Gunshot Wounds to the Abdomen: From Bullet to Incision

Patrick M Reilly MD FACS

The Trauma Center at Penn
A Regional Resource Facility of the University of Pennsylvania Health System
Master?
…I Do Get The Chance to Practice…

Philadelphia Homicides

What Are We Not Discussing?

- Stab Wounds
- Prehospital Care
- Management of Specific Injuries
- Damage Control
- What is the Best New Zealand Pinot Noir
What Are We Discussing?

- Examining the Patient
- Imaging the Patient
- Rapidly Synthesizing Data
- Going to the OR
What Are We Discussing?

- Examining the Patient
- Imaging the Patient
- Rapidly Synthesizing Data
- Going to the OR
- ...Probably...
Injury Identification

“(Accurate) Trajectory Determination Equals Injury Identification”

Mike Rotondo MD
CEO Faculty Group
University of Rochester
Preparation

- Short Prehospital Times
- Little / No Notification
  - It Helps to Have Some
- Universal Precautions
  - Protection of Team
- Assign Roles
Preparation

• Equipment
  • RSI Drugs and Equipment / Team
  • Quick Look Paddles
  • Chest Tubes
  • ED Thoracotomy Tray
• Uncrossmatched Blood Products
Arrival

• Listen to Report – If Any
  • Mechanism
  • Injuries
  • Signs
  • Treatment

• Listen to Patient
  • “I’m Gonna Die”
  • “I Can’t Breathe”
    • Normal Chest Exam / CXR
      • Severe Metabolic Acidosis
Primary Survey

- Airway
- Breathing
  - Triage Quickly Depending on Physiology
- Circulation
  - Shock – Likely OR
- Disability
  - Moving Legs – Trajectory Point
- Exposure
  - Rectal Exam Properly Done
  - Mark Wounds
Secondary Survey and Imaging

• Secondary Survey
  • Extremity Wounds
    • Look Under BP Cuff
  • Disparate Extremity Pulses
  • Obvious Fractures

• Three Plain Films of Torso
  • Lateral Film?

• FAST
More Trauma Dictums

“(Accurate) Trajectory Determination Equals Injury Identification.”

“The Number of GSWs and Foreign Bodies Should Equal an Even Number.” If Not…

• Missing a Wound
• Missing a Bullet
• Patient Has Been Shot Before
  • Ask the Patient!
"You’re gonna be OK, mister, but I can’t say the same for your little buddy over there. ... The way I hear it, he’s the one that mouthed off to them gunfighters in the first place."
FAST Exam and Abdominal GSW

- Do It on Everyone
  - Increased Experience
  - Increased Likelihood Positive Exam
- Positive FAST Predictive
- Negative FAST Not Predictive
  - Keep Churning
  - Going to the OR!
- Do I Tell My Oral Board Examiners?
FAST Exam and Abdominal GSW

What is the utility of the Focused Assessment with Sonography in Trauma (FAST) exam in penetrating torso trauma?

Antonia C. Quinn *, Richard Sinert

Department of Emergency Medicine, SUNY-Downstate Medical Center, Brooklyn, NY, United States
Mandatory Laparotomy

**HISTORY**

<table>
<thead>
<tr>
<th>CONFLICT</th>
<th>MORTALITY</th>
</tr>
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<tbody>
<tr>
<td>Civil War</td>
<td>72%</td>
</tr>
<tr>
<td>WW I</td>
<td>53%</td>
</tr>
<tr>
<td>Korea</td>
<td>12%</td>
</tr>
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</table>
Mandatory Laparotomy

Justification

* Injury Identification Requires Laparotomy
* GSW = Prohibitive Rate of Visceral Injury
* Delay to OR = ↑ Morbidity and Mortality
* Laparotomy = No Morbidity
* Laparotomy = Minimal Economic and Social Costs
Mandatory Lap : Plus Side

* Incidence of Intra-Abdominal Injuries
  Am Surg 1993       85%
  S Afr Med J 1988  98%
  Am J Surg 1980     96%

* Unreliable Physical Exam
  Am J Surg 1980     17%
  Arch Surg 1980     20%
  J Trauma 1977      41%
Mandatory Lap : Plus Side

* No Missed Injuries (Hopefully)
* No Delay in Diagnosis
  No Serial Exams
  Primary Colon Repair
* Maximal Resident Exposure
* Oral Board Answer
Selective Laparotomy

History

* Stab Wounds
  Serial Physical Exams vs. Mandatory Lap
  Peritoneal Irritation
  Decreased Nontherapeutic Lap Rate
  34% → 7%

Am J Surgery 1960
Selective Laparotomy

History

* Stab Wounds - Further ↓ in NT Lap Rate

DPL

Am Surg 1977
Am J Surg 1984

Local Wound Exploration

J Trauma 1977
J Trauma 1980
BUT…..

