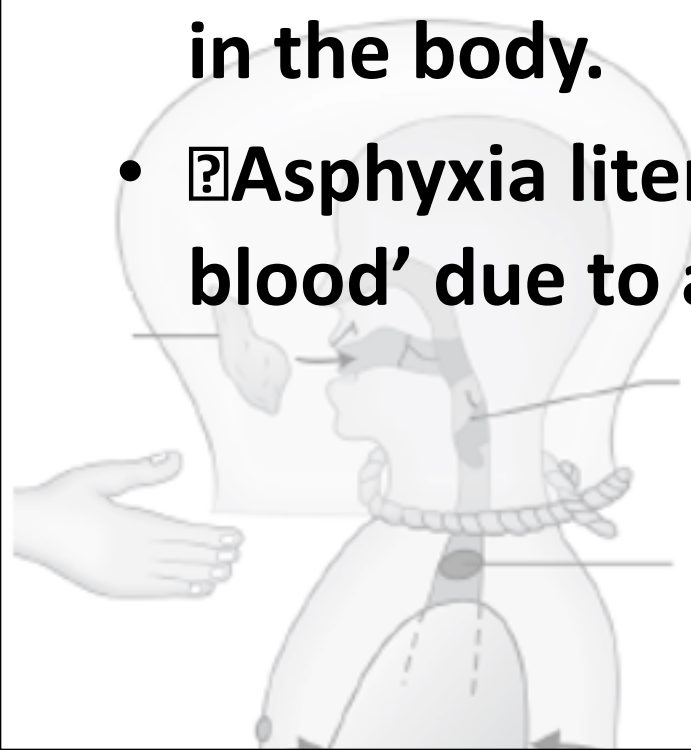
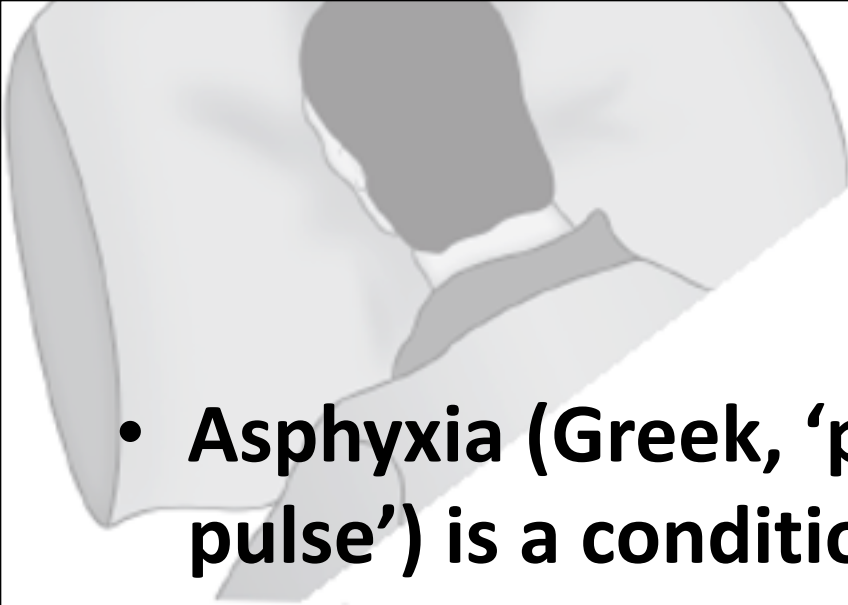


# ASPHYXIA

PART 1

- **Asphyxia (Greek, 'pulselessness' or 'absence of pulse') is a condition caused by interference with the exchange of oxygen and carbon dioxide in the body.**
- **☐Asphyxia literally means 'defective aeration of blood' due to any cause.**



# **Etiology of Asphyxia**

- 1. Mechanical/violent**
- 2. Pathological**
- 3. Toxic or chemical**
- 4. Environmental**
- 5. Traumatic**
- 6. Positional/postural**
- 7. Iatrogenic**

## **i. Mechanical/violent:**

Mechanical interference to the passage of air into the respiratory tract by :

- I. Closure of the external respiratory orifices by closing the nose and the mouth (e.g. **smothering**).
- II. Closure of the air passages by
  - a) external pressure on the neck (e.g. hanging, strangulation and throttling) .
  - b) impaction of foreign bodies (e.g. gagging and choking).
- III. Occlusion of the respiratory tract and lungs by fluid (e.g. drowning).
- IV. Pressure on the chest in a stampede or collapse of a building (e.g. traumatic asphyxia).

**ii. Pathological:** Entry of oxygen to the lungs is prevented by disease of the upper respiratory tract or lungs, e.g. laryngeal edema, spasm, tumors or abscess.

