Infanticide. Abortion. Sexual offences (rape)

NEONATICIDE

DEFINITION. FORENSIC AND JURIDICAL CONSIDERATIONS

The concept of neonaticide has both legal and socio-medical aspects.

The killing of new-born infants goes back into prehistory, both as a sacrificial rite and a method of population control.

It was an accepted practice in a number of cultures and may still be practiced covertly in several areas of the world.

From the juridical point of view, the killing of a newborn by its own mother can either be considered a form of homicide or of murder.

In order to avoid the label of murder, many countries have introduced the notion of neonaticide that includes all the specific conditions in which the mother kills the newborn immediately after birth.

The intensely stressful condition of the mother's organism during labour may lead to a series of particular psycho-physiological conditions that can determine her to take the child's life.

Neonaticide is only accounted for when the newborn was alive so one of the main objectives of the expertise is to find proofs of live birth.

THE OBJECTIVES OF THE EXPERTISE ON THE NEWBORN

1. The condition of newborn

The definition of the newborn condition is of major importance for the difference between abortion and neonaticide. It is usually considered that a foetus is viable when the intra-uterine age is of at least 28 weeks, premature between 28-38 weeks and mature between 38-42 weeks.

2. The viability and maturity of the newborn

In order to rule a case as neonaticide the courts require scientific proof that the newborn was viable. The forensic expertise is called to estimate the *duration of the pregnancy* and the difference between abortion, stillbirth and neonaticide.

WHO standards: a newborn is viable starting with the II-nd half of the VI-th month of pregnancy, at a weight of more then 1000 g.

In forensic medicine, the limits are extended to crown-heel length of 38 cm and weight of 1400 g.

These measurements correspond to the VII-th month of pregnancy, with a minimum degree of pregnancy that permits survival even in the absence of qualified assistance.

An already consecrated calculation formula for the gestational age is the *Balthazard-Dervieux formula*, according to which the age in days equals the length in cm multiplied by 5.6.

The cephalic parameters of a mature, viable infant are: occipito-frontal diameter 10-12 cm, by-parietal diameter 8-9.5 cm, maximum perimeter 33-38 cm.

The skeletal signs of maturity are the length of the long bones, the ossification centres, the partition of the mandible (the appearance of dental alveoli) etc.

The length of a single diaphysis can lead to the calculation of the newborn length in cases of body fragmentation.

The ossification centres are round, reddish areas on the white-greyish background of the cartilage; this aspect is present even in putrefied bodies.

An important ossification centre (nucleus) is the Beclard centre situated in the distal epiphysis of the femur. It is visible beginning with the second intrauterine month but it can be absent at birth; it has a 2-5 mm diameter.

The dental alveoli begin to form in the VI-th month of pregnancy. In on-term newborns the mandible is formed of two segments, united on the median line by a fibrous cartilage. Each segment has 5 alveoli; four of them with one dental burgeon each and one with 4-5 burgeons. At birth, teeth are not visible, being covered by the gingival mucous membrane.

The examination of the internal organs can also be relevant: the aspect of the lungs (aerated or not aerated), the presence of meconium in the large intestine (suggests the proximity of on-term birth). All these findings appear within large limits, depending on sex, race and other individual characteristics.

3. The diagnostic of extra-uterine life (separate existence)

The main proofs of separate life are the on-set of pulmonary breathing and the interruption of foetal circulation.

3.1. The on-set of breathing

Respiratory movements are not absolute proves of separate existence, because there can be breathing while the head of the newborn is still in the vagina. Non-aerated lungs appear in the latero-vertebral spaces, collapsed to the hilum, covering the heart and thymus. They are dark-reddish or brownish, heavy, with a rather liver-like consistency and external aspect.

Ventilation determines the peripheral expansion of the lungs, responsible for the pinkish colouration and the expanded aspect of these areas. Aerated lungs occupy the whole thoracic cavity, have round margins, are violet-bluish with occasional pinkish discoloration spots. They are soft and crepitant. An important test is the hydrostatic test – optical, pulmonary, gastro-intestinal, auricular and histological.

a. the optic inspection of the lungs **is performed with a magnifying glass. The foetal lungs are smooth, elastic; they occupy 1/3 of the thoracic cavity. The aerated lungs are distended, crepitant, with a fine line network on the surface; they completely occupy the thoracic cavity. Airy, 1-2 mm bubbles can appear on the surface. After sectioning, they present sponge-like aspect and consistency. Pressure expresses aerated, foamy blood. Non-aerated lungs weigh 40-45g while aerated lungs weigh 80-85g, due to blood flooding.**

b. the hydrostatic test (flotation test) **is an important proof of extra-uterine life. The test is based on the fact that aerated lungs have a lower density then water so they float on the surface.**

The non-aerated foetal lungs have higher density so they sink to the bottom of water. The flotation test starts with the immersion of the whole buco-cervico-thoracic piece, followed by the immersion of each lung and then smaller and smaller fragments from various pulmonary areas. Partially aerated lungs (premature foetuses) will half float over the water surface (with the aerated portion).

After attempts to resuscitate a stillborn infant, the lung will have a partially aerated aspect, with a false positive hydrostatic test.

Other proofs of attempted resuscitation will corroborate in the exclusion of neonaticide behaviour.

A major error-generating factor in the interpretation of the hydrostatic test is putrefaction.

The test will be falsely positive because of the presence of subpleural and parenchimal putrefaction bubbles.

Prematurity can cause a false negative test, because the density of premature lungs can be between 1 and 1.038.

c. The gastro-intestinal hydrostatic test (Breslau) **is based on the principle that after the onset of pulmonary breathing, air is also swallowed into the digestive tube. If ligatured segments float, the test is positive for extrauterine life, under the reservations regarding putrefaction.**

d. The auricular hydrostatic test (Wreden) **is based on the observation that the presence of air in the middle ear is proof of extrauterine life; the test is relative because it depends on the presence of mucus in the Eustachian tube.**

e. The histological examination **is indispensable in the investigation of neonaticide cases.**

For this examination, samples of pulmonary tissue are collected from different areas of the lungs, including the pleural areas. The fixation is ideal in 100% formaldehyde.

