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Illustrated Review of Agad Tantra evam Vidhivaidyaka (Agad Vigyan Saar)

अगद तंत्र एवं विधिवैद्यक (अगद विज्ञान सार)

As per NCISM Syllabus

Sachin Kumar Bhardwaj

JAYPEE

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UNIT 21

Injury

LEARNING OBJECTIVES

- Basics of injury
- Mechanical injury
- Firearm injury
- Thermal injury
- Dowry death

(Lecture: 5 hours, Nonlecture: 3 hours)

BASICS OF INJURY

Injury Sec. 2 (14) BNS (44 IPC)

- Injury is any harm, whatever illegally caused to any person in body, mind, reputation or property.
- Medically a **wound** or injury is a disruption of the anatomical continuity of any tissue in the living body.

Classification of Injury

- **Medically or depending upon the causative factor:**
- **Due to blunt force:**
  - Abrasion
  - Contusion
  - Laceration
  - Fracture and dislocation
- **Due to sharp object force:**
  - Incision
  - Stab wound
  - Chop wound
- **Firearms:**
  - Firearm wound
  - Blast injuries

Legal (depending upon severity): Simple, grievous, dangerous.

Medicolegal (Depending upon Nature of Injury)

- Suicidal, homicidal, accidental.
- Defense wounds, fabricated wound.
- **Thermal injuries:**
  - **Due to cold**
    - Frostbite
    - Trench foot
    - Immersion foot
  - **Due to heat**
    - Burns
    - Scalds
  - **Chemical injuries:**
    - Corrosive acids
    - Corrosive alkalis
  - **Physical injuries:**
    - Electricity
    - Lightning
    - Radiation
    - Radioactive substances.
- The wound is caused by the mechanical force of either the **movement** of body itself (counterforce is **rigidity** of stationary object)
- A **moving weapon** (counter force is **inertia** of body)
- A combination of these two events is seen in most cases.
- **Tissues** vary in their solidity, fluidity, density and elasticity.
- **Energy** is spent in
  - Moving of body.
  - Compression or traction.
  - Displacement and deformation.
  - Elongation of tissues
  - Bending, torsion or shearing.

आचार्य सुश्रुत अनुसार (सु.चि. 2/4–27)

व्रण की परिभाषा

नानाद्यारमुखैः शस्त्रैर्नानास्थाननिपातितैः।
नाना रूपा व्रणा ये स्युस्तेषां वक्ष्यामि लक्षणम्।। (सु.चि. 2/4)

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❖ विविध रूप के धार तथा मुख वाले शस्त्रों का प्रहार शरीर के विभिन्न स्थानों पर होने से नाना प्रकार के व्रणों की उत्पति होती है। (उनका लक्षण कहता हूँ)

व्रण के प्रकार– (सु.चि.1/3)

❖ व्रण दो प्रकार के होते हैं। शारीर और आगन्तुज।
- **शारीरिक व्रण –** वात, पित्त, कफ, रक्त, सन्निपात से उत्पन्न होता है।
- **आगन्तुज व्रण –** पुरुष, हिसंक पशु–पक्षी, अघात होने से, अग्नि, क्षार, विष, तीक्ष्ण औषध प्रयोग से, काष्ट, कपाल, श्रृंग, शक्ति आदि से आगन्तुज या अभिघातज व्रण उत्पन्न होते हैं।

आगन्तुज व्रण के प्रकार–

छिन्नं भिन्नं तथा विद्धं क्षतं पिच्चितमेव च।
घृष्टमाहुस्तथा षष्ठं तेषां वक्ष्यामि लक्षणम्।। (सु.चि. 2/9)

❖ आकार के अनुसार आगन्तुज व्रणों को वैद्यो ने 6 प्रकार का माना है। छिन्नं, भिन्न, विद्ध, क्षत, पिच्छित, घृष्ट।

छिन्न व्रण (सु.चि. 2/10)

❖ तिर्यक् अथवा सीधी आकृति वाला चौड़े मुख का वर्ण तथा जिसमें अंग कटकर पृथक् हो जाता है। अथवा लटकता रहता है। उसे छिन्न व्रण कहते हैं।

भिन्न व्रण (सु.चि. 2/11)

❖ भाला, शक्ति, ऋष्टि और खड्ग या तलवार आदि शस्त्रों के अग्र भाग तथा श्रृंग आदि के प्रहार से फटे हुए आशयों से किञ्चित स्त्रवित होने वाले व्रण को भिन्न व्रण कहते हैं।

विद्ध (सु.चि. 2/19)

❖ छोटे मुख वाले शस्त्रों के प्रहार से आशयों के अतिरिक्त अन्य अंग का शल्य के साथ ऊपर उठ जाना अथवा शल्य रहित स्थिति में होना विद्ध व्रण कहलाता है।

क्षत व्रण (सु.चि. 2/20)

❖ न अधिक कटा हुआ और न अधिक विदीर्ण, दोनों प्रकार के व्रणों के लक्षणों से युक्त विषम व्रण को क्षत कहते हैं।

पिच्चित व्रण (सु.चि. 2/21)

❖ प्रहार अथवा पीड़न से जो अंग अस्थि समेत कुचल कर या चपटा होकर फैल जाता है और मज्जा व अस्थि से लिपत हो जाता है। उसे पिच्चित व्रण कहते हैं।

पृष्ट व्रण (सु.चि. 2/22)

❖ घर्षण के कारण अंग त्वचा रहित हो जाता है तथा दाह, स्राव से युक्त होता है।

MECHANICAL INJURY

Abrasion

❖ Loss of superficial epithelial layer of skin caused by friction between the skin and a rough surface.
❖ It bleeds slightly and they heal without scar formation.

