Medico-legal investigation of deaths

*Death* is not simply the state of life absence, but is a process of life fading in a viable organism, which is characterized by irreversible cessation of vital functions and definitive stopping of metabolism.

*Dying* is relatively complicated process caused by severe damage of vitally important organ or body system leading to the reduction and cessation of main vital functions.

**Stages of dying process:**
1st stage – agony
2nd stage – clinical death
3rd stage – somatic death
4th stage – cellular death

*Thanatology* is the science on dying and death.

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Medico-legal investigation of deaths

*Pronouncement of death (general aspects):*  
In most states the pronouncement of death is a task of the physician, the registered nurse or the coroner.

*Signs of indisputably true death:*
- dilated pupils which do not react to light
- the absence of all reflexes
- cessation of respiration with absence of breath sounds on auscultation, lack of clouding on a bright surface (small mirror) held in front of the nose and mouth
- cessation of circulation, confirmed by absence of carotid pulse and heart sounds for one to three minutes
- completely flat brain wave tracking on electroencephalography (EEG) may be required for final proof
- postmortal changes: early and late
Medico-legal investigation of deaths

Criteria for diagnosing brain death in clinics:
1. The patient is in deep coma
2. The patient is on mechanical ventilation
3. The irremediable brain damage may be estimated by computer tomography (CT)
4. Such diagnostic tests for brain-stem death must be positive:
   • absence of pupillar and corneal reflexes (the spinal reflex may be persistent)
   • absence of vestibulo-ocular reflex
   • no motor responses of cranial nerves to painful stimuli
   • no respiratory movements when the patient is disconnected from the ventilator
   • no gag reflex to a catheter introduced into the larynx and trachea
5. The EEG and carotic angiography prove definitive cessation of cerebral activity and circulation

Medico-legal classification of manner of death

I. Natural (non-violent) death – such death manner, where the cause of death is known as definitive disease or unknown yet, but violent factors are excluded.
These are three subtypes of the natural death:
1. Expected death – caused by clinically estimated and properly treated severe disease or its complications.
2. Sudden death – rapid natural death, in which the cause is unknown (cannot be discovered without autopsy). Sudden death cases are:
   • case of instantaneous death
   • case of non-instantaneous death
   • case of founding dead individual
3. Unexpected death – death where a known disease was successfully treated or the patient is in recovery but this disease unexpectedly causes death.
**Medico-legal classification of manner of death**

*II. Violent death* – such death manner, where the cause of death is evident violence or complication after violent act committed.

These are three subtypes of the violent death:

1. *Suicide*
2. *Homicide*
3. *Accident*

Violent death generally may be caused by:

- blunt force injury
- sharp force injury
- firearms and explosive injuries
- mechanical asphyxia
- thermal injuries
- electrical injuries
- barotrauma
- intoxication
- medical malpractice

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**Changes after death**

The postmortal changes are of two types:

1. Early postmortal changes
2. Late postmortal changes

1. *Early postmortal changes:*

- Cooling of the body
- Hypostasis (lividity, suggilation)
- *Rigor mortis* (stiffness of muscles)
- Segmentation of columns of blood in the vessels of retina (ophtalmoscopic finding)
- Softening of eyeballs (loss of intraocular tension)
- Drying of thin layers (lips, scrotum), cornea, eye conjunctiva and sclera (*Beloglazov’s spots*)
- Regurgitation of gastric content
- Paleness of skin and conjunctivae
Changes after death

Postmortem cooling of the body
Temperature plateau – from few minutes to 2 - 3 hours
After this plateau the body cools:
- at 0,6 - 0,8 °C / hour in the first 3 hours after death
- at 1 °C / hour in the 4 - 12 hours after death
- at 0,5 °C / hour for the rest of the time after death

Influence on the rate of cooling:
- the mass / surface area ratio
- the body mass (weight)
- the posture of the body
- the clothing
- obesity
- emaciation
- oedema
- environmental temperature
- wind, draughts, humidity
- premortal hypothermia or hyperthermia (infections)

Changes after death

Post-mortem hypostasis – pink to bluish zones on the dead body surface

Principles of these formation are:
- cessation of the circulation
- influence of gravity on red cells
- the blood seek the lowest levels within the vascular system

Colour of hypostasis and factors of dependence:
- dark pink, deep purple, blue (congestive hypoxic condition)
- cherry-pink (carbon monoxide poisoning)
- brick-red (cyanide poisoning)
- brownish (methaemoglobinaemia)
- bronze (anaerobic septicaemia)
- bright pink over the large joints (hypothermia)

Visibility of hypostasis: onset 2 - 3 hours after death, become fixed and could not move or push out after 24 hours (due to postmortal haemolysis), persistance until decomposition
Changes after death

_Rigor mortis_ – postmortem muscle stiffness due to fusing of actin and myosin into a gel by depletion of glycogen, ceasing of re-synthesis of ATP and accumulation of lactic acid with simultaneous influx of calcium through changed membranes.

_The development of stiffness depends on:_
- environmental temperature
- physical rest or exertion before death

Breaking of muscle stiffness in joints (during manipulation with body) is irreversible. Rigor mortis of smooth muscle in the skin is visible as goose flesh (_cutis anserina_).

_Time aspects of rigor mortis development:_
- rigor first detectable within: 1 - 4 h in the face
  4 - 6 h in the limbs
- increasing of the rigidity up to: 6 - 12 h
- secondary flacidity: 24 - 50 h after death

Changes after death

2. _Late postmortal changes_ – the results of chemical (enzymatic), bacterial and fungal influence on the corpse as well as predation of animals.

- Autolysis
- Putrefaction
- Mummification
- Adipocere
- Skeletization
- Post-mortem injuries
Changes after death

**Autolysis** – postmortal delivering of intacellular enzymes and the cellular decomposition in a way of self-digestion.

**Putrefaction** – reductive process of postmortal decomposition with contribution of gut bacteria leading to liquefaction of the soft tissues and gas formation in those tissues.

**Signs of putrefaction:**
- greenish abdominal wall
- body swelling due to gas formation
- outlining of the superficial veins (marbling)
- protrusion of the tongue and eyes
- bloody fluids is squeezed out of the mouth and nostrils

Changes after death

**Mummification** – process of dessication of the body in dry warm conditions with a draught of air. Partial mummification of fingers is a common finding in putrefaction, too.

**Adipocere** – substance created by hydrolitic converting the dead body fat to waxy compound similar to soap in wet conditions.

**Skeletalization** – process of conversion of dead body to a skeleton. In temperate climate most of the soft tissues will decay after 1 - 2 years, tendons and ligaments survive longer. After some years the skeleton become disarticulated. Hair, nails and teeth are resistant parts of body remain intact and available for forensic examining during at least 20 years.
Supravital reactions and vital reactions

*Supravital (transvital, postvital) reaction* is the lasting ability of some organs, tissues and cells to keep physiological processes during some time after death.

The most common supravital reactions are:

- response of the pupils to drugs (atropine, scopolamine)
- muscular reactivity:
  - mechanical (contraction after knocking or pinching)
  - electrical (response to the Faraday’s current)
- cellular reactions (mobility of spermatozoa, vital staining for blood cells etc.)

*Vital reaction* – evidence for injury in living organism

General vital reactions: bleeding, embolism, evidence of carbone monoxide in the blood, soot in the airways etc.

Local vital reactions: inflammation, oedema, necrosis, wound healing, local reparative processes etc.

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External examination of the dead body

At the scene it is very important to document where was the body found, position of the body, postmortem changes, temperature of the body and environment etc. All items must be taken for subsequent toxicological or biological examination (bottles, drug boxes, knives, syringes).

