

Notes compiled by PJ Louw for LLB from the UNISA Study Guide & other material. Whilst care has been taken to ensure accuracy you are advised to also verify facts independently.

## STUDY UNIT 1

### 1. Classify unnatural deaths.

**Unnatural deaths can be classified as follows:**

- (a) deaths **as the result of violence** to the body
- (b) deaths governed by **section 56 of the Health Professions Act**, the so-called "anaesthetic deaths"
- (c) deaths **due to an omission or commission** by someone else
- (d) **sudden and unexpected deaths.**

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### 2. Why is the sudden and unexpected death of a person always treated as an unnatural death? Can these deaths also include natural causes?

- When a person dies suddenly and unexpectedly, **it is not obvious initially whether this death is the result of natural or unnatural causes.**
- It is important that any **unnatural causes should be excluded** before the death is treated as a natural death.
- **For this reason, it is routine practice to treat these deaths as unnatural deaths, and to perform a post-mortem examination.**
- If the cause of death is diagnosed at post-mortem, and if there are **no obvious signs of violence** to the body visible during the post mortem, these deaths can then be further dealt with as **natural**.
- This is done for both **babies** (sudden infant death syndrome (**SIDS** or cot death) as well as in **younger persons (younger than 50±60 years)** who suddenly and unexpectedly die without a pre-existing medical history of significance.

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### 3. *A person under the influence of alcohol is involved in a motor vehicle accident and sustains multiple injuries. During his stay in the intensive care unit, ventilation is*

necessary due to his injuries. He develops a lung infection (pneumonia) and dies due to lung (respiratory) failure.

**What is the primary cause of death?**

- The primary cause of death is multiple injuries.

**What will you regard as the terminal cause of death?**

- The terminal cause of death is pneumonia or lung infection

**And the mechanisms of death?**

- The mechanism of death is respiratory or lung failure.

**Are there any predisposing causes?**

- Alcohol can be regarded as a predisposing cause.

4. *In those cases where there are minimal or no signs of trauma to the body of the deceased, such as drowning, certain evidence may be of value to determine the cause of death. Discuss this statement?*

Circumstantial evidence is often of value in determining the cause of death in this type of situation.

5. **Which findings must be made by the judicial officer during an inquest?**

**The follow findings must be recorded:**

- (a) the **identity** of the deceased
- (b) the date or likely **date of death**
- (c) the cause or likely **cause of death**
- (d) whether the death is brought about by an **act or omission prima facie** involving or *amounting to an offence* on the part of any person

## STUDY UNIT 3

### POST-MORTEM CHANGES

1. *The body of a murdered person is found in the open veld. It is still warm on contact, but rigor mortis has already developed.*

**How long do you estimate the post-mortem interval to be?**

- As a rule of thumb it may be assumed that this person died 3 to 8 hours earlier.

**What factors may affect the rate of cooling of the body?**

- Factors which may influence the rate of **cooling during the post-mortem period** include:
    - (a) the initial body temperature
    - (b) the environmental temperature
    - (c) bodily characteristics
    - (d) the posture of the body
    - (e) movement of air and humidity
    - (f) clothes and other covering material
    - (g) the medium in which the body is found
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2. *The body of a person who allegedly drowned is retrieved from water. A branch of a tree is tightly gripped in the hand. **How will you interpret this?***

- **This is an example of cataleptic stiffening** which sometimes occurs when a person dies during a severely tense and stressful period.
  - In this situation the indication is that the **person was still alive** when he fell into the water, and grabbed a branch in a last effort to survive.
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3. *A female dies a day after having been severely assaulted by her spouse. During the post-mortem examination blue or reddish blue marks are present over the back. The pathologist is convinced that this is only due to hypostasis. **How should this case be managed?***

- Incisions in the skin will **confirm the presence of blood outside the blood vessels**, and therefore help to differentiate between contusions or bruises and hypostatic changes (where the red blood cells will still be limited to the blood vessels).
  - **Microscopic examination** may be of further assistance to confirm the presence of the red blood cells in the tissue, and therefore **outside the blood vessels**.
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## STUDY UNIT 4

### IDENTIFICATION

#### 1. How should a commercial passenger aircraft accident be managed, with specific reference to the identification of the passengers and crew?

- In a commercial passenger aircraft accident it is of importance to identify the passengers and the crew members correctly.
  - Identification is especially important as **further tests**, for example carbon **monoxide and alcohol analysis**, will be performed on these latter individuals.
  - **In a mass disaster it is important to address the following issues:**
    - the number of persons involved
    - the identity of each person, based inter alia on the age, sex, ethnicity, personal identification characteristics, dentistry and genetic material
    - any condition which could have incapacitated the crew, and therefore resulted in the disaster
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#### 2. Discuss the two basic principles used in identification of bodies?

**Identification** of a living or dead person is based on **two basic principles**:

- (a) identification by means of **reconstruction and classification** where the person is placed in a group of specific individuals
  - (b) identification **through comparison**, for example with genetic analysis, DNA typing or finger prints
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## STUDY UNIT 5

### GENERAL TRAUMATOLOGY

1. A person presents with a linear wound to his head. He alleges that he was hit with a panga, although there is also evidence that he was only hit on the head with a hard piece of wood (plank). **How will you differentiate between these two wounds?**

- A blow with a **hard object** over the head **tends to cause skin splitting**. This occurs because the skin is caught between the hard object on the one side and the skull bone on the other.
- Although not necessarily prominent, detailed examination will still show the **features of a lacerated wound**, that is a **thin margin of abrasion and contusion** surrounding the wound, and **tissue bridges in the wound**.
- With the **abrasion** there could also be **loss of hair** surrounding the wound.

