



## Chapter 65 – Forensic Medicine

### Episode Overview:

1. What are some pearls and pitfalls for ER physicians when dealing with Forensic Emergency Medicine?
2. What are proper terms used to describe wound injury patterns?
3. What is the anatomy of a cartridge (bullet)? What are the types and important aspects of wound ballistics?
4. What signs would you see for the various ranges of fire of a bullet?
5. What are common red flags to alert you to the possibility of domestic violence? What risk factors make domestic violence more common?
6. Describe the different types of blunt force pattern injuries and the pathophysiology of how they occur. Describe the same for sharp force and thermal wounds.
7. What does the Health Insurance Portability and Accountability Act permit a physician to disclose to the investigating law enforcement officer?

### Rosen's In Perspective:

#### Forensic EM:

- An area of specialty within EM originally spearheaded by the University of Louisville, but with little exposure in Canada; more of it in the USA and elsewhere
  - The British have the FFLM - with a certification after 2 years of study
  - See: <https://www.acep.org/content.aspx?id=25104> for more information!
    - An excellent 90 page FREE e-book on the “evaluation of the sexually assaulted and abused patient”
    - This is an excellent primer on the subject, highlighting why it is relevant for all emergency medicine providers!
      - <http://www.acepnow.com/article/eps-continue-improve-forensic-skills/>
- The forensic exam consists of:
  - History, physical examination
  - photographs and anatomic diagrams
  - Evidentiary material may also be collected
- And the Forensic exam is useful in many emergency department contexts:
  - Gunshot / stab wounds
  - Physical or sexual abuse
  - Domestic violence
  - MVC's
  -

#### Rosen's goes through three headings:

- Forensic aspects of:
  - Gunshot wounds
    - Much more prevalent elsewhere than in Canada, so we won't cover this in great detail...
  - Physical assault
  - Motor vehicle trauma



## 1) What are some pearls and pitfalls for ER physicians when dealing with Forensic Emergency Medicine?

- Pitfalls:
  - Physicians assessing and treating injuries without considering their forensic significance; we are terrible at this 30-70% of the time committing errors of omission or commission by disposing of evidence!
    - **Misinterpretation of wounds**
    - **Fail to recognize victims of abuse or domestic violence**
    - **Inadequate description of wounds**
      - Poor, improper, inadequate documentation of evidence
    - **Evidence can be lost, discarded, destroyed or washed away**
      - The Joint commission requires physicians to “preserve evidentiary materials and support future legal actions”
      - We need to work WITH law-enforcement:
        - Preserve evidence (e.g. plastic forceps, rather than metal ones)
- Pearls:
  - Documentation, documentation, documentation!!
    - The chart is going to court - write it up so!
    - You won't remember anything about the case two years from now, so don't cut corners
  - Draw pictures, measure wounds, use diagrams
  - Carefully handle evidence:
    - Preserve the chain of custody, but remember that police need the patient's consent OR a search warrant to obtain evidence from the patient. So we shouldn't just hand the patient's belongings to the law enforcement personnel
    - Try to avoid cutting through bullet holes in the clothing and carefully place the evidence in a safe place
    - Handle bullets with gloved fingers or cover the tips of surgical instruments with gauze so as to not destroy the “bullet fingerprints” used to identify the firearm that the bullet came from

## 2) What are proper terms used to describe wound injury patterns?

### Wound

- Anatomic location
- Size
- Shape
- Characteristics
  - Soot - carbonaceous material on the edges of a wound
  - Edge descriptions

Do NOT attempt to identify “exit” or “entry” wounds, what caused the wound, the caliber of the bullet, etc...

From Rosen's: “The size of any wound (entrance or exit) is determined by five factors: the size, shape, configuration or angle, and velocity of the projectile at the instant of impact with tissue and the physical characteristics of the impacted tissue itself.” So there are many factors...and any ignorant attempt to draw conclusions will not help the court determine

innocence or guilt. Just look through the images in Rosen's to see the wide spectrum of features....there's a reason why forensics takes years to learn!