**iii. Toxic or chemical:** Cessation of the respiratory movements due to paralysis of the respiratory center in poisoning with morphine, barbiturates or strychnine. Inhibition of oxidative processes in the tissue preventing the use of oxygen in the blood, e.g. cyanide poisoning.

**iv. Environmental:** Breathing in vitiated atmosphere .

**v. Traumatic:** Blunt trauma to the thorax may result in pneumothorax, hemothorax or pulmonary embolism that will interfere with oxygenation and ventilation by compressing otherwise healthy parenchyma.

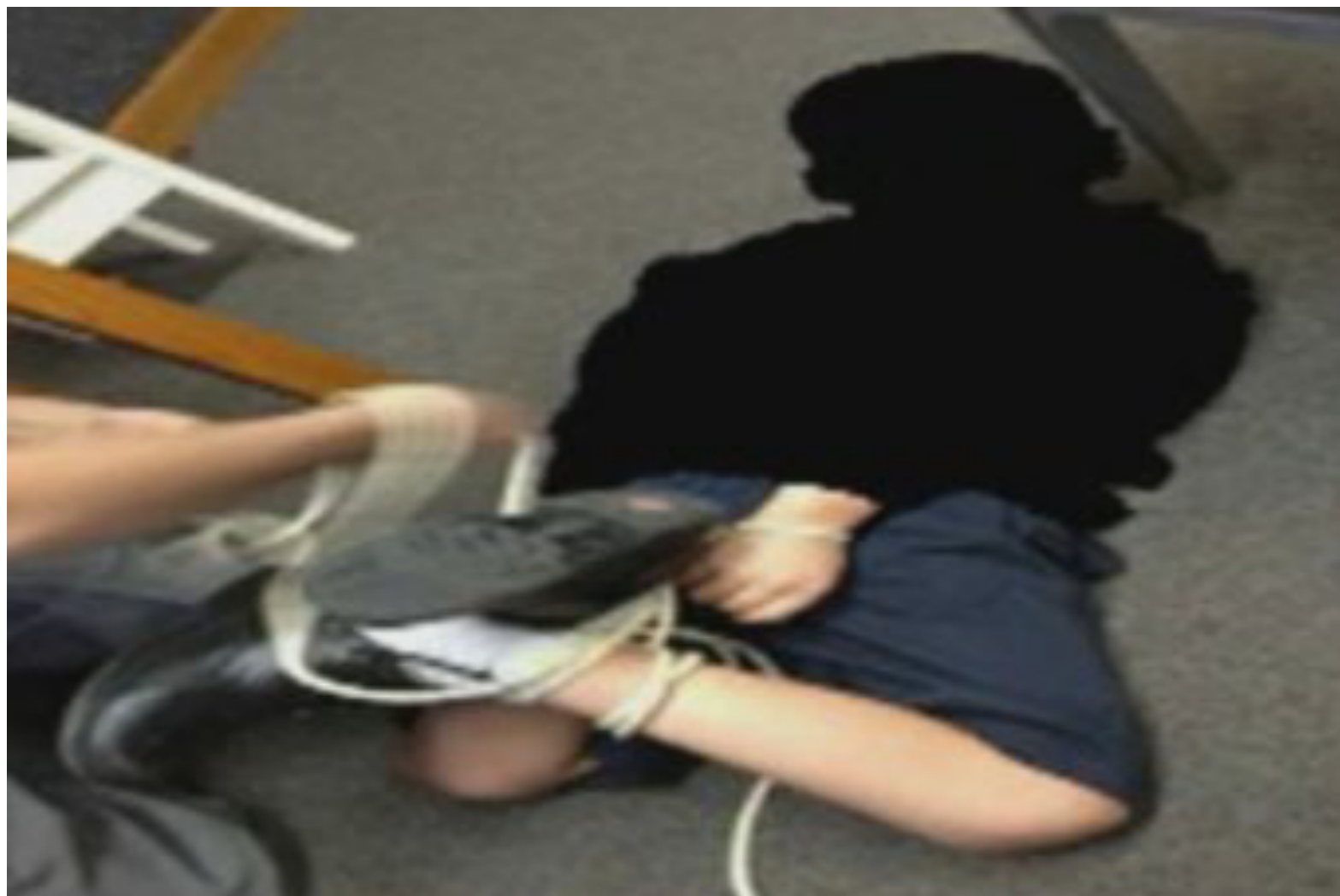
**vi. Positional/postural:** Positional asphyxia is due to abnormal body position that prevents adequate gas exchange.

- In alcoholics or addicts, where the person is unconscious and the upper portion of the body is lower than rest, or neck is forcibly flexed on the chest which prevents normal respiratory movements.

Deaths in such cases are diagnosed based on circumstantial evidence in combination with excluding other significant underlying causes of death.

- ***Positional/restraint asphyxia*** may occur in *hogtying* (individual is placed in a prone position, their hands are cuffed together behind their back, and their ankles are bound and tied to their wrists).