The aerated lung displays extended bronchioli, with a cylindrical epithelium situated close to the cartilage, covered by a basal membrane. The alveoli are distended; the alveolar wall is thin, formed of flattened, fusiform parietal cells with oval nucleus and crossed by a fine, blood-flooded capillary vessel.

The foetal (non-aerated) lung has a dense, homogenous aspect, with closed bronchioli, distant from the cartilage and desquamated epithelium that gives an aspect of pseudo-obstruction.

In partially aerated lungs, it is important to define the topography of the two aspects that require the examination of multiple samples, from various parts of the lungs.

Putrefaction largely complicates the histological examination. Normally, foetal putrefaction shows intra-parenchimal and subpleural putrefaction bubbles, and bronchial bubbles with irregular ampulla-like aspect.

In cadavers of newborns with external life, the onset and development of putrefaction take place along the air passages – polycyclic intra-parenchimal air bubbles secondary to the rupture of the alveolar walls (the putrefaction emphysema).

The microscopic examination of the putrefied lung is centred on the examination of elastic fibres that persist long after death, using special staining methods (Weiylert).

Arch-like, distended elastic fibres are a sign of aerated lung while curled, pleated fibres appear in the non-aerated lung.

3.2. The interruption of foetal circulation

The interruption of the foetal circulation and the changes it involves have a slow onset. Although of great value, these signs are only studied for establishing the duration of the extra-uterine existence. The obstruction of the foetal circulation is intra-vital but slow, so its examination requires minute anatomical dissection.

Information regarding the obliteration of the arterial duct or the Botallo duct are variable, so of less importance. The obliteration of the umbilical vessels begins before the severance of the umbilical cord, starting with the arteries.

Other elements appear after the initial cry that can be taken in consideration as signs of separate (extrauterine) life:

- the presence of food in the digestive tube (digested milk or a white mucus-like matter) proves that the newborn lived and it was fed.

- if the mummified umbilical insertion displays an inflammatory collar due to imminent separation, the child lived after birth;

- extraneous material found in the larynx, trachea, bronchi, bronchioli or even alveoli represents proof of active breathing;

- the passage to separate existence is also marked by a genital crisis, especially in females;

- the presence of a sero-sanguin bossa and/ or cephal-haematoma plead for the presence of extra-uterine life;

- vital infiltrated injuries (expressed by blood infiltrates) are inflicted during the extraction of a live newborn.

4. The duration of extra-uterine life

The desquamation of vernix caseosa **starts on the abdomen then spreads on the thorax, the inguinal and axyllar plicae.**

The process starts after maximum 24 hours of extra-uterine life and reaches a maximum between the third and the fifth day.

The umbilical cord **undergoes changes that respect a rather precise chronology.**

The fresh, whitish aspect of fresh tissue disappears quickly; it only appears if the newborn leaved a short period and the death is recent. The cord dehydrates both in live and dead newborns.

It becomes brownish, and it shrivels so the result is a 8-12 mm wide structure on which the blackish umbilical vessels are visible.

If the external conditions do not favour dehydration, the umbilical cord will putrefy. If occurred, dehydration becomes complete in 3-8 days, or even in 8 hours, if the body is exposed to the sun.

The severance of the umbilical cord is a time-consuming process that involves external survival.

In living newborns, a collar of reddish skin appears around the attachment of the cord.

The collar deepens, the umbilical cover erodes, the umbilical arteries and vein rupture and finally the severance is complete.

The scar at the site (the amnio-cutaneous groove) appears 24 hours after severance; its microscopic examination allows the approximation of the leukocytic reaction.

The cord severance involves a survival period of 3-6 days. It is considered that a dehydrated with no severance reaction around the attachment area indicates a 48 hour survival, a separated cord indicated a minimum 3 day survival and an umbilical scar appears after one week.

The state of the digestive tract also offers indications about external survival.

The presence of air and extraneous material (alimentary or non-alimentary) and the absence or partial elimination of meconium are indicators of separate existence.

It is considered that after 15 minutes the air reaches the stomach, partial colic aeration appears after 6-12 hours and after 20 hours the colic distension is complete.

The hydrostatic test is relevant only if putrefaction is absent and the lungs are completely aerated.

The sero-sanguin bossa resorbs in approximately 24 hours but its presence can indicate a survival period of maximum 10 days. The cephal-haematoma requires a resorption period of 3-4 weeks.

The Botallo interatrial duct closes in two weeks and the arterial duct in four weeks.

THE NEWBORN; CAUSES OF DEATH

1. The natural, pathological death

Stillbirth is defined differently from country to country. According to the British definition, stillbirth is the birth of a foetus with intra-uterine age of over 28 weeks, which after complete extrusion of its body from that of its mother does not breathe and does not present any of the signs of life (scream, movements, pulsations of the umbilical cord)

The pathological causes of foetal death are various and sometimes hard to identify. The most frequent are: prematurity, foetal hypoxia, placenta failure, intrauterine infections (often viral), congenital defects (mostly cardio-vascular or nervous).

a. The ante-partum death of the foetus **can have maternal, paternal or foetal causes. Infectious, cardio-vascular, hepatic and renal diseases, pregnancy disorders and eclampsia are most frequent.**

The foetal disorders that can lead to death are: malformations, placenta anomalies etc.

After intrauterine death, the foetus is rarely expelled, and usually retained in the uterus. The maceration is a clear indication that the dead foetus was retained in utero days before birth. The macerated skin is rose-brownish or reddish, desquamated, wrinkled; the other tissues are translucent, the cranial sutures are frequently superposed, with consequent head shrinkage.

b. The intra-partum pathological death of the foetus **can be determined by various labour-related factors, and by adaptation disorders from the haemo-trophic to the lacto-trophic life.**

A disproportion between the volume of the foetus and the size of the mother's pelvic area, a pelvic malformation, hydrocephaly, uterine atony with prolonged labour are all causes of intra-partum deaths.