Types of Abrasion

1. Scratches
2. Grazes
3. Pressure abrasion
4. Impact abrasion (patterned abrasion)

Scratch/Linear Abrasion (Fig. 21.1)

❖ Caused by a sharp and pointed object running across the skin.
❖ The object collects the scratched epithelium in front of it, leaving a clean area at the start and skin tags at ends.

Graze/Brush of Friction Burn (Figs. 21.2 and 21.3)

❖ This is caused by horizontal friction between the skin and a broad rough surface.
❖ It is seen as serrated border in the start with uneven longitudinal parallel lines with heaped up epithelium at the end.

Pressure/Friction/Crushing Abrasion (Fig. 21.4)

Caused by direct impact or linear pressure of rough object over the skin, for example abrasion of skin under the ligature during hanging.



Fig. 21.1: Scratch/linear abrasion.

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Fig. 21.2: Graze/brush of friction burn.



Fig. 21.3: Graze/brush of friction burn.



Fig. 21.4: Pressure/friction/crushing abrasion.



Fig. 21.5: Imprint abrasion/patterned abrasion.

Imprint Abrasion/Patterned Abrasion (Fig. 21.5)

- Caused when the force is applied perpendicular to the skin with an impact, so that the cuticle gets crushed and bears the imprint of the object.
- **Impact** abrasion and **pressure** abrasion reproduce the pattern of the object causing it and are called patterned abrasions.
  - Patterned is an injury that suggests an inflicting instrument or unique means of its connection.
- It is associated with intradermal bruise due to capillaries damage, for example
  - When motor tyre passes over the skin.
  - Imprint of bicycle chain.
  - Spiral electric wires, rope

Age of Abrasion (Table 21.1)

Table 21.1

Duration	Change in abrasion
Fresh	Bright red abrasion with discharge of serum
12 to 24 hours	Red scab
2 to 3 days	Reddish brown scab, less pain
4 to 7 days	Brownish black scab, heals from the margins, new epithelium grows and covers the defect
7 to 10 days	Scab falls off, leaving lightly pigmented area
More than 10–12 days	New collagen fibers appear and normal skin

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Difference between Antemortem and Postmortem Abrasion (Table 21.2)

Table 21.2

Features	Antemortem abrasion	Postmortem abrasion
Site	Anywhere on the body	Over bony prominences
Color	Bright red	Pale, dry, and parchment-like
Covering	Covered with scab composed of coagulated blood and lymph	No such scab
Inflammation	Signs of inflammation present	No
Microscopy	Congestion and vital reaction present, healing process seen	No

Medicolegal Importance

- Medicolegal aspects of abrasion
- Nature of injury.
- Type of weapon/object of assault.
- Age of injury and therefore time of crime.
- Direction of injury whether injury is antemortem or postmortem.
- Whether injury is suicidal, homicidal or accidental (considering the site, number, size and shape of injury).
- At times abrasion is caused (fabricated/forged) to support a false charge.
- Purpose of injury, e.g.
  - Ligature mark on neck strangulation/hanging.
  - Nail marks on neck—throttling.
  - Nail marks on and around nose and mouth—smothering.
  - Nail marks on and around vulva—rape.
  - Nail marks on and around anus sodomy.
  - Teeth bite marks—cruelty.
- Indicate likely chances of injury to internal viscera.
- An abrasion on cornea can lead to blindness, a grievous injury **Sec. 116 BNS (320 IPC)**

Differential Diagnosis

- Erosions of the skin produced by ants.
- Excoriations of the skin by excreta.
- Pressure sores.
- Drying of the skin.

Bruise (Contusion) (Fig. 21.6)

- It is caused by extravasation of blood into the tissues due to rupture of small blood vessels by the application of blunt force.



Fig. 21.6: Bruise.

- There is no loss of continuity of skin.
- Bruise means bluish-purple lesion visible through intact skin and contusion can be anywhere in the body.
- A **bruise** is **lighter** in colour **in centre** because extravasated blood is pushed outward by the impact.

Cause

- Application of blunt force.
- Compression-like fingers, whip.

Classification of Bruises

Three types of bruises:

1. **Intra-dermal bruise:**
   - It is created by impact with a patterned object and lies in the sub-epidermal layer.
   - The bruise is sharply defined.
2. **Sub-cutaneous bruise:**
   - It is situated in the skin's subcutaneous layer; its edges are elevated above the skin's surface and are blurred.
   - It shows up shortly after an injury.
   - The size might range from a little pinhead bleed to a sizable localized blood collection (hemostasis).
3. **Deep bruise:**
   - Lies deeper to sub-cutaneous tissue.
   - It may take hours or 1 to 2 day to appear at the surface one more examination should be carried out after the interval of 48 hours.

Factor-influencing the Bruise

- **Condition and type of tissue**
  - In vascular and loose parts such as face, vulva, scrotum, large bruise are produced by small impact.
  - In boxers and athletes, bruising is much less because of good muscle tone.

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- **Age**
  - Children bruise more easily because of softer tissues and delicate skin.
  - In old person bruise appear easily because of loss of flesh and cardiovascular changes.
- **Sex:** Women bruise more easily than man because of more subcutaneous fat and more delicate tissues.
- **Color of skin:** More clearly seen in fair-skinned persons than those with dark skin.
- **Natural diseases:** Prominent bruising occurs easily even with small trauma in persons with diseases like haemophilia, scurvy, Vitamin K deficiency, arteriosclerosis, etc.
- **Gravity shifting of the blood**
  - A deep bruise, especially that due to the crushing of the tissue against the bone may take a long time to become visible and may not appear below the actual point of impact. It is known as '**ectopic bruising percolated'** or '**migratory bruising'**
  - **Black eye** may be caused by:
    - Direct trauma
    - Blunt impact to forehead
    - Fracture of floor of anterior cranial fossa
  - A bruise behind ear indicates the basal fracture **(Battle's sing)**
  - Bruise in neck due to fracture in jaw.
  - Bruise in thigh due to fracture in pelvis.
  - Bruise on **ankle** due to blow on calf of leg **(Fig. 21.7)**.

