatalities. Penetrating thoracic trauma (in general) accounts for only approximately 2% of all pediatric trauma. Penetrating thoracic trauma accounts for only 10–20% of all pediatric thoracic trauma.
M handling homemade explosives when one went off and he sustained a blow to his chest (8/2).

Patient's mom (who is an ICU nurse) placed pressure on his axilla where bleeding was coming from.

Clothing blood soaked, but no active bleeding.

PE: Wound at the posterior axillary line just distal to the hairline.

CTA done: shows moderate axillary artery extravasation + palpable distal pulses.

Wound at the posterior axillary line just distal to the hairline was coming from.

Patient's mom (who is an ICU nurse) placed pressure on his axilla where bleeding blow to his chest (8/2) – Trauma stat.

4 yo M handling homemade explosives when one went off and he sustained a
Angiogram performed, with exploration of right axillary fossa. Significant hematoma; brachial plexus carefully retracted out of the way of the axillary artery and vein – both were able to be primarily repaired with 6-0 prolene. Injury to axillary artery and vein – some weakness in ulnar distribution, but working.

Closed over a Blake drain overnight (early am on 8/3).

Drain removed and patient discharged on 8/5. Aspirin x 30 days post-op.

Transferred to floor on 8/4.

Aspirin 81 mg post-op.

Admitted to PICU overnight on 8/3.

See vascular clinic on 8/17 – some weakness in ulnar distribution, but working with PT/OT.

Seen in vascular clinic on 8/17 – some weakness in ulnar distribution, but working with PT/OT.

Some weakness in ulnar distribution, but working with PT/OT.
14 yo M, GSW to Chest, initially seen at Baptist-Desoto (8/12)

Believed to be self-inflicted

Transferred as trauma stat

Decreased strength left hand grip and wrist flexion

2 x 2 cm wound to anterior left upper chest, (3 sutures in place were removed)

2 x 2.5 cm wound to upper left back

2.5 x 2.5 cm wound to anterior left upper chest

Possible 2 mm traumatic pseudoaneurysm arising from proximal axillary artery

Pulmonary contusion

CTA: Comminuted left scapula fracture

Comminuted left scapula fracture

Decreased strength left hand grip and wrist flexion

Transferred as trauma stat

Believed to be self-inflicted
OR: left shoulder explored through an infraclavicular incision

- No arterial injury
- Paired vein - 1 was intact, 1 transected - this was ligated
- Arteriogram performed through the axillary artery - demonstrated patent subclavian and axillary artery with flow distal through branchial artery and its bifurcation
- Neurosurgical evaluation of nerve trunks
- Ortho washed out posterior wound (open, comminuted scapular fracture)
- Transferred to floor and drain removed on 8/12
- Admitted to PICU overnight
- Closed over JP drain

Discharged to inpatient psychiatric unit on 8/14 with neurosurgical follow-up for neuro deficits

Discharged to inpatient psychiatric unit on 8/14 with neurosurgical follow-up for neuro deficits
A 3 yo F who was shot in the chest with a BB gun by her brother at home (8/2) –

Trauma stat

She was seen at an OSH where she had a CT scan, and was found to have a missile

in her heart (images not available)

PE: 4-5mm wound along left sternal border

ECHO: foreign body lodged near the tricuspid valve, avulsed papillary muscle

Cardiology and CT surgery were consulted in the ED

ECMO: Foreign body lodged near the tricuspid valve, avulsed papillary muscle

Taken to CV suite for fluoroscopic and ultrasonound guided evacuation of hemopericardium and placement of pericardial drain (55 ml blood)

Admitted to CVICU
8/3: Repeat x-ray and ECHO performed

Echogenic mass at base of septal leaflet of tricuspid valve consistent with pellet

ECCHO: unchanged, no effusion

Trivial pericardial effusion

8/4: No signs of tamponade, pellet unchanged on imaging

8/5: Repeat ECHO: BB pellet in same location, avulsed papillary muscle with tricuspid regurg, normal biventricular size and function

Transfered to floor

8/6: Repeat ECHO and ECCHO performed

Plan for repeat ECHO and clinic visit in 6 months

Cardiology clinic follow up on 8/14: normal activity without limitations

Discharged home
CASE 2012

6 yo M, presents as level 1 trauma to NCH

Struck in the chest by a projectile ejected from the underside of a lawnmower

Immediately collapsed, question of bystander CPR at the scene

Taken to a local hospital

HR and BP labile on transport from OSH to NCH

Exam: small puncture wound over body of sternum

Awake and complaining of chest pain on arrival

Electively intubated
CASE 2012

Pre-intubation (30 minutes later)

Post-intubation
CASE 2012

FAST exam: Large pericardial effusion
Cardiology performed ultrasound guided pericardiocentesis and drain placement
150 ml blood aspirated
Hemodynamics improved
Thoracic CT performed
Cardiology performed ultrasound guided pericardiocentesis and drain placement