Umbilical cord circular can determine lethal cervical compression. There are also situations in which foetal breathing can onset intra-partum, sometimes even intra-uterine, followed by the asphyxia with liquor amnii.

c. The post-partum pathological death of the foetus **onsets in the period of accommodation to the external environment, various, potentially lethal, pathological phenomena can superpose on the background of specific physiological processes.**

Congenital pneumopathy debuts intra-uterine and manifests in the first 24 post-partum hours. It is characterised by its peri-vascular or peri-bronchial location.

Aspiration pneumonias usually onset during labour as consequences of liquor amnii aspiration. The physiological atelectasis of the newborn is a favouring factor. Microscopy shows elements of liquor amnii in the alveoli and hyaline membranes in the alveolar ducts.

Hyaline membrane disease is frequent in premature newborns, with alveolar surfactant failure as the major atelectatic factor. The hyaline membranes are considered a vital sign because they are proof for the presence of breathing that represents the basis for their onset.

2. The violent death of the newborn

During the intra-uterine period **death can be due to a major abdominal traumatism of the mother, with consequent foetal hypoxia and death**

The intra-partum violent death **can occur during births that take place at home, self-assisted or with unqualified assistance.**

Abrasions on the neck of the foetus can be signs of unqualified assistance but most frequently, they are produced with the mother's nails in an attempt to control labour by tractions by the neck. No signs of strangulation are present.

Self-assisted labour can be proven by the existence of specific, potentially lethal injuries, like the bi-parietal angular fracture.

These fractures are almost symmetrical, situated on each parietal bone, each forming an angle with median opening.

They are the consequence of parietal compression on the pubic symphysis during the traction of the foetus.

Suffocation is very difficult to prove because there is rarely any persistent sign, and the petechiae and cyanosis are practically never discovered in a newborn killed by asphyxia.

In the post-partum period, **violent newborn death can be unintentional (accidental), or intentional (neonaticide or homicide).**

The accidental death **can be the result of precipitated expulsion, when the foetus can hit various rough objects, with consequent lethal cranio cerebral trauma.**

The diagnosis of precipitated labour requires:

- multiple births and large pelvis

- small foetus,

- cranial presentation

- simultaneous expulsion of placenta and ruptured umbilical cord

- the absence of maternal perinea ruptures and of the foetal sero-sanguin bossa.

The intentional death **of the newborn can occur by action (violent acts against the newborn) or by omission (intentional lack of post-partum care).**

a. *Violent death due to active injuries*

Active neonaticide is various but the most frequent forms are the result of:

- mechanical asphyxia

- lethal wounds

- cranio-cerebral trauma.

Mechanical asphyxia

Hand suffocation or smothering with various foreign objects are frequent. The asphyxia is due to the external obstruction of the air passages, obstruction by forceful introduction of a foreign object in the air passages or burial alive.

Manual suffocation can leave bruises and abrasions around the mouth and nose, but if soft fabrics or plastic bags are used, external injuries are usually absent. Burial alive is a typical method of neonaticide. Extraneous material can be found in the air passages (dirt, mud, sand).

Toraco-abdominal compression is rare; the thoracic expansion is stopped by exercising pressure (with the mother's body) on the body of the newborn.

Hand strangulation is rare and often combined with smothering. The injury pattern is represented by crescentic abrasions and oval bruises produces by the nails and the fingers, respectively. Their location is mostly on the lateral cervical area.

Minute dissection reveals profound injuries – muscular, peri-vascular, peri-laryngeal, pre-vertebral blood infiltrates, but also bony and cartilaginous injuries (hyoid and laryngeal cartilage fractures).

Ligature strangulation produces a cervical strangulation mark (groove), with depth depending on the nature of the ligature and the exercised force.

Lethal injuries with tegument discontinuities

These injuries can be lacerations or wounds inflicted with sharp objects.

They are usually accompanied by subcutaneous haemorrhagic suffusions, intramuscular haematomas, muscular wounds, bony and visceral lesions.

Visceral wounds are especially severe and most often associated with corresponding external injuries.

Stabbing agents (needles, knitting needles) leave small, sometimes undetectable external marks, while cutting-stabbing agents leave larger external injuries; both can be profound, producing severe internal damage.

The cranio-cerebral traumatism

Most frequently, neonaticide injuries are skull fractures. They can be the result of direct blows, projection against rough surfaces or precipitation.

The direct blow produces bipolar, comminuted fractures: in the area of direct impact and in the area where a rough plane supports the head.

The projection produces unilateral, comminuted fractures.

Precipitation on the head induces an impact fracture centre, from which multiple fracture lines leave and divide the skull in fragments.

b. The violent death due to omission

A newborn can die shortly after birth if deprived of appropriate care.

The necessary measures are: cord legation, feeding and protection against low temperatures (heating).

Omission to provide these measures or the deliberate neglect also refers to the aspiration of mucus and other inhaled extraneous materials from the air passages.

Obstetrical practice shows that newborns cool with approximately 10 degrees Celsius per minute, so the only chance of survival for the premature newborn is to be immediately placed in the incubator, at 34 degrees Celsius.

The necessary daily liquid supply is of roughly 60-80 ml water/kg.

A sign of dehydration is the urine increased density (Derobert). The most common appearance of a neglected newborn includes:

- bloodstains on the body

- vernix caseosa in the plicae

- ruptured, not legated umbilical cord

- nudity or ill-clothing

- lack of food in the stomach in the second day of life.

In some cases the cadaver can be dirty, with attached placenta, and wrapped in newspapers, rugs etc.

THE METHODOLOGY OF FORENSIC EXPERTISE IN NEONATICIDE

Neonaticide cases require a thorough examination of the crime scene, followed by a complete autopsy of the newborn body and multiple blood and tissue sampling for laboratory examination. The histopatologic examination of lung fragments is of capital importance. In cases where the mother is identified, ulterior actions depend on the autopsy results that will draw the conclusion of live- or stillbirth.