**vii. Iatrogenic:** It is seen during anesthesia.



# Hanging

- Hanging is a form of asphyxia caused by **suspension of the body by a ligature which encircles the neck, the constricting force being at least part of the weight of the body.**
- **?? Near-hanging:** Patients who survive a hanging injury long enough to reach the hospital.



# Classification

- On the basis of position of the knot

- A. **Typical hanging:** When the point of suspension is placed centrally over the occiput, i.e. the knot is at the nape of neck on the back.
- B. **Atypical hanging:** Knot of ligature is anywhere other than on the occiput.

- On the basis of degree of suspension

- A. **Complete hanging:** Body is fully suspended and no part of body touches the ground. Constricting force is weight of the body.
- B. **Incomplete or partial hanging:** Lower part of the body is touching the ground (toes or feet touching the ground) or in sitting, kneeling, lying down or prone position. Weight of the head acts as the constricting force.

- On the basis of intent

- A. Suicidal
- B. Accidental
- C. Homicidal
- D. Autoerotic



**Fig. 10.2:** Classification of hanging (position of knot)



**Fig. 10.3:** Classification of hanging (degree of suspension)

# Cause of Death

- i. ***Asphyxia***: Constricting force of ligature causes compressive narrowing of laryngeal and tracheal lumina, leading to asphyxia.
- ii. ***Venous congestion***: Jugular veins are blocked by the ligature which results in stoppage of cerebral circulation; occurs if ligature is made up of broad and soft material.
- iii. ***Combined asphyxia and venous congestion***: **Commonest cause.**
- iv. ***Cerebral anemia***: It occurs when ligature is made of thin cord.
- v. ***Reflex vagal inhibition*** leading to sudden cardiac arrest.
- vi. ***Fracture/dislocation of cervical vertebrae***: It is seen in judicial hanging.

# Delayed deaths

- **Delayed deaths** are rare which may be due to:

1. [?]. Aspiration pneumonia
2. [?]. Edema of lungs, larynx
3. [?]. Infections
4. [?]. Infarction of brain
5. [?]. Hypoxic encephalopathy
6. [?]. Abscess of brain.

- **Fatal period:**

- a) *Death is immediate*, if cervical vertebrae are fractured or if the heart is inhibited
- b) *Rapid* if cause is asphyxia
- c) *Least rapid* if coma is responsible. Usual period is 3–5 min which may extend to 5–8 min of suspension leading to death.

**Secondary effects** of hanging in persons who have recovered (near-hanging) are:

1. ☐. Hemiplegia
2. ☐. Epileptiform convulsions
3. ☐. Amnesia
4. ☐. Cervical cellulitis
5. ☐. Parotitis
6. ☐. Retropharyngeal abscess.

# Autopsy of Neck (Asphyxial Deaths)

- Photograph of the victim along with ligature (if present) is recommended.

## A - External Examination

- *General features*
- *□ Ligature*
- *Ligature description*
- *Description of ligature mark or furrow*

## B - Internal Examination

# General features

- ☐ Clothing and personal effects.
- ☐ Distribution of lividity, rigor mortis, and algor mortis.
- ☐ Bleeding from any sites, discharge of semen, urine or fecal matter.
- ☐ Ocular or facial petechiae, congestion, cyanosis.
- Tongue protrusion between clenched teeth, and dribbling of saliva.
- Evidence of any other trauma.

