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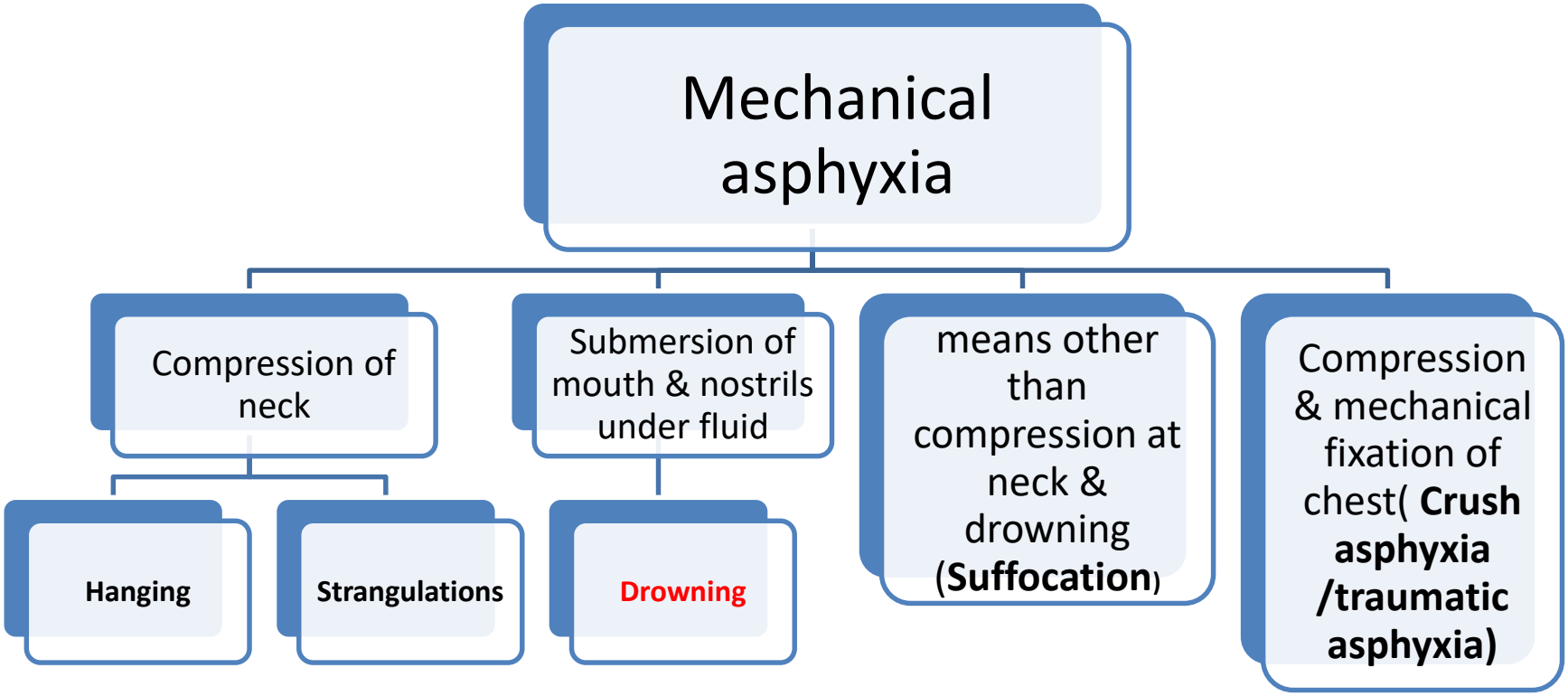
MECHANICAL Asphyxia-