The examination of the alleged neonaticide mother follows two main directions: to establish the state of confinement (childbirth) and to appreciate if her mental state (the existence and the level of discernment) in the moment when she killed her baby.

The childbirth condition can be proven by: the size of the uterus and the cervix, the presence of lochia, the aspect of the breasts, the presence of colostrum and eventual perineal ruptures.

Establishing the discernment of the neonaticide mother can be a difficult task, which is usually performed by the forensic psychiatry commission. The commission is called to examine if, in the moment of committing the criminal actions (discernment present), the woman was under the influence of the psychological changes determined by the strain of childbirth (diminished discernment).

There are situations in which pre-existing psychiatric disorders exonerate the mother from all criminal charges (abolished discernment).

Pregnancy and abortion

The early diagnosis of pregnancy

- The diagnosis of recent pregnancy, in the debut period, is sometimes difficult.
- The clinical signs for the first trimester can include: larger and sore breasts, changes of the areola, amenorrhoea, frequent micturitions, nausea, leucorrhoea, decreased consistency of the cervix and the prominence of the uterus, combined with abdominal pressure (Hegar sign). Another sign is a plateau temperature under 37^0C, for 8 days, with an 8-10 days delay of the period.
- The vulvar and vaginal mucous membrane can be cyanotic, oedematous. The state of the uterus, cervix, isthmus and uterine body rarely give clear indications of pregnancy in the first trimester. The absence of the glera and the blue-reddish discoloration of the cervix may be considered relevant. In case of uterine retroversion, the examination is irrelevant.
- In difficult cases, with doubtful clinical signs, the positive diagnosis of pregnancy can be offered by biological investigations. The methods are relatively simple and precise. Pregnancy test kits are widely available. The determinations are based on the presence of ovarian hormones or other specific substances in blood or urine.

Pregnancy and abortion

The belated diagnosis of pregnancy

- During the evolution of pregnancy, the diagnosis becomes obvious due to the increased volume of the abdomen, the onset of active foetal movements towards the fourth month, and the auscultation of the foetal heart beats.
- In more advanced pregnancies, the size of the uterus can be determined in the supra-pubic area, the foetus can be palpated at approximately 16 weeks and after 24 weeks the foetal parts can also be palpated; the foetal heart beats and movements can be seen during the echogram.
- The clinical examination must appreciate the height of the uterus, the vertical or longitudinal presentation, the position of the foetal head, its engagement, the number of foetuses etc. In difficult cases the forensic specialist can request an echogram examination, hormonal determinations, vaginal smears analyses, in order to obtain information regarding the hormonal balance and even its age. Sometimes it is necessary to demonstrate the presence of a recent or older birth.
- After a recent birth (first 14 days), the vulvar and vaginal mucous membrane is blue-reddish, oedematous, the vaginal introitus is dilated and lax; sometimes perineal lesions or an episiotomy can be present. The uterus remains palpable above the pubic symphysis two weeks after birth. The vaginal secretion (lochia) is reddish for a few days and it becomes brownish and yellowish after one week.
- The persistence of the breasts changes depends on the presence of mother milk and breast-feeding; in the first period breasts are swollen, tensioned, with visible superficial veins. Milk appears in the second or third day and the areola is darker. The abdominal striae gravidarum are initially pink and later become paler then the neighbouring skin. The cervix remains dilated and soft for a while, sometimes with decreased secretion.
- The diagnosis of old pregnancy (two weeks after birth) is based on some important elements: The striae gravidarum are whitish, the perineal lesions are scared and the external orifice of the cervix is a narrow, transversal, sometimes irregular slit. The sanguinolent lochia can still be present and the milk secretion maintains without breast-feeding until the seventh week.
- After months or years the abdominal striae become whitish scars (lineae albicantes).The breasts become smaller but the darker discoloration of the areolae can persist, especially in women with darker skin. A dark, vertical line between the centre of the lower abdomen and mons pubis can persist. The cervical ruptures heal, leaving scars and the hymeneal fragments disappear or persist as small prominent formations (carunculae myrtiformes); in some cases the rugose aspect of the vaginal walls disappears.

Pregnancy and abortion

The diagnosis of intrauterine foetal death

- The 3-4 months old foetus mummifies if retained a longer period of time; it is often covered with a pasty, brownish deposit.
- Older foetuses, with already constituted epidermis, undergo processed of maceration and desquamation; blisters with serous-haematic liquid will leave reddish skin areas. The cranial bones are disarticulated, dislocated. Maceration progresses in a certain order that allows the estimation of the retention period.
- The foetal annexes are also involved in these processes. The placenta is thick, heavy, oedematous. Its villi can undergo a process of fatty degeneracy. The membranes are brownish or greyish, friable, especially along their length. The umbilical cord is infiltrated, soft, dry or oedematous, intensely coloured by haemoglobin.
- The amniotic liquid is present in small quantities. Its aspect varies with the duration of the retention: at first it is greenish, meconium-like and later it becomes pinkish. In long-term retentions the liquid is scarce, thick, dense and brownish.
- After 30 days the foetal remains form a gelatinous mass of soft tissue and infiltrates. The bones and joints are completely disjointed and the foetus is extremely friable. All these changes are aseptic.
- The septic birth of a dead foetus is rare because the premature rupture of the membranes is also rare and when it takes place it usually triggers labour.

