

ASPHYXIA (Suffocation)

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Terminology

- **Asphyxia** (definition)

= state of hypercapnia and hypoxaemia in arterial blood caused by acute ventilatory insufficiency

a.) **lack of oxygen** in the breathable environment

b.) **obstruction** of the external air passages

- asphyxial death

- inferior term to 'acute respiratory insufficiency - 'suffocation: 'lack of oxygen'

- **Asphyxia = gr. “absence of pulsation“**

- usually means global anoxia/hypoxia – **combination of respiratory and circulatory insufficiency**

Pathophysiology

- performing PM blood gases examination is of no value
- hypoxia - oxygen insufficiency in tissues, 4 types – hypoxic, circulatory, histotoxic, anaemic
- anoxia - total lack of oxygen in tissues
- hypoxaemia – when paO_2 level decreases under 10 kPa (75mmHg/Torr)
- hypercapnia – when $paCO_2$ level exceeds 6,0 kPa (45 Torr/mmHg)
- normal blood saturation with oxygen - above

Definition - Oxford Dictionary

I

suffocation

1 The state or process of dying from being deprived of air or unable to breathe.

'suffocation by smoke inhalation'

'the occupants died of suffocation inside the airtight compartment'

count noun 'prisoners told accounts of suffocations and shootings'

Definition – Oxford Dictionary

II

asphyxia

A condition arising when the body is deprived of oxygen causing unconsciousness or death; suffocation.

Origin

- **oxygen supply in blood (adult with normal saturation): 2000ml**
- **time of survival depends on tissues' oxygen demand (disease, activity, overall health) - 2-8 min**
- **4-5 minutes of severe hypoxaemia cause irreversible damage of glial cell**
- **ability to act diminishes after 10s of bloodflow restriction to brain**
- **different sensitivity of tissues to hypoxaemia**

Clinical signs I

- Stage I:

Dyspnoea (25-50s, up to 80s)

- „shortness of breath“ (hypercapnia)
- increased HR, BP, mild cyanosis
- hyperpnoe
- euphoria (hypoxia) / anxiety, fear of death

Clinical signs II

- Stage II:

Cramps + Unconsciousness (2 min)

- BP and HR decreasing
- marked cyanosis
- mydriasis
- tonic-clonic seizures, anaesthesia
- spontaneous defecation, urination, ejaculation
- sometimes pleasurable feelings preceding the seizures

Clinical signs III

- Stage III:

Apnoe (1-2 min)

- irregular breathing, decreased HR
- mydriasis
- muscle relaxation
- deepening unconsciousness

Clinical signs IV

- Stage IV:

Terminal

- terminal breaths – „gaspings“
- acceleration and weakening of pulse
- coma
- exitus

How long does it take...?

* complete apshyxia lasts usually 5-8 min ...
depending on:

- comorbidity
- age
- weight
- activity before the A. etc.

a.k.a. „overall and momentary health
condition“

... and – of course – type of asphyxia

Autopsy findings I

- diagnosis of A. is complex
- excluding all other causes of death - considering all circumstances and other autopsy findings
- NO pathognomonic signs/findings (findings are not constant ...)

Autopsy findings II

A) External examination

- dark (blue-violet) extensive postmortem hypostasis
- petechial haemorrhages – subconjunctival, on skin (vibicés) – small (dot-like, pinpoint) haemorrhages caused by capillaries' rupture when BP increases
- cyanosis (blueness of face/nose/ear lobes)