* Stab Wounds are not Gunshot Wounds

<table>
<thead>
<tr>
<th></th>
<th>SW</th>
<th>GSW</th>
</tr>
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<tbody>
<tr>
<td>Peritoneal</td>
<td>66%</td>
<td>85%</td>
</tr>
<tr>
<td>Of Which…..</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>50%</td>
<td>95%</td>
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</tbody>
</table>
Injury Identification

* Laparoscopy
  Determine Trajectory?
  Peritoneal Penetration?
    Tangential GSW
  Injury Identification?
  Not Surgery? NO
Injury Identification

* Laparoscopy - Literature
  Stable / No Indications for Laparotomy
  Left ThoracoAbdominal GSW
  Peritoneal Penetration
  + Injury Identification
  Retroperitoneum

Arch Surg 1992
J Trauma 1995
J Trauma 1998
Injury Identification

* CT Scan
  Determine Trajectory? YES
  Peritoneal Penetration? YES
  Tangential GSW
  Injury Identification?
    Solid Organs YES
Injury Identification

* CT Scan - Literature
  Stable / No Indications for Laparotomy
  Back / Flank
  Retroperitoneum
  Abdomen / Chest

  J Trauma 1986
  J Trauma 1991
  J Trauma 1998
  J Trauma 1998
Rate of Visceral Injury

* Thought to be High
* Vietnam - 19.2% Negative Lap Rate
* Civilian Wounds - Mandatory Lap
  Negative Lap Rate 12 - 18%
  Nontherapeutic Lap Rate 20 - 50%

J Trauma 1995
Morbidity of Negative Laparotomy

* Multiple Associated Complications
  Pulmonary
  Infectious
  Thromboembolic
  Adhesions / Obstruction
Morbidity of Negative Laparotomy

* Morbidity Rate
  8 - 61%

* Mortality Rate
  0 - 1.6%

Am Surg 1993  J Trauma 1995
J Trauma 1996
Morbidity of Unnecessary Laparotomy

* Prospective Data Base - Emory
  41.3% Complication Rate
  Mean LOS 8.1 Days
  Complications Tend to Add 50 - 100% to LOS

J Trauma 1995
J Trauma 1996
Morbidity of Unnecessary Laparotomy

* Prospective Study - USC

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<tr>
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<th>Comp Rate</th>
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<tr>
<td>Ther Lap</td>
<td>12.5 d</td>
<td>39.3%</td>
</tr>
<tr>
<td>Neg/NT Lap</td>
<td>6.4 d</td>
<td>27.6%</td>
</tr>
<tr>
<td>Observation</td>
<td>3.3 d</td>
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</tr>
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Arch Surg 1997
## Costs of Negative Laparotomy

* Prospective Study - USC

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<th>LOS</th>
<th>Comp Rate</th>
<th>Charges</th>
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<td>Ther Lap</td>
<td>12.5 d</td>
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<td></td>
</tr>
<tr>
<td>Neg/NT Lap</td>
<td>6.4 d</td>
<td>27.6%</td>
<td>$18,123</td>
</tr>
<tr>
<td>Observation</td>
<td>3.3 d</td>
<td></td>
<td>$8,595</td>
</tr>
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</table>

Arch Surg 1997
Costs of Negative Laparotomy

* Retrospective Review
  230 NT or Negative Laparotomies
  Estimated Savings
  $2 Million

* Increased Disability - Poorly Studied

Am Surg 1994
Costs of Negative Laparotomy

* USC Study
* 8 Year Period

3,560 Hospital Days Saved
$9,555,752 Hospital Charges Saved

Annals Surg 2001
What Are We To Do?

• Need to Plan on Going to the OR
  • Slowly Back Away as You Obtain Data

• Unstable / Peritonitis
  • Operating Room

• Unexaminable
  • Operating Room

• Limited Resources
  • Operating Room
What Are We To Do?

* Laparoscopy - Tangential Wounds
  Mid Abdomen
  Left ThoracoAbdomen

* CT Scan
  Back / Flank
  Right ThoracoAbdomen
  Pelvis
What Are We To Do?

* Injury Identification
  Solid Viscus
  Liver /Kidney
  No Arterial Blush on CT
  Option for Nonoperative Management

* R Diaphragmatic Holes
  Natural Hx?
Going to the OR – Practical Issues

- Consent
  - Possible Colostomy
- Antibiotics
  - Stop Them Promptly Post OP
- Tetanus
  - Yes…Unless Clear Up To Date
- Femoral A-Line
- Book
  - How Emergent?
PPMC OR Levels
Add - On cases

