Quick Review: GSW to the Chest: The Effect And Impact of High-Velocity Gun Shots

B Phillips

Abstract

CASE REPORT

Young Male presents via E.M.S. with report of Gun Shot Wound “GSW to the Chest”

- Down-Time: “5 - 8 Minutes”
- E.M.S. Arrival to Field: No Pressure, No Pulse, Pupils Fixed
- CPR Initiated; Lines Placed
- Arrived at MMC, 1945 (“10 Minutes”)

IN THE TRAUMA ROOM

- CPR in progress w/ Bag-Mask Ventilation
- Airway is established per Anesthesia
- No Appreciable Breath Sounds to Right Chest: 36 Fr. Chest Tube placed - obvious hemothorax
- No Pulse, No Pressure, Pupils Fixed & Dilated, GCS 3
- ACLS Protocol Followed: Fluids, Epinephrine, Atropine
  - Wounds: 1 Entry Site at 2 - 3 cm below the nipple in the midclavicular line
  - No Obvious Exit Site !
  - 1952: Carotid Pulse Palpated
  - BP: 183/106
  - P: 120 - sinus rhythm
  - 1954: Entered the Operating Room

THE OPERATING ROOM

- Right Anterolateral Thoracotomy Right Lower Lobe with “through-and through track” Majority of the Right Hemidiaphragm Missing Right Lobe of the Liver Emulsified: Temporary Compression
- Midline Abdominal Incision and All Quadrants Packed Liver Compressed via “Pringle Manuver” Large Amount of Retrohepatic Bleeding
- Left Anterolateral Thoracotomy Descending Aorta Cross-Clamped
- Proximal Control !
  - Minimal Blood or Injury to the Left Chest
  - “Bookshelf Incision”
  - Any Role for Median Sternotomy ?
  - Distal Control ?
- Distal Control: The Abdomen - IVC !
- Right Hepatectomy & Cholecystectomy
- Oversewing of the Retrohepatic IVC

Massive Bleeding relatively Controlled but - Asystole.Coded !
Internal Massage / Intracardiac Epinephrine & Cardioversion Pulse & Pressure Return
- Oversewing of the Gastric Antrum
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- Multiple Enterotomies - Stapled via GIA
- Right Colectomy

Large Amount of Bleeding noted to the Right Perinephric Area!
- Right Nephrectomy

Asystole ........ Coded!

Internal Massage / Intracardiac Epinephrine & Cardioversion
Pulse & Pressure Return
- Significant Bleeding now noted from the chest!
- Exploration
- Right Lower Lobe Wedge Resection but still with Active Bleeding from the Hilum

RIGHT PNEUMONECTOMY
- Now Bleeding at the Junction of IVC & RA probably a secondary tear from resuscitative efforts
  - V. Tach
  - Asystole
  - Internal Massage, Epinephrine, Calcium
  - Cardioversion: Asystole
  - No Pulse, No Pressure – Sustained
  - No Evidence of Electrical Activity
  - Code Called: 2134

Sustained Injuries from a Single GSW to the Right Chest:

<table>
<thead>
<tr>
<th>Operative Time: 1 hr. 39 minutes</th>
<th>Surgical Resection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Lung &amp; Diaphragm</td>
<td>Right Pneumonectomy</td>
</tr>
<tr>
<td>Right Lobe of the Liver</td>
<td>Partial Hepatectomy</td>
</tr>
<tr>
<td>Gallbladder</td>
<td>Cholecystectomy</td>
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<tr>
<td>Stomach, Small Bowel</td>
<td>Closure w/ Repair</td>
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<tr>
<td>Right Colon</td>
<td>Right Colectomy</td>
</tr>
<tr>
<td>Right Kidney</td>
<td>Right Nephrectomy</td>
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</table>

- 14 units PRBC's
- 11 units Cell-Saver
- 7 units Fresh Frozen Plasma
- 12 pk. Platelets
- 11,600 cc. Crystalloid
- 1750 cc. Colloid

(Plasmanate, Hespan, 5% Albumin)

Bullets .... dangerous? The most important wounding characteristic of a projectile is its Kinetic Energy!

\[ F = m \times a \times KE = \frac{1}{2} mv^2 \]

BALLISTICS
- Internal: refers to the passage of a projectile within the gun barrel
- External: refers to the forces acting on a projectile after it has left the barrel & before it contacts the target
- Terminal: refers to the amount of energy impacted to the target by a missile

BULLET VELOCITY
- Low - Velocity: Less than 1100 ft/sec
  - Primarily injure tissue along the Wound Tract
  - e.g. Most Handguns
• High - Velocity: Greater than 2000 ft/sec
  ○ Primarily injure tissue via “Cavity Formation”
  ○ the cavity may be 30x greater than the actual bullet
  ○ e.g. M-16

**PATTERNS OF ENERGY DISPERSION**
Largely determined by the Density, Elasticity, & Cohesiveness of the tissue which has been penetrated

• The High Elasticity of Lung Tissue helps to Protect it somewhat from the Damaging Effects of Temporary Cavity Formation

• Liver, Spleen, & Brain Tissue are very similar to Water in Density & have almost no Elasticity !

**ALTERATIONS IN FLIGHT**

• Precession: a motion continuously at right angles to the plane of torque and angular momentum

• Yawing: the deviation of the bullet's longitudinal axis from the actual line of flight

• Tumbling: a three dimensional end-over-end alteration in the path of movement

**WOUND TRACTS**

• The Low-Velocity Pistol Bullet
  ○ Majority of Gunshot Wounds seen in the ED
  ○ Majority of handgun shootings occur within a 7 yard distance!
  ○ New York Police:
    ○ Officers hit their Assailants 25 % of the time
    ○ Assailants hit Police Officers 11 % of the time

• A High-Velocity Chest Wound
  ○ A Large Cavitation Effect!

  ○ The “Blast Effect”
  ○ Foreign Matter Componen
  ○ Fragmentation! A Pseudo-Shrapnel Effect...Deadly

• Shotgun at a Close Range
  ○ Multiple Wound Tracts
  ○ Usually Minimal Exit Sites
  ○ The Effect of a “Sawed-off Shotgun”
    ○ Allows a Wider Dispersion Pattern but at a Lower Velocity (the shorter barrel promotes discharge of unburned gunpowder and gas from the contained environment out into the air). “Close Range Weapon”!

• Buckshot at a Moderate Distance
  ○ At Ranges greater than 4 ft, the pellets will begin to disperse, with each pellet carrying an equal proportion of the muzzle energy
  ○ Range & the Number of Pellets in the load are the main determinants of the energy that each pellet has as it strikes the target!

• Birdshot at a Moderate Distance
  ○ a 12-gauge shotgun loaded with no. 6 Birdshot has a muzzle velocity of 1,300 ft/sec.
  ○ When fired from a distance of 12 feet, the shot will penetrate a 4-in-thick telephone book, producing a hole with a 2.4-in. diameter and releasing more than 2,000 ft-lb of energy
  ○ An M-16 Rifle has a Muzzle Energy of 1,250 ft-lb
  ○ The Shotgun delivers much greater
energy to a target at close range than does the M-16!

SUMMARY

- Pre-Hospital: Compression & Transfer
- A, B, C's
- The Type of Weapon!
- Application of Ballistic Principles
- Diagnostic studies
- Surgical Intervention
- Hopefully...recovery.

References
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