Age of the Bruise (Fig. 21.8 and Table 21.3)

A bruise undergoes healing from the periphery toward the center passing through a series of color changes due to autolysis of blood.



Fig. 21.7: Ankle due to blow on calf of leg.

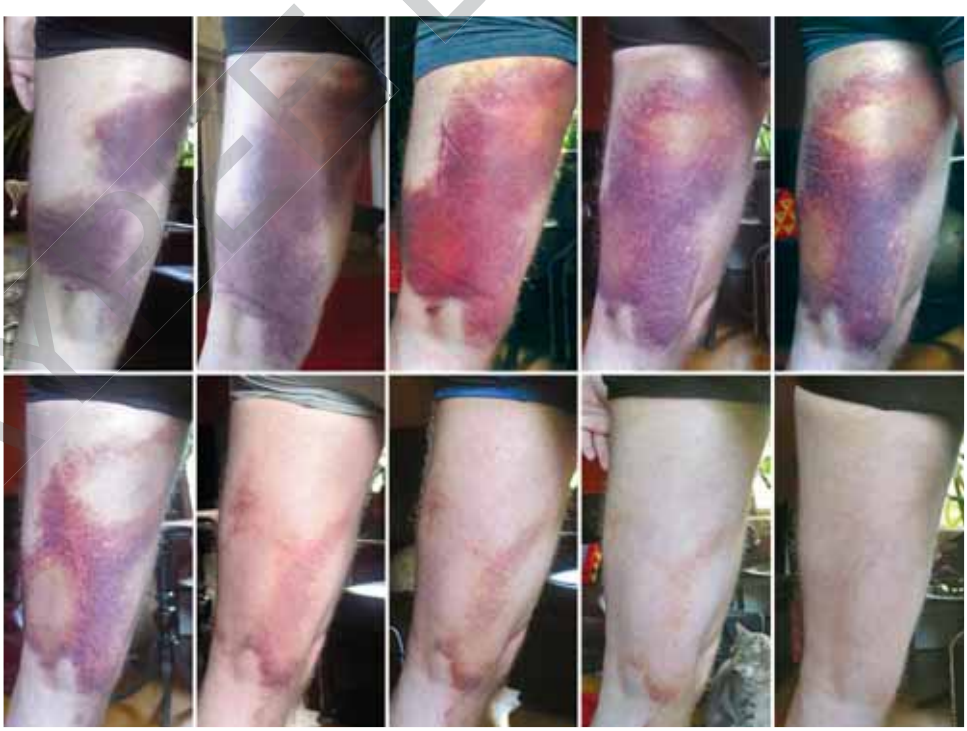

Fig. 21.8: Age of bruise.

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Table 21.3

Duration	Change in bruise
Fresh	Red (oxygenated blood)
Few hours to 3 days	Blue (deoxygenated blood)
4 to 5 days	Bluish-black to brown (hemosiderin)
5 to 6 days	Green (biliverdin) (haematoidin)
7 to 12 days	Yellow (bilirubin)
2 weeks	Normal skin color.

Note: Subconjunctival hemorrhage does not show similar color change. It is red then yellow and finally disappear.

Difference Antemortem and Postmortem Bruise (Table 21.4)

Differences between Antemortem and Postmortem Contusion

Table 21.4

Feature	Antemortem contusion	Postmortem contusion
Swelling	Usually present	Nil
Size	More	Less with the same amount of force
Color	Changes as per stage of healing	Nil
Color uniformity	Not uniform-pale at the center	Uniform
Margins	May be abraded or lacerated	Usually not
Margin diffusion	Diffuse into surroundings	Clear cut
Inflammation and vital reaction	Present	Absent
Blood removal	Blood cannot be easily washed away	Can be easily washed
Microscopic examination	Infiltration of surrounding tissues with blood cells seen	Nil
Enzyme levels	Raised	Nil

Differences between Contusion and Postmortem Lividity (Table 21.5)

Table 21.5

Feature	Contusion	Postmortem lividity
Occurrence	May be antemortem or postmortem	Always postmortem
Cause	Rupture of capillaries leading to extravasation of blood	Stagnation of blood in toneless dilated capillaries
Location	Sub-epidermal	Epidermal
Body part affected	May be present anywhere on the body	Only on dependent body parts
Effect of thumb pressure	No effect	Blanching seen if lividity is not fixed
Incision findings	Bloody serum due to extravasated blood	Few oozing points due to capillary cutting
Swelling	Usually present	Nil
Size	More	Less with the same amount of force
Color	Changes as per stage of healing	Nil
Color uniformity	Not uniform—pale at the center	Uniform
Margins	May be abraded or lacerated	Usually not
Margin diffusion	Diffuse into surroundings	Clear cut
Inflammation and vital reaction	Present	Absent
Blood removal	Cannot be easily washed away	Can be easily washed
Microscopic examination	Infiltration of surrounding tissues with blood cells seen	Nil
Enzyme levels	Raised	Nil
Medicolegal importance	Used to determine nature, type of weapon, and age of injury	Used to determine time since death, body position, and shifting of the body

Medicolegal Aspects

- Identification of the object.
- Degree of violence.
- Cause of injury and time of injury.
- Possibility of infection.

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- ❖ Internal contusion may prove fatal.
- ❖ Homicidal, accidental.

Artificial Bruise (Fig. 21.9)

Causes by application of irritant substances on skin like Calotropis milk, marking nut juice, plumbago root juice, especially on part within reach. It shows vesicle, and inflammation.