2. You are involved in a trial where the victim was an elderly female who was murdered. The post-mortem report states that **numerous bruises/contusions** were present **over the chest**, and there were also **fractures of the ribs and sternum**. These fractures were **surrounded by fresh haemorrhages**. The defence alleges that these injuries were caused by attempts at resuscitation by the assailant, and not by the assault itself. **How can the pathologist refute this allegation?**

- When **injuries** occur **while a person is still alive**, an effective blood circulation is still present. In other words, blood will leak from the damaged vessels as well as from the fractures due to haemorrhaging into the soft tissue.
- **If resuscitation is unsuccessful**, blood circulation will not be reinstated, and therefore minimal leakage of blood from the damaged vessels or fractures will occur.
- For this reason **post-mortem fractures are without surrounding haemorrhage**.
- **If resuscitation was indeed successful**, the wounds will have the appearance of contusions and fractures as usually seen in the living person.

- **In this specific case**, the resuscitation was unsuccessful, and the contusions or fracture-associated haemorrhages are therefore not expected.
  - This statement is therefore most probably incorrect or false.
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3. *You are involved in a trial where the victim had allegedly died of a stab wound.*  
**What are the most important features regarding this wound which you would look for in the post-mortem report?**

The description of wounds consists of a number of important aspects including the number of wounds, the appearance, et cetera. (section 5.5 of this SU).

#### **The description of wounds**

- **It is important to describe wounds in detail.** If possible, **photos** of wounds should be included, but then a **colour chart** should also be added so that **colour changes** can be judged objectively; **sketches** are also important.

#### **The following must be indicated:**

- (1) The **number of wounds**.
- (2) The **time** when the wound was **inflicted**. Except if the contrary is indicated, it is usually assumed that the wounds occurred ante mortem.
- (3) **However, if it is possible that a wound may have occurred in the post-mortem period, it must be mentioned.**
  - (i) This type of situation **often occurs with drowning victims**, where injuries due to propellers of boats as well as rocks may develop in the post-mortem period.
  - (ii) The **precise location of every wound**, measured from fixed reference points (*eg from the middle of the body in the horizontal level and specific vertical points - like the height above the heel, level of the nipples, level of the eyes, etc*).

- (iii) It is also important to remember that the **wounds are described with the body in the anatomical position**, that is *in an upright position with the palms of the hands facing forward*.
- (iv) The **wound tract** of a stab wound therefore **does not necessarily represent the position of the body at the time of the stabbing**. (The same principle applies when the body is hit by a bullet.)
- (4) **The shape of every wound. For instance:**
  - (i) is the abrasion an oval shape with accumulation of skin on the one side?
  - (ii) are both corners of the stab wound sharp (pointed), as those made by a knife with a double-edged blade?
- (5) **The size of the wound. For instance:**
  - (i) **Abrasions and contusions have two dimensions.**
    - (a) **Lacerated wounds** and incised wounds have only one dimension, namely length, even if the wound is gaping.
    - (b) **Stab wounds** also have a depth measurement.
- (6) **Any additional wounds. For instance:**
  - (i) abrasions or contusions surrounding a laceration wound.
- (7) **The estimated age of the wound.** It is important to decide whether the wound is **still fresh** or whether it **shows signs of healing**.
- (8) Any **signs of complications**, for instance inflammation or abscess formation.
- (9) Any **signs of medical treatment**, for example sutures
- (10) **In the case of a stab wound**, the **direction of the wound tract**, the **depth** as well as any **important structures** involved, must be mentioned.

**Any other additional factors of importance, including**

- (a) the impression sometimes seen in contusions and abrasions, or
- (b) the presence of foreign material in the wound, must be mentioned.
- (c) examination of the entire body, also concealed areas - some pathologists will even indicate on the sketch with a tick mark that they have examined the part in question and found no wounds.



- (d) the distribution of wounds can be of assistance to reconstruct the scenario.
  - (e) contusions and abrasions over the **posterior aspects of the forearms** are often seen when the victim tries to protect his head by folding the arms over the head (**self-defence wounds**).
  - (f) incised wounds of the hands can be seen if the **victim tried to grab the knife** from the assailant.
  - (g) **tentative wounds** in cases of suicide have already been mentioned.
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## STUDY UNIT 6

### COMPLICATIONS OF TRAUMA

1. *During a fight one person **stabs the other in the neck**. While they are still standing upright and arguing, the stabbed **individual collapses and dies almost immediately**. How should the pathologist approach this death?*

**This scenario is typical of an air embolism.**

- During a fight a **stab wound or incised wound** is often inflicted to the neck, which opens (injures) the jugular vein(s), and sometimes also the carotid arteries.
- While the patient is in the **upright position**, the **wound is higher than the heart**, and *air is sucked into the vessel*, especially during inspiration.

**In this type of death the presence or absence of air embolism must be established.**

- Although the majority of these deaths are caused by venous air embolism, **opening of the carotid arteries** may also cause arterial air embolism to the brain.

2. *A scuba diver surfaces, coughs blood and dies.*

**What condition will the pathologist have to consider?**

**This scenario** is that of **pulmonary barotrauma** with **rupture of lung tissue**.

- This develops when a scuba diver surfaces after having inhaled additional air while under water.
- If this extra volume of air is not exhaled while he surfaces, the volume of air will increase at the lower pressure, and rupture and damage the lung tissue.
- The blood vessels rupture, and air enters the vessels causing arterial air embolism. It develops because the air enters the pulmonary or lung vein and is then distributed to the left side of the heart and ultimately to the vital organs such as the brain and heart.