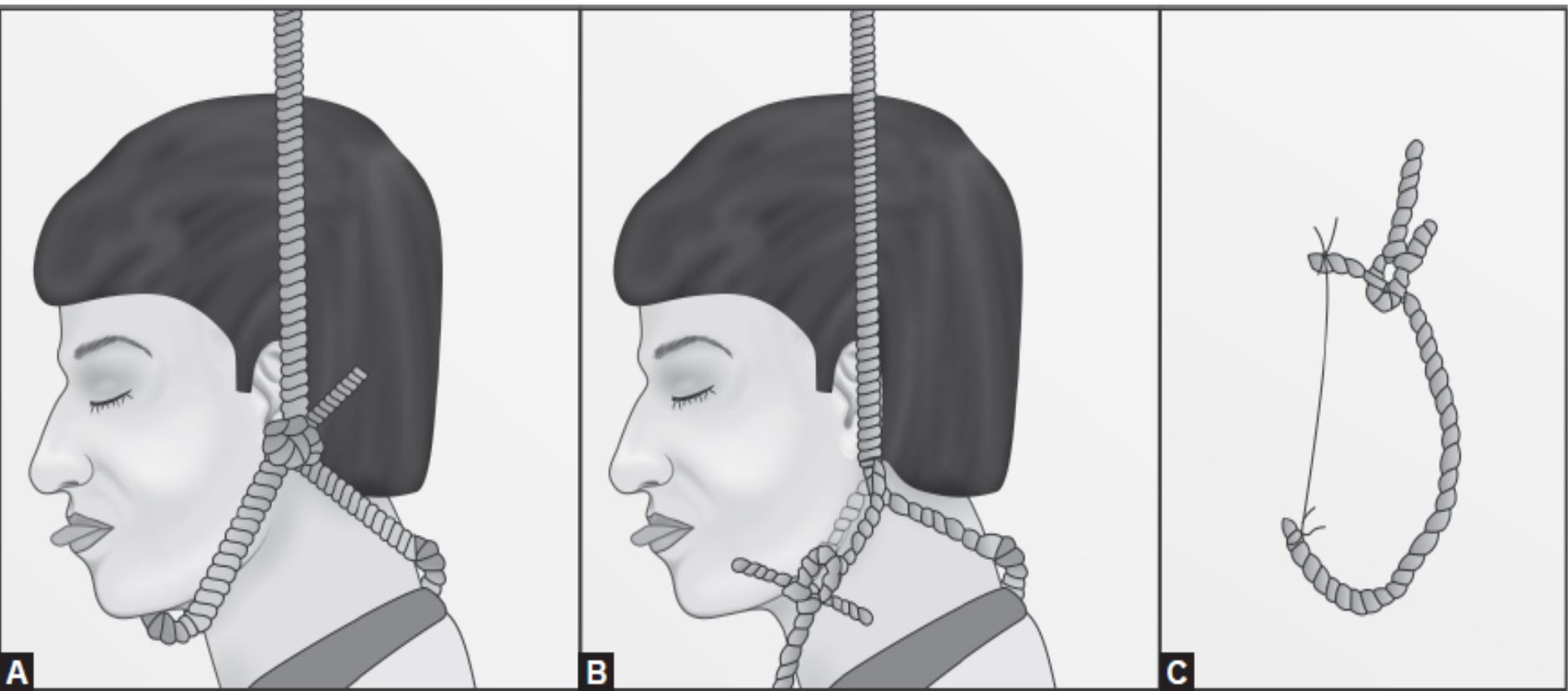


# *Ligature*

- Is ligature present in situ or removed?
- **Knot:** If in situ, note knot position, number of loops.

# *Ligature description*

- [?]Type of material
- [?]Circumference of noose
- [?]Width
- [?]Nature of knot (slip-knot or fixed).
- If, in situ, it should be cut away from knot and reconstructed by joining cut ends with tape or another cord



**Figs 10.4A to C:** (A) Fixed noose, (B) Running noose, (C) Method of cutting the noose and preserving the cut ends and the knot

# *Description of ligature mark or furrow*

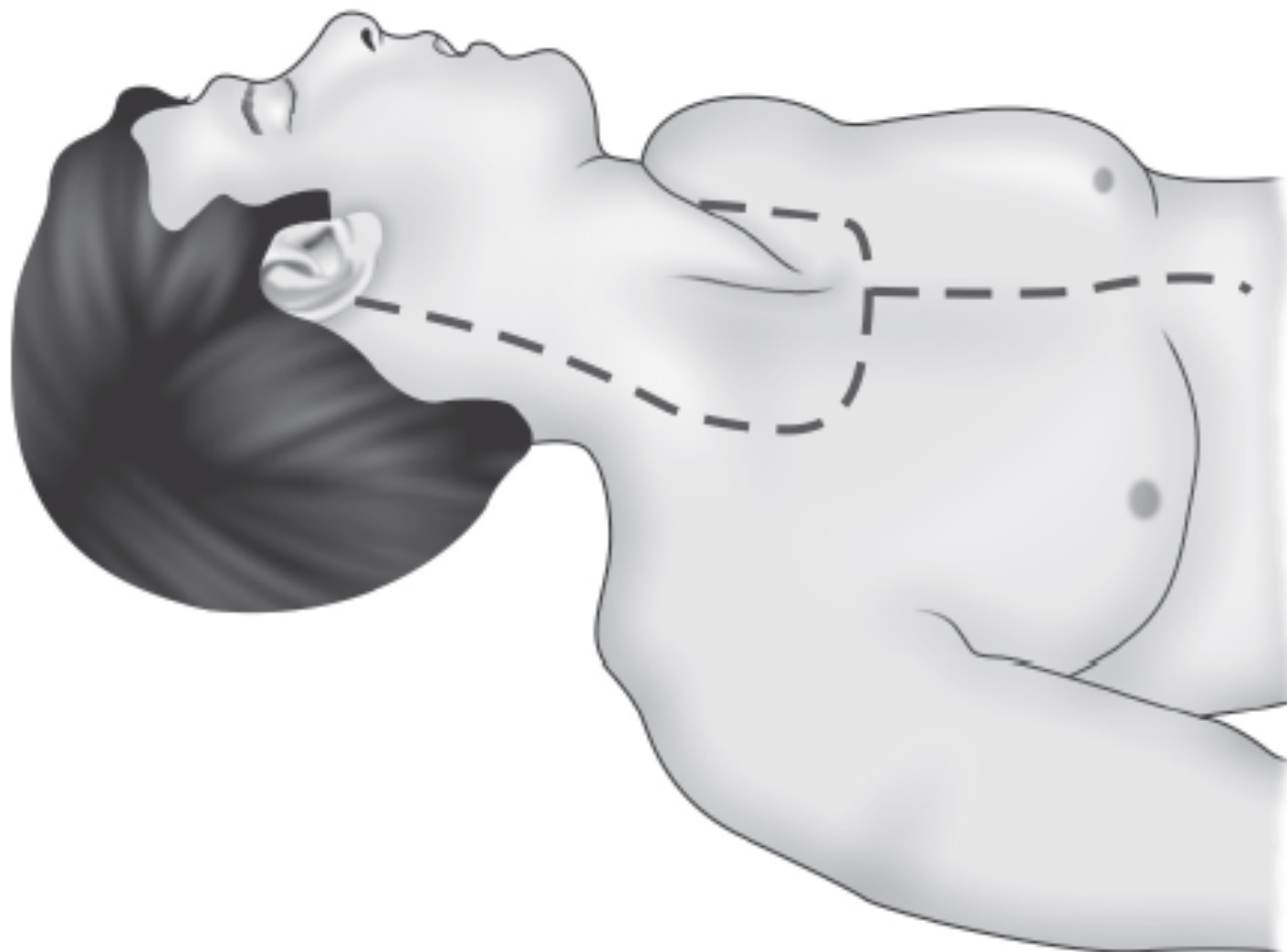
1. Course (angled or straight)
2. Width
3. Associated skin changes or trauma
4. Relation to thyroid cartilage
5. Pattern
6. Neck circumference at level of furrow (to determine degree of neck constriction)
7. Transfer of ligature material.