(**Part2:**Drowning and Suffocation**)**

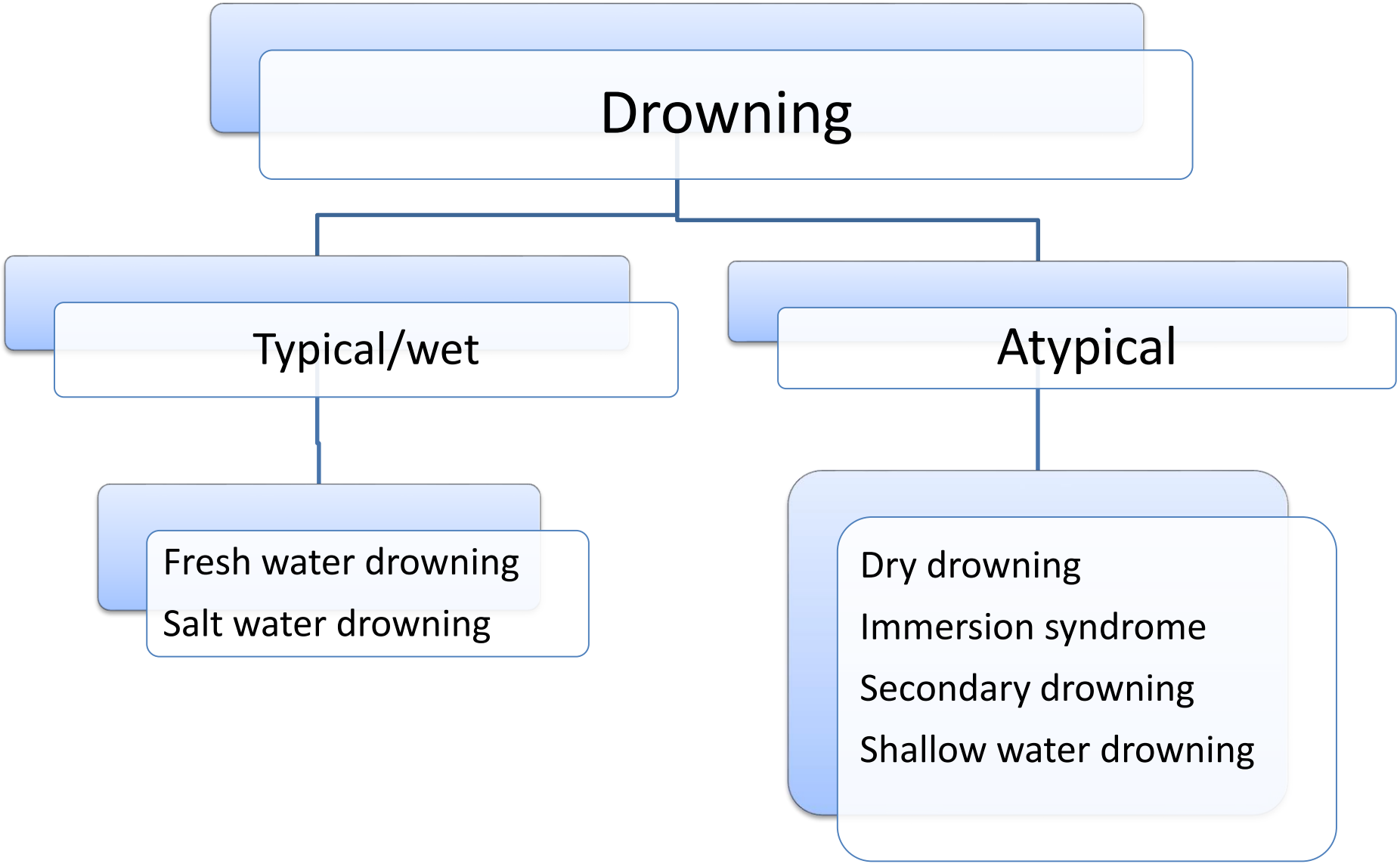

Mechanical asphyxia
Compression of neck
Hanging
Strangulations
Submersion of mouth & nostrils under fluid
Drowning
means other than compression at neck & drowning (Suffocation)
Compression & mechanical fixation of chest(Crush asphyxia /traumatic asphyxia)

Drowning

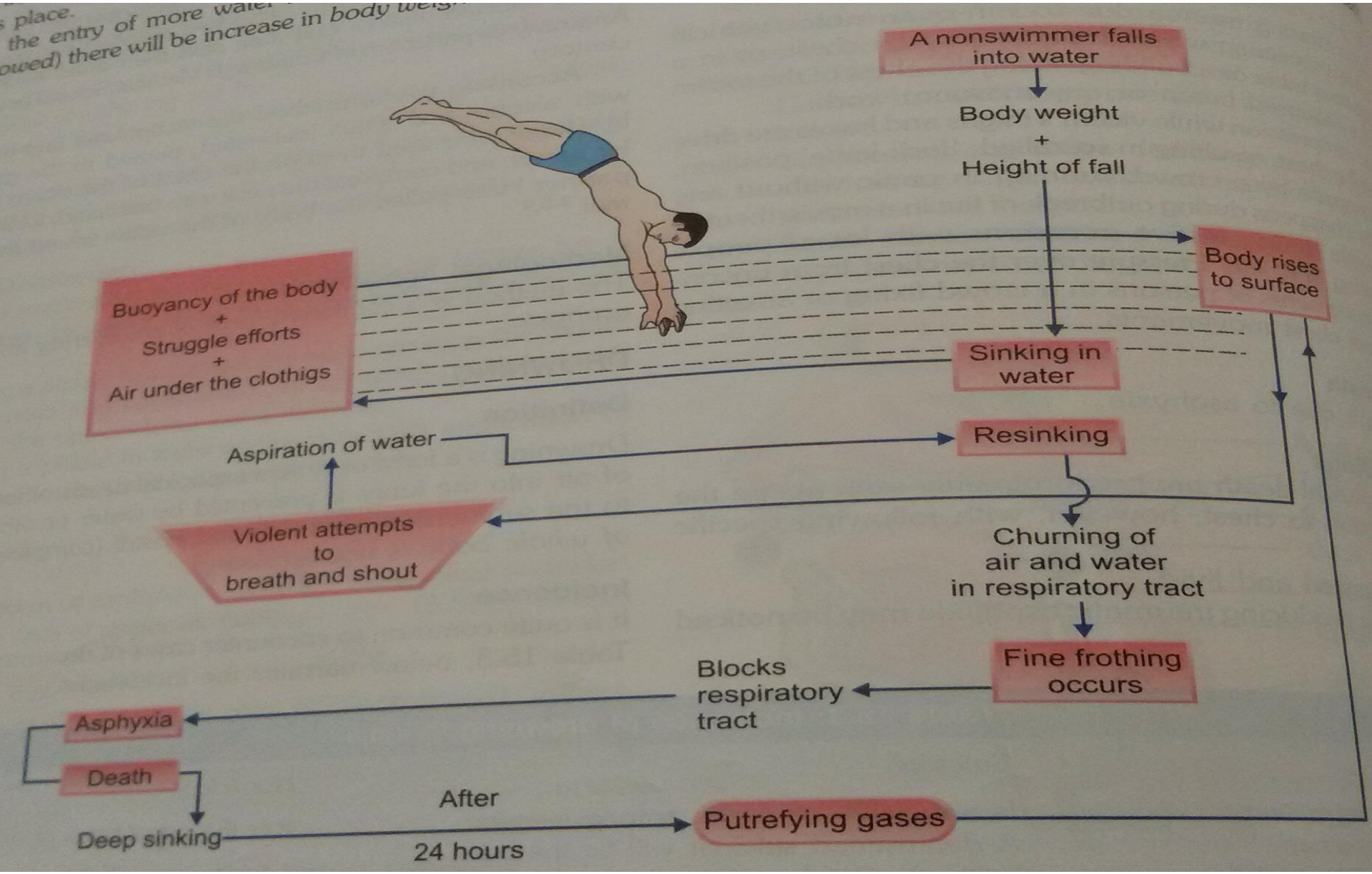
voilent asphyxial death , wherein the entry of air into the lungs is prevented by water or any other fluids due to submersion of mouth & nostril