CASE 2012
Admitted to PICU

Trauma/general surgery, CT surgery, cardiology, IR

Risks of removal felt to outweigh any potential benefit

Repeat ECHO: no accumulation of fluid

No structural or functional cardiac damage

Pericardial drain removed and pt extubated on HD #2

Discharged on HD #6

Asymptomatic with stable CXR at follow-up

Admitted to PICU

CASE 2012
Patients extracted from trauma registry 10 year period (Jan 2003 - Dec 2012)

Data collected:
- Demographics
- Mechanism of injury
- Diagnoses
- Procedural information
- GCS, AIS, ISS
- ISS
- ICU days, total LOS, ventilator days
- Outcome and complications
- ICU days, total LOS, ventilator days
- Data collected

Patient extracted from trauma registry

NCH REVIEW
65 patients were found to have penetrating thoracic injuries. These patients were reviewed and categorized into 2 groups:

- High velocity (GSW)
- Low velocity (knife stab wound)

There were 7 total fatalities. All were high velocity wounds. All patients that underwent CPR, defibrillation or ED thoracotomy died.
## NCH Demographics

<table>
<thead>
<tr>
<th>P-value</th>
<th>High Velocity</th>
<th>Low Velocity</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>p=0.903</td>
<td>15 (29.4%)</td>
<td>5 (3.5%)</td>
<td>20 (30.8%)</td>
</tr>
<tr>
<td>p=0.002*</td>
<td>15 (29.4%)</td>
<td>12 (85.7%)</td>
<td>27 (41.5%)</td>
</tr>
<tr>
<td>p=0.271</td>
<td>43 (84.3%)</td>
<td>10 (71.4%)</td>
<td>53 (81.5%)</td>
</tr>
<tr>
<td>p=0.018*</td>
<td>12.89 (1.33-20)</td>
<td>9.53 (2.42-16)</td>
<td>12.16 (1.33-20)</td>
</tr>
<tr>
<td></td>
<td>51 (78.5%)</td>
<td>65</td>
<td>65</td>
</tr>
</tbody>
</table>

- **Private Insur.**
- **White Race**
- **Male sex**
- **Age, mean**
- **Number**
<table>
<thead>
<tr>
<th>p-value</th>
<th>High Velocity</th>
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<th>All Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0=d</td>
<td>0.6 ± 1.8 (0-12)</td>
<td>0.1 ± 0.4 (0-1)</td>
<td>0.5 ± 1.6 (0-12)</td>
</tr>
<tr>
<td>0.356</td>
<td>1.6 ± 5.1 (0-36)</td>
<td>0.6 ± 0.7 (0-2)</td>
<td>1.4 ± 4.5 (0-36)</td>
</tr>
<tr>
<td>0.640</td>
<td>0.6 ± 1.8 (0-12)</td>
<td>0.1 ± 0.4 (0-1)</td>
<td>0.5 ± 1.6 (0-12)</td>
</tr>
<tr>
<td>0.637</td>
<td>13 ± 4 (3-15)</td>
<td>14 ± 3 (3-15)</td>
<td>13 ± 4 (3-15)</td>
</tr>
<tr>
<td>0.900</td>
<td>0.6 ± 1.8 (0-12)</td>
<td>0.1 ± 0.4 (0-1)</td>
<td>0.5 ± 1.6 (0-12)</td>
</tr>
<tr>
<td>0.331</td>
<td>18 ± 16 (1-75)</td>
<td>12 ± 7 (1-26)</td>
<td>17 ± 14 (1-75)</td>
</tr>
<tr>
<td>0.090</td>
<td>12 ± 7 (1-26)</td>
<td>7 ± 5 (1-17)</td>
<td>10 ± 7 (1-36)</td>
</tr>
<tr>
<td>0.640</td>
<td>7 ± 5 (1-17)</td>
<td>3.6 ± 2.2 (1-9)</td>
<td>6.3 ± 9.0 (1-45)</td>
</tr>
<tr>
<td>0.637</td>
<td>14 ± 3 (3-15)</td>
<td>7 ± 5 (1-17)</td>
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</tr>
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</tr>
<tr>
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<td>17 ± 14 (1-75)</td>
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**LOS (days)**
- 6.3 ± 9.0 (0-45)
- 3.6 ± 2.2 (1-9)
- 6.3 ± 9.0 (1-45)

**ICU LOS (days)**
- 1.4 ± 4.5 (0-36)
- 0.6 ± 0.7 (0-2)
- 1.6 ± 5.1 (0-36)

**Ventilator Days**
- 0.5 ± 1.6 (0-12)
- 1.4 ± 4.5 (0-36)
- 0.6 ± 1.8 (0-12)

**Initial GCS**
- 13 ± 4 (3-15)
- 14 ± 3 (3-15)
- 13 ± 4 (3-15)

**Total AIS**
- 11 ± 7 (1-36)
- 7 ± 5 (1-17)
- 10 ± 7 (1-36)

**ISS**
- 18 ± 16 (1-75)
- 12 ± 7 (1-26)
- 17 ± 14 (1-75)
Major vascular injuries occurred in 11 patients (1 low velocity)
Cardiac injuries identified in 4 patients
Neurologic injuries in 7 patients
Solid organ injuries most commonly liver, followed by renal injuries
Hollow viscus injuries less common
Major vascular injuries occurred in 11 patients (1 low velocity)
NCH REVIEW: MOST COMMON INJURIES

