

Gunshot Wounds

- ED Management

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天祐台灣

炮聲夾道 扁呂受寄繼任...中槍了

【本報台北、高雄十一日電】連戰、/台



總統連戰和副總統呂秀蓮，昨日下午到台南市新莊區，實、兩人同乘一輛巡邏車，經過金華路二段時遭槍擊；連戰被連開兩槍，共彈了二十二針，呂副總統右膝受傷，送醫後經搶救後均無生命危險。

台南市警方在金華路二段十一號設崗，找到兩顆彈殼，已即送驗屍檢驗。這兩顆彈殼，是連戰的左腿和右腿。

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問題 (1)

● 請問 .33 口徑子彈的直徑是幾 mm ?

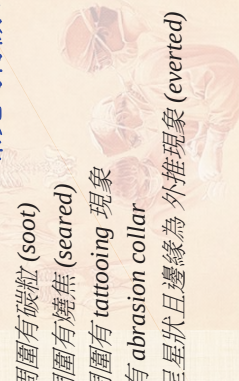
- A. 約 11 mm
- B. 約 8 mm
- C. 約 5 mm
- D. 約 3 mm



問題 (2)

● 何者不是 **entrance wound** 常見的特徵 ?

- A. 傷口周圍有碳粒 (soot)
- B. 傷口周圍有燒焦 (seared)
- C. 傷口周圍有 tattooing 現象
- D. 傷口有 abrasion collar
- E. 傷口呈星狀且邊緣為外推現象 (everted)



問題 (3)

● 請問何者是決定子彈傷口外觀的因素 ?

- A. Caliber
- B. Velocity
- C. Jacketed or not
- D. Tissue type
- E. All of the above



問題 (4)

- 請問哪種子彈的傷害最可能併發 **vascular embolism** 的現象？

- A. Lead nose
- B. Hollow point
- C. Fully jacketed bullets
- D. Teflon bullets
- E. Magnum rounds

問題 (5)

- 高速子彈是指速度超過？

- A. 500 fps
- B. 1000 fps
- C. 1500 fps
- D. 2000 fps
- E. 2500 fps

Hint: fps = feet per second

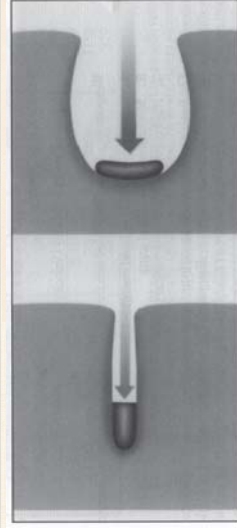
Definitions

- **Missile injury**
 - any object that travels and causes physical contact and hence injury
- **Ballistics (彈道學)**
 - motion of projectiles
- **Internal ballistics**
 - study of projectiles in weapons
- **External ballistics**
 - study of projectiles in air
- **Wound ballistics**
 - study of projectile penetration of tissues

Wounding Potential

- **Rules**
 - Kinetic Energy = $\frac{1}{2}MV^2$
 - Energy cannot be created or destroyed
- **Consider**
 - Range
 - Weapons
 - Ammunition characteristics
 - Path & entry profile
 - Anatomy of impact site

Cavitation



Energy exchange between moving object and body tissue

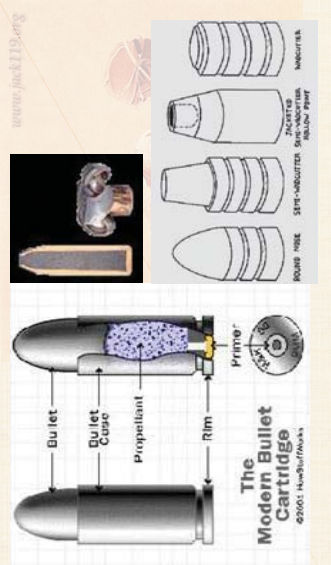
1. Surface area of impact point
2. Density of tissue
3. Velocity of projectile at impact

Wound at Point of Impact

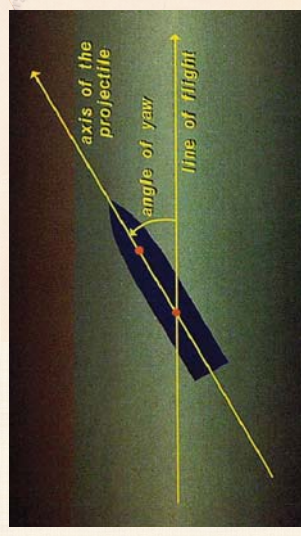


- Shape of missile ("mushroom")
- Ballistic tumble and yaw
- Fragmentation (shotgun, bullet fragments, special bullets)

Mushroom (Deformation)



Yaw (偏航)