# Factors which influence the appearance of ligature mark

- ***Ligature material:*** If it is tough and narrow, then the mark is deep and prominent. If it is soft and broad, then mark is less prominent or deep.
- ***Period of suspension:*** Longer the suspension, deeper is the groove, and it is more prominent and parchmented.
- ***Degree of suspension:*** Mark becomes more prominent and deep in case of total suspension.
- ***Weight of the body:*** Heavier the body, more marked is the ligature impression.
- ***Position of knot:*** Main force applied to the neck by ligature is opposite to the point of suspension.
- ***Slipping of ligature during suspension:*** Produces double impression of ligature.

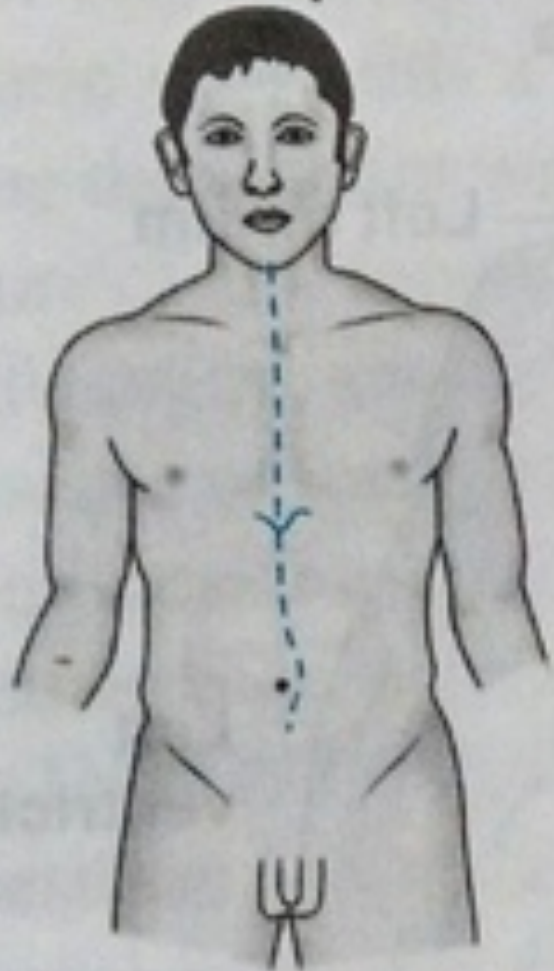
# Internal Examination

- i. **Anterior neck structures** are examined at the end of autopsy .
- ii. **Modified Y-shaped** incision is preferable to expose the neck structures .
- iii. **Anterior neck structures** (tongue, larynx, trachea with thyroid gland, attached strap muscles including sternocleidomastoid muscles and submandibular glands) are inspected before removing them.
- iv. **Tongue** is inspected and cut through (tip to base) to observe hemorrhage.
- v. It is noted whether hemorrhages are present in **the submandibular glands and strap muscles**.
- vi. **The thyroid gland** is removed and sectioned.
- vii. Any hemorrhage or fracture is noted in the muscle **around the cricoid, laminae of the thyroid cartilage and superior horns**.
- viii. **Hyoid bone** is palpated, and hemorrhages adjacent to the hyoid or thyrohyoid ligament are also noted. Dissect away the hyoid (note that the lesser cornua are variably long and may be inadvertently cut).
- ix. Longitudinal sections through the larynx may be done to note intracartilaginous hemorrhages—in suspected hanging cases.
- x. **The esophagus and larynx-trachea** are dissected posteriorly to observe any submucosal hemorrhage or petechiae, mucosal injuries and aspiration.

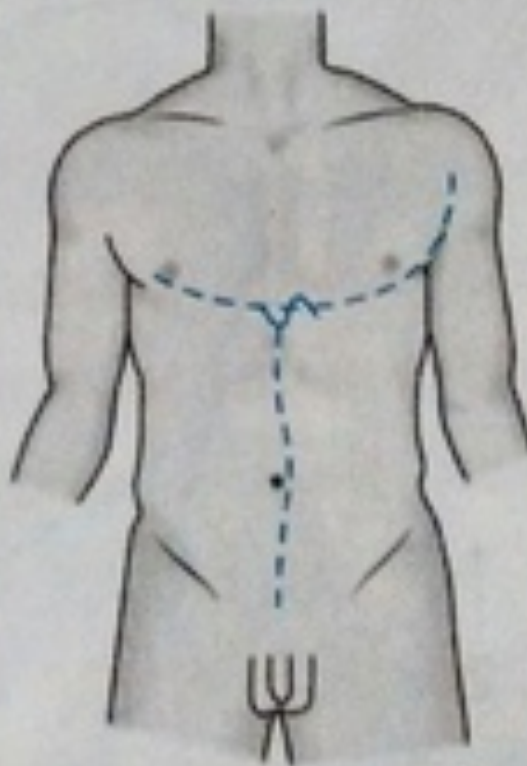


