



PENETRATING TRAUMA

DND Primary Care Paramedicine

Module: 05

Section: 04

- Introduction
- Physics of penetrating trauma
- Specific tissue/organ injuries
- Special concerns

- The number and severity of penetrating traumas increased greatly
- Additional mechanisms
 - Knives
 - Arrows
 - Nails
 - Pieces of glass or wire

- Recall kinetic energy equation
 - Double the mass, double the energy
 - Double the speed, quadruple the energy
- Explains why small fast bullets have the potential to do great harm
- Wounds from rifle bullets are two to four times more lethal than handguns
 - Heavy bullets travelling very fast

- Different projectiles of different weights traveling at different speeds cause:
 - Low energy/low velocity
 - Knives and arrows
 - Medium energy/medium velocity weapons
 - Handguns, shotguns, low-powered rifles
 - High energy/high velocity
 - Assault Rifles

- Study of the characteristics of projectiles in motion and effects upon objects impacted
- Aspects of projectile motion
 - Trajectory
 - Energy dissipation

- The path a projectile follows
- Bullets are pulled down by gravity as they travel through the air
 - Causes a curved path
 - The faster the bullet the straighter the path

- Drag
- Cavitation
- Profile
- Stability
- Expansion
- Shape



- Handguns
 - Small caliber, short barrel, medium-velocity
 - Effective at close range
 - Severity of injury based upon organs damaged
- Rifle
 - High-velocity, longer barrel, large caliber
 - Increased accuracy at far distances

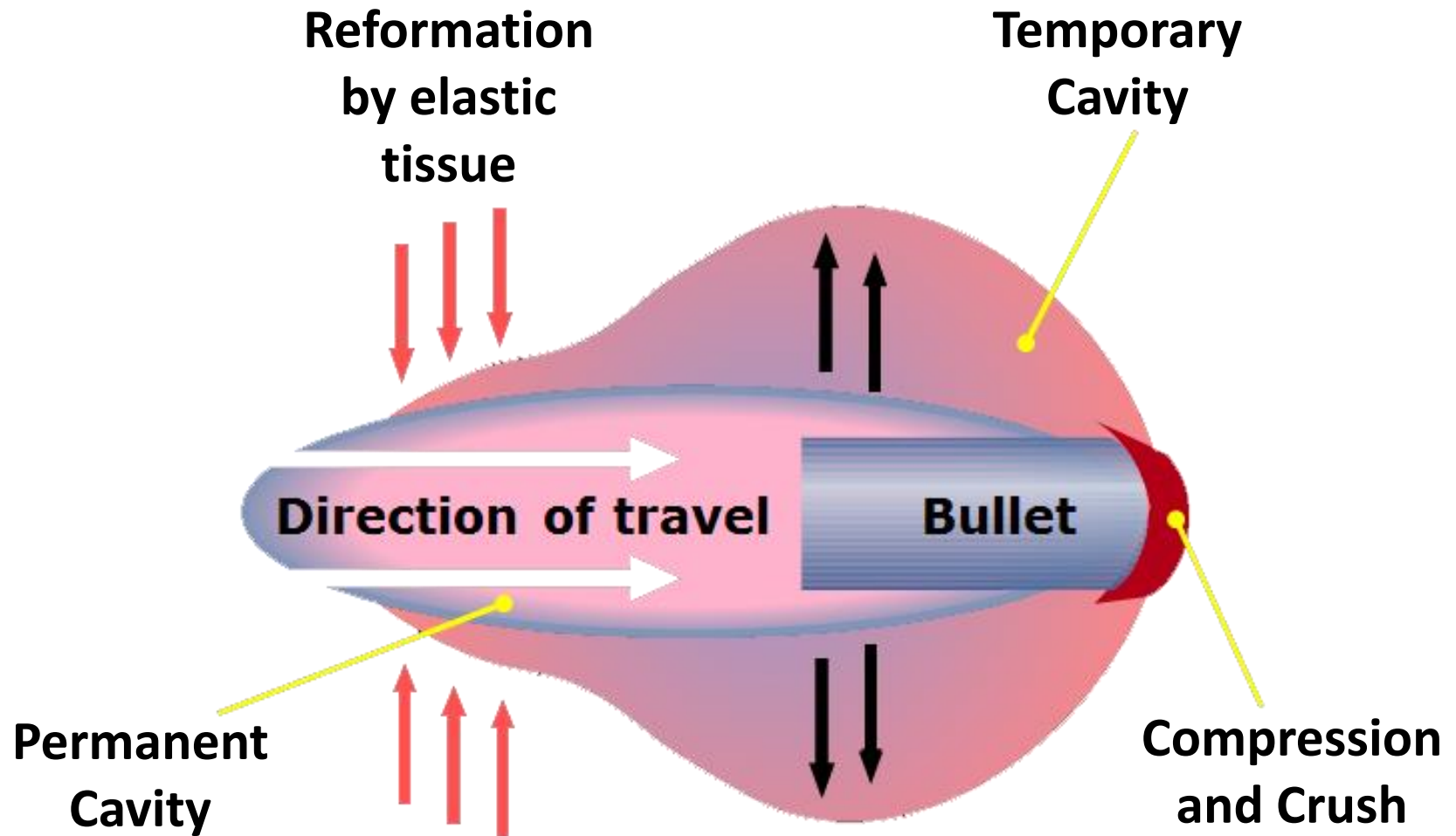
- Assault Rifles
 - Large magazine, semi- or full-automatic
 - Similar injury to hunting rifles
 - Multiple wounds
- Shotgun
 - Slug or pellets at medium velocity
 - Larger the load, the smaller the number of projectiles
 - Deadly at close range