Pregnancy and abortion

The diagnosis of intrauterine foetal death

- The signs of foetal death are the arrest of foetal growth and the increase of the uterine volume, the disappearance of foetal signs if they were already present (active movements, heart beats), the decrease of the general signs of pregnancy (vomiting, varicose veins etc).
- The onset of lactation, similar to the postpartum one, usually signifies the suppression of the placental activity. Still, this sign is not constant because sometimes the placenta can continue its activity after the death of the foetus.
- Laboratory tests can show a decrease of gonadotropines and sexual hormones levels, but there are no precise limits between the live and dead foetus. The prolan dosage is more useful then the determination of foliculine or pregnandyol levels, because they can also decrease during menstruations.
- The radiological examination can show the superposition of the skull bones, 10-15 days after the death of the foetus. Foetal ECG and echogram are extremely useful for the positive diagnosis of intrauterine foetal death.
- When the ebrio dies at small age, it is resorbed and the remaining fragments are expulsed.
- After 10-12 retention days the foetus has a characteristic aspect of "sanguinolent foetus". The epidermis is completely detached, rendering large dermal, light-reddish areas visible. The cranial bones are completely dislocated, considerably superposed, they lack normal consistency and at palpation the sensation is of "wall-nuts bag".
- In this stage, the foetal transformation is dominated by haemolysis. The released haemoglobin gives the reddish discoloration of the derma. The serous membranes are also reddish. The abdomen is enlarged and the pleural and pericardic cavities are filled with abundant liquid. The visceral changes are significant; the eyes undergo some specific haemolytic changes: the cornea (day 8) and then the lens (day 12) become reddish, while the whole eye becomes soft.

Pregnancy and abortion

The sudden death during pregnancy or labour

- The exhaustion of the mother's body and especially of the cardio-vascular system during pregnancy and moreover during labour can determine the onset of maternal sudden death, even more so in the presence of pre-existing pathological entities.
- The most important triggering or favouring cause of sudden death is eclampsia. Death can onset due to toxaemia, hypertension, meningo-cerebral oedema or haemorrhage. One of the complications of eclampsia is the eclamptic liver rupture, secondary to the haemorrhagic necrosis of the hepatic parenchyma, followed by rapid death.
- Another cause of sudden maternal death is represented by the intense uterine contractions during labour; provoked by oxytocic hormones, they can be associated with renal vascular constriction, intense ischemia and renal cortical necrosis.
- Some sanguine dyscrasia (Werlhoff disease) can worsen during pregnancy or labour, thus becoming favouring factors; for example, in spontaneous abortions they can determine massive, lethal haemorrhage.
- Placenta acreta can contribute to the onset of intra- or post-partum sudden death, either due to the haemorrhage it induces, or by favouring post-partum uterine rupture.
- The uterine rupture can also take place on a scared uterus, with previous caesarean section; the old, surgical scar can open, with consequent sudden death.
- Surgical interventions during labour can be accompanied by fatal air embolisms; they can also occur in placenta praevia cases, even in the absence of a surgical procedure.
- During strenuous labour, with premature placental detachment, liquor amnii emboli can develop. They represent one of the most common causes of obstetrical sudden death, occurred intra-partum or early post-partum.

Pregnancy and abortion

THE OBJECTIVES OF THE FORENSIC EXPERTISE IN PREGNANCY-RELATED CASES

- The most important problems that the forensic expert is requested to answer to are:
- *The date of the fecundating sexual act* – The date of the last ovulation is very important, also the date of the last menstruation, the duration of a menstrual cycle and the beginning of the amenorrhoea. The vaginal smears have certain particularities: the prominence of the superficial cells, an acidity index of 70% and a pycnotic index of 90%. Other useful determinations and findings are: The presence or absence of the inter-menstrual syndrome signs, the crystallisation of the cervical secretion, the temperature, hormonal levels, the bio-chemical and dynamic exploration of the corpus luteus.
- *The diagnosis of pregnancy* – the above-mentioned clinical and biological findings will be taken in consideration;
- *The diagnosis of the age of the foetus* (the duration of the pregnancy);
- *The differential diagnosis with:* various abdominal illnesses (tumours) and the simulated pregnancy.

ABORTION

GENERAL NOTIONS, CLASSIFICATION

- The interruption of pregnancy in the first 28 weeks is considered "abortion". Abortion in the first 20 days after the conception, when the product is not even an embryo, is considered "ovular abortion"; in the first three months of pregnancy the abortion is called "embryonic" and after three months it is called "foetal". Another classification divides abortion in: spontaneous (natural, pathological) and provoked (at request, therapeutic, illegal) abortion.
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THE SPONTANEOUS (NATURAL, PATHOLOGICAL) ABORTION

1. The maternal factors

- The maternal factors can be general or local.
- An important general factor is represented by the hormonal disorders secondary to the underdeveloped corpus luteus.
- Some substances can have direct toxic effects on the embryo, after crossing the placental barrier, or indirect effects dictated by the influences on the pituitary oxytocin centre, with secondary uterine contractions and the expulsion of the foetus.
- Another important factor is the Rh; the Rh incompatibility leads to foetal erythroblastosis, followed by intra-uterine death or premature birth.
- Infectious diseases in the acute phase can determine uterine contractions.
- Various genital disorders can play abortive roles. Purulent salpingitis can determine decidua infections, followed by necrosis. Other infections can follow the vaginal path (gonorrhoea); they affect the utero-annexial area or can travel through the blood circulation and determine remote infections (pulmonary); the result is the alteration of the materno-foetal circulation followed by the death of the embryo.
- The acute and chronic renal disorders (nephrites) and decompensate cardiac disorders can determine circulatory stagnation, with secondary maternal and/or foetal anoxia and the arrest of the foetal development.

- The excessive, acute or chronic, use of alcohol and tobacco can play favouring roles in triggering pathological abortions.
- Some women present a particular predisposition for abortion at the slightest physical, mental or chemical trauma.
- Local maternal factors are various. Some particular morphological types of pelvis or genital organs predispose to spontaneous abortion (uterine hypoplasia, malformed uterus, uterine fibromas prominent in the uterine cavity, the rigid, myomatous or fibromatous uterus, the total retro-flexion, uterine scars, endometrites, salpingites, polypous cervical tumours and the "cervical incontinence").
- Multiple curettages for the interruption of previous pregnancies can predispose to abortion. Large ovarian tumours, periuterine adherences and the prolapse can also cause spontaneous abortion.
- Although it is often incriminated as cause of abortion, the abdominal trauma can hardly be admitted in the first part of the pregnancy because the uterus is situated in the depth of the abdominal cavity and it is well protected by the intestines and the abdominal wall. An intense traumatism directed on the uterus can stop the evolution of pregnancy during the last trimester.