### What other complications may also be caused by this mechanism?

- Other complications are pneumothorax and surgical emphysema as well as unique complications such as "the bends" (decompression sickness)
  - Explosions in enclosed spaces may also result in pulmonary barotrauma.
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#### 1) Caisson disease / Decompression sickness ("the bends)

- » Seen in divers
- » nitrogen gases in blood come out of solution & form minute air bubbles when decompression is too rapid

#### 2) Amniotic fluid embolism

- » Dangerous (but rare) complication of pregnancy & labour
- » amniotic fluid enters maternal circulation via mechanism similar to air embolism.

## STUDY UNIT 7

### HEAD INJURIES

1. *A 60 year old alcoholic falls and hits his head while under the influence of alcohol. He is admitted to the local casualty department.*

**Discuss possible head injuries which may be caused by such a fall, as well as the problems which may confront the doctor in diagnosing this condition?**

**The possible head injuries** which may occur in this case include:

- **wounds to the scalp** as well as
- **fractures of the skull.**

There is often a **higher incidence of subdural haemorrhages in alcoholics**. These types of haemorrhages tend to occur often in alcoholics, inter alia due to the **presence of brain atrophy** which may occur and which may result in increased mobility of the brain in the skull. This results in **rupture of the bridging veins**.

- The doctor is often confronted in this situation with the fact that the patient is under the **influence of alcohol** and it is therefore **difficult to differentiate findings due to alcohol intoxication from those due to a head injury**.
- Because subdural haemorrhages tend to **take a while before they present**, it is **advisable to admit these patients for observation**.
- Otherwise the individual can be discharged, but only if he is in the care of a responsible person. This person must be informed of any warning signs which may indicate **increased intracranial pressure** due to the development of a **subdural haemorrhage**.

2. *A patient with a skull fracture over the temporal bone is initially apparently normal, but over a period of 12 hours becomes gradually more confused and drowsy. He dies before treatment can be administered.*

**Discuss the probable cause of death?**

- (a) This most probably indicates an **extradural haemorrhage**. It is a result of **rupture of the middle meningeal artery** which lies on the inside of the temporal bone.
- (b) The **intracranial haemorrhage** results in **increased intracranial pressure**, which in time may be **complicated by herniations**.
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## STUDY UNIT 8

### ASPHYXIA

1. *During a court case the one party alleges that the **dark blue discoloration** of the **hands and feet** of the deceased's body (**cyanosis**) is a **definite sign that the person was throttled**. How would you deal with this statement?*

**Post-mortem cyanosis is controversial**, as **all deaths** are associated with:

- **failure of the circulation** with
- **lack of oxygen delivery by the haemoglobin** to the peripheral tissues and cells.

**Therefore almost all deaths present with blue discoloration or cyanosis.**

**Exceptions include:**

- bodies that have been refrigerated,
- cases of drowning and also
- certain poisonings.

**In this case**, the fact that cyanosis is present, is no indication of the type or mode of death.

2. *During **cleaning of a wine tank**, one of the workers dies while climbing into the tank.*

**What is the probable cause of death?**

This is an example of suffocation due to **fermentation** in the wine tank, which **causes oxygen to decrease** and **carbon-dioxide** to be **produced**.

- **Cause of death due to CO<sub>2</sub> inhalation**

3. *A person is **throttled with the hands** during an assault. **What could be the causes of death?***

During the **application of pressure to the neck**, death may be caused by the following:

- (a) **airway obstruction**
- (b) **occlusion** of the neck veins
- (c) occlusion of the carotid arteries
- (d) **neurogenic stimulation**
- (e) **a combination** of the above

Especially in **throttling**, which is a **dynamic process**, the hands tend to change their grip continuously, and therefore any one or a combination of the above could play a role.

4. *The body of a young man is found in **weird circumstances**. There is a rope with a **sliding knot** around his neck. The body is **naked and pornographic material** is present on the scene. **With what phenomenon are we faced here?***

This is an example of an **auto-erotic death**.

- » **Cerebral hypoxia** \*
  - (\*hypoxia - deficiency in the amount of oxygen reaching the tissues).
  - causes **erotic hallucinations**
  - hypoxia **induced by pressure to neck or mask over face**
- » **Usually ligature around neck**
  - » placed to loosen as person becomes unconscious
- » **Important - inspect scene of death** for other sexual practices (bondage / transvestism / fetishism)
- » **Erotic literature** often found
  - » deaths unplanned/unforeseen – **NO suicide letters**

5. **Which risk factors may increase the risk of death during the application of a neck grip?**

The risk of neck grips is increased by the following factors:

- (a) ischaemic heart disease
- (b) psychiatric illness,

- (c) epilepsy,
  - (d) drugs,
  - (e) alcohol and certain medication
  - (f) physical exercise preceding the application of pressure - this **increases the sensitivity of the carotid sinus** due to **adrenalin sensitisation** of the **sinus**
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6. A person may **die during immersion** with or **without aspiration of water**. What are the causes of death in these two groups of death?

**When there is aspiration of water**, death is usually caused by hypoxia or fluid electrolyte disturbances.

The latter will be more prominent in cases of drowning in fresh water than in salt water or seawater.

Where death occurs **without aspiration**, possible causes include:

- neurogenic heart arrest,
- hypothermia or a
- defective aspiration apparatus (scuba diving) or a diving accident.