LACERATION

Tearing or splitting of tissue caused by blunt shearing or crushing force when applied to a broad area.

Types of Laceration

Five types

Split Laceration (Fig. 21.10).

- ❖ Found in parts overlying bones without much tissue in between.
- ❖ Commonly seen on scalp, forehead, cheeks, bone, shin, eyebrows.
- ❖ Skin is crushed between two hard objects (blunt weapon and bone) resulting in a linear split which looks like an incision.

Stretch Laceration (Fig. 21.11)

- ❖ Due to overstretching of the skin till it splits producing a flap.
- ❖ It is due to blunt, tangential force, e.g., run over motor vehicle injury.

Avulsion or Grinding Compression (Fig. 21.12)

Due to compressing grinding force so as to separate skin from deeper structures (degloving) and crushed the muscles underneath.

Tear (Fig. 21.13)

Tearing of skin due to impact against hard irregular sharp objects, e.g., broken bottle, car door handle.



Fig. 21.9: Artificial bruise.



Fig. 21.11: Stretch laceration.



Fig. 21.10: Split laceration.



Fig. 21.12: Avulsion or grinding compression.

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Fig. 21.13: Tear.



Fig. 21.15: Incised wound.

Internal Laceration (Cut Laceration) (Fig. 21.14)

When the blunt force exceeds the elasticity of an internal organ, laceration may result in such organ without abrasion or bruise at the impact site.

Characteristics

- **Margin:** Ragged, irregular, bruised, abraded.
- **Site:** Mostly over bony prominences.
- **Foreign body:** Mud, sand, glass, hair, fibers, etc., may be found on depth of wound.
- **Depth:** The deeper tissues are unevenly divided and are seen criss-crossing, hair bulbs are crushed.
- **Bleeding:** It is less.



Fig. 21.14: Internal laceration.

Medicolegal Importance

- Type of laceration may indicate cause of injury.
- Chances of infection there.
- Accidental, homicidal and rarely suicidal.
- It entrapped foreign bodies may reveal important evidences.

Incised Wound (Fig. 21.15)

- A clean-cut injury caused by sharp cutting edged weapon when it is drown across the skin.
- The length of incised wound is greater than its depth.

Characteristic

- **Margin:** Clean cut, well defined, mostly verted, free from bruises, bleeding is profuse.
- **Breadth:** The injury is broader than the edge of the weapon because the cut ends are retracted due to elasticity of skin.
- **Shape:** It is usually spindle shaped, the wound gapes more if the skin is cut across the cleavage line of Langers line.
- **Direction:** At the beginning the cut is deeper which progressively become shallow known as tailing of wound.
- Tailing suggest that the force is applied from the opposite direction.
- **Beveling:** If the weapon strikes obliquely one margin will fold inward producing a flip.

Age of Incised Wound (Table 21.6)

Medicolegal importance:

- Homicidal, suicidal.
- Rarely accidental.
- Give an idea about the direction of force.
- Age of injury can be determined.

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Table 21.6

Duration	Change in incised wound
Fresh	Red with clotted blood
12 hours	Margins red swelling, adherent with blood and lymph
24 hours	Scab formation of dried clot
2 to 6 days	Scab remains, healing starts and sign of inflammation reduce scab falls off, leaving the scar.
7 to 10 days	Scab fall off leave a scar.

Hesitation Cut/Mark or Tentative Cuts (Fig. 21.16)

Multiple, small, superficial skin deep cuts, often seen at the beginning of final incised wound when the person gains sufficient courage to make the final cut. It indicates suicide.



Fig. 21.16: Hesitation cut/mark or tentative cuts.

Chop Wound (Fig. 21.17)

- It is caused by impact with a moderately sharp cutting edge of a heavy weapon like-axe, meat cleaver.
- It may damage bone also.
- Dimension of the wound correspond to dimension of the blade.
- Margin are sharp, irregularly cut, with bruising and abrasion and with severe split of the tissue.



Fig. 21.17: Chop wound.

Medicolegal Importance

- Usually homicidal and can be accidental also.
- In homicidal incised wound defense incision on dorsum of hands ulnar aspect of forearm or on the palm.

STAB WOUND

- Injury caused by long, narrow, pointed instruments when it is pushed into the skin, e.g., knife, screwdriver, ice pick.
- Stab wounds are deeper than its length and width.

Classification

Two type

- **Penetrating wound**
  - When weapon entry a body cavity such as thorax and abdomen it produces only one wound (entry wound).
- **Perforating wound (Fig. 21.18)**
  - When the weapon, after penetrating the body comes out from the other side.
  - It has two wound entry and exit wound.

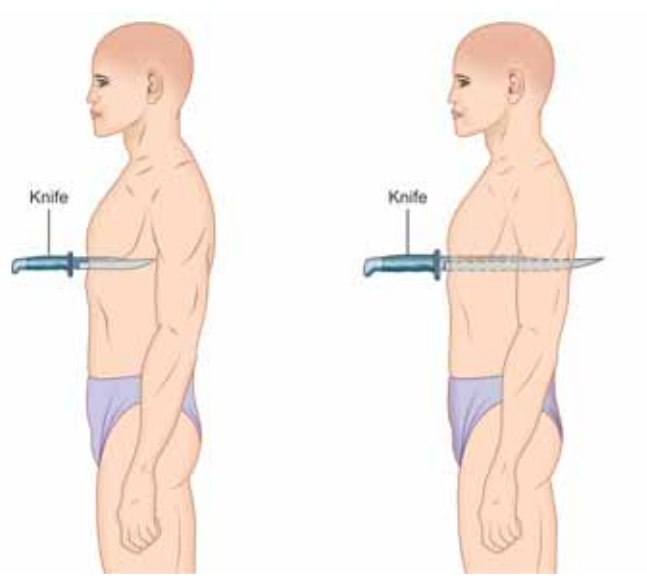

Fig. 21.18: Perforating wound.