*The steps of external examination:*

1. Observation on body colour, weight, height, eye colour, hair, size and shape of the nose, mouth and ears, dental examination.
2. Postmortem changes: early and late
3. Vital reactions and traumatic lesions (petechial hemorrhages, cyanosis, edema, abrasions, contusions, lacerations, ligature marks, finger marks, nail marks, bite marks, needle marks, scars, congenital defects, deformations, tattoos, cut or stab wounds, gunshot wounds, fractures etc.)
Internal examination of the dead body.

Autopsy

Autopsy – full post-mortem external and internal examination of the body with the objective to estimate the cause, manner and mechanism of death.

The autopsy is a highly specialized procedure which should ideally be taken only by the experienced medico-legal pathologist.

The value of autopsy:

- Certification of death may be incorrect or inaccurate in 50% of cases.
- Autopsy will ascertain the cause of death and should prevent concealment of homicide.
- It is source of information, that can be helpful in the process of identification.

Autopsy

Classification of autopsies:

1. Anatomical autopsy: for academic interest, teaching and research purposes

2. Clinical (pathological) autopsy: it is performed by doctor-pathologist if the cause of death is known with the objective to confirm the diagnosis, to discover the extent of the lesions and to exact complications

3. Medico-legal autopsy by Medical Care order: it is done by forensic doctor in cases of violent or non-violent death, where the suspicion of the other person's guilt is excluded

4. Medico-legal autopsy by Criminal Law order: it is done by two forensic doctors-experts in cases of violent death, where the suspicion of the other person's guilt is not excluded
Medico-legal autopsies

Medico-legal autopsies both by Medical Care order and by Criminal Law order discover following things:

- the identity of the body
- the cause of death
- the nature, number and extent of injuries
- the time of death
- the presence of toxic substances in the dead body
- the expectation of duration of life
- the presence of natural disease and its contribution to death
- the interpretation of the mechanism of death
- the interpretation of the mechanism of injuries
- the interpretation of any other unnatural conditions, including those associated with surgical and medical procedures

Medico-legal autopsies

Several important rules of autopsy performing:

1. The dead body must be definitely identified before autopsy.
2. Where definite crime or suspicion exists, the doctor should visit the scene of the death.
3. The body should be examined with the clothing. The clothes must be carefully retained for police laboratory examination.
4. The body should be photographed both at the scene and in mortuary first with the clothing and then after removal.
5. Access must be given to police of forensic scientists before and during the autopsy for their collection of trace evidences.
6. In a medico-legal autopsy the external examination often means more than internal examination (dissection).
7. The external appearances must be recorded by photos, video, sketches and description, the nomenclature of injuries must be accurate.
8. The biological material (blood, urine, parts of organs) must be taken for histo-, toxico-, serohematological & other investigations.
9. The internal examination must be complete, not partial.
Exhumation

*Exhumation* is a medico-legal procedure when a dead body has to be removed from its grave in the cases when autopsy needs to be performed.

Exhumation happens usually when some facts or allegations have arisen and the original cause of death has become doubt.

Several months or even years after burial may still allow a useful autopsy to be carried out, because the corpse may be in a relatively good condition: the decay desintegration may be minimal.

The grave, headstone and coffin must be identified, in the case of toxicological suspicion the samples of soil are taken from above, below and at the sides of coffin, as well as control sample from a distant part of the cemetery.

The medico-legal autopsy in an exhumation takes the same form as any other, though may have to be modified according to the condition of the corpse.

Identification

*Identification* is the process of equality estimation of different compared events, subjects and persons by those specific and characteristic individual features.

**Common principles of identification:**

- There are two groups of objects in the process of identification:
  - *(identified objects)* (living persons, corpses, objects of evidence, other things)
  - *(identifying objects)* (records, photos, descriptions, radiograms).
- The objects of identification are divided into two groups: changeable and non-changeable.
- The identification is the process of both analytical and synthetical approaches and methods.
- Each comparising sign must be learned in dynamics.
Identification

*Degrees of identity:*
I. Proved identity
II. Probable identity
III. Doubtful identity
IV. Identity excluded

*The identification of persons may be of 2 main types:*
1. *The identification of living subject. Reasons when is actual:* coma, amnesia, infancy, mental defect, language barrier, other reasons.
2. *The identification of dead subject* to be performed in the cases of:
   - criminal death (homicide)
   - mass disaster
   - unknown dead body

Identification

*The identification of dead subject* – there are several possibilities concerning objects of such an identification:
   - fresh, intact corpses
   - extremely destroyed (devastated) corpses
   - progressive putrefaction (decomposition) of bodies
   - skeletalized human remains

Identification has own specialised tasks for forensic physician, other experts (forensic odontologist) and in general for any doctor. The main method of identification is *comparison* of documentation (records) and data obtained, and the common result of identification – confirming or excluding a person.
Identification

The main steps of the identification process:
1. Identification by:
   - clothing
   - jewelery
   - personal things
   - cosmetics (on the eyes, lips, nail)

2. External examination (sex, age, height, weight, racial pigmentation, racial and ethnic facial appearances, color of eyes and hair, size and shape of the nose, mouth and ears, scars, skin blemishes and birthmarks, congenital defects, deformities, prior injuries, tattoos, occupational marks or injuries).

3. Dental examination (anomalies of the teeth, types, materials, shape, surfaces of restorations)

4. Internal examination and microscopic examination of selected organs and tissues.

Dental identification

Dental identification is performed by a dentist experienced in forensic work. The main principle is a comparison of:

- postmortem dental examination form – antemortem data (dental card)
- postmortem radiograph – antemortem x-ray

The dental identification is based on such main elements:

- features of the dentition and oral tissues - missing teeth, supernumerary teeth, abnormalities in jaw relationships and arrangement of the teeth, congenital or occurred defects

- features of dental restorations and replacements - the heat-resistant dental materials as well as remains of natural teeth can be found even in the ashes of bodies after cremation

- by means of dental records - dentists maintain records for each patient, an incompleteness in records may cause difficulty in the evaluation of evidence
**Dental identification**

*Age determination by teeth in the case of dead body:*

It is inevitable to remove teeth together with the alveolar part of jaws. Then longitudinal slice of the isolated tooth is prepared and examined.

*The sites of evidence showing age changes are following:*

- degree of occlusal wear, abrasion of the tooth crown (A)
- amount of secondary dentine in the pulp chamber (D)
- gum attachment around the neck of the tooth (G)
- translucency of the root (T)
- amount of secondary cementum at the root apex (C)

*By Gustafson’s method of age determination using tooth section (slice) the arbitrary points of crown occlusal wear (A), the amount of secondary dentine (D), level of the gum (G) and the amount of secondary cementum (C) may be calculated by following Gustafson’s equation:*

\[
\text{Age (years)} = 11.43 + 4.56 \times \sum \text{points (A, D, G, C)}
\]

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**Identification**

*Assessment of the age:*

- general appearance
- arcus senilis iridis et corneae
- wrinkling of the skin
- arthritic changes
- dental status
- ossification centres (x-ray examination)

*Fingerprints* are mainly a matter for police (dactyloscopy)

*Tattoos* have a great significance in the recognition of the bodies of unknown persons.

*Skeletalised remains.* The first problem in any examination of such a case is find out whose body it was. Remember that identification of remains by distraught relatives is notoriously unreliable.
DNA identification

Initially discovered by Professor Jeffreys at Leicester University (England) in 1984.