**The latter includes:**

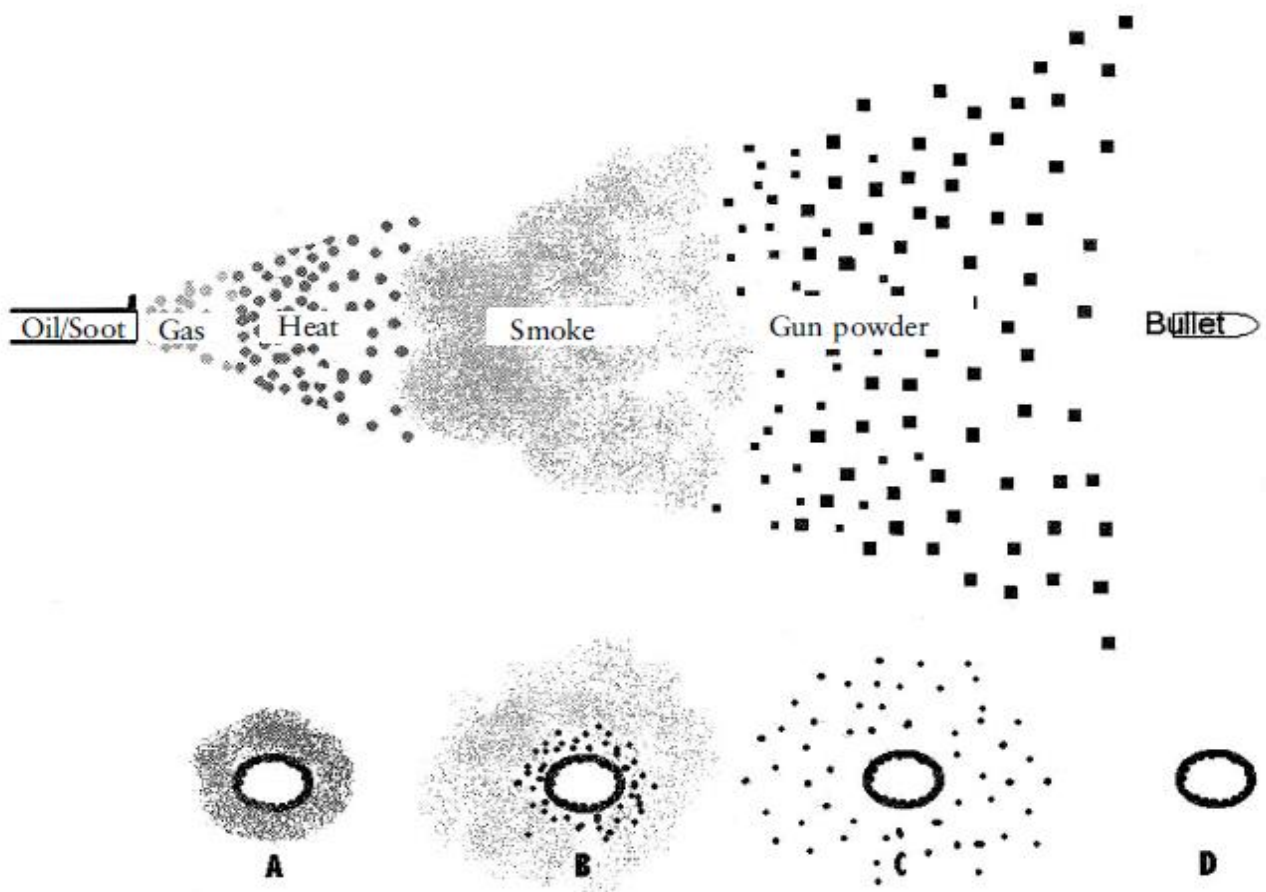
- » carbon-dioxide poisoning
  - » decompression disease ("the bends") and
  - » barotrauma.
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## STUDY UNIT 9

### FIREARM INJURIES

1. Correlate the products produced during the firing of a cartridge with their possible effect and appearance on the skin of the victim.



**A number of products are released** when a shot is fired and leaves the muzzle of the firearm.

- The **bullet** or projectile is also **coated with any oil or soot** which may be present in the barrel.
- Each of these products **will travel for a certain distance from the muzzle**.
- Burnt, unburnt and partially burnt powder particles travel the furthest.

**Wounds A to C are so-called intermediate wounds**

**Wound D is a distant wound, ie usually more than 75 cm from the muzzle**

It is important to note that the appearance will differ with different firearms.

Therefore **each case must be compared with the relevant firearm** by means of **ballistic tests**. If the shot is fired through clothes, some of the features will be visible on the clothing.

2. The examination of a firearm entrance wound shows an **oval-shaped central defect** surrounded by an **irregular abrasion ring**, which is wider on the right-hand aspect of the wound. There are **no signs of soot deposits or singeing/burning of the skin**, but **tattooing is present**. This is also irregularly distributed, with a more concentrated distribution over the right-hand aspect compared with the left side.