- Knives and arrows
 - Low-energy and low-velocity
 - Damage related to depth and angle of attack
 - Movement of the victim can increase damage
 - The extent of the damage is often difficult to assess

- Tip impacts tissue
- Tissue pushed forward and to the side
 - Tissue collides with adjacent tissue
- Shock wave of pressure forward and lateral
 - Moves perpendicular to bullet path
 - Rapid compression, crushes and tears tissue
- Cavity forms behind bullet pulling in debris with suction.

- Direct injury
 - Damage done as the projectile strikes tissue
- Pressure shock wave
 - Human tissue is semi-fluid
 - Solid and dense organs are damaged greatly

- Temporary cavity
 - Due to cavitation
- Permanent cavity
 - Due to seriously damaged tissue
- Zone of injury
 - Area that extends beyond the area of permanent injury



- Entry wound
 - Smaller
 - May be darkened, burned
- Exit wound
 - One, none or many
 - Larger
 - May be ragged

- Objects
 - Knives, ice-picks, arrows
 - Flying objects or debris
 - Slow speed limits kinetic energy exchange as the object enters the body
- Injury limited to tissue impacted
 - Object pathway
 - Object may be twisted or moved
 - May be inserted at an oblique angle

- 20 y/o male involved in a fight with another male at a bar.





- Male attacker
 - Most often strike with forward, outward or crosswise stroke
- Female attacker
 - Strike with an overhand, downward stroke
- Victim
 - Initially attempt to shield themselves with their arms
 - Often receive upper extremity lacerations (defensive wounds)

- Extent of damage varies by the particular type of tissue that a projectile encounters
- Density of tissue affects the efficiency of energy transmission
- Resiliency:
 - Strength and elasticity of an object

- Dense, elastic and held together very well
- Limited tissue damage
 - Characteristically absorbs energy
 - Wound track closes quickly due to resilience, limiting projectile's pathway

- Solid organs
 - Have density but not resiliency
 - Tissues compress and stretch in relation to cavitation wave
 - Hemorrhage tends to be severe
- Hollow organs
 - Filled with noncompressible fluid that rapidly transmits energy
 - Energy can tear organ apart explosively
 - Slower, smaller projectiles may produce small holes and create slow leaks

- Air in lung absorbs energy
- Parenchyma is compressed and rebounds
- Injury less extensive than with other tissue
- Significant disruption of chest wall integrity may result in pneumothorax or hemothorax

- Densest, most rigid and nonelastic body tissue
- Resists displacement until it fractures often into numerous pieces
- Significantly alter projectile's path through the body

- Extremities
 - Injury limited to resiliency of tissue
 - 60-80% of injuries with <10% mortality
- Abdomen (includes pelvis)
 - Highly susceptible to injury and life-threatening hemorrhage
 - May perforate bowel resulting in irritation and infection

- Thorax
 - Rib impact results in explosive energy
 - Heart and great vessels have extensive damage due to lack of fluid compression
 - Any large chest wound compromises breathing

- Neck
 - Traversed by several critical structures
 - Penetrating trauma likely to damage vital structures:
 - Airway compromise
 - Hemorrhage
 - Neurological deficits
 - Associated swelling and hematoma may lead to similar complications

- Head
 - Skull is a hollow strong and rigid container
 - Brain is a delicate semisolid organ very susceptible to injury
 - If bullet penetrates the skull, cavitation energy trapped, damage extensive
 - Suicide attempts often result in facial trauma as a result of weapon recoil

- Size of bullet profile for non-deforming bullets
- Deforming projectiles may cause large wounds
- Close Range
 - Powder burns (tattooing of powder)
 - 1-2 mm circle of discoloration
 - Localized subcutaneous emphysema

- Caused by the physical damage
 - Passage of bullet
 - Cavitation wave
- Blown outward appearance
- May more accurately reflect damage caused by bullet

- Ensure that police have secured the scene before you enter it
 - Potential for violence
- Consider the possibility
 - Additional assailants
 - Victim may be armed
- Preserve crime scenes as much as possible
 - Cut around bullet or knife holes and preserve clothing as evidence

- Determine pathway of object
 - Projectiles do not always travel in straight lines
 - Look for entrance and exit wounds
- Anticipate potential organ injury
- Bullet wounds to head, chest or abdomen
 - Rapid transport
 - Treat aggressively for shock

- Gunshot wounds may destroy airway landmarks
- May have to consider more invasive procedures

- Chest wall is thick and resilient
- Requires a large wound to create opening for air movement
 - Smaller wounds usually result in no air movement
- May have to utilize:
 - Three sided dressing or chest seal
 - Needle decompression
- Consider the possibility of trauma to the heart and great vessels

Chest Wounds



- Mainly a low velocity wound, dangerous to remove
 - May cause more damage on exit
 - May be restricting blood loss
- Immobilize as the object is found
- Objects to be removed
 - Lodged in cheek or trachea that interfere with airway
 - Interfering with CPR



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