Complete submersion of whole body is not necessary.

Types of drowning



Mechanism of drowning



Classification of drowning

A. Typical Drowning :

also k/a **Wet Drowning**

i. Fresh water drowning
ii. Sea water drowning.

Pathophysiology of fresh Water drowning

FRESH WATER

(hypotonic as compared to alveolar capillaries)

↓

Water from alveoli enters alveolar capillaries & thus enters circulation

↓

Dilution of blood (Haemodilution)

↓

RBC'S swell & burst

↓

K^+ levels elevated

↓

Cardiac arrthymias

↓

Death(4-5mins)

Pathophysiology of Sea Water drowning

SEA WATER

(hypertonic as compared to alveolar capillaries)

↓

Water is drawn into alveoli from circulation

↓

Haemoconcentration of blood

↓

RBC'S crenated

↓

Pulmonary odema

↓

Myocardial dysfuction

↓

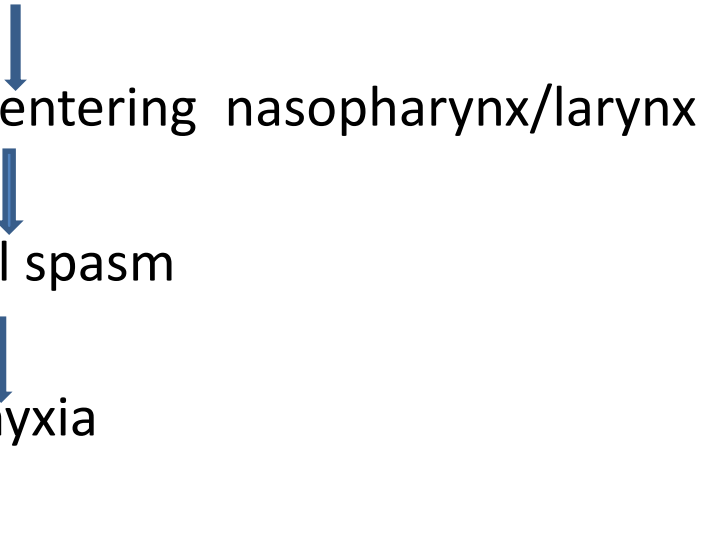
Death(8-12mins)

B. Atypical drowning

1.Dry drowning :

Rare , 10-15% cases

fall into water column



*on autopsy no water in lungs

2.Immersion syndrome/ Hydrocution/cold water drowning/submersion inhibition :

Seen in cold & temperate environment.

Causes:

- cold water stimulating the nerve endings of surface of the body
- Water striking epigastrium
- Cold water entering eardrums ,nasal passages ,pharynx & larynx.
- Falling or diving into water with feet's first or duck driving by inexperienced.

Duck diving- Head first

3. **Near-drowning/post-immersion syndrome/secondary drowning**:

survival beyond 24hrs of a submersion episode

Death is caused by complications or sequelae:

ARDS

Pneumonia

Sepsis

hypoxic-ischaemic encephalopathy

cerebral odema

DIC

4.Shallow water drowning/submersion of unconscious

Seen in persons:

epilepsy

heart disease

drunkenness

sustains a head injury during fall

Symptoms

- Recalling of memory of past events.
- Mental confusion with auditory & visual hallucinations
- Tinnitus , vertigo
- Chest pain etc.