**Fig. 10.5:** Modified Y-shaped incision

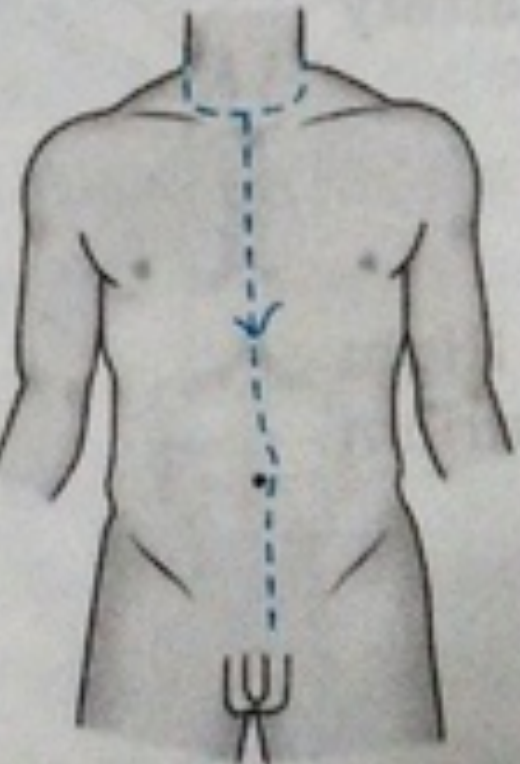
**I-Shaped**



**Y-Shaped**



**Modified  
Y-Shaped**



**Fig. (5-1). Primary skin incisions.**



# **Postmortem Findings in Hanging**

- **A . External Findings**
  - 1. Face**
  - 2. Neck**
  - 3. Other parts of body**

# 1. Face

- i. **Swollen, cyanosed face .**
- ii. **Prominent eyeballs**
- iii. **Dilated pupils** If the knot presses on cervical sympathetic, eye of the same side may remain open and pupil is dilated (**la facie sympathetique**). **It indicates antemortem hanging.**
- iv. **Subconjunctival hemorrhages.**
- v. **Protrusion of tongue.** Injuries include bite marks with or without underlying small hemorrhages (**'marginal' hemorrhages**).
- vi. **Bleeding from nose/ears .**
- vii. Lips and mucous membrane of mouth are blue.
- viii. **Dribbling of saliva: Surest sign of antemortem hanging.**

## 2. Neck

### i. Ligature mark ('furrow')

1. *Site*: Usually above the hyoid bone.
2. *Size/shape*: Depends on the type of material used.
3. *Direction*: It runs obliquely, backwards, non-continuous, upwards and towards the point of suspension. Mark is noncontinuous because of a gap at the nape of neck, and hair intervening between ligature material and the skin underneath. When the knot is in contact with the skin, it is usually inverted 'V' shaped, due to extension of ligature material downward on both sides from the knot above .
4. *Skin at the site*: Usually depressed/grooved, pale in color, but later becomes yellowish brown, dry, hard and parchment-like with small abrasions at its edges, corresponding to the thickness and edges of the rope. These abrasions, known as *rope burns*, are due to frictional force.
5. The pattern of ligature may be reproduced in the furrow.
6. Postmortem blisters may be seen on skin squeezed adjacent to the furrow.
7. An abraded area below the furrow may indicate upward slippage of the ligature, usually seen when suspension is complete.
8. Neck veins above the furrow may be distended.