2. The ovular factors

- Radiations determine severe malformations of the embryo. In other cases, the placental villi can undergo certain transformations into fleshy, sanguine or vesicular moles. The aetiology of spontaneous abortion also includes placental infarctions, circulatory or growth disorders of the placenta, the early maturation of the placenta with concomitant syncytial transformation, nidation disorders, the extra-amniotic or extra-chorionic placement of the foetus etc.

3. The paternal factors

- The paternal factors are rarely involved in the aetiology of spontaneous abortions. They are mostly represented by occupational intoxications (saturnims), chronic alcoholism, and tuberculosis. All these entities can have an important influence on the morphology of the sperms and on their fecundation capacity.

THE PROVOKED ABORTION

1. Abortion on request

- Nowadays many countries have laws that refer to the legal interruption of pregnancy at the request of the pregnant woman. In other countries, special conditions are necessary for the abortion to be legal; the limits and the severity of these conditions vary within large limits.

2. Therapeutic abortion

- The therapeutic abortion is usually performed in the first three months of pregnancy and exceptionally in the first six, when the foetus is still not viable. This type of abortion applies in cases when the pregnancy or the birth (the labour) endangers the life of the mother or when one of the parents has a disease that would severely affect the offspring. If the pregnancy is the result of incest or rape, it can be recommended for therapeutic termination.

3. The illegal abortion

- In general terms, this notion defines the deliberate termination of pregnancy, outside the limits stipulated by the law. In most countries this is a serious and severely punished crime.
- The illegal abortions can be provoked by the mother or by another person (physician, midwife, nurse or other persons with no medical background). Almost all illegal abortions are performed in the second or third month of pregnancy, when the woman is certain about the absence of the menstruations and the morning sickness confirm the pregnancy.

Illegal abortive methods

- The habitual methods of illegal abortion differ from one country to another and range from "magical" remedies to sophisticated clinical methods. Some of the used drugs and toxic substances are not very efficient. Most illegal abortions are practiced in the early period of pregnancy, when the uterine effects of some specific drugs are absent because the organ is still small and not dilated.
- The most frequently used are the substances that stimulate the menstrual flow. The use of apiol or parsley essence in high doses can determine severe hepato-nephrites. Rue, a plant with yellow flowers, and the absinth are used as leaves concoction. Some coniferae (thuya) can determine gastro-intestinal disorders and convulsive manifestations. Claviceps purpureea has excitant effects on the uterine muscular fibbers and it is also used as a medicine (ergotine) in obstetrics; it can also lead to the tetanisation of the uterus and to general convulsive phenomena.
- Other vegetal mixes contain juniper, mint, rue, aloe, etc. Most of these substances have low effects on the pregnant uterus. Other substance with better chances of success because they induce uterine contracture, are rarely used in the practice of illegal abortion (lead, hypophyisis extract, quinine and prostaglandines)
- Hormones, especially estrogens, have the reputation of reinstalling the menstruation in pregnant women and that they lead to the termination of pregnancy, but the administration of high doses lead to no conclusive result.
- Indirect abortive manoeuvres on the pregnant uterus, although very popular in the past, have lately been abandoned, because of their doubtful efficiency.
- Vaginal injections with very cold or very hot liquids seem to have some excitant effects on the uterine motility, especially when the pregnancy is advanced.
- Some traumatisms of the cervix, repeated sexual intercourse and the energetic massaging of the abdomen can theoretically provoke abortion. In rare situations, intense violent incidents (hetero- or self-provoked) that include abdominal traumatisms can be encountered as abortive methods.
- Other well-known methods are hot baths, vaginal lavages with various substances, intensive physical exercise (jumping), horse-back riding or rough-country cycling.

The foetus is a very resistant symbiont, so in many cases of violent maternal deaths, no changes of the foetus can be found (Knight).

The consequences of illegal abortive methods

1. The consequences of drugs and toxic substances

- Acute toxic nephrosis (quinine, cantharides, mercury dichloride, various iodine compounds etc)
- Renal alterations are frequently associated with hepatic ones. Mercuric salts block the SH groups of various enzymes and the result is the inhibition of the respiratory systems in the renal tissues, with consequent anoxia and the decrease of the tubular secretion.
- The acute renal failure is the result of high doses of substances with renal toxicity.

2. The consequences of mechanical manoeuvres

Local consequences

- *Haemorrhages*
- *Cervical and uterine lesions*
- *The local infection*

General consequences

- *Embolisms*
- *Septicaemia*
- *Sudden death in shock*

PROBLEMS OF THE FORENSIC EXPERTISE IN ABORTION

In cases of illegal abortion or suspicion of illegal abortion, with or without fatal outcome, the forensic expertise must clarify the following aspects:

- *The diagnosis of pregnancy;*
- *The age of the foetus;*
- *The diagnosis of termination of pregnancy;*
- *The type of abortion;*
- *The possibility of self-infliction;*
- *The abortive method used;*
- *The medical cause of maternal death:* haemorrhage, embolism, intoxication, infection etc.
- *The evaluation of the complications.*

Rape

Definition

- Rape is the most severe sexual offence, for which in some countries the punishment is still capital. Penal codes define rape as „a sexual intercourse with a female subject, using a form of constraint or taking advantage of her impossibility to defend herself or to express free will".
- From the medico-legal point of view, rape is defined as the sexual act that includes intercourse, with a woman, against her will. In the absence of intercourse, the crime is considered attempted rape. In this situation the hymen remains anatomically intact since the sexual intercourse can be consumed ante portas. Intercourse presumes the intromission of the penis, even if only between the labia, so the penetration can be incomplete and the hymeneal rupture can be irrelevant.
- If a certain degree of penile penetration cannot be proven, the accusation of sexual intercourse or rape cannot be sustained; the plead will be made for a lesser crime, like attempted rape or indecent assault. In some cases, if the man uses drugs or alcohol to determine the woman to engage in a sexual act, the deed is considered rape, because the foreign substances render the woman mentally and physically incapable of taking a conscious decision.