**Advantages of DNA identification method:**
- the most powerful tool to discriminate between individuals
- the method is unique with exception of uni-ovular twins
- in paternity testing – valuable results with minimal mistakes in comparison with blood group methods

**Samples for DNA investigation:**
- 5-15 ml of blood or material containing nucleated cells is taken
- in case of sexual offences fluid from vagina is taken by pipette, swabs can be used, too
- hairs with cellular material in the root bulbs
- saliva is not always sufficient for satisfactory profiles
- DNA profile can also be obtained from other tissues (e.g. muscle, tooth dentin or pulp etc.)
- in case of delay in getting it to laboratory, sample in plastic tube should be frozen at –20°C

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**DNA identification**

*The main steps of the method:*

1. Separation of DNA from other components.
2. Long strands of DNA are cut into millions of small pieces at predetermined points by using enzymes.
3. DNA fragments are sorted according to size using a gel and electric current. The smaller molecules move quickly through the gel.
4. The fragments are transferred to a membrane and then identified by using either mono- or multi-locus probes, which are short chains of DNA linked to radioactive isotope.
5. A film sensitive to radiation is placed over the membrane. An exposed area on the film shows where the probe has combined with DNA fragment. The developed film is called autoradiograph (looks like a bar code).
Sudden death

- occurs in each age but it is most common in elderly people
- the male:female ratio is about 7:3
- psychological or physical stress should be considered as an initiating factor
- the diagnosis of sudden death can be temporary because of the autopsy may discover an unnatural death

The causes of sudden death are divided into several groups:

1. Lesion of cardiovascular system
2. Lesion of central nervous system
3. Lesion of respiratory system
4. Lesion of gastrointestinal system
5. Gynecological conditions

Sudden death

1. Lesion of cardiovascular system

Heart and coronary arteries diseases:
- acute coronary insufficiency – spasm, complication of atheroma (rupture, subintimal haematoma, thrombosis)
- myocardial infarction (rupture – haemopericardium)
- myocardial fibrosis – cardiac aneurysm
- failure of valves, papillary muscle rupture
- hypertensive heart disease
- primary myocardial disease:
  - myocarditis
  - cardiomyopathies
  - degenerative conditions

Diseases of the arteries:
- ruptured aneurysm – of the aorta or of intracranial arteries
- cerebral haemorrhage – most vulnerable is a. thalamostriata
- cerebral thrombosis, embolism and infarction
- mesenteric thrombosis and embolism
- pulmonary thrombo-embolism
Blood stains

Bleeding happens mainly from the opened wounds, sometimes from natural openings (mouth, nostrils, ears, anal orifice, vagina).

Blood stains may show us the manner (the type) of death.

Site of blood stains - wall, ceiling, ground, other objects
- skin, clothing

The blood is flying through the air (spattering). The blood drops and spatters form blood stains on the surface.

The pattern depends on the angle of impact and height falling:
- **right angle** – circular stain
- **oblique angle** – tapering stain, oval stain, a small separate globule in front of the stain
- **sliding movement of the body** during or after the bleeding lead to formation of smears of blood.
- **direct patterns of blood** (indicate the shape of weapon, fingerprints, stepmarks etc.)
- **runnels of blood** always passing vertically down (indication of the original posture of a person)
- **pool (puddle) of blood** - under or near the corpse.
- **direct contact** with blood-stained objects is also important.

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Blood stains

*There are three main questions for blood stain analysis:*

1. **Is this a blood?** Detection of suspect blood stains by methods of orientation:
   - non-specific: benzidine test, fluorescent test chemoluminescent test etc.
   - specific: Kastel-Meyer test, Bertrand test, Takayama test

2. **What blood is this?** Distinguishing human blood from animal blood by such methods:
   - immunological tests
   - gel precipitation and gel electrophoresis
   - fluorescent-antibody techniques

3. **What type of human blood is this?** Examination of blood groups and individual systems:
   - red cell antigens
   - serum proteins
   - red cell enzymes
   - DNA profiling
The examination of wounds

The definition „wound“ suggests that the lesion was caused by a deliberate action.

The definition „injury“ suggests that the lesion arised from any cause including pure accident.

Assault - is the threat of an attack or the actual attack, the attacking person is an „assailant“.

Homicide - generally deliberate or non-accidental killing caused by other person.

Murder - is a homicide, when killer either intends to kill or intends to cause severe injury.

Manslaughter - is a homicide, when killer has no intent to cause death or severe injury, but the killing was the result of unlawful act or a negligence or when the killer was provoked by the actions of the victim. In some countries the manslaughter means any accidental killing even causing death e.g. by the reckless driving of car.

Infanticide - is the killing of a new-born infant at the age up to 1 year old.

Justifiable homicide - is the killing as a judicial execution in those countries where capital punishment still exists, and also is a killing by a police officer to prevent serious offence or to defend themself.

Excusable homicide - is the killing of an assailant in self-defense, though theoretically only comparable force must be used, for example, a person attacked by someone using his fists is not entitled to shoot him dead.
The examination of wounds

Each examination of wounds may have serious medico-legal importance. The purpose of the examination of any wound can be summarized as an attempt to answer these questions:

1. *When it was caused*: before, at the time of or after death?
2. *How it was caused*?
3. *What caused it*?
4. *What amount of force was required to produce it*?
5. *What degree of injury has resulted from it and whether it has influenced death or caused disability*?

Such fundamental rules must always be observed:

1. The doctor would not neglect any injury however small, it may be important later.
2. Besides treating the injury, basic data have to be recorded. Where the victim is dead, doctor has time to make a full examination and record.
3. The doctor has to make a good description and, if necessary, photographs with a scale, sketches, schemes with a measurement as well as videorecords. Radiographs may be important. In cases of fatal termination, the actual injuries can be retained at autopsy by forensic doctor.
4. The doctor must examine the whole body and preserve the clothing of the victim.
5. Foreign materials have to be taken for laboratory examination.
The examination of wounds

*Such fundamental rules must always be observed* (continuation):

6. Wound must be measured with a ruler. In traffic accidents, shootings and stabbings is useful to measure the height of the injuries above heel level as well as angles of wound channels and traces by three-dimensional method. The observation must include such information:
   - the site of wound
   - the shape of wound and its edges
   - the size of wound (length, width, diameter, depth)
   - the description of wound from without inward: surface, underlying tissues, deep structures and viscera
   - the analytical conclusion on the mechanism of wounding: which object, force and which direction of impact may cause this wound.

7. Blood samples for grouping and DNA analysis, respectively blood, urine and other biological fluids for alcohol or drug estimation would be taken.

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The examination of wounds

*General classification of wounds:*
1. *Job wounds* (in plants, works, mines, agriculture)
2. *Transportation wounds* (by car traffic, railway, aircraft, boats)
3. *Outdoors wounds* (falling down on a ground, injuries by falling things and the most wounds outdoors)
4. *Home wounds* (the most wounds indoors)
5. *Military wounds* (wounds during the war and wounds of military men in usual time)
6. *Sports wounds* (injuries of sportsmen)

*Forensic classification of wounds:*
1. *Ante-mortem injuries*
2. *Agonal injuries*
3. *Post-mortem injuries*
The examination of wounds

Morphologically all wounds can be classified into 4 main types:

1. **Abrasions** (scratches, grazes, impact marks, pressure marks)

2. **Bruises** (contusions, ruptures of blood vessels beneath the skin or into the tissues)

3. **Lacerations** (splits, tears, gashes)

4. **Incised wounds** (cuts, slashes, stabs)

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The examination of wounds

_Abrasions_ are the most superficial type of injury concerning the mechanical damage of epidermis or entering the dermis.

**Characteristics of abrasion:**
- most informative (retain the pattern of the causative object)
- not life-threatening
- mechanism of formation – tangential or vertical impact
- causes of abrasions may be different

**Kinds of abrasions:**
- linear abrasion (scratch)
- broad abrasion (graze, brush abrasion)
- patterned abrasion
The examination of wounds

Bruises are the sequels of blunt injury which are characterized by damage of blood vessels. These localization is mostly under the skin. Bruises do not reproduce the pattern of the causative object.