Characteristics

Margin

- Clean cut, often free of bruising and abrasion, regular, sharp, and well-defined
- Entry wound margins are typically larger and inverted.
- The edges of the exit wounds are narrower and everted.

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Length

It does not necessary match the blade's width or length.

Dimension

Depth is the greatest dimension of a stab wound.

Shape

- It has two acute angles, is slit-shaped, and gapes in the middle.
- A single-edged weapon will cause a triangle wound.
- A double-edged weapon will cause an elliptical wound; and a round-pointy weapon will cause a circular wound.

Medicolegal Importance

- Suicidal, homicidal and accidental.
- Indication in the type of weapon.

Concealed Stab Wound

- Sometimes hidden small puncture are made by pin or needles in parts like fontanelle, vagina, rectum, etc., It is usually done in the case of infanticide.
- Therapeutic or diagnostic wounds.

Fabricated Wounds/Fictitious or Forged Wounds

- These wounds are produced by a person himself on his body or by another person with his consent.
- The objective is to make a false allegation against another person or to avert suspicious from oneself.
- Mostly superficial incision artificial bruise are made.

FIREARM INJURY

Ballistics

- Science of projectile motion and conditions affecting it. It is of two types:
  1. **External ballistics**: The study of projectile motion after it exits the firearm barrel is known as external ballistics.
  2. **Internal ballistics**: The study of physicochemical processes that occur inside the firearm between the primer's explosion and the projectile's exit from the barrel.

Firearm (Figs. 21.19 to 21.21)

Any instrument or equipment that uses the expansion force of gasses produced by burning an explosive material can launch a missile.

The assembly of the firing mechanism of gun (action) consist of:

- Breech block.
- Hammer.
- Trigger.
  - The interior diameter of the firearm barrel is known as the bore, gauge, or caliber. It is expressed in inches, millimeters, or the quantity of lead balls that fit the barrel nearly exactly and are created from one pound of lead.

Cartridge

- An ammunition unit. Primers, propellant charge, and wads are contained in the cartridge case with percussion cap.
- Bullet mean projectile of firearm.

Mechanism of Discharge of Projectile/Bullet (Fig. 21.22)

- In general, the firearm has a
  - Barrel
  - Action (breech block firing pin, trigger)
  - Grip butt stock.

Barrel

- It is steel tube, long in rifles and shotgun and short in revolver and pistol.
- The proximal end is called breech end and the distal end is called muzzle end.



Fig. 21.19: Revolver.

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Fig. 21.20: Pistol.



Fig. 21.21: Rifle.

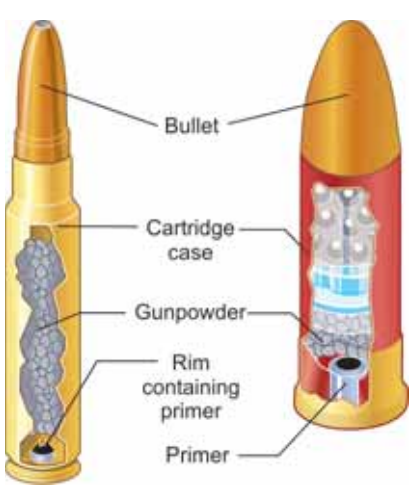

Fig. 21.22: Discharge mechanism of bullet in shotgun and rifle cartridge.

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Action

- Breech block is a metal block which seals the breech end when the firearm is closed.
- It can be opened to put a new cartridge.
- It is pierced in the center to accommodate the firing pin, which strikes the center of cartridge when the trigger is pulled.

Grip or Butt Stoke

- The part which is gripped in the hand or supported against the shoulder.
- It is made up of metal or wood.
- **Magazine:** Sometimes it may accommodate a spring-loaded container having cartridges.

Operating Principle

- A firearm is loaded with bullet, cartridge or magazine and then it is cocked (the breech end is closed and the firing pin is pulled back) and fired with the trigger is pulled.

↓

- This releases the firing pin which strikes the percussion cap.

↓

- Detonating the sensitive composition of the primer. Primer detonation ignites.

↓

- The primary propellant charge releases hot gases at high pressure that expand quickly.

↓

- This pressure pushes the empty cartridge case backwards into the breech blocks while also forcing the missile out of the barrel quickly.

↓

- The muzzle velocity firearms can be low, medium and high velocity.

Classification of Fire Arms

Depending upon the type of barrel (Fig. 21.23)

1. Rifled weapons.
2. Smoothbore weapon.

- **Rifled firearms:**
  - These weapons fire missile spinning on their longer axis, e.g., service and sporting rifles, revolver, pistol.

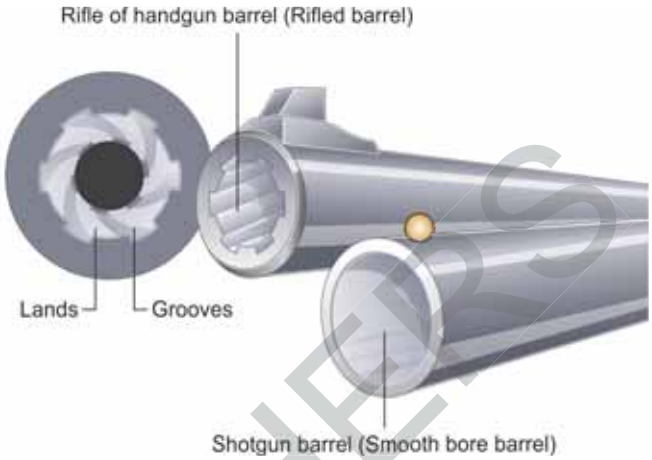

Fig. 21.23: Rifle and shootgun barrel.