Tumble (翻滚) and Yaw



Bullets

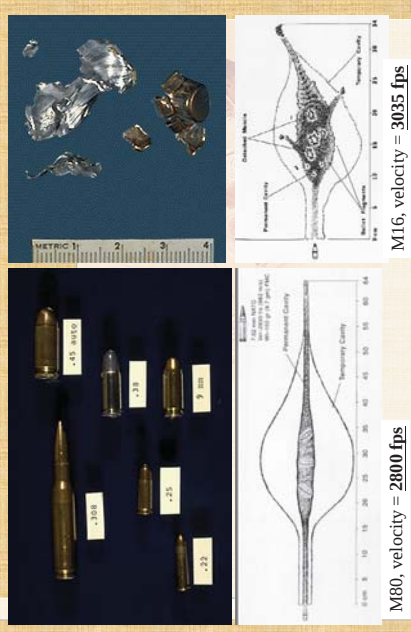
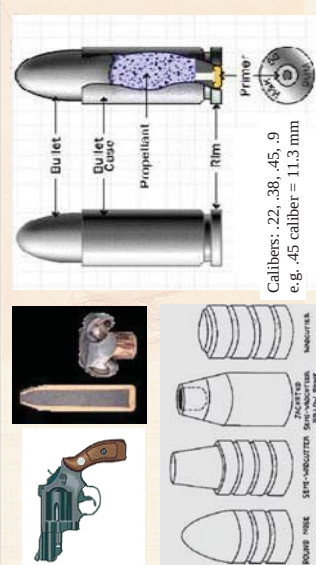
Low-velocity missiles

- Lead bullets: melt if > 2000 ft/s
- Semi-jacketed bullets: lead nose / hollow point – designed to mushroom

High-velocity missiles

- Fully jacketed with copper-nickel or steel
- Teflon bullets
 - Slugs (散彈), pellets (小彈珠)
- Magnum rounds
 - Cartridges with greater amount of gunpowder

Low-Velocity Missiles



High-Velocity Missiles



Teflon Bullets



Magnum Rounds (高彈藥量子彈)



Size



Energy Level of Projectiles

- **Kinetic energy**
 - Kinetic Energy = $\frac{1}{2}MV^2$
 - Muzzle velocity $\neq$ Impact velocity
- **Low-energy weapons**
 - Knife / hand energized missiles
- **Medium-energy weapons**
 - Hand guns
- **High-energy weapons**
 - Hunting / military rifles

ATLS

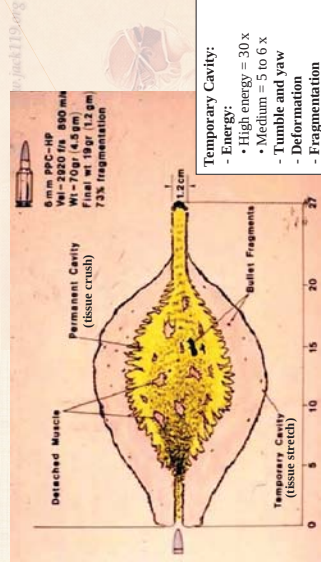
Velocity and Energy Level

- **Conventional classification:**
 - Low velocity < 1000ft/s (305m/s)
 - Handguns / air-rifles
 - Medium Velocity 1000-2000 ft/sec (305-610m/s)
 - Shotguns
 - High Velocity > 2000ft/s (>610m/s)
 - Rifles / semi-automatic / automatic
- **BUT**
 - Energy of weapon $\neq$ Energy on impact with tissue
 - The velocity of a projectile is highest at the muzzle and drops off steadily because of air resistance
 - Treat the wound not the weapon

Missile Kinetic Energy

Caliber and Manufacturer	Bullet Weight (Grains)	Velocity (Feet/Second)	Energy (Foot-Pounds)
Rifle Ammunition			
.22 Remington Rim Fire	40	1180	124
300m .243 Winchester	115	2900	2607
300m .270 Winchester	150	3000	3000
.308 Winchester	165	2900	3000
.375 H and H Magnum	270	2720	4440
Handgun Ammunition			
.25 Remington Automatic	50	810	73
.32 Short Remington	80	745	100
.32 Automatic Remington	71	960	140
.357 Magnum Remington	158	1410	540
.38 Special Remington	158	965	255
9mm Luger	140	850	220
10mm Automatic	170	1340	680
.44 Magnum Remington	240	1470	1150
.45 Automatic Remington	230	850	370

Temporary Vs. Permanent Cavity

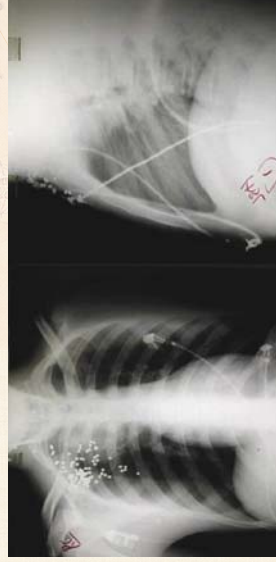


Shotgun Wounds

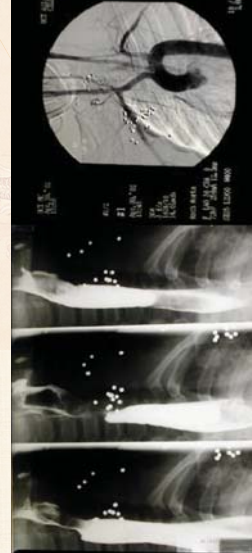


- Spread occurs at 14 inches
- Close-range shots may introduce clothing and wadding (infection) (包装・填塞物)
- Pool ball effect
- Blast effect
- Rarely exit
- Embolize
- Lethal at close range; ineffective at greater distance