Lacerations are the most dangerous injuries of a body. Their features:

- splitting or tearing wound (bleed profusely, ragged edges, crushing and bruising along the edges, crossing tissues strands)
- fibrous bands, vessels, nerves etc. in the depth of wound
- mechanism of formation: blunt injury passes through the full thickness of the skin as a sequel of impacting of a blunt object, rolling or grinding movement (run over, dragging, stretching, crushing in a „sandwich“ fashion)

Incised wounds are injuries from knives, razors, broken glass, metal edges and any object with a cutting edge (stiff paper, grass). They are of 2 main types:

- slashed wounds have the length greater than the depth (tangential slices), may be result of accidental or suicide attempts and less dangerous than stabbing

- stab wounds have the depth greater than the length, may be result of movement with any sharp-pointed weapon (knife, chisel, bayonet, sword, scissors, screwdriver, file, poker, metal rod, railing).
The examination of wounds

**Characteristics of stab wounds:**

- a stab wound is usually slit-like
- the wound is not the same size as the blade
- the wound may be longer because of the "rocked" knife
- the wound is "V-shaped" or "swallow tail shaped", if knife is twisted
- a single-edged knife cause a wound, which may have one end pointed, the other square or blunt
- bruising or abrasion may occur from the hilt-quard
- the depth of wound may be greater than the length of the blade (on the abdominal or chest wall)
- a wound from a closed pair of scissors is like a shallow "Z"

The examination of wounds

**Stab wounds - forensic and legal analysis:**

**Stabbing is the most common method of homicide**

**Relevant facts in stabbing:**

- The sharpness of the tip of the weapon is most important. If penetration is once through the most resistant skin, the sharpness of the rest of the edge is much less important
- The faster the movement, the easier it is to penetrate
- Very little force is needed to push a sharp knife through the skin stretched across ribs
- A person can easily transfix themself by falling or walking into a sharp knife held by another person
- Activity of the injured person after stab wounding is generally saved (ability to walk, to run, to drive the car etc.)
The examination of wounds

* Bite mark is the combination of bruise, laceration and/or incised wound, that are usually made on skin of victim with teeth by animal or human assailant as well as by victim as self-defense.

* There are following problems with the interpretation of bite marks:
  - resistance and elasticity of the tissues
  - degree of body curvature of the body surface
  - lapse of time (superficial bites exist only 4 - 36 hours)

Types of human bite marks:
- **Aggressive type** – using of teeth as weapon, bite is forceful and rapid
- **Sexual type** – teeth are used to grip during, sucking, suck marks are visible as petechiae, bite is not forceful and slow

Effects of injury

* The most common sequelae of trauma:
  - Haemorrhage (bleeding)
  - Infection
  - Embolism
  - Adult respiratory distress syndrome (ARDS)
  - Bone fractures

1. **Haemorrhage (bleeding).** May be classified into 2 types:
   - * external bleeding: from lacerations, from incised wounds
   - * internal bleeding: into body cavities, into organs

The dangerous sequelae of bleeding:
- actual blood-loss – haemorrhagic shock, hypotension, circulatory collapse
- bleeding within the skull and space-occupying effect upon the brain
Effects of injury

2. Infection

Infective consequences can still occur especially in situations where rapid and effective treatment is not available.

The common possible risks are:

• anaerobic infection (*Clostridium perfringens, Clostridium tetani*)
• aerobic purulent infection (*Staphylococci, Streptococci, Colibacillaceae, Pseudomonas, Proteus*)
• „septic shock“ from exotoxins originating in suspected foci of infection

Effects of injury

3. Embolism

*Embolus* is a foreign bolus (solid, liquid, gaseous) migrating through the vascular system to lodge at a bifurcation and thus making an obstacle for regional circulation.

Kinds of emboli are:

• fat embolus
• bone marrow embolus
• air (gas) embolus
• thrombo-embolus
• foreign body in a vessel
• amniotic fluid in a vessel
Effects of injury

3. Embolism

Fat embolism is a sequel of tissue trauma (after hours even days) with origin of the fat in adipose tissue, bone marrow or plasma. It is a common sequel in a crushing effect.

Grading of fat embolism: from degree I (slight) to IV (severe).

- Pulmonary fat embolism – a filtration effect of lung capillaries recognised histologically.
- Generalised (systemic) fat embolism – fat globules penetrate from lungs into the systemic circulation:
  - brain embolism (brain purpura)
  - kidney embolism
  - myocardium embolism
  - embolism of the skin
  - embolism of the retina

Consequences of embolism – small haemorrhages (petechiae), micro-infarcts

Effects of injury

3. Embolism

Air embolism - kind of embolism regarded as a cardiac embolism which is characterized by the evidence of frothy bubbles of air in the right atrium, ventricle and pulmonary arteries, is a common sequence of wounding of cervical veins. The minimal fatal volume of air in blood vessels is cca 100 ml.

Possibilities of air embolism:

- opening the large veins in the neck (cut throat, thyreidectomy etc.)
- the head above the level of the chest (suction effect)
- criminal abortion
- empty infusion (transfusion) bottles
- barotrauma of the lungs

The peculiar type of air embolism is nitrogen gas embolism in a decompression disease (divers).
Effects of injury

3. Embolism

Thrombo-embolism – pulmonary thrombo-embolism is the most common consequence of injury.

The focus is almost commonly in the deep leg or pelvic veins. The main causative factors are:
- increase in the coagulability of the blood
- inactivity of the victim
- predisposition: trauma, surgical operation, immobility in bed, childbirth etc.

Parts of thrombus break off, sweep to heart and impact in the lumen of pulmonary arteries and its branches. Pulmonary red infarcts sometimes occur.

Foreign body embolism – may be observed in the systemis veins and/or lungs, foreign bodies are insoluble and commonly consist of:
- contaminant material in injected drugs of dependence (crushed tablets, talc etc.)
- bullets or shot-gun pellets (rarely)

Effects of injury

3. Embolism

Amniotic fluid embolism – complication of childbirth, when the amniotic fluid escapes into the maternal circulation.

Consequences of the amniotic fluid embolism are:
- blocking of the pulmonary capillaries
- DIC (disseminative intracapillary coagulation)

Diagnostics: histologically - fetal squames, lanugo, vernix lipid and meconium (special staining for keratin squames in multiple sections of lung)
4. Adult respiratory distress syndrome (ARDS)

Is a complication of most traumatic or stressful incidents. The appearance of lungs is distinctive: these are shock lungs.

The causes of ARDS are:
- aspiration of gastric contents
- near-drowning
- blast injuries to the chest
- heavy impacts on the thorax
- irritant gases
- infection and systemic shock

Clinical features: dyspnoea, hypoxemia, progressive respiratory insufficiency.

Histological examination of lungs reveals intraalveolar exsudates, hyaline membranes, haemorrhage, cellular proliferation and sometimes interstitial fibrosis (in long survival).

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5. Bone fractures

Bone fractures are the common sequences of blunt force injuries. The cause may be of three types:

- **direct violence** - the force acts on a bone deforming it by compression, distension or pitch and produces an injury. The typical situations are transportation injuries.
- **indirect violence** - injury is produced at a distance from the point of application of blunt force. Such indirect injuries occur:
  - in various types of falls onto the heals
  - in car accident, where driver’s knees impact on a dashboard, the fracture of hip bones is common
- **proper muscular action** - in some cases rapidly intermittent contractions of the muscles (electric shock, epilepsy) may cause bone fractures (especially in osteoporosis)
Effects of injury

6. Defence injuries

Defence injuries are the characteristic injuries on the victim’s body which indicate that the victim interfered in the assault and attempted to defend himself.

These injuries are divided into two groups:

- active defence injuries: bruising and lacerations of fists due to defensive punching, incised wounds on the palms and fingers due to gripping the blade in the fist

- passive defence injuries: bruises, abrasions and lacerations of the outer side of forearms, the outer side of thighs, the back of the hands which indicate the victim’s passive protection

Firearm injuries

Types of firearms:

Shot guns – main details are: stock, lock with extractor, breech, barrel.