Fatal period

Fresh water: 4-5 mins

Sea water: 8-12 mins

Treatment

- Artificial respiration with close chest cardiac massage
- Defibrillators

Causes of death

1. Asphyxia
2. Ventricular fibrillation
3. Vagal inhibition
4. Laryngeal spasm
5. Concussion / head injury
6. Apoplexy
7. Secondary causes

- septic aspiration pneumonia
- Sudden bursting of an aneurysm etc

Postmortem findings

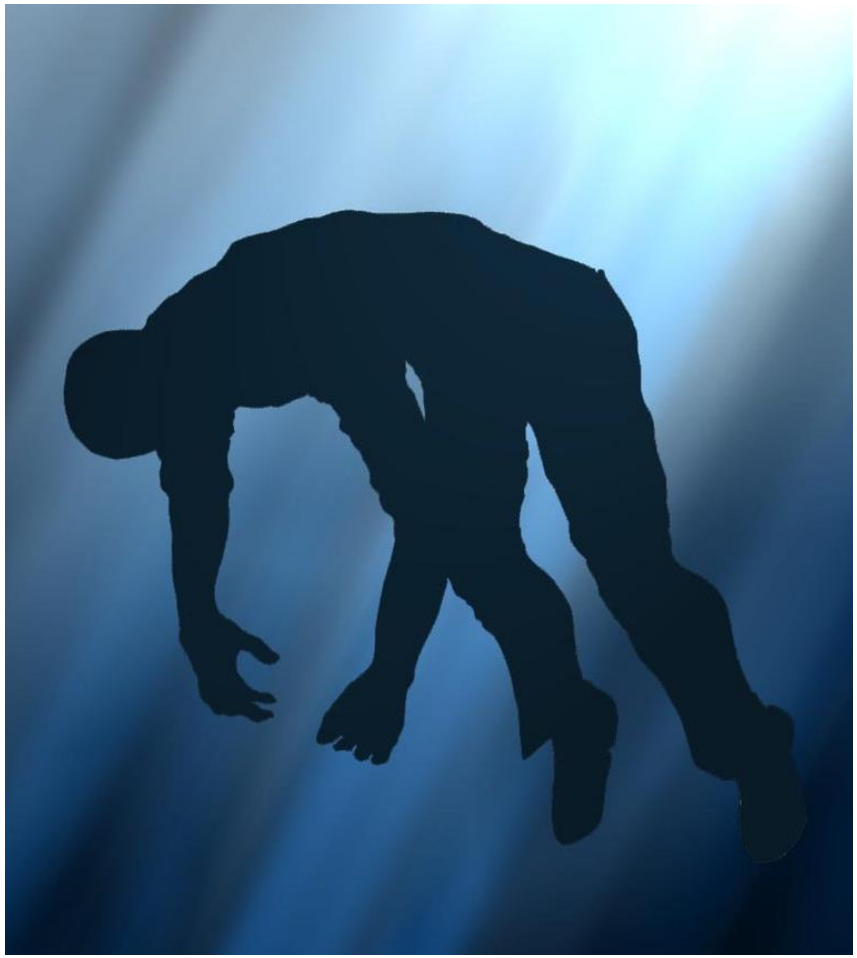
1. External signs of drowning
2. Internal signs of drowning
3. Biochemical & biophysical test for drowning
4. Analysis of diatomaceous material

External signs

When freshly removed from water:

1. Body & clothes wet, sand & mud stains may be +nt.
2. Body surface pallid & cold
3. Face: pale,bloated & discolored with putrefaction
4. Eyes: half open or closed, conjunctiva suffused,petechial haemorrhages +nt.
5. Tongue swollen & protuded

6. P/M lividity: free flowing – no lividity, in stagnant water- pink color , confined to head ,neck & front of upper part of chest,extremities



7. Froth : from mouth & nostrils

Froth in antemortem drowning

- White
- Copious
- tenacious
- persistent
- Fine
- leathery
- Ocassionally blood tinged

- Foam consist of fine bubbles & do not collapses on touching with pointed knife

- Foam production is a vital process

Mechanism:

Fluid in respiratory tract provokes production of mucus

Mucus+water + air+ surfactant---------- is churned into tenacious foam by voilent respiratory mov. Made by victim during course of drowning.

Foam also seen in…….

1. Opium poisoning
2. Organo-phosphorous poisoning
3. Strangulation
4. Epileptic attacks
5. Acute pulmonary odema
6. Electric shock
7. Putrefaction.

