The Use of a Pediatric Abdominal Trauma Protocol Improves Resource Utilization

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Background

• After failure to control the airway, blunt abdominal trauma (BAT) is the second most frequent cause of preventable death in pediatric trauma patients.

• Evaluation of pediatric BAT can be challenging:
  • External signs may be few
  • Physical examination can be unreliable
  • CT is over-utilized and poses radiation risk
Background

• Young level I trauma center (certified in 2010)

• Large institution: multiple EM and Surgery providers leads to variability in evaluation/management

• New protocol in Aug 2011 – primary evaluation level 2 activations by EM staff; trauma surgeon consulted only when necessary
Objectives

• QI project: Development of an evidence-based protocol to evaluate abdominal trauma in EC
  • To standardize care among multiple providers
  • To ensure appropriate and timely surgery consultation
  • To decrease unnecessary CT and lab use in evaluation of abdominal trauma
  • To maintain or improve safety and quality of care of trauma patients
ABDOMINAL TRAUMA PROTOCOL
BLUNT TRAUMA - UNCONSCIOUS

Unconscious child (GCS <=8), significant mechanism (ex. High speed MVC, fall >10 ft, suspected NAT)

Call Surgery STAT if not already present

Hemodynamically UNSTABLE

FAST if available

Look for other sources of hypotension, fluid resuscitation

OR if clinical or FAST evidence of abdominal bleeding

Admit to Trauma Service in PICU

Hemodynamically STABLE

CT abd/pel w/ IV contrast

Admit to Trauma for OR vs. Non-operative mgmt
ABDOMINAL TRAUMA PROTOCOL
BLUNT TRAUMA- CONSCIOUS, RELIABLE EXAM

Conscious child (GCS 14-15), significant mechanism (ex. High speed MVC, fall >10 ft, suspected NAT)
Reliable abdominal examination

Abdominal tenderness or distention

CONSULT SURGERY

Hemodynamically UNSTABLE
FAST if available
OR if clinical or FAST evidence of abdominal bleeding

Hemodynamically STABLE
CT abd/pel w/ IV contrast (per surgery discretion)

Admit to Trauma for OR vs. Non-operative mgmt
Observe in EC, OK to discharge if pain-free, tolerating PO and no additional injuries needing admission
ABDOMINAL TRAUMA PROTOCOL
BLUNT TRAUMA- CONSCIOUS, UNRELIABLE EXAM

Conscious child, significant mechanism (ex. High speed MVC, fall >10 ft, suspected NAT) Unreliable or equivocal abdominal examination (ex. GCS 9-13 or distracting injury)

CONSULT SURGERY

Hemodynamically UNSTABLE

FAST if available

OR if clinical or FAST evidence of intraabdominal bleeding

Hemodynamically STABLE

FAST if available

ALT/AST > 100, Hgb <10 or Hct <30%, Amy/Lip elevated, UA >50 RBC/HPF

CT abd/pel w/ IV contrast (per surgery discretion)

Admit to Trauma for OR vs. observation

LABS: AST/ALT, CBC, Amy/Lip, UA w micro

Repeat abd exam

Discharge (only if GCS 15) vs. admit to trauma service for obs for pain or anxiety control
ABDOMINAL TRAUMA PROTOCOL
BLUNT TRAUMA- ABDOMINAL WALL BRUISING

Seatbelt Sign or other abdominal wall bruising (ex. Handlebar injury)

CONSULT SURGERY

Hemodynamically UNSTABLE and/or signs of peritonitis

FAST if available

2-view lumbar spine before moving patient to r/o fracture

OR if clinical or FAST evidence of abdominal bleeding or bowel injury

Log roll, for exam, maintain on board until spine imaging completed

Hemodynamically STABLE

CT abd/pel w/ IV contrast

Admit to Trauma for OR vs. observation

Don’t need additional spinal CT
Methods

- Protocol implementation
- Prospective, longitudinal study
- Comparison of outcomes Pre/Post Protocol (POST 1)
- Protocol revision based on review of outcomes
- Comparison of outcomes following revision (POST 2)
2011

JAN

P1

DEC

Pre-Protocol
(n = 117)

2012

JAN

2013

SEPT

P2

AUG

Post-Protocol v1
(n = 148)

SEPT

Post-Protocol v2
(n = 56)

2014

MAR

P1

DEC

P2

AUG

SEPT

Pre-Protocol
(n = 117)

Post-Protocol v1
(n = 148)

Post-Protocol v2
(n = 56)
Methods

• Study population:
  • Patients who presented to EC with mechanism for abdominal trauma who received CT at our institution

• Exclusion criteria:
  • Neonates
  • Prior abdominal imaging at another facility
  • Suspected non-accidental trauma
  • Remote injuries (> 24 hours)
  • Significant congenital anomalies
<table>
<thead>
<tr>
<th></th>
<th>Pre (n=117)</th>
<th>Post 1 (n=148)</th>
<th>Post 2 (n=56)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender</td>
<td>61%</td>
<td>63%</td>
<td>55%</td>
<td>0.62</td>
</tr>
<tr>
<td>Admission rate</td>
<td>73%</td>
<td>83%</td>
<td>82%</td>
<td>0.24</td>
</tr>
<tr>
<td>Mean age at admission (SD)</td>
<td>8.4 (5.2)</td>
<td>9.1 (4.8)</td>
<td>7.8 (5.3)</td>
<td>0.21</td>
</tr>
<tr>
<td>Median ISS (Range 0-75)</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>0.11</td>
</tr>
<tr>
<td>Median Hosp LOS (Range 1-57 days)</td>
<td>1.5</td>
<td>2</td>
<td>3</td>
<td>0.05</td>
</tr>
<tr>
<td>Survival (%)</td>
<td>98%</td>
<td>100%</td>
<td>98%</td>
<td>0.27</td>
</tr>
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</table>
# Mechanism of Injury