Usual guns are of two types:

- single-barrel
- twin-barrel

Shot gun usually fire a large number of small spherical lead shots or pellets.

Rifled weapons – may be short (revolvers, pistols) and long (rifles, machine-guns). These features:

- fire one projectile at a time
- the barrel has spiral grooves and ”lands“
- self-loading, repeated action

Special type of firearms is slaughter weapons.
Firearm injuries – definitions (1)

- **Entrance wound** is penetrating or perforating defect of the surface (commonly skin) according to the place of projectile introducing to the body.
- **Exit wound** is perforating or lacerating defect of the surface according to the of exiting the projectile from the body.
- **Wound channel** is a channel between entrance and exit wounds in the body. Due to pulsation and contusion of surrounding tissues the wound channel may be wider than the firearm caliber.
- **Perforating firearm injury** is the type of injury, when both the entrance and the exit wounds connected by wound channel are present, the projectile exited the body.

Firearm injuries – definitions (2)

- **Penetrating firearm injury** is the type of injury, when the projectile is situated within the body: entrance wound and wound channel are present, exit wound is absent.
- **Graze firearm injury** is the non-severe injury, when the wound channel is absent, the entrance and exit wounds are contacted with each other on the surface of the body, the subcutaneous tissue is not involved.
- **Tangential firearm injury** is the firearm injury, when the wound channel is opened to the surface, the entrance and exit wounds are contacted with each other on the surface of the body, extending to the subcutaneous tissue.
Firearm injuries

Common morphological components of firearm injuries:

- entrance wound
- wound channel
- exit wound

Entrance wounds can be divided into four broad categories:

1. Contact wound:
   - hard contact wound
   - loose contact wound
   - angled contact wound
2. Close range (near contact) wound
3. Intermediate range wound
4. Longer range wound

Firearm injuries

Entrance wound

The contact or close range entrance wound on the skin has following surrounded limbs and zones:

1) limb of friction soiling – has grayish or brownish color
2) limb of skin abrasion and contusion – has a red-brown color (may be a sign of vital reaction)
3) zone of searing and sooting – has a black color
4) zone of gunpowder tattooing – has a black to grayish color
Firearm injuries

Characteristics of shot-gun wounds:

1. **A contact wound (barrel is in contact with skin):**
   - the muzzle is touched the skin and the muzzle mark is present
   - circular abrasion
   - entrance wound: circular, over a bone – ragged
   - pink area from carbon monoxide around the entrance wound
   - wad inside wound
   - head: huge ragged exit wound

2. **A close range wound (distance is a few centimeters to 20 cm):**
   - no muzzle mark
   - smoke soiling, powder tattooing
   - burning of skin and hairs

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Firearm injuries

Characteristics of shot-gun wounds (continued):

3. **Wound at intermediate ranges (20 cm - 1 m):**
   - powder tattooing persists
   - burning persists
   - irregular wound rim (like in a „rat hole“)

4. **Wound at longer ranges (1 m - 30 m):**
   - satellite pellet holes around the central wound, at long ranges the uniform peppering of shot is observed and thus the shooting is not always fatal
## Firearm injuries

*Characteristics of wounds from rifled weapons:*

1. **A contact wound:**
   - the entrance wound is circular, over a bone – ragged
   - a muzzle mark present
   - escape of smoke
   - local burning of skin and hair
   - redness of carbon monoxide staining
   - surrounding bruising

2. **A close range wound (distance is within 20 cm):**
   - circular or oval entrance wound
   - smoke soiling, powder burns, skin and hair burning
   - abrasion collar around the entrance wound
   - surrounding bruising
   - exit wound: stellate appearance, irregular, large defect, no burning, smoke or powder soiling

## Firearm injuries

*Characteristics of wounds from rifled weapons (continued):*

3. **Wound at intermediate ranges (20 cm - 1 m):**
   - slight powder tattooing
   - entrance wound with regular margins, its diameter is within weapon caliber tolerance
   - exit wound: stellate appearance, irregular, large defect

4. **Wound at longer ranges (1 m - up to several kilometers):**
   - beyond 1 meter: no smoke soiling, burning or powder tattooing
   - regular entrance wound
   - exit wound: stellate appearance, irregular, large defect, in some cases the exit wound is absent (penetrating firearm injury)
Firearm injuries

Doctor’s duty in case of firearm injuries:
1. In the living:
   - saving life (immediately)
   - notes and photo of the original appearances of shooting wound before cleaning and operative procedures
   - preserving of foreign bodies and biological material for further investigation
2. Post-mortem examination:
   - preservation of lead shot, bullets
   - removing and keeping of the skin around the entrance wound
   - photographs, drawings with accurate measurements of wound should be done, RTG may be important
   - clothing of the victim should be preserved
   - blood samples for grouping, DNA analysis, alcohol or drug estimation should be taken
   - report to the police

Explosive injuries

The post-mortem examination of an explosion victim involves two main objectives:

1. Identification
2. Reconstruction of the events

1. Identification procedures of explosion victims are the same as those for identification in general, but certain complications occur due to dispersion of bode parts by the blast, for example, jaws and fingers may be blown off and must be retrieved for identification by dental comparison or fingerprints.
Explosive injuries

The post-mortem examination of an explosion victim involves two main objectives: identification and reconstruction of the events

2. **Reconstruction of events** includes getting answers on such questions:
   - What was the type and amount of explosive substance?
   - Where had been the explosive situated before event?
   - What type of initiator and firing system were used?
   - Was the explosion deliberate or accidental?
   - Had the explosive device an envelope (casing), what things were used as secondary projectiles?
   - What is the mechanism of explosive injuries.
   - What injuries were fatal?
   - What traces of evidence are available to make a conclusion about the case?

Explosive injuries

*The mechanism of explosive injuries includes:*

- burns from the near effect of the explosive and subsequent conflagration
- physical fragmentation, disruption and laceration of the victim
- massive hemorrhages in the lungs due to shock wave (barotrauma)
- ruptures of some organs and structures (bronchi, alveoli, tympanic membrane, rectum)
- missile injuries from parts of the bomb casing and from adjacent objects and fragments projected by the explosion
- peppering (impregnation), bruises, abrasions, lacerations by small fragments, debris and dust propelled by the explosion
- all types of injury due to collapse of buildings, roofs, walls damaged at the explosion
Sexual offences

The classification of sexual offences:

1. Rape
2. Indecent assault
3. Indecent exposure
4. Indecency with children
5. Incest
6. Bestiality
7. Homosexual offences

Sexual offences - law definitions

„Unlawful“ means without valid consent of woman, either because the woman did not give any consent at all, or because her consent was invalid, because she was too young or her mental state was deficient. A woman wouldn’t be a wife to a man, because sexual intercourses were held to be part of the marriage contract.

„Sexual intercourse“ means the penile insertion, if this is only just between the labia, but for a definition of charge of rape the some degree of penile is necessary sign. An orgasm or ejaculation of semen is not revelant, only some degree of penetration.

„Consent of a woman“ – in more countries is 16 years, below the age of consent sexual intercourse is always unlawful.
Sexual offences

1. **Rape** – is the most common and most serious sexual offences, it is defined as unlawful sexual intercourse by a man with a woman by compulsion through force, threats or fraud.

   Where a man uses alcohol and drugs to subdue a woman in order to have sex with her, it can be defined as rape, if she was physically or mentally incapable of forming decision about consent.

2. **Indecent assault**

   When the penis does not pass between the labia, a charge of rape cannot succeed, but any sexual offence, called an „indecent assault“.

3. **Indecent exposure**

   This is a sexual misbehavior known as „flashing“ or „exhibitionismus“, where a man or woman displays his genitals in public.

   **Sexual offences (continued)**

4. **Indecency with children**

   This is more serious sexual offence, where the man (rarely woman) prey on small children, not to assault them, but in the framework of certain play, to handle or masturbate his/her sexual organs.