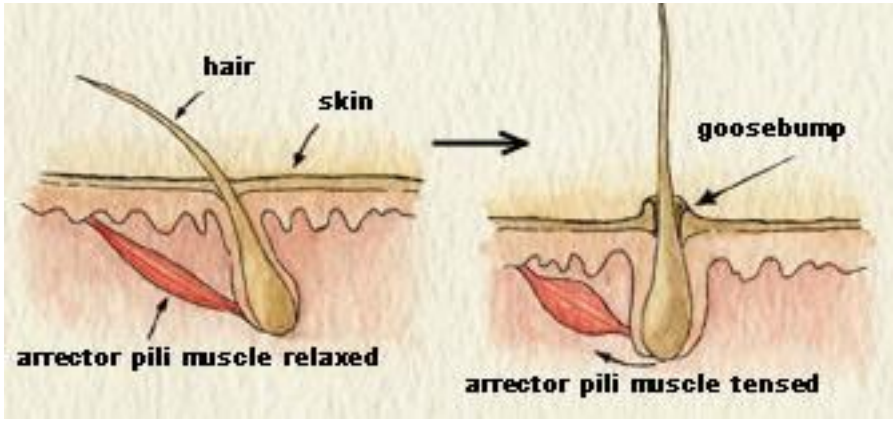
8. Cutis anserine/ goose skin/goose flesh/goose bumps/horripilation:

Puckered ,granular appearance of skin

Medicolegal importance:

Seen in both antemortem & postmortem.

(postmortem due to rigormortis in erector pilli muscle.)



9.Maceration of skin/ washer women's hands & feets :

d/t imbibition of water in outer layer of skin

- Usually involves fingertips, palms, back of hands & soles

- Skin **whitened**
- **swollen**
- **Sodden**
- **wrinkled**
- **corrugated.**

- Later on epidermis loosened followed by nails & from hands & feet can be detached **in glove & stocking fashion**

First seen in fingertips – 3-4 hrs

Entire hands – 24hrs.

Maceration helps in estimating approx. duration of immersion.

wrinkling of skin= **1-2 hrs**

bleaching of cuticle **= 12 hrs**

bleaching , corrugation & soddening **= 24 hrs**

cuticle *separation from palms of hands & soles of feet* = ***48 hrs***

*easily p*eeled off = **3-4 days**

Floatation of body

summers= 24hrs

winters = 2-3 days

10. Gravel, mud,sand,weeds or aquatic vegetation held firmly in clenched hands – ***cadaveric spasm***

- ***vital proof of antemortem drowning***
- ***indicates place of submersion.***

11. Scrotum & penis gets retracted in contact with cold water.
12. Rigor mortis appears early
13. Antemortem injuries

Two important Antemortem features

Internal signs

- **voluminous, bulky ,water-logged ,over-inflated , filling the entire chest cavity & over-lapping the heart**
- **indentations of ribs**
- - lung surface shows **mottled** appearance
- sub-pleural haemorrhages **k/a paltauf's haemorrhages** seen.(anteriorly)

- - cut surface of lung- copious amt. of frothy blood-stained liquid seen. Continous Column of froth seen

This overall picture of lungs is k/a **emphysema aquosum.**

Odema aquosum:

Person Unconcious at time of drowning- mere flooding of lungs with water ,columns of froth not continous

Hydrostatic lung :

dead person thrown in water . d/t hydrostatic forces water enters lungs.

2.larynx, trachea, bronchi:

+nce of sand, mud, aquatic vegetation, algae, diatoms in trachea & lower bronchi.

Fine white froth in trachea & bronchi lumen

Mucosa of larynx, trachea & bronchioles red & congested.

3. Heart : rt .full lf. Empty

4**. Stomach & intestines** : +nce of some **disagreeable material** like muddy water, liquid manure, aquatic vegetation etc. which could not have swallowed voluntarily is highly suggestive of antemortem drowning.

Middle ear:

+nce of water & haemorrhages in middle ear & mastoid air cells

strongly suggests antemortem drowning.

6. brain, liver,spleen , kidneys – congested

Biochemical & biophysical test for drowning

Gettler’s test

Gettler's test

1921 by **Alexender Gettler-** chloride content s of both sides of heart .

Normal chloride content of right & left side of heart is same

= 600 mg/100ml

Difference b/w 2 chambers not more than 5mg/100ml

A difference of 25mg/100ml --- inducates death d/t drowning.

Fresh water drowning:

Chloride of lf. Side of heart < rt. Side

Salt water drowning

Chloride of lf. Side of heart > rt. Side

Limitations of test:

laryngeal spasm

vagal inhibition

patent Foramen ovale

saline content of drowning media approximates that of blood.

1944 Mortiz suggested magnesium levels

Mg left side of heart > right side.- sea water drowning

1955 Freimuth et al.

Specific gravity of plasma of 2 sides

-ve difference of both side – drowning/non drowning

+ve – other than drowning.