### ii. Dimension of neck

### iii. Bending of neck

# 3. Other parts of body

- i. *Tardieu's spots*
  - ii. Cyanosis of fingernails.
  - iii. Purple colored postmortem staining in the lower limbs and lower regions of upper limbs (hands/ forearms)—**glove and stocking PM staining**.
  - iv. Hands are usually clenched.
  - v. In males, there may be penile turgidity and involuntary discharge of semen.
  - vi. In both sexes, there may be an involuntary discharge of fecal matter and urine.
- 
- Signs of asphyxia may be lacking in case of complete hanging as death occurs almost instantaneously by vagal stimulation.
  - ☐Florid asphyxial changes can be seen in cases where a fixed knot was used or in incomplete hanging.

❖ Based on the ligature mark in the neck, the **diagnosis of antemortem hanging can be made if the following triad of characteristics** is present:

- i. Streaks or bands of reddened or pink tissue
  - ii. Imprint of the pattern of the ligature in the furrow
  - iii. Sloping or upward angle towards the suspension point.
- Microscopically, engorgement in the reddened and pinkish area in contrast to the adjacent non-engorged and nonhemorrhagic areas may be demonstrated.

# **Postmortem Findings in Hanging**

- **B . Internal Findings**

- 1. Neck**

- 2. Lungs**

- 3. Brain**

- 4. Viscera**

- 5. Blood**

## ?? Neck

- i. Subcutaneous tissue underneath the ligature mark is dry, white, firm and glistening. Platysma and sternomastoid may show hemorrhages, and are sometimes ruptured.
- ii. Hyoid bone may be fractured .
- iii. Transverse carotid intimal tears may be seen in obese victims, long drops and posteriorly placed knots (**Amussat's sign**).
- iv. Vertebral artery injuries—rupture, intimal tear and subintimal hemorrhage (most frequent) may be present.
- v. Larynx and trachea are congested.
- vi. Fracture of superior horn of the larynx may be present.

- **☒☒ Lungs:** They are congested, distended and emphysematous with plenty of Tardieu's spots subpleurally, particularly at the interfaces of the lobes.
  - **☒☒ Brain:** Congested and shows multiple petechiae.
  - **☒☒ Viscera:** All the abdominal organs are congested.
  - **☒☒ Blood:** Fluid and purplish in color.
- ☐ There may be hemorrhages on ventral surface of the intervertebral disks beneath the anterior longitudinal ligament in the lumbar spine (**Simon's sign –a vital sign of hanging**).
- It may also be seen in other traumatic elongation or overextension of spinal column (e.g. traffic accidents), drowning and putrefaction (**'false positive'**).



# Medico-legal Questions

**Q. Whether the hanging was suicidal, homicidal or accidental?**

➤ **?? Suicide**

➤ **Homicide:**

Very rare. Not ordinarily possible in an adult victim, unless intoxicated or made unconscious or the victim is either a child or a debilitated person.

- Homicide should be suspected where:
  - i. There are signs of violence/disorder of furniture
  - ii. Clothing of deceased is torn or disarranged
  - iii. There are injuries, either offensive or defensive.

# Postmortem hanging/postmortem suspension

- Person may be murdered and the body suspended to simulate suicide. Look for signs of dragging to the place of suspension. Beam or branch of tree shows evidence of the rope having moved from below upwards, as the body has been pulled up. *In true suicidal hanging, the rope moves from above downwards .*