5. **Incest**

   This is an ancient and widespread sexual offence, consisting of sexual intercourse between close relatives.

6. **Bestiality**

   This is a sexual intercourse of a man with animals, including birds, either vaginal, anal or cloacal. Sometimes the victims are tortured and killed in the process of sexual intercourse.

7. **Homosexual offences**

   In many countries the sexual acts between men are illegal, but the situation was changed since the beginning of movement for homosexuals’ rights. In some countries homosexual activity in private is not illegal between consenting adults over 21 years.
Sexual offences – doctor’s duty

1. Writing down the history of a case
2. General physical examination with following conditions:
   • third person should be present
   • full record of the examination
   • the history should cover the event complained of and also details of menstruation, pregnancies, sexual activity in the past
   • apparent age should be compared with real age
   • victim’s clothes are required for science examination. The victim have to undress standing on a large piece of brown paper to preserve all traces falling down
   • full body surface inspection
   • abrasions, bruises, bite marks, blood stains, semen, mud or other foreign material should be noted
   • pubic hair
   • visual inspection of the vulva and anus, swabs taken from those parts
   • liquid in the vaginal tract should be collected
   • venous blood sample for grouping, alcohol, drugs, DNA
   • fingernails - searching for blood or skin tags

3. Examination of an alleged assailant

Medico-legal aspects of pregnancy and abortion

Pregnancy – the state which occurs in the female when an ovum, discharged from ovary into the genital tract, is fertilized by a spermatozoon in the male semen introduced. The normal duration of pregnancy is about 40 weeks or 280 days (10 lunar months).

It is legally important to show if woman is, has been or could be pregnant in following resons:

• complicated relations between man and woman - claim of divorce, breach of promise to marry, illegal taking away a woman
• alleged criminal abortion
• cases of infanticide or concealment of birth
• the civil matter about the estate of dead husband
• pregnant woman may be excused attendance as a witness in a court
• pregnant of convicted woman may postpone or cancel the execution of capital punishment.
Medico-legal aspects of pregnancy and abortion

**Diagnosis of pregnancy** is based on subjective and objective signs, which are chronologically divided into the first, second and third trimester.

The most common subjective signs are:
- cessation of menstrual flow
- nausea and vomiting
- quickening (subjective sensation of fetal movements)
- emotional disturbances

The most common objective signs are:
- positive laboratory rapid „kids tests“
- enlargement of uterus and its ballotment inside the abdominal cavity
- ultrasound and radiological evidence of the uterus
- palpation of the fetus at about 16 weeks of gestation
- fetal heart sounds at 24 weeks of gestation
- enlargement of breasts, areolae and nipples

Many medico-legal problems have arisen because of the development of methods of artificial initiating of pregnancy.

1. **Artificial insemination**

   1. **Artificial insemination** – the production of pregnancy in woman by introducing seminal fluid directly into the cervix of uterus by means of cannula.

   There are two types of artificial insemination:
   - *artificial insemination by husband*
   - *artificial insemination by donor* – the donor must not be relative, he should be over 18 years old and preferably have his own children. Tests for absence of chronic diseases and familial abnormalities should be carried out before donation
Medico-legal aspects of pregnancy and abortion

2. In vitro fertilization - a method which allows to fertilize in vitro ova removed laparoscopically and to return them subsequently to uterus. A multiple ovulation caused by medicines has performed before the fertilization.

There are following possibilities of such method:
• the woman’s own to be fertilization by her husband’s sperm and re-introduced into her uterus
• the woman’s own ova to be fertilized by a donor sperm and re-introduced into her own uterus
• the woman’s own ova to be fertilized by her husband’s sperm and returned to another woman’s uterus
• the woman’s own ova to be fertilized by donor sperm and returned to a surrogate woman’s uterus
• an infertile woman may have another woman’s ova implanted to her, fertilized either by her husband or by a male donor

Medico-legal aspects of pregnancy and abortion

Abortion – is the premature expulsion of the fetus from uterus at any time before its term of gestation is complete.

Medically and pathologically the term „abortion“ is applied to the termination of pregnancy during the first three months, while an abortion occurring during the middle period of pregnancy is designated as „miscarriage“, and after 7th month is called a premature birth.

Abortion:
1. Spontaneous abortions
2. Accidental abortions
3. Legal termination of pregnancy
4. Self-induced criminal abortions
5. Criminal abortions induced by another person
Medico-legal aspects of pregnancy and abortion

*Criminal abortion* – is a deliberate ending of a pregnancy by woman herself or by another person unlawfully, outside any legal provisions adopted by the State Law.

*Self-induced criminal abortion* occurs when the woman attempts to end her pregnancy by following means:

**Mechanical means:**
- direct violence on lower part of abdomen
- bicycle and horse-riding
- hot baths
- the insertion of long instruments (syringes, pipettes, cannulas, sticks, needles etc.) into the cervix of uterus

**Chemical means:**
- drugs and toxins (ergot, lead, quinine)
- hormones (pituitrin, prostaglandins, other ecbolics)
- purgatives (jalap, croton oil, colocynth)

*Criminal abortion induced by another person* may be performed by doctor, medical worker or by layman. The method commonly involves both mechanical (curettage, suction, drainage) and chemical means.

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Medico-legal aspects of pregnancy and abortion

*Criminal abortion*

*Non-fatal cases* - these cases are classified in law as felonies automatically with the revoking of licence to the doctor being involved the case. The evidence necessary to establish the crime of non-fatal abortion. The woman is sent to a hospital for examination and curation.

*Fatal cases* - the most common causes of death are:
- haemorrhage from local genital trauma during clumsy instrumental interference
- sepsis due to unsterile instruments and retained products of conception
- shock associated with the haemorrhage or with the dilatation of cervix in unanaesthetized woman
- air embolism
- later complications: womb gas gangrene, pulmonary thrombo-embolism, intravascular coagulopathy, renal failure
Medico-legal aspects of pregnancy and abortion

The doctor’s duty on scene of criminal abortion:

• If the act was performed by woman itself the doctor must give her all necessary medical care.
• To notify coroner (medical examiner) or police about the case.
• Pieces of tissue found at the scene of an abortion must be collected and sent to the laboratory for histologic and seologic examination.
• In hospital, if laparotomy or other operation is performed, careful records should be made, all injuries of genitals and other abdominal viscera must be described.

Death and injury in infancy

Still-birth

The still-born child is a child of more than 28 weeks gestational age which after being completely expelled from mother, did not breathe or show any signs of life.

The still-born child is:
  • discoloured (pinkish-brown or red)
  • with desquamation of the skin
  • with soft and sliny tissues
  • with overriding skull plates
  • with partial collapse of the head

Infaticide is form of homicide commonly defined as the deliberate killing of a child occurring in the first year of its life.

Filicide is general term for killing of child by its parent.

Neonaticide is the deliberate killing of new-born child within 24 hours of its birth by its mother. The killing must take place during a very limited period (not later than after the first feeding and swaddling of the infant).
Death and injury in infancy

The medico-legal questions in cases of infanticide are:
1. Was the child fully matured?
2. Was the child born alive?
3. Did the child survive after birth?
4. The identity of the body.
5. What was the cause of death?
6. How long has the body been dead?