  - These are high velocity weapon. Rifle more than pistol and pistol more than Revolver.

Rifling:

- The inside of the bore of these weapons is cut longitudinally with the number of spiral grooves (4 to 6).

↓

- Which run parallel to each other but are twisted spirally from breach end to muzzle end.

↓

- This causes the missile to rotate during its forword motion.

↓

- The raised part of the rifling is called land and the lower part is called groove.

↓

- **Smoothbore weapons:**
  - The inside of the barrel is perfectly smooth, e.g., shot guns, muzzle lodder, and musket.
  - The barrel of shotgun is usually 24 to 30 inches most common bore is 12.
  - They fire lead, steel, or pellet shots.

Cartridge Case (Fig. 21.24)

- It is outer covering of cartridge. It is generally made up of brass, and sometimes of cardboard/plastic with a rimmed brass base.
- Its base (percussion cap) contains a small amount of sensitive detonating substance (primer). It may be potassium chlorate, antimony sulfide, lead azide, barium nitrate, etc.

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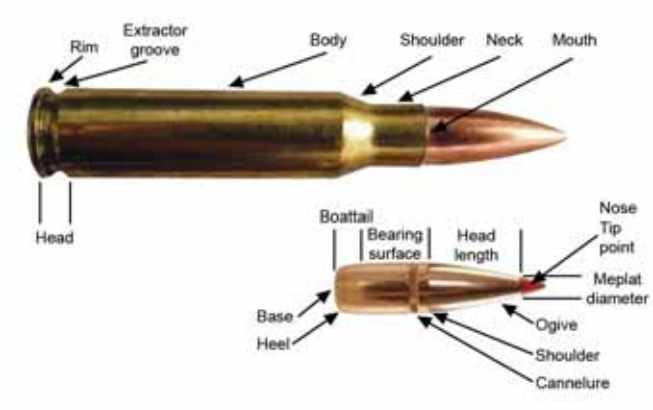

Fig. 21.24: Cartridge case.

- The detonation of primer ignites propellant charge which propels the missile/bullet.
  - It is composed of gun powder (15% charcoal, 10% sulfur, 75% potassium nitrate).

Projectile/Bullet (Figs. 21.25 and 21.26)

- It means the object propelled out by the force of rapidly expanding gases due to burning of propellant charge.
- It may be bullet, lead shots, and pellets.
- Most the bullet made up of lead because of higher cross-sectional density (mass/diameter).

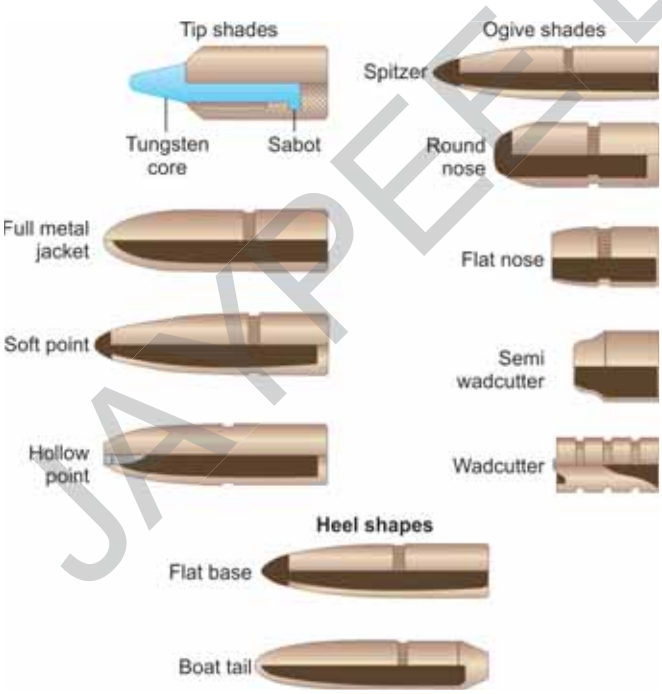

Fig. 21.25: Types of bullets and shape.

Wad (Figs. 21.27 and 21.28)

- It is a circular disc made up of felt, cardboard, thick paper, plastic, etc.
- It is used to separate, seal and pack various content of shot gun cartridge.



Fig. 21.26: Bullet.



Fig. 21.27: Board wad.



Fig. 21.28: Plastic wad.

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Characteristic of Firearm Injury at Varying Ranges (Table 21.7)

Table 21.7

Range	Shotgun	Rifle
Contact/near contact	• Shot enters as a mass. • Wound is single, circular, about the size of the muzzle. • Imprint abrasion on the skin if the muzzle is pressed against it. • If the muzzle is near-contact, flame, gas, soot may soil the skin. • Singeing of hair present. • Blast effect is seen due to a large amount of gas entering the wound; the track is stained pink due to absorption of carbon monoxide.	• Flame, powder grains, metallic particles, hot gases enter the wound along with bullet. • Imprint abrasion. • Track of bullet may be pink due to CO. • The wound may be small and regular. • Burst fracture is found in the skull. • No burning, soot, tattooing.
Closed discharge (between actual contact-6 inches from the skin)	• Singeing of hair, clothes. • Tattooing of skin, soot is present. • Flame effect. • Wound is circular, elliptical. • No separate pellet hole. • Wads may be found in the wound.	• Entrance wound is circular. • Grease collar (deposition of dirt, lubricant present of the bullet surface on to the skin). • Singeing, tattooing, soot is present.
Mid/near range (6 inches to 6 feet)	• Tattooing and soot disappear after 16 inches. • Edge of the wound will be abraded and crenated (rat hole). • Pellet holes increase around the main wound.	• Soot and tattooing spread over to a larger area. • No charring or singeing of hair and skin. • Size of the entry wound resembles the size of the bullet.
Long/distant range (beyond 6 feet)	• No burning, soot, wads seen. • Only pellet holes seen, there is multiple entry wound.	• No burning, soot, or tattooing. • Wound is circular with inverted margins. • Abrasion and grease may be seen at the entry site.