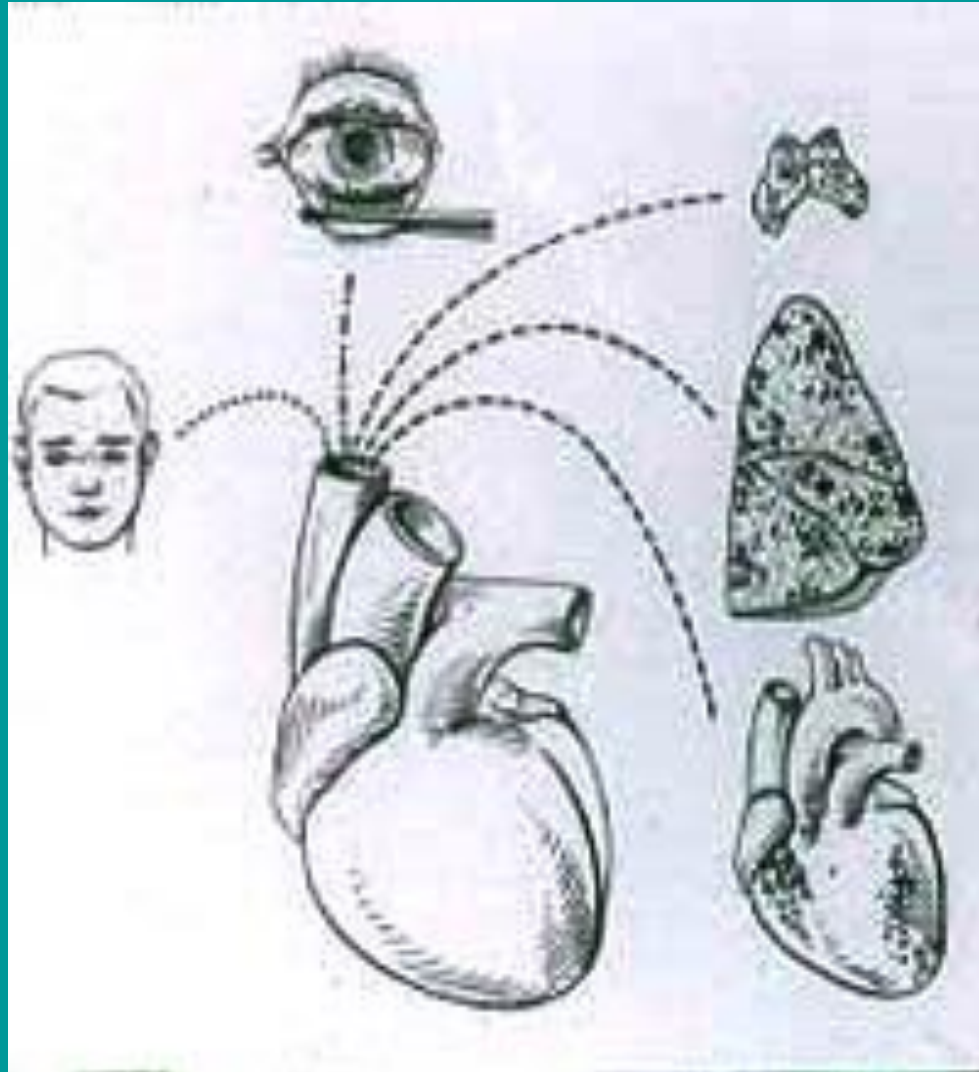
* the more extensively marked signs, the longer the tract of suffocation

Autopsy findings V

B) Internal examination

- petechial haemorrhages under serous membranes – Tardieu spots (subpleural, subepicardial, under capsule of thymus)
- petechiae on the inner side of scalp (subgaleal petechiae)
- dark liquid blood in venous sinuses, heart, vessels ...
- visceral congestion
- cerebral oedema
- pulmonary oedema
- dilatation of right cardiac ventricle (in children, heart is usually empty)
- positio asphyctica epiglottidis

Autopsy findings VI



Asphyxial death - aetiology

- (Internal causes – ... PE, pulmonary diseases, diaphragm paresis, exsanguination, methemoglobinemia, CO/CO₂/HCN intoxication, PNO, kurare/strychnine intoxication)
- External causes

1/ Strangulation

2/ Choking + Aspiration of foreign material

3/ Smothering

4/ Enviromental asphyxia

5/ Postural (positional) asphyxia

6/ Traumatic asphyxia

7/ Drowning

* 1,2,3,7 – mechanical asphyxia

Strangulation I

- the use either of hands(limbs) or a ligature as a means of applying neck pressure (=strangulation), causing closure of the blood vessels and air passages of the neck

FORMS:

- Hanging
- Ligature strangulation
- Manual strangulation (*throttling*)

Strangulation II

... fatal pressure on the neck

- aetiology is most complex and most controversial ALTHOUGH very common problem.
- except of the 3 main types --- direct blows, arm-locks, entanglement within cords/metal fence/railing, falling onto the neck etc.