• Now – Self Explanatory*

• Hot – OR Less then Two Hours

• Cold – OR Less then Six Hours

• Urgent – OR Today

• Elective – Self Explanatory
Going to the OR – Practical Issues

- Intubation: Trauma Bay vs OR
- Comfort Level
- OAFAT

<table>
<thead>
<tr>
<th></th>
<th>EM</th>
<th>Anesth</th>
</tr>
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<tbody>
<tr>
<td>Total</td>
<td>460</td>
<td>198</td>
</tr>
<tr>
<td>DL x 1</td>
<td>86.4%</td>
<td>89.7%</td>
</tr>
<tr>
<td>DL &gt; 2</td>
<td>2.6%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Surgical Airway</td>
<td>0.4%*</td>
<td>0%</td>
</tr>
</tbody>
</table>

* PI - Care Appropriate

Annals of Emerg Med 2004
Anesthesia Communication

• Formal Process
  • A : Intubated / Details
  • B : Chest Tubes?
  • C : Physiology and IV Access
    Blood Requests
  • D : Neuro Status in Trauma Bay
  • E : Location of Suspected Injuries
Blood Products

• Bring Trauma Bay Blood
• Type and Cross
  • Cell Saver
• Trauma Exsanguination Protocol
  • Cell Saver Included
• TXA
An Emergency Department Thawed Plasma Protocol for Severely Injured Patients

Zayde A. Radwan, BS; Yu Bai, MD, PhD; Nena Matijevic, PhD, PharmD; Deborah J. del Junco, PhD; James J. McCarthy, MD; Charles E. Wade, PhD; John B. Holcomb, MD; Bryan A. Cotton, MD, MPH

Table 3. Primary and Secondary Outcome Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Median (IQR)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TP-ED (n = 164)</td>
<td>TP-BB (n = 130)</td>
</tr>
<tr>
<td>Time to first unit of RBCs, min</td>
<td>18 (11-73)</td>
<td>20 (10-72)</td>
</tr>
<tr>
<td>Time to first unit of plasma, min</td>
<td>43 (21-106)</td>
<td>89 (48-192)</td>
</tr>
<tr>
<td>24-h RBC transfusions, U</td>
<td>5 (2-10)</td>
<td>6 (3-11)</td>
</tr>
<tr>
<td>24-h Plasma transfusion, U</td>
<td>6 (3-11)</td>
<td>7.5 (4-14)</td>
</tr>
<tr>
<td>24-h Platelet transfusion, U</td>
<td>12 (6-18)</td>
<td>12 (6-18)</td>
</tr>
<tr>
<td>24-h Cryoprecipitate transfusion, U</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Massive transfusion rate, %</td>
<td>27.0</td>
<td>39.0</td>
</tr>
<tr>
<td>24-h Mortality, %</td>
<td>9.7</td>
<td>6.9</td>
</tr>
<tr>
<td>30-d Mortality, %</td>
<td>20.7</td>
<td>22.3</td>
</tr>
<tr>
<td>Hemorrhage-related mortality, %</td>
<td>14.7</td>
<td>27.5</td>
</tr>
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</table>
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Table 4. Multiple Logistic Regression Model Predicting 30-Day Mortality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thawed plasma in ED</td>
<td>0.43 (0.194-0.956)</td>
<td>.04</td>
</tr>
<tr>
<td>Injury severity (ISS)</td>
<td>1.12 (1.070-1.174)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Physiologic status (w-RTS)</td>
<td>0.84 (0.694-1.012)</td>
<td>.07</td>
</tr>
<tr>
<td>Admission base deficit</td>
<td>0.99 (0.921-1.070)</td>
<td>.84</td>
</tr>
<tr>
<td>Blunt mechanism of injury</td>
<td>2.32 (0.608-8.825)</td>
<td>.22</td>
</tr>
</tbody>
</table>
Positioning

- Chest Tubes / Foley at Head of Bed
  - Make Sure Someone is Monitoring
- Majority of Patients
  - Supine
- Thoracoabdominal GSWs
  - Modified Taxi Hailing Position
  - Long Roll – Spine Precautions
  - Elevate Arm
  - Airplane the Table as Needed
Modified Taxi Hailing Position
Positioning

• Pelvic GSW
  • Supine NOT Lithotomy
  • Concern for Pelvic Vascular Injury
    • Don’t Want to Operate Uphill
    • Distal External Iliac Artery Injury
  • Stop / Reposition and Do Rigid Sigmoidoscopy Later
  • Presacral Drains PRN at End of Case
Incision

• Favor Abdominal Exploration First
  • Abdomen as a Black Box
  • Chest Tubes for Pleural Issues
  • Transdiaphragmatic Pericardial Window
  • Drape in / Follow Extremity Wounds?
• Generous Midline Incision
  • Chevron Incision for Prior Midline and Extreme Shock
• Good Luck!
Summary

- Plan on Going to the Operating Room
- Rapidly and Systematically Evaluate the Patient
- Let Physiology and Incoming Data Slowly Lead You to Further Studies and Away from Your Surgical Plan
- Plan on Going to the Operating Room
Thank You

Heal like a champion today