- **High velocity**
  - Pneumothorax (47.1%)
  - Hemothorax (41.1%)
  - Pulmonary contusion (35.3%)
  - Liver laceration (29.4%)

- **Low velocity**
  - Pneumothorax (50%)
  - Liver laceration (28.6%)
  - Hemothorax (21.4%)
  - Pulmonary contusion (21.4%)
  - Liver laceration (29.4%)
  - Pulmonary contusion (35.3%)
  - Hemothorax (41.1%)
  - Pneumothorax (47.1%)
## NCH Review: Procedures

### Low Velocity

<table>
<thead>
<tr>
<th>Procedure</th>
<th>High Velocity</th>
<th>Low Velocity</th>
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</tr>
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<tbody>
<tr>
<td>Transfusion</td>
<td>6 (11.76%)</td>
<td>2 (14.29%)</td>
<td>8 (14.29%)</td>
</tr>
<tr>
<td>Chest Tube</td>
<td>26 (50.98%)</td>
<td>5 (35.71%)</td>
<td>31 (47.69%)</td>
</tr>
<tr>
<td>Intubation</td>
<td>17 (33.33%)</td>
<td>2 (14.29%)</td>
<td>19 (29.23%)</td>
</tr>
<tr>
<td>CPR/Defib</td>
<td>7 (13.73%)</td>
<td>0 (0%)</td>
<td>7 (10.77%)</td>
</tr>
<tr>
<td>Chest Thorac OR Other OR</td>
<td>3 (4.62%)</td>
<td>16 (31.37%)</td>
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</table>

### High Velocity

<table>
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</tbody>
</table>

### P-value

<table>
<thead>
<tr>
<th>Procedure</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfusion</td>
<td>0.232</td>
</tr>
<tr>
<td>Chest Tube</td>
<td>0.316</td>
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<tr>
<td>Intubation</td>
<td>0.203</td>
</tr>
<tr>
<td>CPR/Defib</td>
<td>0.331</td>
</tr>
<tr>
<td>Chest Thorac OR Other OR</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Penetrating thoracic trauma in children is rare, but on the rise. 4,500 firearm-related deaths per year in children. Most common complications are from pericardial tamponade or VSd. Penetrating thoracic trauma in children is rare, but on the rise.
There is also one institutional review of patients undergoing either pericardial window for severe chest trauma or non-therapeutic sternotomy. Fifty percent of the patients had a positive pericardial window (n=55) and prompted the review (2 blunt, 3 penetrating). Three patients with positive pericardial windows were successfully treated without sternotomy, and hemodynamic instability were positive predictors of therapeutic sternotomy. Penetrating trauma and hemodynamic instability were positive predictors of values, resuscitation fluids, or vital signs.

There were no differences with respect to age, mechanism of injury, injury severity score, presenting lab values, resuscitation fluids, or vital signs. Eighty-nine percent (49) had sustained penetrating trauma, and 38% of those patients had non-therapeutic sternotomy.

PENETRATING THORACIC TRAUMA

The Thorson paper is not the only one to report high rates of non-therapeutic sternotomies. This method not applicable to patients that present in extremis or cardiovascular collapse. Our patient TC was clearly very stable on presentation. A coordinated multi-disciplinary effort is required when these treatment modalities are employed.

Has been reported to range from 0-67%. The Thorson paper is not the only one to report high rates of non-therapeutic sternotomies.
Foreign body embolization is rare. Emboli include needles, bullets, and other projectiles. Risk of a bullet lodging in the vascular system is only 0.3%. Many foreign bodies that embolize to the pulmonary tree have been reported post-operatively (cardiac repair performed, but bullet not identified intra-operatively). Many emboli include needles, bullets, and other projectiles. Risk of a bullet lodging in the vascular system is only 0.3%. Many emboli include needles, bullets, and other projectiles. Most have no significant complications. Most are left in place. The biggest risk is infection, erosion, pulmonary necrosis, and thrombosis.

EMBOLIZATION
Penetrating thoracic trauma in pediatric patients is rare, but may be increasing. Vascular injury from penetrating thoracic injury may be more common than previously reported. Patients treated non-operatively need close follow-up. Cases should be considered on an individual basis, as standard treatments may not be necessary. Prevention and education may be the most important factors to try to reduce the incidence of penetrating trauma in pediatric patients. Penetrating thoracic trauma in children is rare, but may be increasing.
Given the number of significant penetrating thoracic trauma that presented this summer alone to Le Bonheur, there may be a much larger population in Memphis. A retrospective review may lead to information that could be used for prevention programs. A specific review of both blunt and penetrating vascular trauma would likely also yield a larger population than may have been previously reported. Given the number of significant penetrating thoracic trauma that presented this summer alone to Le Bonheur, there may be a much larger population in Memphis. A retrospective review may lead to information that could be used for prevention programs. A specific review of both blunt and penetrating vascular trauma would likely also yield a larger population than may have been previously reported.