Ballistic and Blast Wounds
PFN: SOMTRL04

Hours: 1.5
Instructor:

Terminal Learning Objective

- Action: Communicate knowledge of military projectile and blast mechanics
- Condition: Given a lecture in a classroom environment
- Standard: Received a minimum score of 75% on the written exam IAW course standards

References

- Explosions and Blast Injuries: A Primer for Clinicians, CDC, Referenced 2013
- Blast Injuries: Essential Facts, CDC, Referenced 2013
- Reconstruction of IED Blast Loading to Personnel in the Open: Dr. Suthee Wiri, Charles Needham, 2014
- U.S. Navy Small Arms Ammunition Advancements, NAVSEA Warfare Centers
Reason

As a SOF medic you need to understand what happens between the entrance wound and the exit wound. Understanding basic blast mechanics and the basics of military projectiles is the first step.

Agenda

- Identify basic modern military small arms projectiles and define their effects on impact
- Define ballistic wounding effects on various categories of tissue
- Describe the basic process of blast MOI
- Identify the four categories of blast injury
- Identify the primary blast wounding effects on specific organs

Ballistic and Blast Wounds
Identify Basic Modern Military Small Arms Projectiles and Define Their Effects on Impact

Basic Terminal Ballistics
- Terminal Ballistics - The science dealing with the impact of projectiles on target
  - Permanent Cavity
  - Temporary Cavity/Zone of extravasation
  - Zone of Concussion

Basic Ballistic Wound
Projectiles by Type

- High and Low velocity
- Standard full metal jacket
- Deforming, frangible, and other "high tech" bullets—Current Threat bullets

Projectiles by Type: Full Metal Jacket/AP
- The standard for modern military projectiles
- Can yaw and destabilize in tissue and inflict damage by tumbling
- AP behaves similar to FMJ, but with enhanced barrier penetration
Precession

Yaw

Theory of Bullet Behavior (Non-deforming)
Hollow Point and Soft Point Bullets

- Illegal for military use under international law, BUT extremely wide usage in law enforcement circles.
- With adequate velocity, cause massive temporary cavities, and tends not to yaw in tissue, if they expand as designed.

Typical Jacketed Hollow Point (JHP) Wound Profiles

The "Work Arouns"s"

Long history of military work-arounds attempting to achieve the effects of a JHP/SP without manufacturing a "hollow point."
MK 318 Mod 0

- Developed by USMC to correct shortcomings of M855
- "OTM" design
- "Barrier blind"
- Expansion instead of tumbling

We in America would NEVER use hollowpoints!!!

"It isn't a hollow point. It is an Open Tip Match round much like the M118.A. The jacket is drawn from the base (instead of the cheaper method of jacket drawn from the nose and an exposed lead base) to the tip of the bullet. The tiny little hole there is just a remnant from jacketing the bullet that way. It isn't designed for expansion or calculated to cause unnecessary suffering, so it doesn’t violate the Hague conventions”

– Commentator “explaining” MK 318 Ammo

MK 319 Mod 0:
The 7.62 Variant

- Designed to correct the shortcomings of M80 Ball FMJ
- Specifically designed to maintain velocity from carbine length 7.62 weapons.
- Designed to reduce recoil from 7.62 weapons.
- Same basic design principles of MK 318 ammunition.
M855A1 Enhanced Performance Round: The "Green Round"
- The Army Solution
- Steel Penetrator sitting in a solid copper cup.
- Combines the attributes of an AP bullet with those of a hollow point.
- Capable of penetrating 3/8in. Steel at 400m, with 50% of rounds completely penetrating plate.

The "Work Arounds": Threat Variations
5.45x39 7N6 Various configurations to include:
- Pictured version with air pocket
- Updated version with (possibly) frangible tip and enlarged steel penetrator, renamed 7N10.
- 7N10 capable of penetrating 16mm of steel armor at 100m with 80% of shots fully penetrating the plate.
- Older version without air-pocket

Armor Piercing/Armor Piercing Incendiary
- Typically a standard bullet integrating a steel penetrator, and/or incendiary chemicals.
- Some variants also utilize tungsten with a sabot type design (US SLAP)
- High-Tech threats, such as Russia and China, can be expected to utilize armor piercing ammo in small arms.
- Russian B32 7.62x54 API capable of penetrating 1cm armor at 200 yards
AP/API Cont:
Heavy Caliber Sniper Systems
- Combine the capabilities of .50 BMG (or larger) AP munitions with the capability of precision shot placement.
- Users of .50 cal. SWS includes Iran, Mexican Drug Cartels, etc.
- M903 SLAP penetrates 18mm Steel plate at 1,500 m.
- Standard Russian 12.7mm API penetrates 13mm steel plate at 1,000 m.