Hanging I

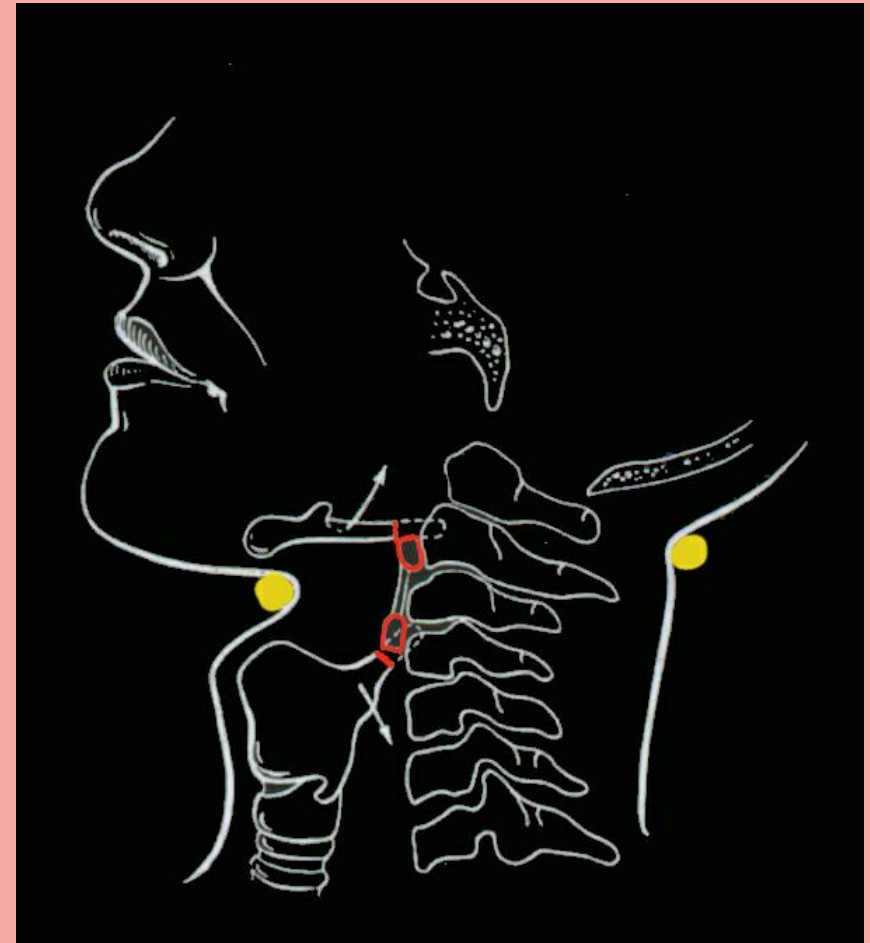
- **form of ligature strangulation in which the force applied on the neck is derived from the gravitational drag of the weight of the body**

Hanging II

- the ligature is tightened by the weight of the body (head...)
- ligature/noose – rope, cords, scarf, tie, socks, belts, bed sheet etc.
- slip-knot /fixed noose
- position of the body (scene finding): hanging, „standing“, kneeling...

Hanging III

- Mechanism:
 - constriction of air passage (tongue root elevated against soft palate)
 - constriction of blood vessels (veins and arteries)
 - irritation of nerves (n. vagi et nn. laryngici sup. glomeris carotici)



The pressure required to obstruct various neck structures

- jugular veins (2kg)
- carotid arteries (2.5 – 10kg, or 250mmHg)
- airways (8 – 12kg)
- vertebral arteries (35kg)