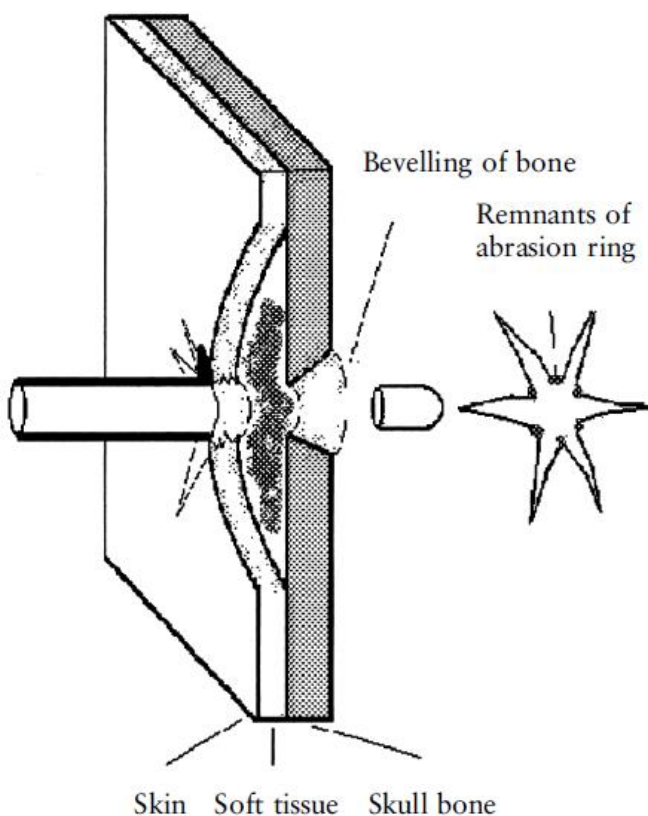
**What conclusions can be drawn from this?**

The two findings relate to **direction and distance**.

The **direction** is from **right to left**, and the **distance** is approximately an **arm's length (50±75 cm)**.

However, in all cases **experimental shots must be fired with the same firearm** and the **same type of ammunition**, as the above-mentioned method to determine the distance gives **only a rough estimate** based on the absence of smoke and heat-related changes, and the presence of tattooing on the skin.

3. **Discuss the unique appearance of a contact firearm entrance wound to the head?**



The typical presence of a **contact gunshot entrance wound** to the head is the result of the **muzzle being closely and tightly** applied to the skin, while the **underlying subcutaneous tissue is supported by the skull**.

**When the firearm is fired, the gas cannot escape**. The **skin balloons and lacerates around the entrance wound**, this is a **typical stellate wound**.

If the muzzle is held tightly against the scalp, the gases, heat and other products of combustion cannot escape. The gases will elevate the skin from the underlying skull, and this will result in tearing forces at the site of entry, with a stellate or star-shaped wound.

All the products of combustion will be visible in the wound, including a cherry-red appearance due to carbon monoxide.

When the bullet passes through the skull, it bevels (chips away) the opposite aspect of the skull bone.

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4. *Examination of the victim of a **shotgun** shooting accident shows a central defect with a **crenated\* (\*serated) margin surrounded by smaller individual entrance wounds**. The distance between the peripheral wounds is 30 cm. **From how far do you think the firearm was fired?***

**Pellets disperse approximately 3 cm for every 1 meter**. In this case the distance is therefore roughly  $30/3 = 10$  m.

Again experimental shots are essential, as the barrels and muzzles of shotguns often vary, and distribution of the pellets may therefore vary accordingly.

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## STUDY UNIT 10

### THERMAL, ELECTRICAL, ATMOSPHERIC PRESSURE AND RADIATION ASSOCIATED DEATHS

1. Discuss hypothermia and hyperthermia due to exposure to abnormally low and high environmental temperatures.

**Hypothermia** or **low body temperature** is defined as a condition where the **central** or **core temperature** is **35<sup>0</sup> C** or less.

It occurs among mountaineers and other adventurers, as well as drowning victims.

**Hyperthermia** occurs when the **internal body temperature** is **higher than 40,5<sup>0</sup> C**.

It occurs in two situations:

- exposure to **high environmental temperatures** and
- **malignant hyperthermia\*** - \* a disease passed down through families that causes a fast rise in body temperature (fever) and severe muscle contractions when the affected person gets general anaesthesia

2. Discuss the post-mortem findings in a burn victim, including problems which may arise during identification. Discuss how you will determine whether the victim was alive when the fire started.

- **Identification may be difficult in charred bodies**, and **DNA analysis** as well as **dental records** and **identification by comparison** may be of value.
- During the post-mortem examination, not only the **degree of the burn wounds**, but also the **percentage of body surface** involved, must be noted.
- **The following factors can play a role in establishing whether the person was alive when the fire occurred:**
  - (a) the **carbon monoxide level in the body** (by determining the **carboxyhaemoglobin level (COHb)** - a level of more than 5% in a non-smoker and more than 10% in a smoker **indicates that the person was alive when the fire started**

- (b) **soot and ash** in the **airways, stomach and oesophagus**
  - (c) some authors also mention the presence of **fat embolism in the pulmonary vessels**
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**3. Discuss factors which may have an effect when an individual is accidentally exposed to a domestic electrical current.**

The following factors may play a role

- (a) **the characteristics of the electric current**
    - (i) the **type** of current (**alternating** current vs **direct** current)
    - (ii) the **strength** of the current (**ampere**)
    - (iii) the **tension** of the current (**voltage**)
    - (iv) the period of exposure to the current
  - (b) **the characteristics of the body**
    - (i) the **resistance** of the body
    - (ii) the **route of the current** through the body
    - (iii) **underlying pathological conditions**, like **heart disease** with rhythm disturbances or abnormalities
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**4. A scuba diver surfaces. He coughs blood and dies instantly. What is the most probable cause?**

**This scenario** is that of **pulmonary barotrauma** with **rupture of lung tissue**.

- This develops when a scuba diver surfaces after having inhaled additional air while under water.
- If this extra volume of air is not exhaled while he surfaces, the volume of air will increase at the lower pressure, and rupture and damage the lung tissue.
- The blood vessels rupture, and air enters the vessels causing arterial air embolism. It develops because the air enters the pulmonary or lung vein and is then distributed to the left side of the heart and ultimately to the vital organs such as the brain and heart.