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Pre</th>
<th>Post 1</th>
<th>Post 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVA</td>
<td>30%</td>
<td>22%</td>
<td>36%</td>
</tr>
<tr>
<td>Auto-ped</td>
<td>22%</td>
<td>27%</td>
<td>22%</td>
</tr>
<tr>
<td>Fall</td>
<td>21%</td>
<td>19%</td>
<td>16%</td>
</tr>
<tr>
<td>Blunt object</td>
<td>13%</td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>ATV/Bike</td>
<td>6%</td>
<td>14%</td>
<td>6%</td>
</tr>
<tr>
<td>Sports</td>
<td>6%</td>
<td>3%</td>
<td>7%</td>
</tr>
</tbody>
</table>
POST 1 Results: Before and After

- % Positive Scans
- % Clinically Significant Scans

Pre-Protocol: 23% Positive, 13% Clinically Significant
Transition: 24% Positive, 19% Clinically Significant
Post-Protocol v1: 33% Positive, 24% Clinically Significant
Protocol Deviation

• Some step of the protocol was not followed 30% of the time. Most common:
  • CT based on mechanism alone
  • CT before surgeon evaluation most common

• 46 CT scans (36%) may have been avoided if protocol had been followed

• Clinically significant CT scans when protocol followed = 43% vs. 11% when not followed (p = 0.001)
POST 1 Laboratory Use

- The cost of ER laboratory tests ordered for these patients did not change after protocol implementation (mean $254 vs. $269 per patient, p=0.50)
Unconscious child (GCS \(\leq 8\)), significant mechanism for abdominal trauma

Hemodynamically Stable

Call Surgery STAT if not already present

CT abd/pel w/ IV contrast

Admit to Trauma Service in PICU

Admit to Trauma for OR vs. non-operative management

No initial Abdominal labs needed
CONSCIOUS, RELIABLE EXAM

Conscious child, GCS 14-15, significant mechanism (ex. High speed MVC, fall >10 ft, suspected NAT)
Reliable Abdominal Examination and Hemodynamically Stable

Abdominal tenderness?

- **TENDER**
  - CONSULT SURGERY
    - CT abd/pel w/ IV contrast (per surgery discretion)
    - Admit to Trauma for OR vs. Non-operative mgmt

- **NON-TENDER**
  - OK to discharge if pain-free, tolerating PO and no additional injuries needing admission
  - NO Abdominal labs needed

Obtain Stable AT lab panel
Conscious child, significant mechanism for abdominal trauma

**Unreliable or equivocal abdominal examination**
(ex. Young age, distracting injury, GCS 9-13),

**Hemodynamically Stable**

CONSULT SURGERY

ALT/AST > 100, Hb <10 or Hct <30%, Amy/Lip > 100, UA >50 RBC/HPF

CT abd/pel w/ IV contrast (per surgery discretion)

Admit to Trauma for OR vs. observation

OK to discharge if tolerating po and no other injuries requiring admission

Repeat abdominal exam if reliable and GCS 15. If unreliable, consider evidence for head injury

TENDER

NON-TENDER
Seatbelt Sign or other abdominal wall bruising (ex. Handlebar injury), **Hemodynamically Stable**

**CONSULT SURGERY**

Get a **CT abd/pelvis w/ IV contrast** (per surgery discretion)

Maintain strict spinal precautions for seatbelt sign until imaging complete – if no CT, then obtain T/L spine x rays

**Admit all patients to Trauma for OR vs. observation**

**Obtain Stable AT lab panel**

* CT A/P with reconstruction is enough to evaluate spine – additional spinal CT is NOT necessary
Abdominal Trauma Lab Panel
Hemodynamically Stable

H/H
Amylase/Lipase
AST/ALT
UA w/ micro
UPT for teen female

Abdominal Trauma Lab Panel
Hemodynamically Unstable

H/H
Amylase/Lipase
AST/ALT
UA w/ micro
UPT for teen female
PT/PTT
T+S
BUN/Cr
POST 2 Results: Improved CT Utilization

- % Positive Scans
  - Pre-Protocol: 23% (N=117)
  - Protocol v1: 32% (N=148)
  - Protocol v2: 49% (N=56)
  - ** p=0.03

- % Clinically Significant Scans
  - Pre-Protocol: 14% (N=117)
  - Protocol v1: 21% (N=148)
  - Protocol v2: 32% (N=56)
  - * p=0.003
Balance Measures

There were no missed injuries during these time periods
**Laboratory Cost Analysis**

<table>
<thead>
<tr>
<th>Component</th>
<th>Pre (n=117)</th>
<th>Post 1 (n=148)</th>
<th>Post 2 (n=56)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean total cost of labs (SD)</td>
<td>244 (149)</td>
<td>273 (137)</td>
<td>202 (140)</td>
<td>0.006</td>
</tr>
<tr>
<td>Component CBC (%)</td>
<td>4%</td>
<td>19%</td>
<td>63%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Component Chemistry (%)</td>
<td>6%</td>
<td>0%</td>
<td>54%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Component LFTs (%)</td>
<td>21%</td>
<td>31%</td>
<td>74%</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Conclusion

• An institutional protocol to streamline evaluation of children with suspected blunt abdominal trauma was effective in decreasing unnecessary CT use and laboratory costs

• Future directions include further protocol refinement to decrease the role of CT in the evaluation algorithm
Thank You!