Diatom test

Diatoms :

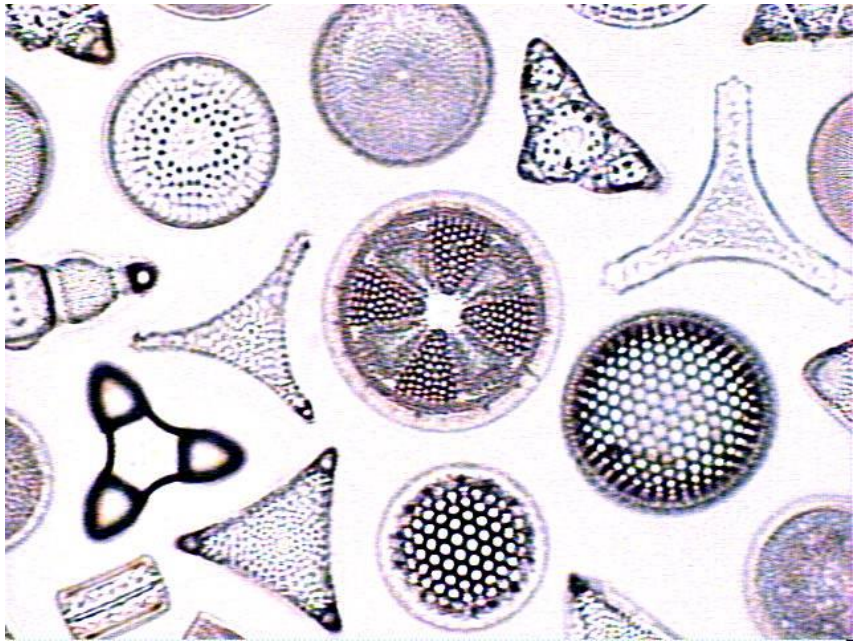
1904 Revenstrof first attempted to use diatoms as a test for drowning. (1896 by Hoffmann)

Diatoms / bacillariophycaes

Unicellular algae with **silicious exoskeleton** – frustules

Chemically **inert, indestructible, resistant to strong acids & resists putrefaction.**

15000 species (1/2 in fresh water & ½ in sea water)



Principle of test

Victim falls in water with diatom

diatoms carried to pulm. Parenchyma

enters blood stream (alveolar capillaries) via tears of alveolar walls which occurs during forceful inspiratory & expiratory efforts

diatoms to distant organs via systemic circulation

bone marrow , bone , kidney .

Method

2-5 gm of tissue /40 gm of bone marrow

↓

Place in Kjeldahl flask , add con HNO_3

↓ Heat for 1-2 hrs

Transparent yellow fluid with supernatant disc of fat

↓

Yellow fluid centrifuged

↓

Centrifuged Deposit examined on a slide while still wet.

Comparison of no. nature & distribution of **diatoms in visceral** organs / marrow with those **observed in alleged medium of submersion**.(Drowning medium also collected as control)

Interpretation

+nce of diatoms in distant organ & marrow –suggestive proof of antemortem drowning .

Absence of diatoms does not exclude drowning

Limitations

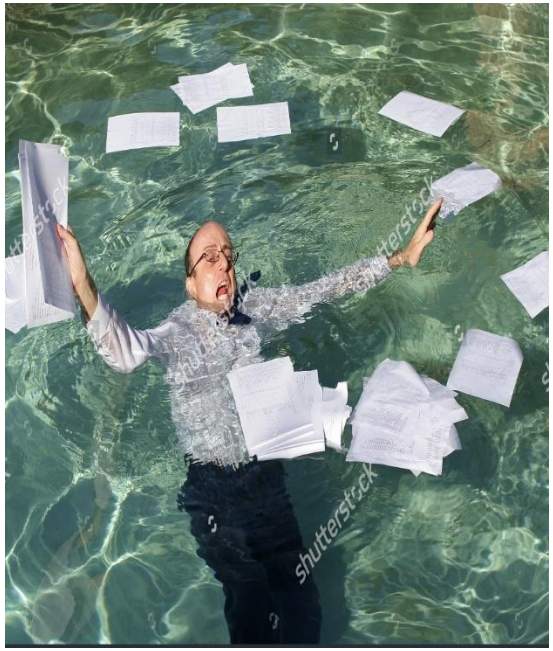
1. Drowning media does not contains diatoms
2. Drinking water containing same diatom
3. Since ubiquitous in nature may enter circulation via GIT

- Contaminated foods(salads, sea foods etc)
- Via Resp. tract- +nt in air in some paints ,building plasters, dusts, chalk powder etc.

Medicolegal importance

1. Accidental – common

Also seen in precipitate labor.



2.Suicidal common in India, specially in females

3.Homicidal also not rare.