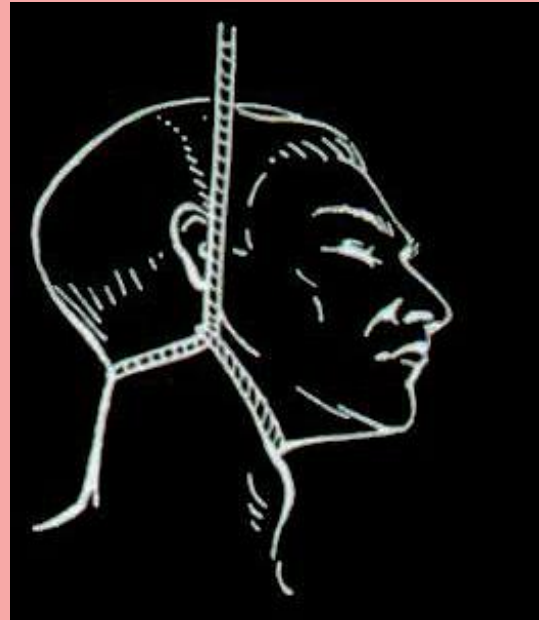
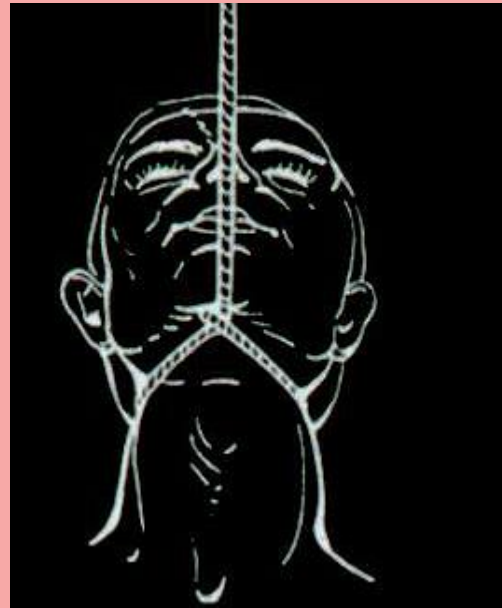
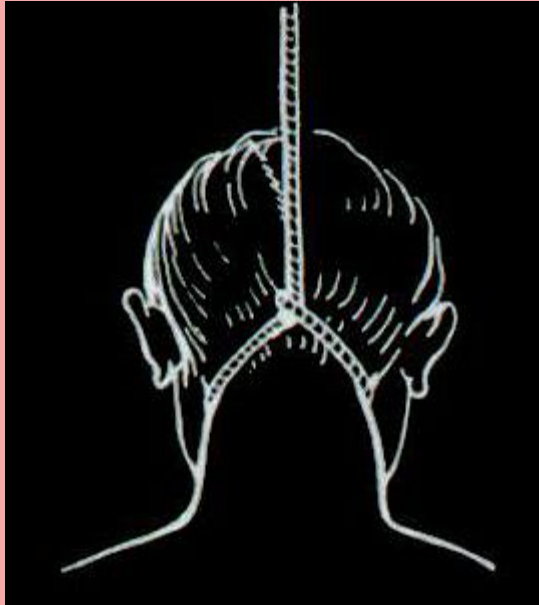
<http://www.forensicmed.co.uk/pathology/pressure-to-the-neck/>

Hanging IV

- Autopsy findings:
 - signs of asphyxia (PM hypostasis according to gravitational forces)
 - ligature mark – hanging mark
- *bleeding from ears, nose, congestion of the head, protruding (dried) tongue

Hanging mark I

- opened / closed
- simple – single loop / multiple loops
- typical / typical inverted / atypical (according to position of the knot)



Hanging mark II

- the appearance depends on ligature material (soft, hard, textured...), site of suspension point aso.
- a rope will give deep, well distinguished mark, often with impression of the rope's texture pattern on the skin, soft cloth – will give poorly defined, pale mark with no bruises and excoriations
- the longer the body remains hanging, the more prominent is the hanging mark

Hanging mark III

- vital reaction +/-

- appearance - parchment-like, red-brownish, dried, skin folds, hyperemic demarcation or small haemorrhages present around the mark

Suicide? Accident? Homicide?