### Differentiation 10.1: Antemortem and postmortem hanging

S.No.	Feature	Antemortem hanging	Postmortem hanging
1.	Salivary dribbling mark	Present	Absent
2.	Fecal/urinary stains	May be present	Absent
3.	Ligature mark <ul style="list-style-type: none"> <li>♦ Direction</li> <li>♦ Continuity</li> <li>♦ Level in the neck</li> <li>♦ Parchmentization</li> <li>♦ Vital reaction</li> </ul>	Oblique Non-continuous Above thyroid Present Present	Circular Continuous At or below thyroid Absent Absent
4.	Knot	Single, simple, on one side of neck	Multiple, granny or reef type on occiput/chin
5.	PM staining <ul style="list-style-type: none"> <li>♦ Above ligature mark</li> <li>♦ In lower limbs</li> <li>♦ Glove-stockings like</li> </ul>	Present Present Present	Absent Absent Absent
6.	Evidence of injury <ul style="list-style-type: none"> <li>♦ Self-inflicted</li> <li>♦ Struggle</li> <li>♦ Tear of carotid artery intima</li> <li>♦ Imprint abrasion</li> </ul>	Present Absent Present Present	Absent Present Absent May/may not be present
7.	Elongation of neck	Present	Absent
8.	Cyanosis	Deeply positive	Absent or faintly present
9.	Emphysematous bullae on lungs	Absent	Present
10.	Point of suspension	Compatible with self-suspension	Not so
11.	Histochemistry of ligature mark	Increased serotonin and histamine	Not so

# Accidental hanging

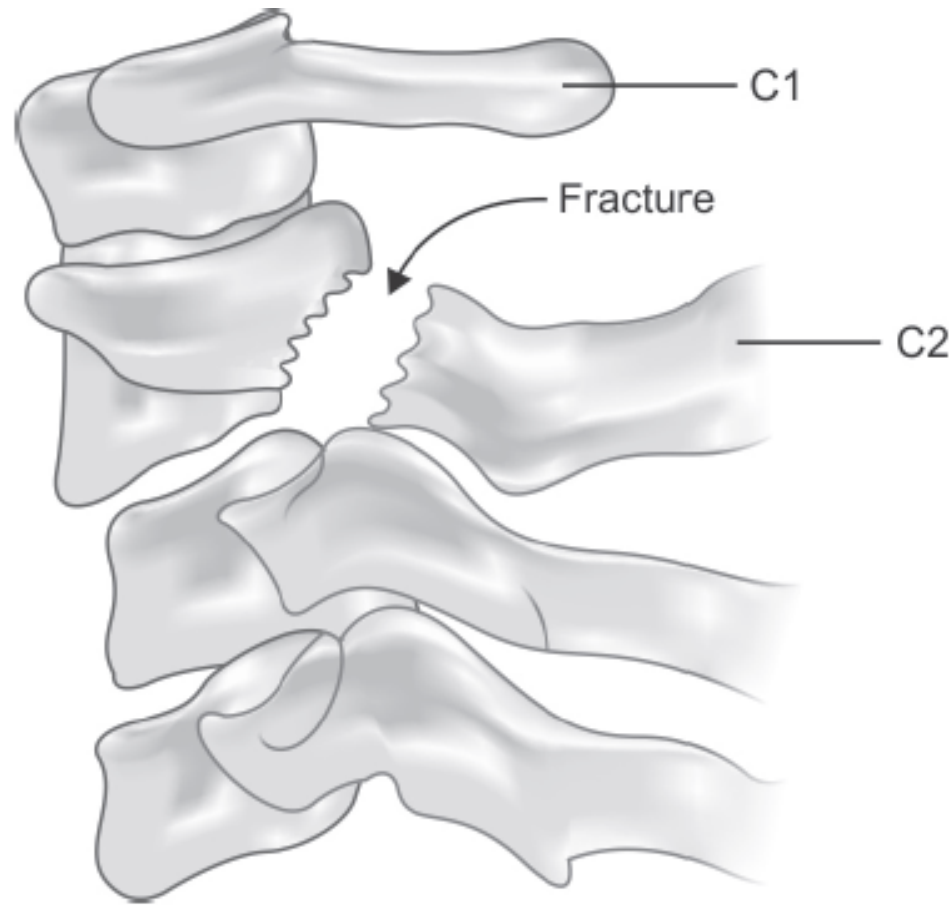
- Hanging deaths in children < 6 years .
- Sometimes even in adults (e.g. autoerotic hanging).

# Lynching

- Lynching is *a form of homicidal hanging*.
- A suspect, an accused or an enemy is overpowered by several persons, acting jointly and illegally, and hung him by means of a rope from a tree or some similar object.
- It was prevalent in North America, where it was practiced by whites on blacks .

# Judicial Hanging

- In case of judicial hanging, the ligature is looped around the neck with the knot under the chin (submental), but subaural (below auricle) knot is also used.
- The drop is at least the height of the person (5–7 feet, depending on the weight) and the hanging is complete. The ligature around the neck causes a forceful jerky impact on the neck at the end of the fall, so as to cause fracture of cervical column (fracture dislocation of C2 from C3, rarely C3 and C4 vertebrae—*hangman fracture*) with stretching or tearing of cervical spinal cord, but not decapitation. In judicial hangings, odontoid process is usually not fractured.



**Fig. 10.7:** Hangman's fracture

The mechanism of the injury is forcible hyperextension of the head. This injury may also be seen in sports, fall or road traffic accidents.