Rape

The anatomy of hymen

- The hymen is an epithelial membrane situated in the vaginal opening; its morphological structure insures the attribute of anatomical virginity.
- The hymen has: one margin inserted on the vaginal wall (the hymeneal base) and a free margin that surrounds the vaginal orifice; one internal (vaginal, superior) side and an external (vestibular, inferior) side. The hymeneal opening has various shapes and sizes; most frequently, its diameter is of 1-1.5 cm and its shape is almost round, when visualised by moderate labial extension. The width if the hymen is measured between the vaginal insertion and the free margin; it ranges between 2-3 mm and 1-1.5 cm. The structure of the hymen can be: epithelial, elastic, flesh-like, conjunctive, fibrous or tendinous.
- Shapes:
  - The *unperforated hymen*
  - The *septate hymen*
  - The *appendicular hymen*
  - The *carina hymen*
  - The *crescentic hymen* is the most typical type;
  - The *collar-like hymen;*
  - The *rudimental* hymen;
  - The *double hymen* is rare;
  - The *denticulate hymen*
  - The *lobate or lobulate hymen* is formed of several lobes of various sizes;
  - The *fimbriate or fringed hymen*
  - The *cribriform hymen*

Rape

The recent defloration can be proven especially by the presence of hymeneal ruptures. These hymeneal discontinuities are most frequently located in the inferior or/and lateral parts of the hymeneal collar. In some cases, especially young girls, rape-related ruptures also extend to the vaginal mucous membrane, often accompanied by perineal ruptures. The margins of recent ruptures are reddish, rugged, with haemorrhagic aspect.

- In the evolution of hymeneal ruptures, the following macroscopically significant changes can be observed:
- 1-2- days – profound blood infiltration, especially in the floor of the rupture, near the insertion of the hymeneal base, sometimes with important bleeding. This aspect of haemorrhagic infiltration can be observed up to 3-4 days on the free margin and up to 6-7 days around the hymeneal base.
- 2-3 days – the margins of the rupture are still swelled, with occasionally abundant fibrin secretion, as a sign for the beginning of the scarring process;
- 6-7 days – acute traumatic lesions are reduced so the haemorrhagic infiltrates disappear; a certain degree of swelling may persist. The signs of recent deflowering gradually fade so after 7-8 days it is difficult to differentiate a recent from an old defloration macroscopically;
- 7-14 days –small sanguine infiltrates and inflammation on the margins of the rupture can still be observed only under stereoscope (10-14× magnifier);
- over 14 days – dating back the rupture becomes impossible.
- In evolution, the free margins of the rupture become rounded when the healing process begins (10-14 days); in complete ruptures, a fine rose-whitish line can appear, as the only sign of scarring. In general, the traumatic ruptures are asymmetrical while the natural ones (congenital) are symmetrical. In time, the ruptured lobes of the hymen atrophy and shrink, becoming small irregularities of various sizes, with mammillary aspect, called hymeneal caruncles.

Rape

The methodology of forensic expertise in sexual offences

The reality of sexual assault charges

- The forensic pathologist must take in consideration the possibility of false accusations, and to remain as impartial as possible. His decisions must only be based on objective elements of case history and findings during the complete medical examination.
- In order to interpret the results of the medical examination correctly, the forensic specialist must have clinical experience and knowledge of the normal aspect of the adult genital and anal area.

The phases of the examination

- The well-being and the health of the victim are always the most important; any required medical treatment will precede the forensic examination. Severely injured victims that require hospitalisation can undergo forensic examination only after emergency medical procedures and only with the approval of the physician.
- Prior to the examination, the consent of the victim has to be obtained. The consent must be given in full knowledge of the situation; the victim has to be informed that any evidence obtained in this manner can be used in court, exposed to publicity and cross-examining by the defence. In all cases, the intimate nature of the examination itself requires a fully conscious consent. The presence of a witness (third party) is strongly recommended; in fact, the presence of another woman is the best option, even if the examining physician is also a woman. The history of the case must cover the events that make the object of the complaint, but is should also cover information regarding menstruation, previous pregnancies and the recent involvement in sexual activities. Proves of recent, legitimate, sexual activity (especially semen) can be misinterpreted as proves for the sexual assault. The needed information can be collected according to the following scheme:

Rape

The methodology of forensic expertise in sexual offences

Information regarding the incident

- the date/period of time;
- the place: indoors/outdoors (weather: moist/dry);
- the number of assailants;
- drug/alcohol abuse – details;
- weapons/objects used as intimidation means;
- injuries on the victim (when and how they were inflicted, topography);
- injuries on the assailant (if the victim inflicted injuries in a defence attempt);
- the type and the number of sexual intercourses (use of condoms/lubricants);
- The approximate position during the sexual assault;
- body parts where traces of ejaculation, kissing, suction, licking or biting are found;
- vaginal or anal bleeding due to the assault/menstruation;
- the use of tampons.

Relevant information after the incident (for all recent cases)

- the traumatic mechanism of the injuries and the way the crime scene was left;
- if the victim changed/washed pieces of clothing;
- if the victim bathed or showered;
- if the victim washed, brushed or combed her hair;
- if the victim consumed alcohol or drugs;
- if the victim received medical treatment.

Rape

The methodology of forensic expertise in sexual offences

Relevant information related to accusations of oral intercourse

- if the victim washed her teeth or rinsed her mouth after the incident;
- if the victim ate or drank after the incident.

Relevant information regarding the vaginal intercourse

- consented vaginal intercourse;
- use of contraceptive methods (condom);
- use of lubricants;
- vaginal lavage;
- vaginal haemorrhage/pain

Relevant information regarding the anal intercourse

- consented or not consented anal and/or vaginal intercourse;
- use of protective measures (condoms)
- use of lubricants
- anal pain/haemorrhage
- defecation.