Don't use terms like "powder burns"; don't attempt to determine if it was a homicidal/suicidal/accidental GSW

### 3) What's the anatomy of a cartridge (bullet)? What are the types and important aspects of wound ballistics?

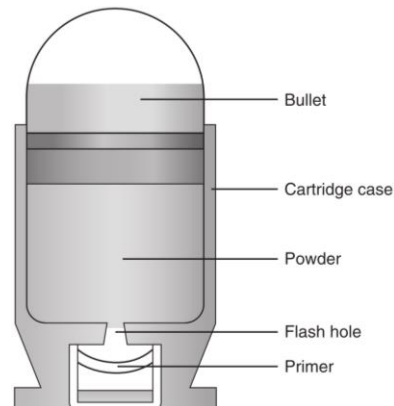


Figure 65-1. A cartridge consists of several distinct components: bullet, cartridge case, gunpowder, flash hole, and primer.

- Primer
- Cartridge case
- Powder
- Bullet
  - The Diameter of the bullet's base determines its **caliber**
    - This is described in hundredths of an inch or in millimeters
      - E.g. a .22 caliber is 5.56 mm
    - A bullet's weight is measured in grains
  - "The most common bullet types are the round nose, the full metal jacket, the hollow point, the wadcutter, and the semi-wadcutter." - Rosen's
  - The hollow points significantly increase soft tissue damage.

When the powder is ignited, a small percentage of it can travel out the end of the muzzle for up to 48 inches (1.2 meters)

Wound severity (tissue destruction) is described by:  $KE = \frac{1}{2} m v^2$

**So, higher velocity guns (long rifles) will have higher wounding potential.**

The mechanism by which bullets cause damage is "crushing". The bullet creates two cavities:

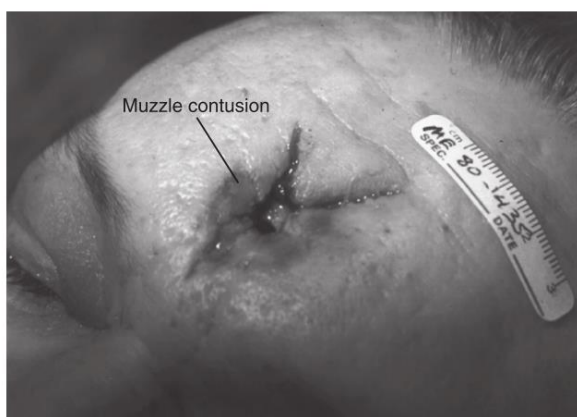
1. Permanent cavity
  2. Temporary cavity - due to tissue stretching over milliseconds
- A hollow-point bullet increases its diameter 2.5 times, and will increase the crush area up to 6.25 times.
  - A high velocity bullets create MASSIVE temporary cavities (shockwaves) that can be >10x the size of the bullet, leaving a massive amount of soft tissue destruction in their wake...

#### 4) What signs would you see for the various ranges of fire of a bullet?

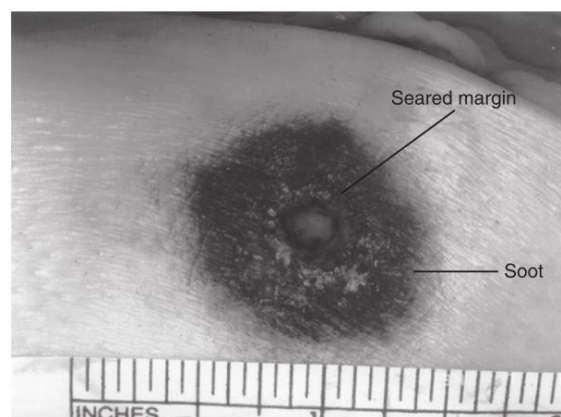
There are four categories - they relate to the distance from the muzzle (end of the gun) to the victim. THESE APPLY TO HANDGUNS....

RANGE	INCHES (BARREL TO SKIN)	PHYSICAL PROPERTIES
Contact	0	Soot, seared skin, triangular tears
Close	0-6	Soot, abrasion collar (abrasion collar may be obscured by soot)
Intermediate	<48	Tattooing, abrasion collar
Distant or indeterminate	Any distance	Abrasion collar (intermediate objects will prevent soot and gunpowder from contacting the skin)

- Contact wounds: the gun muzzle is pushed next to the patient’s skin/clothing
  - Rosen’s has a couple pictures on this.
    - Look for **soot-seared blackened wound edges** from the explosion of hot gases, flames and gunpowder
    - It may form a **stellate wound** from the injection of hot gases under the skin forming tears
    - Look for muzzle contusions

