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

B Phillips

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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 Hemidiaphraghm Missing Right Lobe of the Liver Emusified: 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

- 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
    - Asysytole
    - 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:

Figure 1

Cavitation Injuries	Surgical Resection
Right Lung & Diaphragm	Right Pneumonectomy
Right Lobe of the Liver	Partial Hepatectomy
Gallbladder	Cholecystectomy
Stomach, Small Bowel	Closure w/ Repair
Right Colon	Right Colectomy
Right Kidney	Right Nephrectomy

Operative Time: 1 hr. 39 minutes

- 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 it's Kinetic Energy !

$F = m \times a$ $KE = 1/2\ mv^2$

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-guage 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

Author Information

Bradley J. Phillips, MD
Dept. of Trauma & Critical Care , Boston University School of Medicine , Boston Medical Center