seen in infanticide

Scuba divers –

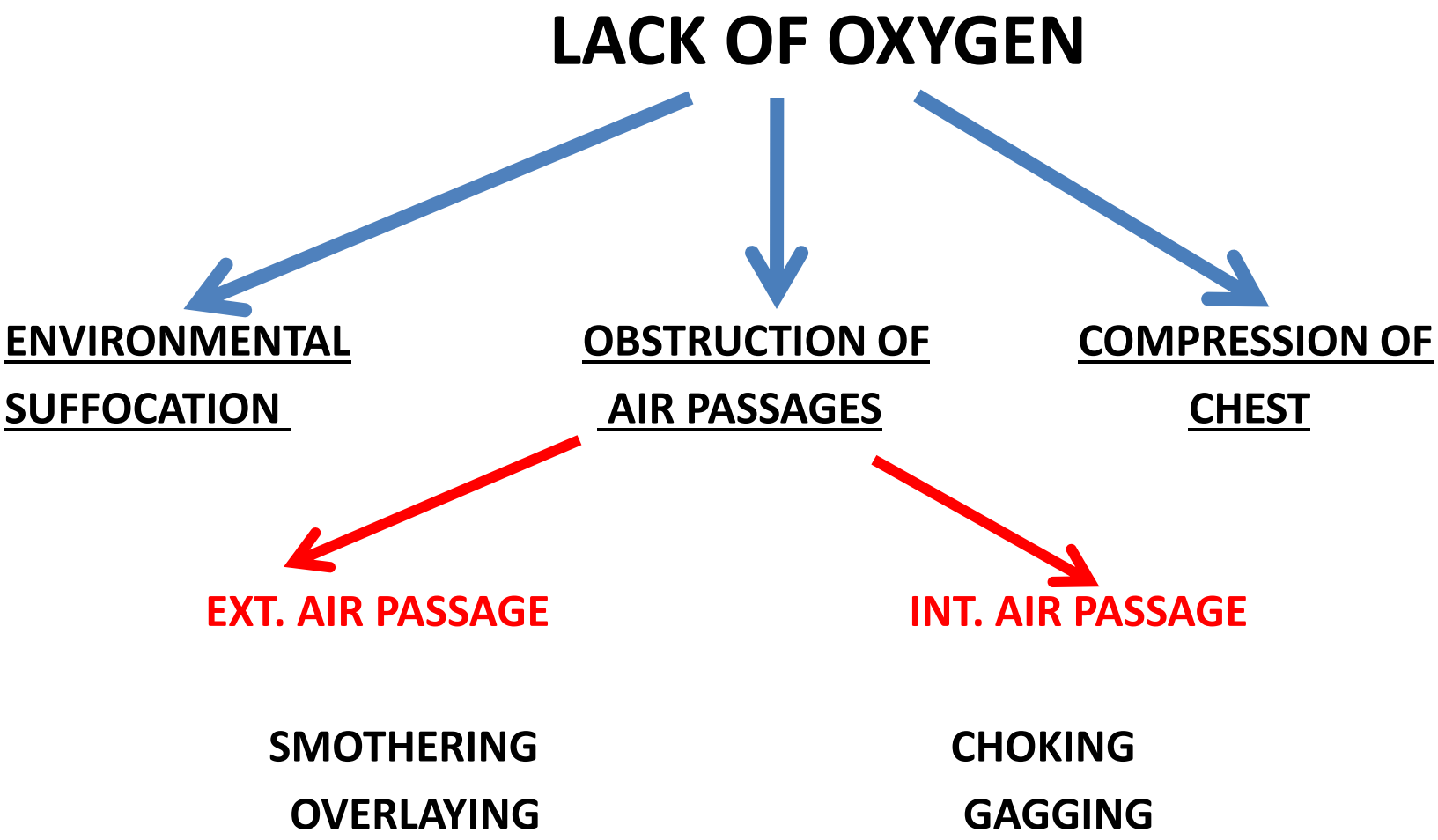
defective equipment(rapid ascent / decent)

Causes air embolism, pneumothorax or interstitial emphysema

SUFFOCATION

Defination ….

Form of asphyxia caused **by lack of oxygen** in an atmosphere or by **mechanical obstruction of the air passage** by means other than constriction of neck & drowning .


LACK OF OXYGEN
ENVIRONMENTAL SUFFOCATION
OBSTRUCTION OF AIR PASSAGES
COMPRESSION OF CHEST
EXT. AIR PASSAGE
INT. AIR PASSAGE
SMOTHERING
OVERLAYING
CHOKING
GAGGING

1. Environmental suffocation

- High altitudes
- Underground chambers
- Underground sewage entrapment
- Entrapment
- Domestic circumstances
- Carbon-monoxide & CO_2 poisoning .

Smothering

Mechanical occlusion of ext. air passage **(Nose & mouth**) by hands , cloths, plastic bags, duct tape etc.

Autopsy findings:Externally

- Abrasion ,bruises & lacerations
- crescent shaped nails marks*
- # of nasal cartilage with bleeding
- frenular tears, abrasions, contusions, lacerations seen over inner aspects of lips,
- teeth loose & dislocated & tearing of gums.
- **Associated struggle marks**

Internally :

+nce of sand ,dust, mud, cotton wool, flour, barley grains etc. in mouth ,nostrils

+nce of such material in the deeper respiratory passage intermixed with fluid & mucus - highly significant

Lungs show congestion, odema, & areas of haemorrhage & collapse with intervening emphysema

Medicolegal aspects

1. **Accidental smothering** :

- common in alcoholics,
- epileptics ,
- newborn born with membranes covering mouth & nose (cul-de-sac),
- children while playing with plastic bag.
- Auto-erotic asphyxias etc.

OVERLAYING

infant & mother sharing same bed

Mother roll over the child or occlusion of air passages by her breast while feeding.

- In infants < 5mths & seen upto 2years.

MLI- SIDS & infanticide case.