Difference between Entry Wound and Exit Wound Characteristics (Table 21.8 and Fig. 21.30)

Table 21.8

Entry wound	Exit wound
The wound is smaller in size (except at contact range, where the skin may be torn by blast or rarely when the bullet ricochets or loses its gyroscopic stability).	The missile tears out the tissues and has sharply defined outwardly split edges.
In flat bone, especially the skull, the entry wound is clean-cut on the outer surface and chipped inward.	In flat bone, especially the skull, the exit wound is beveled and everted.
Edges are inverted because the missile penetrates from outside. In fat persons, they may be everted due to the protrusion of fat.	Edges are everted because the missile forces its way out.
Abrasion collar is present; grease collar may or may not be present.	Abrasion collar **(Fig. 21.29)** is absent except in shored exit wounds when irregular abrasion will be seen. Grease collar is never seen.
Burning, blackening, singeing, and tattooing may be seen at appropriate distances.	Burning, blackening, singeing, and tattooing **(Fig. 21.31)** cannot be there except from another overlapping wound with its own pattern.
Clothing may be turned in and carried into the wound.	Clothing may or may not be turned out.
Track near the entry wound may be bright pink due to carboxyhemoglobin in the case of near discharge.	Not usually so, but very exceptionally, gas can be blown along a wound track.
Lead ring may be seen on radiological or micro-chemical examination.	Lead ring absent.

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Fig. 21. 29: Abrasion collar.

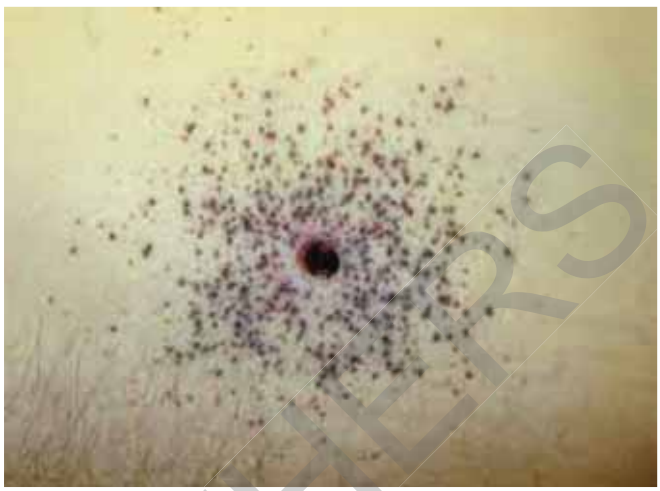

Fig. 21.30: Tattooing of skin.

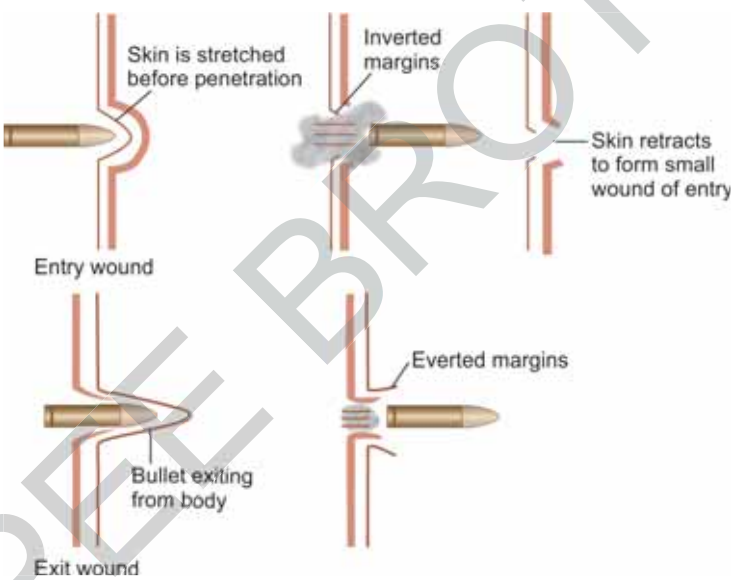

Fig. 21.31: Difference between exit wound and entry wound.

THERMAL INJURY

Death Due to Cold

- Effect of cold on human body may be local and general.
- Moist cold atmosphere is more damaging than dry cold one.
- Fatigue, alcohol, hunger, lack of sleep, improper cloths and mental depression increase the risk of cold injury.
- Severity of effect of cold depends on intensity of cold, duration of exposure, age, general health and clothing.

Sign and Symptoms

- Metabolism is low.
- Respiratory and heart rate is slow.
- Fall in peripheral circulation (to maintain core body temperature).
- Body surface become pale.
- Oxygen does not readily dissociate, so anoxic changes occur.
- Transudation of fluid takes place due to capillary endothelial damage.
- Muscles become stiff and contract with difficulty.
- Vasomotor control is paralyzed.
- Vital processes stops at 21°C.
- Dilatation of capillary causes stasis of blood and thrombosis.

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Fig. 21.32: Severe frost bite.

- Feelings of exhaustion and sleepiness come before dying.

Types of Cold Injury

(A) Local cold injury

Frost Bite (Fig. 21.32)

- Injury due to freezing which causes vascular spasm leading to tissue necrosis.
- It occurs in exposed parts of the body, e.g., tip of nose, finger, toes, ears.
- Affected part is patchy red with general pallor elsewhere.
- Thawing causes tenderness and burning pain.
- Frostbite is produced only once in life.