Shotgun Wounds



Shotgun Wounds



Range of Fire

Wound characteristics vary:

- Contact
 - The most devastation
- Close Range
 - Arm's length
- Distant
 - Most handguns: significant decrease in KE at 100 m
 - Most military rounds: retain large KE at 500m

At Close / Contact Range



Tattooing

Entrance Vs. Exit Wounds

- **Caution!**
- **Wound appearance:**
 - Type of projectile
 - Jacketed or not
 - Hollow-point / ball ammunition
 - Velocity
 - Yaw
 - Tissue type
- **Legal purpose?**

Entrance Wound



Soot is a carbonaceous material which will deposit on skin.

stellate tears are the result of injection of hot gases beneath the skin.

Entrance Wound



"Tattooing" = punctate abrasions from unburned grains of gunpowder.

Entrance Wound

- Only one single wound
- Histologic evidence of powder burns around wound

Exit Wound



1. Skin edges are generally everted.
2. Abrasion collars and soot are not usually associated with exit wounds.
3. Tattooing is never seen at an exit wound.
4. Are NOT always larger than its corresponding entrance wound.
5. May not appear directly opposite the entrance wound.

Clinical Purpose

- **2 holes = entrance & exit**
 - Anatomy damaged
 - Type of surgical procedure
- **Entrance**
 - Round or oval with surrounding 1 to 2-mm blacked area of burn or abrasion
 - Close range: tattooing, subcutaneous air
- **Exit**
 - Stellate / slit-like in appearance



GSW?

總統右腹流血 走進急診室 縫了32針



陳水扁總統昨天在台北市榮民醫院急診室中腹，子彈擦傷腹部，傷處長約十一公分，寬似深處約兩公分，傷處內有碎骨。

記者張建國攝 / 趙國

Entrance or Exit?

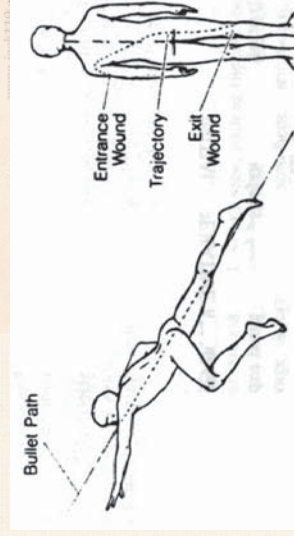


Entrance or Exit?



A 'shored' exit wound has the appearance of a 'false' abrasion collar. This false abrasion collar results when epithelium is forced outward and makes contact or is slapped against a supporting structure, i.e. floor, wall or furniture. A short exit may also be referred as a supported exit wound.

Entrance Vs. Exit Wounds



ED Management

- **ATLS approach**
 - A - B - C - D - E - Secondary survey - Transfer
- **Consider Intra-abdominal injury**
 - Small wounds can have associated extensive internal damage
- **Signs of vascular injury**
 - Missile do not always travel in straight lines
 - Hematoma, pulse deficit, bruit, pulsatile or uncontrolled bleeding
 - Need urgent investigation
- **Wound description and projectile collection**
 - Legal-forensic consideration
- **Beware multiple wounds**

Abdominal GSW

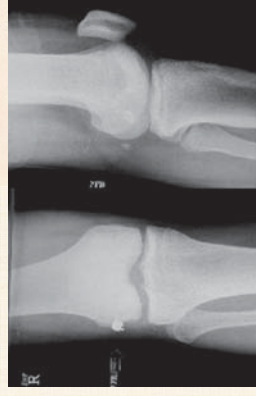
- **Peritoneal penetration in > 80%**

- Significant visceral injury in > 95%
- Laparotomy mandatory

- **Studies**

- Biplanar radiographs
- DPL* / FAST / CT / Angio
- Wound exploration – impractical
- PE alone – unreliable (FN > 20%)

Imaging



- Look for FBs, fractures, gas
- If cannot find bullet, re-examine patient!

Surgery

- **Indications**

- Significant tissue damage
 - Echymosis, swelling
- Neuro-vascular injury
- Obvious contamination
- Joint involvement
- Unstable fractures

High Energy Transfer

- **Evidence**

- Functional disturbance and swelling
- Bullet fragmentation
- Visible cluster on x-ray

Disposition

- **Surgery or**

- **Superficial debridement**

- Betadine dressing
- Left open
- Antibiotics (oral or IV)
- Follow up in OPD until healed
 - 2% infection – Staph or Strep

Questions ?



GSW: Summary

- More and more common
- Legal & Forensic issues
- Wounding potential
- Treat patient and wound NOT the weapon
- Surgery
- Antibiotics



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Thank You



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Fashion
Accessories