2. **Homicidal smothering:**

Adults very rare, & difficult

unless victim weak,

stupefied by drugs or alcohol, or

great physical disparity between victim & assailant .

3. suicidal smothering :

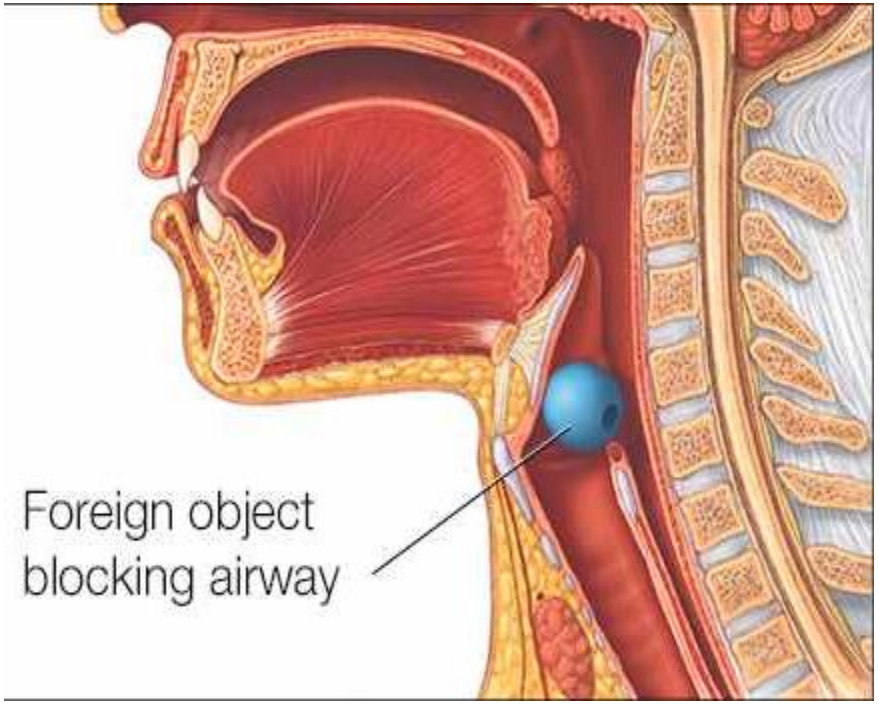
By owns hands is impossible

Tying plastic bag over mouth & nostril & applying multiple knots

Or tying a pillow in front of face with application of knots.

2.Choking

Form of asphyxia caused by mechanical occlusion within various sites of upper air passages by foreign objects



objects

1. Metallic coin, edible fruit seed, toffees, candies etc.
2. Food particle- bolus of rice, fish bone etc.
3. Tongue of the person in an epileptic attack may fall back onto the posterior pharyngeal wall
4. Sucking piece of balloon while inflating.

Cause of death in choking

Asphyxia

Vagal inhibition

Laryngeal spasm

Autopsy finding

Specific findings:

+nce of foreign object in the resp. tract

If victim epileptic, tongue must be specially examined for its position,& +nce & -nce of bruising or bite marks

Medicolegal importance

1. Usually accidental

Café coronary : eg .of accidental choking where a bolus of food produces complete obstruction of the larynx.

it mimics heart attack.

Cause:

suppressed gag reflex due to gross intoxication with alcohol or drugs .

reflex cardiac arrest as a consequences of stimulation of laryngeal nerve endings.

Clinical findings :

apparently healthy individual suddenly turns blue while eating

Autopsy findings: bolus of unchewed food or such other material found impacted in larynx.

Gagging

Preventing air entry into the respiratory tract by stuffing **gag material** (clothes,paper balls etc.) into the mouth.

Cause/mechanism

Gag material tightly stuffed into the mouth & obstructing breathing through the back of the throat.

Saliva,mucus or odema fluid moistens & air pockets in cloth & paper collapses

Traumatic asphyxia.

Form of asphyxia resulting from **trauma of the chest** leading to forceful compression of the chest **preventing respiratory movement**s.

Causes

1. Penetrating injuries- stab injury
2. Non-penetrating injury- runover motor vehicle accidents, steering vehicle impact injury on chest , collapse of mine or building etc.
3. Indirect compression- victims thighs & knees are drive against the chest resulting in so called ‘jack-knife’ position.
4. Stampede by crowd-----also k/a **RIOT CRUSH**

Autopsy findings:

Predominantly seen over level of obstruction of chest

Face congested & livid

Medicolegal importance:

Usually accidental

Rarely suicidal

Could be homicidal------- eg. Burking.

Burking

Combination of –

smothering/palmar strangulation

traumatic asphyxia

This was used by 2 criminals William Burke & William Hare- who used to kill victims to sell their bodies to the Anatomy dept. of Edinburg Medical School (19th century) of Scotland.

Victim first intoxicated with alcohol---- then pinned to the ground ---- Burke used to sit on the chest of the victim & cover his mouth & compress the neck with one hand---while other partner Hare pulled the body of victim round the room by feets.

16 murders over period of 10 mnths & bodies were sold to Dr.Robert Knoxx.