**What other complications may also be caused by this mechanism?**

- Other complications are pneumothorax and surgical emphysema as well as unique complications such as "the bends" (decompression sickness)
  - Explosions in enclosed spaces may also result in pulmonary barotrauma.
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## STUDY UNIT 11

## TOXICOLOGY AND ALCOHOL

1. Which **factors** will influence the **intensity of a reaction** which a person may experience after exposure to a specific drug or substance?

The intensity and nature of the reaction to a poison often becomes an important issue in court. The many variables which need to be considered when attempting to solve this problem are best expressed as a functional equation:

$$IR = D \frac{rA}{rE} SP$$

IR = Intensity of reaction

D = Dose

rA = rate of ..... Absorption

rE = rate of ..... Elimination

S = Specific properties of subject

P = Physico-chemical nature of the poison

- A poison is a substance which, when absorbed by a living organism, results in harm or death. There are many thousands of substances occurring naturally or in synthesised form that exhibits this property. (i.e. alcohol / sugar abuse)
- **Poisoning** can be **acute, sub-acute or chronic** and its intensity as well as its signs and symptoms can vary from person to person.

IR = **Intensity of the reaction** ranges from the most insignificant to death.

D = **Dose** is the amount administered and the frequency of administration.

rA = **Rate of absorption** - influenced by the route of administration, i.e. - by mouth; intravenous; per vagina; per rectum; by inunction (rubbing in) or inhalation.

rE = **Rate of elimination** may be accelerated by vomiting, diarrhoea or accelerated metabolic pathways such as in people addicted to the particular substance or habitually exposed to it in the workplace.

Both absorption and elimination may be delayed by a variety of medicines in use at the relevant time. The converse (accelerated) is equally true.

S = **The specific properties** of the subject include hypersensitivity, various diseases, as well as the inherent biological variability of living material even in the same population group.

P = **The physico-chemical nature of the poison** (solid, gaseous, liquid, soluble) is also an important variable in the equation.

## 2. Discuss the effects of carbon monoxide on the physiological functions of the human body.

**Carbon monoxide has the following effects:**

- (a) It **binds with haemoglobin** in the red blood cells. Subsequently there is a decrease in the available haemoglobin for oxygen transport, and **anaemic hypoxia occurs**.
- (b) It has a **direct depressing effect on the brain**, similar to anaesthetic drugs. It therefore **causes depression of respiration**.
- (c) Carbon monoxide also **combines with the enzyme systems** in the cells **involved with cell metabolism** (the cytochrome-oxidase system). This results in cytotoxic anoxia / hypoxia.

**Cytotoxicity** is the quality of being toxic to cells. Examples of toxic agents are an immune cell or some types of venom, e.g. from the puff adder (*Bitis arietans*) or brown recluse spider (*Loxosceles reclusa*). - causing the **absence of oxygen = Anoxia**

**Hypoxia:** represents the **deficiency** in the amount of oxygen reaching the tissues.

**Cytochrome oxidase** is one of a superfamily of proteins which act as the terminal enzymes of respiratory chains - of a living cell. **The human cytochrome oxidase complex** is a multi-subunit assembly in the inner



mitochondrial membrane responsible for the terminal event in electron transport in which molecular oxygen is reduced.

### 3. Discuss the factors which may influence the absorption of alcohol from the gastro-intestinal tract.

#### FACTORS INFLUENCING RATE OF ALCOHOL **ABSORPTION**

**INGESTION** (most common) - absorbed into body **directly & unchanged** by process of diffusion

**ABSORPTION** - proceeds **immediately** in stomach & small intestine

- 1) **Peristaltic movement**
- 2) **Nature / composition / amount & strength of beverage ingested**
  - **Optimal absorption** occurs when beverage has **lower** (between 10 & 20%) alcohol **concentration**
- 3) **Contents of stomach & small intestine**
  - fatty foods / carbohydrates / proteins **prevent absorption**
- 4) **Medicines & other chemical substances** → influence peristalsis & speed of absorption

#### **METABOLISM & SECRETION** of ALCOHOL

About **85% to 90%** alcohol **metabolised by liver**

- Rest **secreted unchanged** via lungs / kidneys & perspiration
- **Alcohol elimination**
  - » STARTS moment alcohol is distributed through body & reaches liver
- Alcohol eliminated at **constant rate**
  - » **average used** = 0,015g% per hour → called the B60 value
  - » **NOT affected** by cold / exercise / sleep or any other factor
- **Concentration** of blood alcohol **does NOT influence elimination rate**

- » In practice rate will be constant
- Assumed that approximately
  - » 60% of ingested drink will be absorbed after 60 minutes &
  - » 90% after 90 minutes

**4. The legally acceptable blood-alcohol level is 0,05 g%. Does any risk of danger and even death exist at a blood-alcohol concentration lower than this legal limit?**

**Even at alcohol levels as low as 0,05 g%, depression of certain brain functions that control the personality and inhibitions occurs.**

A false feeling of self-confidence may increase the risk getting involved in a fight that can be fatal.

- Interestingly, some studies show that there is a decline in the risk for motor-vehicle accidents at levels less than 0,05 g%.
- This is most probably because these individuals will drive more carefully and with more concentration, because they may be afraid that their abilities are already affected by the alcohol.