Degree of Frostbite (Table 21.9)

Table 21.9

Degree	Features
1.	Numbness, central pallor, surrounding erythema/edema, desquamation, dysesthesia
2.	Skin blistering with surrounding erythema and/or edema
3.	Tissue loss involving entire thickness of skin, hemorrhagic blisters
4.	Full-thickness tissue necrosis

Trench Foot

- It is called so because soldiers fighting trench during winters use to experience that.
- It occurs in foot after prolonged exposure to moist, cold condition (less than 10°C).

Immersion Foot

It occurs in foot after long exposure to cold water.

(B) General cold injury

Hypothermia

Classification

It is divided into three category:

1. **Mild hypothermia:** Exposure to cold (body temperature 32–35°C).
2. **Moderate hypothermia:** Core body temperature less than 32–28°C.
3. **Severe hypothermia:** Core body temperature less than 28°C.

Signs and Symptoms

- ICE like cold skin.
- Generalized muscular stiffness.
- Dull consciousness.
- Fall in respiration, heart rate and BP.
- Depressed reflexes.
- Red patches and pallor of the skin.
- Suspended animation.
- Eventually death occur.

Treatment

Main aims of the therapy are:

- Gradual restoration of warmth to the patient.
- Maintain electrolyte imbalance.
- Treatment of inflammatory diseases.

Postmortem Finding

- Expose part have red patches.
- Localized inflammation like frost bite, immersion foot, etc., may be seen.
- Postmortem lividity is pink in color.
- Edema of feet and blistering of skin.
- In prolonged hypothermia, erosion and necrosis in viscera may occur.
- Rarely skin white and thus hypothermic death are also called **white death.**
- Gastric mucosa show small hemorrhage and ulceration **(Wischnewski ulcers).**

Medicolegal Aspects

Homicidal, accidental.

Paradoxical Undressing

- The body is found partially or fully undressed because of sudden feeling of warmth because of vascular dilatation before to death.
- This results in assumption that death is associated with sexual assault. It is called so because the body is found naked and semi-naked in spite of cold atmosphere.

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Medicolegal Aspects

Homicidal, accidental.

INJURY DUE TO HEAT

- Excessive heat exposure can cause peripheral vasodilation, perspiration, and an increase in cardiac output.
- **Predisposing factors:** Include alcohol, exhaustion, hunger, sleep deprivation, inadequate hydration, and mental depression.
- Hot and humid atmosphere makes the condition worse.

Hyperthermia

- The normal temperature in human is said to be 37 °C (98.6°C).
- The body temperature rises over the hypothalamic set point.

The effects may be seen as:

- Heat cramps.
- Heat exhaustion.
- Heat strokes
- Heat prostration
- **Heat cramps: (Miner's/Fireman's cramps)**
  - Due to fluid and electrolyte depletion.
  - Occur in workers, working in high temperature condition where sweating is profuse.
  - Painful spasm of voluntary muscles which results when sweat losses are replaced with water alone.
- **Heat exhaustion (heat collapse):**
  - Condition of collapse from prolonged strenuous activity in hot and humid condition.
  - The body temperature is not high.
  - Hypotension and sudden weakness.
  - Poor venous return.
  - A collapse with a red face, aching temple.
- **Heat stroke (hyperpyrexia, sunstroke, hyperthermia) (Fig. 21.33)**
  - Impaired functioning of heat regulating mechanisms caused by failure of cutaneous circulation and sweating.
  - Due to prolonged exposure to sun-rays or hot atmosphere.
  - Before collapse of the person, headache, nausea dizziness, high fever, weakness in legs, excessive desire to urinated occur.
  - Skin is hot and dry, pulse is full and rapid.
  - Mortality rate is high.
- **Heat prostration:** Same as heat exhaustion
  - Treatment
  - Immediate steps should be taken to lower the core temperature.

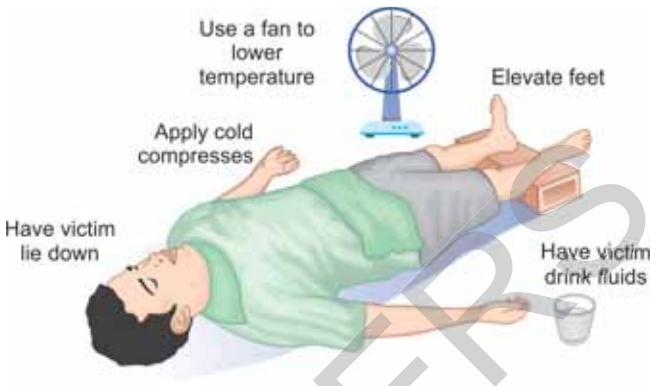

Fig. 21.33: Heat stroke treatment.

  - Patient is unclothed to minimum and spraying with water or wet sponging should be done.
  - Treatment should be continued till rectal temperature is 39°C.
  - Fluid and electrolyte imbalanced should be treated.
  - Alkalinization of urine is recommended.

Postmortem Appearance

- No specific autopsy finding.
- Postmortem caloricity.
- Rigor mortis comes and goes early.
- Visceral congestion.

Medicolegal Aspect

- Accidental.
- Infanticide.

BURNS

An injury caused by application of dry heat, radiant heat or hot solid substances over the body surface.

Types of Burns

1. **Contact burn:**
   - Due to physical contact between the body and the hot objects like metal.
   - It produces a blister and erythema.
2. **Flame burn:**
   - Contact between body and flame.
   - Blister, singeing of hair and charring of skin in seen.
3. **Scalds:**
   - Causes by contact between the body and hot liquids.
   - Sometime the vesicles (blister) are seen.
4. **Chemical burn:**
   - Due to contact between skin and corrosive acid or alkali.
   - Ulcerated patches, staining of skins seen.
   - Singeing of hair and vesication absent.
   - Healing results in keloid and disfiguration.

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