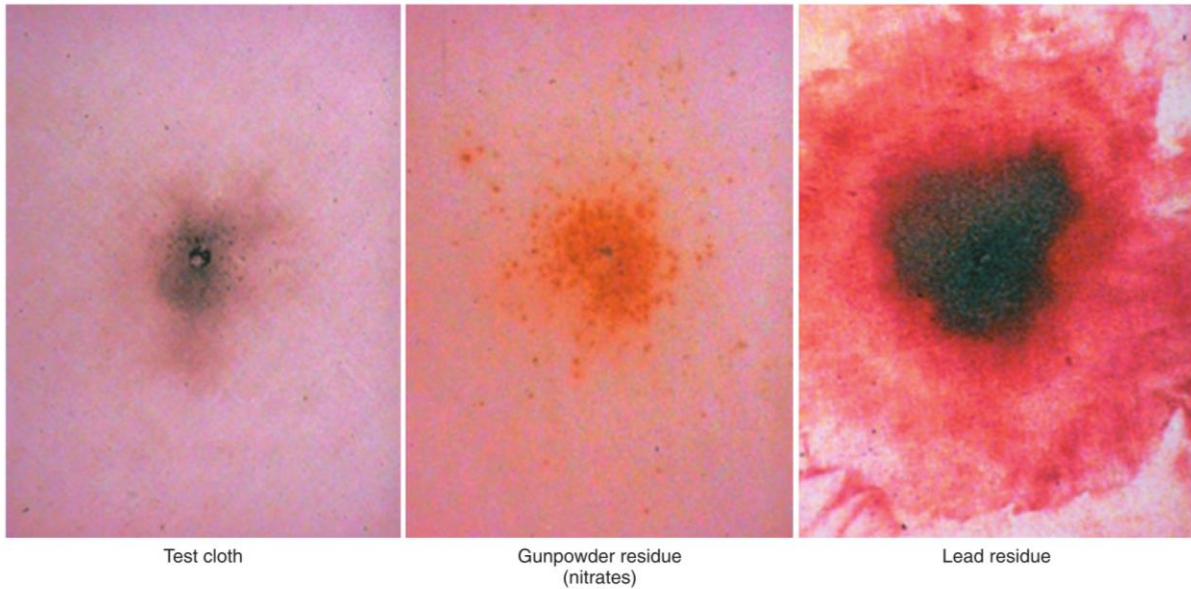


**Figure 65-3.** A muzzle contusion is a contusion caused by skin expansion against the barrel of the weapon. Muzzle contusions are associated with contact wounds.



**Figure 65-4.** Close-range wound with soot deposition. Soot is associated with a range of fire of 6 inches or less.

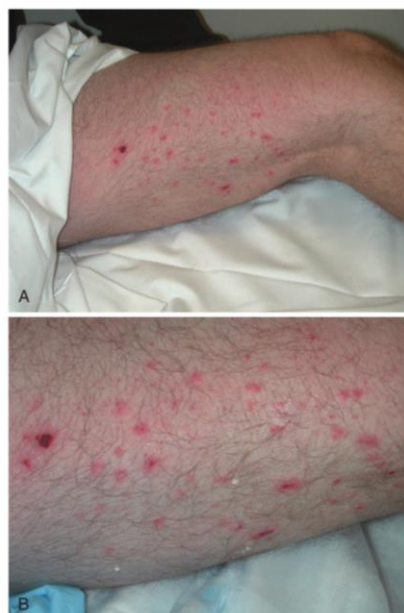
- Close range wounds: “the maximum range at which **soot** is deposited on the wound or clothing”



**Figure 65-5.** Gunshot residue testing conducted at 6 inches with a .32-caliber revolver. The testing searches for the presence of soot (burning of gunpowder), nitrites (unburned gunpowder), and vaporized lead residue. These tests determine the range of fire from the barrel to the clothing.

- This is usually found at distances of 0-15 cm
- Intermediate range
  - This is a pattern caused by partially burned pieces of gunpowder - which (unlike soot) **cannot be wiped away**
  - This is usually found at distance of 60 cm or less
- Long range:
  - The wound is from the bullet hitting the skin - causing an abrasion collar.
  - This can be from a bullet from any distance: 3 meters to 300 meters - because the skin findings can appear the same
    - Therefore it is called **indeterminate range**

**Don't forget about pseudo-tattooing:**



**Figure 65-9.** "Pseudotattooing" or punctate abrasions from glass fragments, not unburned gunpowder, on the medial aspect of the thigh associated with a gunshot wound. The leg was showered with glass fragments after the round penetrated the windowpane.



Rifles and shotguns - cause massive amounts of damage depending on the caliber or type of round discharged. E.g. Shotgun shooting buckshot vs. a slug

### 5) What are common red flags to alert you to the possibility of domestic violence? What risk factors make domestic violence more common?