In relation to legal medicine, neonaticide may be considered in different countries:
- as a type of homicide
- as a murder in peculiar circumstances (woman’s disturbance by the effects of childbirth or lactation)
- as a committed manslaughter

Death and injury in infancy

Physical abuse of children (true child abuse). Legal medicine classifies these cases as „child or baby battering“ and „non-accidental injury“.
The main characteristics of these cases are:
- they are very common
- there is a various threshold between parental punishment
- they are mostly non-fatal: 60 % recure, many cases end in permanent damage (neurological defects from brain injury)
- the murder commonly is a single episode of deliberate killing
- fatal child abuse is culmination of repeated injury
- manual violence in most cases is proved
- the incidence in any age (mostly under 2 years of age)
- sexual abuse is usually observed in an older children
- statistically most risk in the „lower middle social classes“
- the most common physical lesion are on the skin and skeleton
Death and injury in infancy

Injuries in physical abuse of children (true child abuse):

1. **Bruising** - the cardinal sign:
   - bruising around the large joints (upper arms, forearms, wrists, ankles, knees as the sign of gripping by adult)
   - bruises on the face, ears, lips, neck, lateral thorax, abdomen, buttocks, thighs are suspicious if the doctor reveals:
     - finger-tip discoid marks of different ages
     - slap marks
     - pinch marks
     - knuckle punch marks
     - instrument marks (belts, straps, canes, electric flex)

2. **Skeletal lesions** - fresh fractures (skull, limbs, ribs), evidence of previous damage (callus formation, subperiostal calcification of haematomas)

3. **Eyes and mouth injuries**:
   - eyes: vitreous haemorrhage, dislocated lens and retina
   - lips: bruised or abraded, lacerated by teeth contact
   - mouth: torn frenulum inside the upper lip

4. **Head injury** (most frequent cause of death):
   - subdural haematoma. The mechanism is: direct impact or vigorous violent shaking ("shaken baby syndrome")
   - skull fracture as a result of throw against a hard surface (floor), punch, heavy slap
   - cerebral oedema
   - diffuse axonal damage

5. **Visceral injuries**:
   - gut crash
   - mesentery laceratin
   - liver and spleen rupture
   - kidney decapsulation
   - urinary bladder rupture

6. **Other lesions**:
   - burns, scalds on the skin – the instruments are: hot iron, hot water, burning cigarette
   - bites
Death and injury in infancy

**Sudden Infant Death Syndrome (SIDS)**

- regarded as a case of small infant dying with no apparent cause, autopsy fails to reveal an adequate cause of death
- the critical age – from 2 weeks to 2 years old
- incidence: 1 in 500 live births (preponderance of males)
- incidence markedly greater in twin pairs, premature and low birth-weight infants, colder and wetter months (seasonal variations), lowest social classes
- the child is perfectly well or with only trivial symptoms being put in the sleeping place at night, to be found dead in the morning
- autopsy findings: petechiae on the pleura, pericardium, thymus
- cause of SIDS is unknown yet, there are several theories: the most adoptable is the theory of prolonged sleep apnoea
- doctor’s duty – support of the family by explanations
- prevention – cardio-pulmonal monitoring, revealing of risky groups and factors

Forensic histopathology

**Forensic histopathology** is a branch of forensic medicine dealing with the microscopic investigation of pathological causes, complications and mechanism of death in different organs and tissues of human body.

The histological examination has its own features such are:

- certain superiority over the macroscopic observation
- long-term preservation of organs or organ sections
- methodological completeness
- possibility of verifying the assertions by other doctors
- higher level of medical work and documentation
- the formation of basis for further considerations

Omitting the histopathological examination may lead risks:

- the case appears sufficiently „clear“
- quick „settlement“ of a case
- knowledge of the necessity of a histological examination is absent
Forensic histopathology

Value and significance of histopathological data:

Group 1.
Findings permit an independent assessment of the causal connections between the condition and etiology (tuberculosis, abortion etc.). The etiological manner is also of great significance in the case of poisoning by ethylenglycole due to formation of oxalate crystals in the kidney.

Group 2.
Findings only have a significance in association with further premises (fresh haemorrhages in the deep soft parts of the neck).

Group 3.
Unspecific, informative findings neither singly nor in combination exclude other possibilities of causal explanation (vascular congestion, pulmonar emphysema, cerebral edema, necrosis etc.)

Medical malpractice

Medical malpractice – medico-legal phenomenon which covers all defects in the profesional behavior of doctors.

Medical malpractice is divided into two types:
1. Medical negligence - the standard of medical care given to a patient is considered to be inadequate.
2. Professional misconduct - personal professional behavior falls that which expected of a doctor.

Generally medical malpractice may be:
- ethical malpractice: violations of principles of medical ethics which migh subject the medical practitioner to disciplinary action by his professional society
- civil malpractice: generally concerns of cases of monetary renumeration and careless doctors
- criminal malpractice: the result of performing illegal operations, violation of narcotics laws, falsifying records and reports, fatal mistakes in diagnostic and treatment
Medical malpractice

The main types of medical negligence are:

In obstetric and gynaecology:
• brain damage in the newborn due to hypoxia from prolonged labour
• failed sterilization by unsuccessful tubal ligation
• complications of hysterectomy

In orthopaedics and accident surgery:
• missed fractures
• undiagnosed intracranial haemorrhage
• missed foreign bodies in wounds and eyes
• inadequately treated injuries
• discharge of ill patients, instead of admission to hospital

In general surgery:
• delayed surgical diagnoses
• retention of instruments and swabs in operation sites
• operation on the wrong side of body, wrong organ, technics

In anaesthesiology:
• brain damage from allowing hypoxia to occur
• neurological damage from spinal or epidural injections
• incompatibile blood transfusion
• periferal nerve damage from splinting during infusion
• incorrect or excessive anaesthetic agents
• allowing awareness of pain during anaesthesia

General medical errors:
• failure to act on radiological and laboratory reports
• inadequate clonical records and failure to communicate with other doctors involved in the treatment of a patient
Medical malpractice

*Professional misconduct*

- The general level of ethical behavior, morality and competency is stated by the Hippocratic Oath, declaration of Geneva and proclamations of the World Medical Association.
- The professional behavior of a doctor may lead to allegations of misconduct.
- The doctor’s professional career is dependent upon various systems of registration and licensation, thus the best way to control professional misconduct is to examine the doctor’s fitness to remain an accredited physician by various tribunal.

Drugs of dependence and abuse

*Drugs may by taken by different routes:*

- by injection
- by sniffing
- by inhalation
- by smoking
- *per os* (orally)
- *via rectum* (rectally)
- *via vagina* (vaginally)
Drugs of dependence and abuse

Physical lesions are apparent, particularly a loss of weight, due to:

- lost appetite
- avitaminosis
- intercurrent infections
- lack of money
- sleep disorders

Drugs of dependence and abuse

Dependence – condition in the case of using legal and illegal drugs, when the substance takes a participance in metabolism, and the organism needs the constant presence of that drug by using for its own normal function. The drugs of dependence are: alcohol, nicotin, analgetics, all kinds of banned drugs.

Dependence means inability of the user to give up the habit, it can develop within 1 – 2 weeks even after the first injection of a potent drug.

Tolerance – condition, when large doses of remedy or poison no longer have the effect that they had originally (increasing doses need to be given for the same beneficial effect). The effect of tolerance is observed in the case of taking amphetamines, barbiturates, benzodiazepines, drugs of morphine-heroin-methadone group. Most of drugs of dependence exhibit tolerance.
Drugs of dependence and abuse

*Idiosyncrasy* – condition, when abnormally small amounts of substance may cause health disorders or even fatal effects; greatly it has neurological or allergical matter.

*Withdrawal symptom* – is the sequel of dependence. This is a complex of general signs e.g. headache, psychical lability, total arrogancy and a desire to use the drug of dependence immediately (alcohol, opiates and so on).