Rape

The methodology of forensic expertise in sexual offences

Preliminary aspects

- The victim must be allowed to dictate the pace of the examination and to be reassured that she can interrupt it at any time. The respect for the person's decency is also essential.
- The behaviour and mental state of the victim must also be observed during the whole examination process, because these information might be required in court. The use of alcohol or drugs may alter the victim's behaviour, so any proof of such abuses must be noted.
- An assessment of the state of the victim's clothing and jewellery (if worn during the incident) might also prove useful.

The physical examination

- The victim might not be aware of some injuries, so a thorough examination of the whole body is necessary, with sufficient light and eventually using a magnifier. The inspection must also cover hidden parts, like the retro-auricular area, the axilla, the breasts and orifices like the inner side of the lips, the mouth, and the external auditory meatus.
- Any significant or potentially significant injury has to be accurately described, indicating its type, location (in report with a fix bony area), shape, colour, degree of inflammation, size and signs of healing (if present). The injuries must also be palpated in order to detect indurations or in-depth extensions. The victim might also indicate areas of discomfort that lack external signs of trauma.
- The victim replaces her clothing with a special examination robe before any procedure starts. The examination has to start with areas remote to the genitalia, in order to gradually win the patient's trust and to perform a complete external examination. Often injuries located in other bodily parts then the genital area can offer better proves of struggle; in mature victims the genital injuries can be minimal or even absent.
- Bruises and abrasions on the neck, shoulders, breasts, arms, gluteal area, thighs and shanks can be relevant, especially if the victim is tied or pressed against a rugged surface. Bite marks on the neck, shoulders or breasts are significant but they can also be the result of voluntary sexual activities. The presence of blood, semen or other humours, fragments of vegetation or other extraneous material must be noted. If bite marks are evident, with tooth marks or suction petechiae, photographs need to be taken and, is possible, a forensic odontologist's opinion is requested.

Rape

The methodology of forensic expertise in sexual offences

The examination of the genital area

- The examination starts with the pubic hair; it has to be combed with a fine brush, because the presence of foreign hair can help identify the assailant. Traces of dry semen on the pubic hair or on the skin around it must be carefully collected for laboratory examination.
- The perineal inspection starts with the vulva, with sample collection with a tampon. After the careful retraction o the vaginal walls with a vaginal speculum, samples are also collected with a tampon from several parts of the vagina. The anus is examined and samples are taken from this area too. The anal and genital area must be thoroughly searched for erythema, erosions, abrasions, haematomas and even ruptures of the labia, anus, vaginal opening or vaginal walls. Intradermic nail abrasions or erosions, erythema or haematomas can also be found. Bruises and abrasions on the inner thighs can be the result of the attempts of forcible spreading the victim's lower limbs. Old ruptures and ruptures hymen rests must be interpreted in correlation with the victim's age, with the apparent duration of sexual experience and the number of pregnancies.
- Even among virgin hymens, there are large variations of size and aspect; after sexual contacts or giving birth the hymen atrophies and often disappears completely. In adult victims, the role of the hymen in confirming the sexual assault is very limited but if the victim was a virgin, the ruptured hymen can provide the main evidence of intercourse. More obvious proves, especially for the less experienced examiner, are recent the bleedings, ruptures or oedema. The examination method for the vagina differs with the examiner and the available medical equipment. The method also varies from a victim to another; the examination of the sexually active adult can be complete while for virgins or minors it can be limited.
- In all cases if the presence of liquid is observed in the vagina, it should be collected with a pipette or a small tampon and introduced in a recipient. Sperms can de identified from the vaginal after 24 or even 72 hours. The enzymatic and serological tests for semen (except for sperm identification) can be performed even after longer periods of time, both on samples collected from the vagina and from clothing.

Rape

The methodology of forensic expertise in sexual offences

- Depending on the particularities of each case, blood samples can also be taken for establishing the blood group, the alcohol blood level and eventually for DNA fingerprinting.
- Vaginal secretion can also be sampled for laboratory tests in case victim infestation with a sexually transmitted disease (STD) is presumed.
- If the victim scratched the assailant, she can have blood or skin samples under her nails; they must be carefully extracted and sent to the laboratories for the blood group or even the DNA profile that will be later compared with those of the suspects.

At the end of the examination, all collected samples (tampons, clothes, hair etc.) must be carefully labelled and sent to the forensic criminalistics or forensic bio-serology laboratories. Based on the examination of the victim and on all the scientific findings, the forensic pathologist can state:

- If the victim was a virgin or not;
- If the victim engaged in sexual intercourse in the distant past;
- If the victim engaged in sexual intercourse in the recent past;
- If the injuries suggest struggle or opposition;
- If injuries are present in the genital area, and if they are suggestive for a consented or a forcible sexual intercourse.

Rape

The examination of the alleged assailant

- Injuries and especially scratches on the assailant's face, neck or chest can be relevant. The examination of the genital area rarely offers valuable clues; non-specific injuries like local tenderness or erythema can be present. In exceptional cases, haematomas of the penile glans or prepuce can be found, or the penile fraenulum can be ruptured.
- The search for pieces of evidence is often more important then the inspection of the genital area. Samples of pubic, cephalic and facial hair must be collected. The pubic hair must also be combed in an attempt to find foreign hairs. Blood sampling for the blood group, the blood alcohol level and the DNA profile must be performed and notes are made concerning any STD signs.

The problems of the forensic examination in sexual assault cases

All the materials necessary for the examination of the victim and the alleged assailant must be provided by the forensic laboratories. Depending on the history of each case, the forensic pathologist will decide what samples must be collected during the examination. If the victim does not remember a certain incident or is reluctant to describe precisely what happened, sampling from all bodily orifice might be considered necessary, in order to avoid loosing important forensic evidence. In case oral intercourse (with or without ejaculation) is denounced, samples of saliva and buccal smears must be collected; sperms can persist in the mouth up to 36 hours, even after the ingestion of liquids. Samples have to be obtained from any bodily part that has been licked, kissed, bitten, sucked or ejaculated on. The physician must also gather all tampons used during or after the incident.