- The stats on the incidence of domestic abuse are staggering; some sources state that 40% of victims of abuse come to the ER 6 or more times before being identified as victims of domestic abuse.

### 6) Describe the different types of blunt force, sharp force, and thermal pattern injuries and the pathophysiology of how they occur.

#### Blunt force injury patterns

##### Box 65-1 Commonly Inflicted Pattern Injuries

Slap marks with digits delineated  
Looped or flat contusions from belts or cords  
Circular contusions from fingertip pressure  
Parallel contusions with central clearing from linear objects  
Contusions from shoe heels and soles  
Semicircular contusions and abrasions from bite marks

- Contusions
  - Pattern contusions with parallel lines and central clearing (bat), circular contusions (from finger tips), kick from a tennis shoe leaving an imprint
  - It's not possible to date contusions based on their colour
- Abrasions
  - Rubbing or scraping away of the superficial layers of epidermis (as occurs in some bite trauma)
- Lacerations
  - Tears in the skin
    - *Abraded or crushed skin*

#### Sharp force injury patterns

- Incised wound = longer than it is deep
- Sharp wound = deeper than it is wide

These have clean wound margins.

May be important for ER physicians to be able to differentiate self-inflicted wound patterns from those sustained during an assault:

- Self inflicted:
  - Multiple, parallel superficial incisions
  - Non-dominant side of the body
  - Sparing sensitive areas



### Box 65-2 Characteristics of Self-inflicted Knife Wounds

Multiple superficial incisions located on the anterior trunk, arms, and face  
Multiple superficial stab wounds located on the anterior trunk, arms and face  
Parallel incisions, in close proximity to each other, on the nondominant side of the body  
Sparing of sensitive body areas  
Linear or curved incisions toward the hand inflicting the wound  
Intact clothing covering the wound  
Evidence of prior wounds in repeat offenders

### Thermal force injury patterns

- Look for sharp/clear lines of demarcation - dipping or immersion burns
- Irregular borders = splash burns
- Round or oval shapes = drops of hot liquid or cigarettes

Length of time and temperature of the liquid/object determines the severity of the burn.

### **7) What does the Health Insurance Portability and Accountability Act (HIPAA) permit a physician to disclose to the investigating law enforcement officer?**

#### **From Wikipedia:**

“The effective compliance date of the Privacy Rule was April 14, 2003, with a one-year extension for certain "small plans". The HIPAA Privacy Rule regulates the use and disclosure of Protected Health Information (PHI) held by "covered entities" (generally, health care clearinghouses, employer sponsored health plans, health insurers, and medical service providers that engage in certain transactions.)<sup>[16]</sup> By regulation, the Department of Health and Human Services extended the HIPAA privacy rule to independent contractors of covered entities who fit within the definition of "business associates".<sup>[17]</sup> PHI is any information held by a covered entity which concerns health status, provision of health care, or payment for health care that can be linked to an individual.<sup>[14]</sup> This is interpreted rather broadly and includes any part of an individual's medical record or payment history. Covered entities must disclose PHI to the individual within 30 days upon request.<sup>[18]</sup> They also must disclose PHI when required to do so by law such as reporting suspected child abuse to state child welfare agencies.<sup>[19]</sup>

Covered entities may disclose protected health information to law enforcement officials for law enforcement purposes as required by law (including court orders, court-ordered warrants, subpoenas) and administrative requests; or to identify or locate a suspect, fugitive, material witness, or missing person.<sup>[20]</sup>”



## Wisecracks:

“Some simple tips and techniques can make a difference in fulfilling the forensic needs of the patient and the criminal justice system.” <http://www.acepnow.com/article/eps-continue-improve-forensic-skills/>

Check out the link above for a great summary of steps to take (outlined below).

### **1. Comprehensive injury documentation**

- a. Include thorough descriptive words
- b. Draw injury / body maps
- c. Using a documentation camera

### **2. Preserve clothing evidence carefully**

- a. Place in paper bags (plastic bags promote degradation of DNA evidence), and cautiously cut through clothing

### **3. Handle firearm evidence gently**

- a. Use gloved hands

### **b. Place evidence in paper envelopes and use plastic clamps to remove foreign bodies / shrapnel**

### **4. Preserve the chain of custody**

- d. Carefully document who, what, when, where, how evidence was obtained, placed and passed on

### **5. Collaborate with your forensic nurse examiners**