**5. An 80 kg female is arrested for alleged driving under the influence of alcohol. Her blood-alcohol concentration is 0,14 g%. She alleges that she consumed three glasses of white wine, the last one two hours before arrest. How will you confirm or refute her statement regarding alcohol consumption?**

The **Widmark formula** can be used to calculate the minimum amount of alcohol, which in this specific case will result in an alcohol level of 0,14 g%.

- As two hours had already passed, it can be accepted that all the ingested alcohol had been absorbed.

$$A = p \times c \times r \times 10$$

A: = The amount of alcohol in gram in the body at a given time to cause the blood alcohol concentration

P: = the mass of the person in kg

C: = the blood alcohol concentration in g% or g/dl

R: = the Widmark or distribution factor

### The Widmark formula

The Widmark formula is **used to calculate the amount of alcohol in grams ingested** by an individual to produce a specific **blood-alcohol concentration** at a given time. It is important to realise that it does not reflect any alcohol already absorbed and eliminated, nor any alcohol ingested but not absorbed.

As mentioned above, **alcohol is water-soluble**. The higher the water content of a tissue or body, the more alcohol can be dissolved in the tissues, and the lower the blood-alcohol level will be.

As **males generally have more muscle tissue than females**, the same quantity of alcohol ingested by a male and female of the same mass (all other factors being equal) will result in a **lower level in the male than in the female**. This **"r" or distribution factor** is 0,6 for females and 0,7 for males.

#### ➤ Applied to the scenario:

$$A = p \times c \times r \times 10$$

alcohol in gram = kg mass of the person x blood alcohol concentration in g%  
x distribution factor for females x 10

$$\therefore A = p \times c \times r \times 10$$

$$\therefore A = 80\text{kg} \times 0,14\% \times 0.6 \times 10$$

$$\therefore A = 67,2 \text{ g} \dots\dots\dots \text{rounded} = 7$$

She therefore consumed at least 7 units of alcohol. Although this formula is a rough indication, it is obvious that her **defence cannot be upheld**.

**6. How will the alcohol level of a deceased driver in a fatal motor accident be determined?**

- **Eye fluid or venous blood may be used.** The latter must be obtained as far as possible from the **heart**, preferably from the **thigh or femoral vein**.
  - **Cardiac blood is not acceptable.**
  - It must be **preserved in sodium fluoride** to eliminate any changes due to decomposition and therefore alcohol production or metabolism.
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## STUDY UNIT 12

### PREGNANCY- ASSOCIATED DEATHS

1. *A young female undergoes a criminal abortion and dies during the procedure.*

**Discuss the possible causes of her death?**

**When a woman dies due to a criminal abortion** it must be remembered that certain causes will result in instant death, that is, during the procedure. Other causes will only present at a later stage.

**These latter causes include:**

- conditions such as local *inflammation or infection*, as well as
- the *toxic effects of the drugs used to induce the abortion.*

Conditions where the death occurs during the procedure includes:

- *haemorrhage* due to *hypovolemic shock*,
- *neurogenic shock* due to *dilatation of the cervix*,
- *venous air embolism* as well as
- *amniotic fluid embolism.*

**Discuss also how a post-mortem examination may be of assistance in determining the cause of death?**

**One of the primary aims of the post-mortem examination is to exclude the above conditions.**

**Air embolism:**

- **X-rays of the abdomen and chest** may be of assistance to establish the presence of air in the vascular system.
- The post mortem must also be performed in such a way that air embolism can be excluded.
- A detailed examination of the genital system is necessary to identify any **damage to large blood vessels** causing a **fatal haemorrhage.**

**Amniotic fluid embolism**

- Can be excluded by **histological assessment of lung tissue.**
- **Amniotic fluid elements** may be detected in the maternal vessels.

- **Neurogenic shock** can only be determined after exclusion of other causes of sudden collapse and death.

**Amniotic fluid embolism** is a **dangerous**, but fortunately **rare**, complication of pregnancy and labour.

When the **amniotic fluid enters the maternal circulation** (via a mechanism similar to that of air embolism), the amniotic fluid does not only cause **mechanical obstruction to the blood flow in the lungs**, but it also contains certain substances which can interact with the **blood clotting mechanism**. It can also **suppress cardiac function**.

### How to diagnose an air embolism

In certain circumstances **the possibility of an air embolism must be considered before the post mortem is performed**, for example when there is a stab wound in the neck, or a young female dies suddenly and unexpectedly (criminal abortion).

- In these cases it is advisable to take X-rays so that air in the heart and blood vessels could be detected.
- Often air is found in the tissues surrounding the defect, and this can result in a **crackling sound with palpation**, so-called **crepitus**.
- The tissue can also appear swollen, known as **surgical emphysema**.

**If a young female in her fertile years dies suddenly and unexpectedly**, it is important to **examine the uterus in situ**, that is before it is removed.

- Any signs of recent pregnancy must be noted, and **the inferior vena cava must be examined for air bubbles**.
- The next step is to **open the pericardial sac** and to examine the coronary arteries for an air embolism.

**Process:** The pericardial sac is then filled with water and the right heart chambers and thereafter the left heart chambers opened under water with a knife or scissors. If there is an air embolism, air will bubble out of the heart.

**The cerebral arteries must also be inspected for air bubbles.**

- It is important to remember that air can be sucked into the cerebral veins during the removal of the skull, and that this does then not indicate an air embolism, but is due to human intervention.

**If decomposition has set in:**

- air may either dissolve and disappear if there indeed was an air embolism, or
- decomposition gases can be produced, presenting as an air embolism.