Munitions for Hard Target Interdiction Rifles
RUAG Swiss API
Mk211 Armour Piercing Explosive Incendiary

"High Tech" Ammo
Specialized low penetration ammo
Ultra high velocity Handgun ammo
Low penetration "varmint" ammo
Glaser Blue
Define Ballistic Wounding Effects on Various Categories of Tissue

Skull and Brain

Skull and Brain
Solid Contact and Near Contact Wounds

Lungs

- Low-density tissue
- Low energy transfer
- Tissue struck prior to lung tissue will influence damage
- Very delicate and vascular tissue
- Pneumothorax and hemothorax are the most common result
- Lung parenchyma tolerates cavitation fairly well
Lungs

Solid Organs

- Liver, kidney, and spleen
- Very vascular
- "Capsule" like and low elasticity
- Do not tolerate cavitation or shearing forces well
- Have tendency to rupture
- Heart can be considered a solid organ

Solid Organs (Liver)
Solid Organs (Heart)

Solid Organs (Heart)

Carotid

Aorta

Left ventricle

Apex

Hollow Organs

- Stomach, intestines, and bladder
- Very elastic
- Relatively less vascular than solid organs
- Relatively smaller permanent cavity and zone of extravasation
Bone

- Very dense
- Large energy transfer
- Secondary fragmentation
- Can be very vascular
- Can deflect bullet path

Describe Basic Process of Blast MOI

Blast Wave

- Pressure Wave
- Blast Winds
- Flame Front
Blast Wave

- The shock wave generated by the rapid release of gas from an explosive is termed *blast wave*.
- The rush of air caused by the net motion of the gas is termed *blast wind*.
- Increased pressure (above normal atmospheric pressure) from a blast is termed *blast overpressure*.

Blast Overpressure

- The level of overpressure will depend on:
  - Energy of explosion
  - Distance from the point of detonation
  - Elapsed time since the explosion
  - Environment of explosion (enclosed/open space or under water)

Blast Overpressure

- Blast Wave Reflection
  - Casualties struck by the direct and reflected blast waves receive the overpressure effects of both waves.
Confined Space Explosion

- Increased overpressure by containment
  - Enclosed room, vehicle, water, etc.
  - Increased risk of primary blast injury

Reconstructed Blast Scenario

Overpressure versus time
Blast Gauge Data

Identify the Four Categories of Blast Injury

Four Categories of Blast Injury

- Primary injury - caused by the direct effect of blast overpressure on tissue
  - Affects air-filled structures: spalling, shearing, rupture, and implosion
- Secondary injury - collateral damage from blast projectiles (e.g. shrapnel)
Four Categories of Blast Injury

- Tertiary injury - results from the victim being propelled through the air and striking stationary objects
- Quarternary injury - all other injuries caused by explosions
  - Burns, smoke inhalation, crush, chemical agent release, etc.

Overpressure Protection

- Barrier protection (ear & eye protection, face shield, and body armor) may mitigate blast injury
- Barriers partially deflect the blast wave; reduces amount of overpressure absorbed by victim
- The extent of protection offered from barriers is not well quantifiable (endless variables)

Identify the Primary Blast Wounding Effects on Specific Organs
Blast Lung Injury (BLI)

- Overpressure/under-pressure cycle generally traumatizes lung parenchyma
- Collapses alveoli, injures vessels, tension pneumothorax often secondary to BLI
- Inflammation results in further fluid shift/pulmonary edema.
- Air Emboli

BLI Cont.

- "Wet lungs" to auscultation
- Dypsnea
- Poor perfusion/SPO2
- Pink frothy sputum
- Signs may be subtle, and may develop over time.
- Building tension-pneumo???
- 10mg Dexamethazone IV/IO/IM/PO QD X 5 days
- NO needle decompression UNLESS positive signs of a true tension pneumothorax
- Caution with positive pressure ventilation

- "Wet lungs" to auscultation
- Dypsnea
- Poor perfusion/SPO2
- Pink frothy sputum
- Signs may be subtle, and may develop over time.
- Building tension-pneumo???
Abdominal Blast Injury

- Perforation
- Hemorrhage
- Peritonitis/Rapid onset of sepsis due to gram neg. anaerobes.

YOU DO NOT HAVE EQUIPMENT IN YOUR AID BAG TO SEE THESE. YOU MUST BE ALERT TO INSIDEOUS ONSET OF SYMPTOMS!!

General Considerations

- Compartment syndrome, rhabdomyolysis, and acute renal failure are associated with structural collapse, prolonged extrication, severe burns
- Possibility of exposure to inhaled toxins in both industrial and terrorist explosions
- Significant percentage of survivors will have serious eye injuries
- Suicide Bombing results in exposure to body pathogens due to parts of the bomber's body becoming shrapnel
Questions?

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Reason

As a SOF medic you must understand the nature of ballistic and blast wounds in order to effectively assess and treat combat casualties on the battlefield and in a clinical setting.
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