- hanging - most often suicidal
- accidental hanging - uncommon (children, mountaineers, autoerotic asphyxia)
- homicidal hanging - very rare (drunks, children)

Other injuries in hanging

- fractures of thyroid cartilage (cornues) – laryngeal fractures
 - fractures of cervical spine (C2 – hangman's fracture)
 - abruption of cornues of hyoid bone
 - Amussat's sign - tears of intima of the carotic arteries
- usually insignificant neck structures haemorrhages
- other injuries: suffered during seizures (excoriations), postmortem (CPR, cutting off the ligature), self-defence injuries ...

Ligature strangulation I

- pressure to the neck is applied by constricting band (ligature) that is tightened by force applied by limbs (hand-s) or some thing (e.g.machine)
- most often homicide (silent, quick,...rapes)
- suicidal/accidental – rare (e.g.tie, scarf, shirt is captured by a moving machine)

Ligature strangulation II

- ligature: scarf, tie, pantyhose, electrical cord, wire, shoe lace...
- mechanism of death: the same as in hanging
- slower dying than in hanging – incomplete constriction of the neck
- surviving victims: retrograde amnesia

Ligature strangulation III

- Autopsy findings:
 - signs of asphyxia
 - extensive congestion of the head and dominant subconjunctival and periorbital skin petechiae
 - ligature mark – usually horizontal, closed, same depth along whole circumference
 - no Amussat's sign
 - more frequent laryngeal and hyoid bone fractures
 - marks of violence on the neck (excoriations, bruises)
 - haematomas in anterior cervical muscles

Manual strangulation I

- pressure to the neck is produced by hand(s), limb (arm), leg (tread on the neck)
- homicide
- accident – very rare (e.g.during children´s play, chokehold = sudden hold of the neck may evoke reflex cardiac death by irritation of carotic sinuses – in hypersensitive individuals)

Manual strangulation II

- Methods of manual strangulation

1/ assailant using one hand, victim attacked from the front –

small contusions and erythematous marks in association with nails on the side of the neck in the front, caused by the fingers (if right hand is used – thumb mark is on the right side of the neck)

2/ assailant using both hands, victim attacked from the front –

erythematous marks and contusions (bruises) or nail marks (scratches) on both sides of the front of the neck - usually posterior to SCM, thumbs press in central part of the neck – erythematous marks on the anterior side of the neck

3/ assailant using both hands, victim attacked from the back –

erythematous marks and contusions caused by fingertips and nails found in the front of the neck between the larynx and sternocleidomastoid

Manual strangulation III

- Autopsy findings:
 - signs of asphyxia
 - congested, cyanotic face
 - extensive subconjunctival and skin haemorrhages (upper and lower eyelids, brows, cheeks), haemorrhages under mucosa of larynx, trachea...
 - marks of violence (excoriations, haematomas) on the neck, often also around the nose and mouth, linear or semilinear – depending on the length, sharpness and regularity of the nails
 - haematomas in mouth vestibule (!!! if + smothering)
 - extensive haematomas in anterior cervical muscles
 - fractures of hyoid bone or thyroid cartilage (old people)
- * sometimes there are no signs on the neck – attacker presses the neck through clothes (collar, scarf...)

Manual strangulation IV

- Mechanism of death
 - occlusion of blood supply to the brain, occlusion of air-way passage (minor role), irritation of carotic sinuses (cardiac arrhythmia-vagal death)
 - pressure to the neck applied repeatedly
 - if survival – injuries to larynx, trachea ...
 - resuscitative injuries – misleading!

Smothering I

- blockage of the external air-passsage usually by hand or soft fabric eg.by pillow, cloth, paper (covering nose and mouth)
- variety: 'gagging' – fabric or adhesive tape occludes the mouth to prevent shouting