**The gases then have to be analysed in order to determine what they are.**

**2. A pregnant female in her last trimester of pregnancy dies suddenly and unexpectedly. Which possibilities must be considered?**

**Causes of death in a pregnant female during the last trimester of pregnancy**

**include:**

- conditions such as pre-eclampsia and eclampsia;
- abnormalities of the placenta (abruptio placentae and placenta praevia)
- pulmonary or lung embolism and
- any other pre-existing disease, for instance heart disease, which are complicated by the pregnancy.

Amniotic fluid embolism, injuries and infections usually follow as a complication of pregnancy or in the post-partum period. An undiagnosed ectopic pregnancy seldom occurs in a third trimester pregnancy, but may cause sudden death in the first trimester.

**Pre-eclampsia and eclampsia:** Pregnant women can also die due to conditions unique to pregnancy. With **pre-eclampsia** there is high blood pressure (hypertension), oedema and protein in the urine.

**If the patient develops convulsions or epileptic fits, it is known as **eclampsia**.**

These patients also have a **risk of intracranial haemorrhages** (bleeding inside the skull).

**Late in pregnancy the placenta can become detached from the uterine wall.**

### **abruptio placentae**

- Blood-clot abnormalities can develop, and death could follow.
- If the baby is not delivered immediately, both the mother and baby could die. **This condition is known as abruptio placentae.**

### **placenta praevia**

- In placenta praevia the placenta is in a low-lying position.
  - With the onset of labour the cervix or the neck of the uterus dilates.
  - The placenta can then become detached from the uterine wall, causing possible death of the mother and foetus.
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## STUDY UNIT 13

## PAEDIATRIC FORENSIC PATHOLOGY

**1. Which questions must be answered in cases where a new-born baby is found dead and it is obvious that the birth was concealed?**

In a case of alleged **concealment of birth** it is necessary to determine the following:

- \* whether the child would have survived (ie the gestation period)
- \* whether the child indeed lived (ie established its own respiration)
- \* if the child did live, for how long
- \* what the cause of death is
- \* how long the child had been dead when it was found
- \* whether it can be established whether the child belongs to a specific mother (ie on the basis of identity and the fact that the mother shows signs of a recent pregnancy which correlate with the age of the child)
- \* if the child was stillborn, why it did not survive

**2. A boy, three years of age, presents in the trauma unit with a **fracture of the skull** and **vague history of a fall off a chair**.**

**a. Which condition must be considered by the medical practitioner?**

This case raises suspicion about **non-accidental injury syndrome** or **child abuse**.

**b. Which other injuries must be excluded?**

- Other injuries include multiple bone fractures, often of different ages,
  - contusions and
  - other skin wounds
  - retinal haemorrhages as well as
  - intracranial haemorrhages, especially subdural haemorrhages.

**c. What is the medical practitioner's legal obligation?**

- **The medical practitioner must report this case in terms of the Child Care Act. Failure to do so constitutes an offence.**

3. *A baby of four months of age dies unexpectedly in the cot.* **How should such death be managed?**

This case of unexpected death in a 4-month-old baby is highly suggestive of the sudden infant death syndrome (SIDS) or cot death.

- As there is **no pre-existing history** which may assist in defining a possible cause of death, it **must be initially managed as an unnatural death**.
- The sudden unexpected death in a baby **may be the result of other natural diseases**, such as a lung infection, abnormalities of the heart, meningitis, et cetera. **SIDS can only be diagnosed** after violence and any other natural disease processes had been excluded.
- **During the (complete) post-mortem examination**, which includes **histological** or **microscopical examination** of **vital organs**, as well as **microbiology** and **other tests**, the absence of any morphological abnormalities will support this diagnosis.

4. **In cases of cot death the cause of death is obvious. Discuss this statement.**

The **unique characteristic of cot death** is the fact that **there is no obvious physiological or anatomical cause of death**.

- Although there are certain **theories** about the possible cause of death, no single abnormality has been identified as a possible cause of this condition.
- Cot death is the result of the **exposure of an already compromised young baby** to a number of different stress situations, which may lead to death.

**Apnoea (ie cessation of respiration) plays a central role.**

- Research has also shown that when a **normal person** ceases to inhale/exhale for whatever reason, an **auto-resuscitative mechanism** will stimulate respiration.
- This is the reason why a person cannot voluntarily commit suicide by just holding his/her breath. In time the auto-resuscitative mechanism will re-establish respiration, if not severely depressed by drugs or alcohol.

**This defence mechanism is not yet effectively developed in babies.** If their respiration stops due to some or other stress factor, this mechanism does not optimally operate to end the period of apnoea, and the baby accordingly dies

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## STUDY UNIT 14

### SEXUAL OFFENCES

#### 1. Discuss the injuries which may be present in cases of rape.

**Injuries in cases of alleged rape may be of a general or genital nature.**

- The general injuries may be any type of skin injury as described elsewhere in this guide. Genital injuries may be minimal or extensive. They may even be absent.
  - It is also important to remember that injuries may sometimes be caused by overenthusiastic intercourse.
  - It is important to remember that injuries are not always visible initially, and if absent at the initial examination, the patient must be re-examined 24 hours later, as some contusions may only appear at a later stage.
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#### 2. *The absence of spermatozoa in the female genital tract or vagina excludes rape.*

**Discuss this statement.**

**This statement is incorrect.**

- Ejaculation can occur outside the vagina, in a condom, or the ejaculate can be azoospermic (without spermatozoa), for instance after a vasectomy.
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