*Withdrawal symptom may be of two subtypes:*
  - *physiological*: fear, anxiety, muscle twitching, yawning, sweating, lacrimation, tremors, cramps, diarrhoea, incontinence, restlessness, insomnia, tachycardia, hypertension
  - *psychological*

Drugs of dependence and abuse

*The danger of drug dependence:*
- repeated injection of drug leads to vein thrombosis, phlebitis, fibrosis, abscesses, fat atrophy and necrosis, chronic myositis (dark, hard and cord-like veins under skin and silvery linear scars as well as depressed areas on the limbs)
- injection of crushed unsterile tablets causes microemboli, giant cell granulomata and abscesses in the lung and liver
- use of shared syringes and needles is a risky factor to obtain hepatitis B and C, HIV infection, infective endocarditis, septicaemia
- poor nutrition and reduced resistance - pulmonary tuberculosis, pneumonia
- accidents
- death from poisoning
Drugs of dependence and abuse

Brief classification of drugs of dependence:

- **Opiates**: heroin (diacetylmorphine), morphin and other opioids (codein, dihydrocodein, papaverine, pethidine, pentazocine, methadone, dextromoramide, cyclizine etc.)
- **Barbiturates, benzodiazepines and other hypnotics** (cyclobarbitone, amylobarbitone, phenobarbitone etc.)
- **Amphetamines** (dextramphetamine, methylamphetamine, MDMA – methylenedioxymethamphetamine („Extasy“) etc.)
- **Cocaine** („Crack“ – heating cocaine together with sodium bicarbonate)
- **Cannabinoids** (marihuana, hashish)
- **Hallucinogens** (LSD – lysergic acid diethylamide, psilocybin, phencyclidine)
- **Solvents** (toluene, ethylene chloride, carbon tetrachloride, benzene, halon, trichlorethane, xylene, trichlorethylene etc.)

General aspects of poisoning

*Poison* is any substance, which being entered to the organism in relatively small amount may cause its chemical damaging, pathologic condition and even a death.

*Poisoning* (from the general point of view) is a damage to the tissues by any chemical agent.

**Poisons biologically are of two main groups:**

1. **Quantitative poisons.** Any substance can act as a poison in a sufficient and increased quantity (therapeutic agents or remedia in excess of the prescribed dose or even a water has been drunk in a huge amount). For such a substance, especially for drugs, exists a proportion, which is called „Risk-benefit“ ratio (relation between the therapeutic effect and the toxicity). For hard drugs this ratio is poor.

2. **Qualitative poisons.** They are harmful in such small doses and have no treating effect (for example: cyanids, mercury, pesticides).
General aspects of poisoning

Poisoning from the point of view of forensic doctor may be of three types:

1. Accidental poisoning - most common
   - individual (a child is eating medicinal tablets in mistake for sweets, a drunken person is drinking a pesticide or ethylene glycol anti-freeze from a beer bottle in mistake for beer)
   - faulty gas-appliances (CO, lack of oxygen)
   - agriculture (paraquat, organophosphorus compounds - paration)
   - mass industrial disasters (contaminated cooking oil in Spain, dioxin gas in Italy and India, blastfurnace gas in East Slovakian Ironwork)

2. Suicidal poisoning - common
   - mostly appears in advanced
   - easy obtaining of toxic drugs and agricultural products
   - decreased using of corrosive agents (acids, alkalia) - painful
General aspects of poisoning

3. Homicidal poisoning

the cases are rare (traditional weapons are arsenic and cyanide) but:

new intention: immobilization instead killing of the victim for robbing (using benzodiazepines or narcotic analgetics mixed with alcoholic and non alcoholic drinks)

the newest intentions:
- euthanasia (the death as a will of patient)
- legal punishment (the fatal dose of hard somniferous drug intravenously instead shooting down or hanging)
The doctor´s duty in suspected poisoning:
The main task is the management of the situation in the most effective way. The steps are:
1. Early recognising the possibility of poisoning.
2. Instituting primary treatment, if the victim is alive.
3. Identifying and retaining any drugs or possible poisons.
4. In the case of death: full co-operation with the police in the investigation:
   - pick up data of full medical and psychiatric history
   - to estimate the schedule of drugs prescribed in the recent past
Main sings for recognition of poisoning:
• sudden vomiting and/or diarrhoea, changes of eye pupils, skin and mouth corrosions
• unexplained coma
• knowledge of a depressive illness in the past
• rapid onset of neurological or gastrointestinal illness (occupational exposition to chemicals)

The collection and storage of samples for toxicological analysis:
The doctor must do these things:
1. Venepuncture with placing the blood into an appropriate tube.
2. Labeling of the tube with:
   - patient´s name
   - address (hospital number)
   - date and time of taking blood
   - doctor´s signature
3. Taking the biological samples for toxicological investigation.
4. Labeling of the plastic bag or box for transport.
5. Medical notes (time and nature of the sample, the name of the person to whom it was given).
The collection and storage of samples for toxicological analysis:

Samples required for toxicological analysis:

1. From living persons:
   
   blood in such amounts:
   - 15 ml in a plain tube
   - 5 - 10 ml in a tube containing anticoagulant
   - 5 ml in sodium fluorid tube for alcohol estimation

   urine: 20 - 30 ml (with no preservatives)

   vomit and stomach contents placed in glass screw-topped jars, plastic tubes or containers

   faeces: 20 - 30 g in suspected heavy metal poisoning (arsenic, osmium, mercury, lead) or mushroom poisoning

   hair and nail clippings are antimony, arsenic, thallium intoxication and drug abuse

2. From dead bodies:

   blood
   urine
   stomach and intestine contents
   liver
   kidney
   lung
   heart
   brain
   fat tissue
   adrenal gland
   bile, vitreous body of eyeball, cerebrospinal fluid, synovial fluid
   hair, nail clippings
   putreous fluid, living maggots
Main methods of toxicological investigation:

1. Screening (qualitative) methods:
   • express-methods with indicative papers and solutions
   • method of fluorescence polarization immunoassay
   • qualitative chemical reactions

2. Semiquantitative methods:
   • thin-layer chromatography
   • densitometry

3. Quantitative methods:
   • gas chromatography
   • high performance liquid chromatography
   • mass spectrometry

Forensic documentation

1. The autopsy report.

2. The expert opinion

3. Medical reports for police, judges, government, layers

4. Photos, videorecords, drawing schemes
Forensic documentation

1. The autopsy report
This document is issued by forensic doctor after medicolegal investigation of dead person. It consists of:
• the general data of dead person - name surname, age, affiliation, and other types of identification (born number)
• the data of doctor who performed the autopsy (note that autopsy is performed by two doctor)
• clinical diagnosis (only in case of death in hospital)
• type of death and type of autopsy
• external examination - postmortem changes, violence marks, external pathological signs
• internal examination - cranial, thoracic and abdominal cavity, eventually other cavities (middle ear cavity, spinal column cavity, orbita and cavity of joints)
• results of additional laboratory investigations - toxicological (including alcohol), serological, microbiological, histological
• definitive diagnosis - cause of death, the main disorder (trauma, illness, intoxication etc.), complications, other changes, which were not in dependence on death.

Forensic documentation

2. Expert opinion
• can be made only by specialist-expert, who accomplished all requirements given by the law
• concerns both living and dead persons
The structure of an expert opinion:
Part 1. Introduction
• doctor-expert: affiliation, address
• patient or deceased - name, address, age
• who requested the report
• where and when the examination took place
• what basic documents and investigations were the source
Part 2. Findings and diagnoses
• brief account of the reason for the examination and short note of the circumstances
• given questions
• history by the patient, police
• external and internal examination
• results of additional investigations: toxicological, sero-haematological, histological etc.
• medico-legal interpretation of revealed circumstances
• explanation of mechanism of death
Forensic documentation

2. Expert opinion
Part 3. The expert opinion itself - conclusion
Part 4. Signature, seal
• medical reports and statements for police, judges, lawyers and government
• photographs, videorecords, drawing schemes

The doctor in a court

The doctor may play the role of:
• medical witness
• doctor-expert

Kenedy defined he main characteristics of doctor in a court:
• the doctor must be ready to present his opinion at any time
• the doctor must be precise
• the doctor must be brief
• the doctor must realize his responsibility
• the doctor must control his behavior
• the doctor must be coherent and should not use difficult Latin medical terms