Smothering II

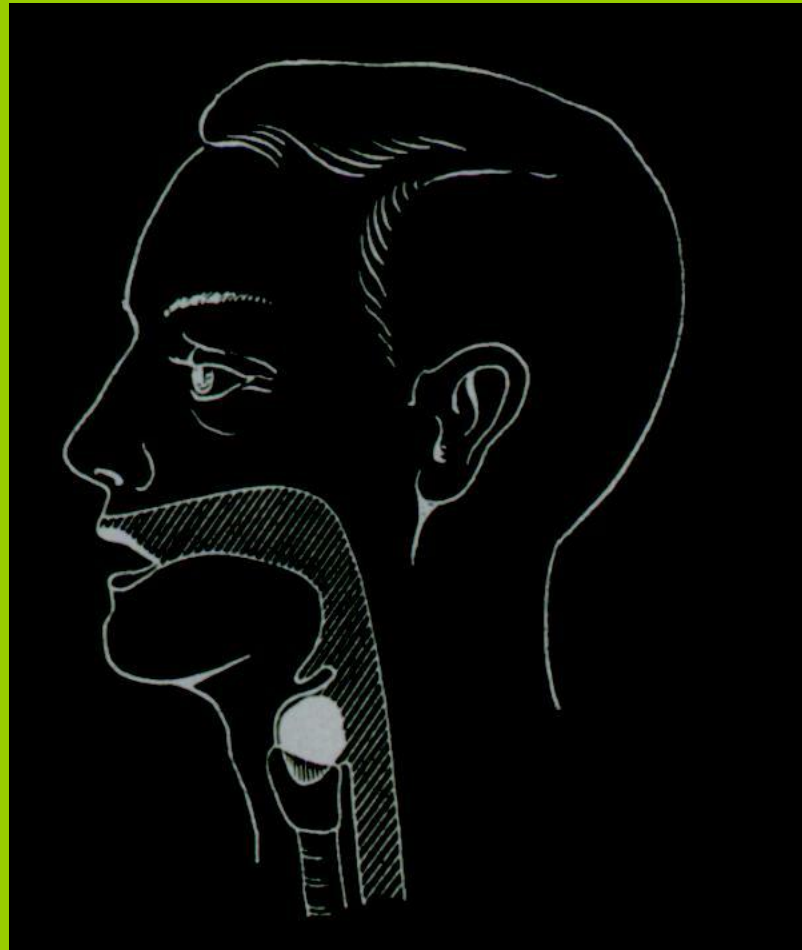
- homicide – victims are usually elderly people, new-borns, drunks aso.
- suicide – by putting plastic bag over the head (combination with enviromental asphyxia)
- accident – in epileptics, drunks, unconscious ones – e.g.if falling down on the face onto pillow, overlying of infants

Smothering III

- Autopsy findings
- signs of asphyxia
- excoriations and haematomas in the face, mostly around mouth/lips and nose (sometimes texture of the used cloth may be seen)
- lacerations and haematomas in the mouth vestibule
- diagnosis of smothering is difficult ... there can be no violent marks ...
- combination: throttling+smothering

Choking I

- blockage of the airways by foreign body
- reflectory
- e.g.in dysphagia
drunks, children,
talking while
eating, coughing...
- food, toys, broken
dummy part, beads ...



Choking II

- Mechanism of death:
 - obstruction of air-way passage
 - + reflectory – irritation of nn.laryngici sup.

- Autopsy findings:
 - signs of asphyxia
 - finding foreign body in larynx region/trachea

Choking III

- most often accidental
- homicide – in children or elderly by gagging them – injuries to pharynx (caused by finger nails) may be seen

Aspiration of foreign material into trachea and bronchi I

- vomit
- blood
- soot
- soil
- gravel
- mud
- debris

... any small foreign bodies

... any fluid/'runny' material

Enviromental aspyhxia I

- inadequate composition of breathable enviroment:
 - 1/ in places with low or none partial pressure of oxygen in the air
 - 2/ in small, closed spaces by 'using up' oxygen – mines if swamped
 - 3/ in places where carbon dioxide replaces oxygen – old wells, wine cellars, caves ...
 - 4/ in places where oxygen is replaced by non-respirable gases (methane, CO ...)

Enviromental asphyxia II

- accidental
 - small confined spaces (car trunk, wardrobe, fridge, dryer...), mines, caves, abnormal sexual practices (e.g.putting plastic bag over one's head in order to reach pleasing feelings while masturbating – combination with 'smothering')

Positional (postural) asphyxia

- may happen in some 'unnatural' positions of the body (lying on the abdomen, with head sloping down)
- accidental
- Mechanism of death:
 - cardiac failure, congestion of blood in head region may lead to brain hypoxia
- * Diagnosis: unnatural position + all other findings negative

Drowning I

- death caused by submersion in a liquid and aspiration of water into airways
- submerging only the face into a liquid is enough to drown...

Mechanism of death:

- irreversible cerebral anoxia
- obstruction of airways by liquid
- liquid presses the air in bronchi and causes pulmonary emphysema
- the air is mixed with the liquid and the foam occurs, the liquid absorbs into the blood

Drowning II

- Autopsy findings: NO TYPICAL SIGNS
- signs of asphyxia
- !!! diagnosis is based on the circumstances of death, plus a variety of nonspecific findings
- foam around mouth and nose, goose bumps, cyanosis of the face, constriction of the skin of penis, scrotum, nipples, maceration of skin – hands of the washerwoman (after 2-4hrs)
- pulmonary ‘emphysema aquosum’
- white or hemorrhagic foam of trachea and bronchi

Drowning III

- Autopsy findings II:
- water in lumen of stomach and duodenum
- fissures of mucosa of stomach
- silt, small stones, water plant in trachea and bronchi
- Paltauf spots – subpleural dot-like haemorrhages as a result of rupture of alveolar septa (lighter colour than the petechiae described previously)
- signs of subgaleal haemorrhage
- postmortem injuries ...

Drowning IV

Types of drowning:

1. wet drowning – major role – water in airways, also without submersion, covering of the nose and mouth by the water
 2. dry drowning – death caused by laryngospasm, death caused by the submersion
- near-drowning = secondary drowning = delayed drowning syndrome – death several days after drowning

Drowning V

- 2 types of inhaled water:
- fresh water: large volumes of water can pass through the alveolar capillary membranes and alters or denatures pulmonary surfactant – hypervolaemia – reduction of level of sodium, chlorides, potassium and plasma proteins – death: combination of alternation of ions and hypoxia
- salt water: dilutes or washes surfactant away – liquid in lungs increases – decreasing circulating blood – death: combination of acute pulmonary oedema + hypovolemic shock
- Tests for drowning – Gettler chloride test, diatoms(algae) in tissues

Drowning VI

- mostly accidental
- may be suicidal – difficult to prove (suicide note, circumstances)
- homicide – difficult to prove, rare

Dead body in water

- Causes of death of dead persons pulled out of water may differ!
 1. sudden natural death before falling into water (e.g.sudden cardiac death)
 2. sudden natural death happened in water
 3. death caused by injuries that were inflicted before so. was thrown into water (homicide - body thrown into water)
 4. death caused by injuries that happened in water (impact on the pier, bottom of the pool...)
 5. death caused by laryngospasm on the strength contact of the body with the cold water – reflectory death - dry drowning
 6. wet drowning

Traumatic asphyxia I

- pressure from the outside of the body precludes ventilation = stops the movements of the chest and upper abdomen
- congestion of blood of drainage area of vena cava superior = cyanosis of face, neck and upper trunk with numerous petechiae in these areas, sclerae, conjunctivae and periorbital regions – blue mask syndrome + signs of asphyxia

Traumatic asphyxia II

- homicide – individuals buried with head above ground
- suicide – rare
- accident - most often, in car accidents, crowds, mines...

Traumatic asphyxia III

- Autopsy findings:
 - signs of asphyxia
 - blue mask syndrome
 - injuries caused by compressing object
 - aspiration of material (soil, gravel...)

...might be interesting

- Garotting: ligature strangulation, spanish method of judicial execution
- Waterboarding: form of torture in which water is poured over cloth covering the face and breathing passages, causes the sensation of drowning – „dry drowning“
- Burking: kneeling on the chest of the victim + smothering

Death in avalanche

- suffocatio ex occlusionem nasi et oris
 - suffocatio ex impossibilitate motus respiratorii
 - crush syndrome
 - freezing
 - aspiration of the snow powder
- fractures of ribs, spine, pelvis + contusions of organs of the abdomen and thorax