INFANT DEATH

Definitions:

Infanticide: It means unlawful killing of a child under the age of 1 year.

Foeticide: It means unlawful killing of a foetus at any time prior to birth.

Neonaticide: It is the deliberate killing of a child within 4 weeks of birth.

Filicide: It is the killing of a child by its parents.

Stillbirth

Definition: A stillborn child is one which is born after 28 weeks of pregnancy and which did not breathe or show any sign of life at any time after being completely born.

Features of stillbirth:

- The child was alive in uterus, but died during the process of delivery.
- Stillbirths are quite common in poor people, illegitimate and immaturesly delivered children.
- It is born in sterile condition, and putrefaction starts on the surface and extends inwards.
- On post-mortem examination, no abnormality is found in most of the cases.
- The lungs would be found dark red in colour and irrespirable but no signs of maceration are seen.
- Signs of prolonged labour (edema and bleeding into the scalp and severe moulding of the head) indicate stillbirth.

DEADBIRTH

Definition: A deadborn child is one which had died in utero and shows one of the following signs after it was completely born:

1. Maceration:
   - Maceration is a process of aseptic autolysis and occurs when dead child remains in the uterus for about 3-4 days surrounded by liquor amnii but air has not reached the uterus.
   - If air enters into liquor amnii due to rupture of membranes, the foetus goes into putrefaction rather than maceration.
• Due to maceration, the body of the foetus becomes soft, flaccid and a peculiar sweetish disagreeable smell is present.
• On histological examination, evidence of phagocytosis may be seen.
• The changes with time are described below:

<table>
<thead>
<tr>
<th>Time since death</th>
<th>Changes appear</th>
</tr>
</thead>
</table>
| 12 hours (earliest changes) | • Reddening and peeling of the skin,  
| | • Gas in aorta. |
| 24 hours | • Large blebs appear which may contain a red serous fluid.  
| | • Peeling of epidermis leaving greasy and moist areas.  
| | • Tissues are oedematous.  
| | • The abdomen is distended. |
| 48 hours | • The serous cavities contain a red turbid fluid.  
| | • All viscera become soft and oedematous and lose their morphology, **but lungs and uterus remain unchanged for a long time.**  
| | • Umbilical cord is red, smooth, soft and thickened. |
| Spalding’s sign (few days to 2-3 weeks) | • Bones are flexible and readily detached from the soft parts.  
| | • Joints become abnormally mobile.  
| | • Skull bones are separated.  
| | • Collapse of the vertebral column occurs. |

Due to shrinkage of the cerebrum after death of foetus, there are:  
• Loss of alignment and  
• Overriding of the bones of cranial vault.  
• It develops earlier in a vertex presentation.

2. **Mummification:**  
• This is sometimes seen in conditions where the foetus dies due to deficient supply of blood from uterine vessels and liquor amnii is dried up.  
• Air has not entered the uterus in such cases.

3. **Rigor mortis at delivery.**

**VIABILITY OF THE INFANT**

**Viability:**  
It means the physical ability of a foetus **to lead a separate existence** apart from its mother after birth, **by virtue of a certain degree of development.**  
A child is viable after 210 days of intrauterine life.
Livebirth:

According to Indian law, livebirth means that the child showed signs of life, when only a part of the child was out of the mother, though the child may not have breathed or completely born. The causing of death of such a child is regarded as murder.

**SIGNS OF LIVEBIRTH**

- *In civil cases, any sign of life after complete birth of the child is accepted as proof of livebirth.*
  
  Ex.: The cry of the baby is considered as the sign of live birth but in some cases, the child may cry even while he is in uterus or vagina but dies when completely born.

- *In criminal cases, signs of livebirth have to be demonstrated by post-mortem examination of the child.*

The most important criteria that doctor has to establish is whether respiration has taken place or not. To determine this, the following criteria should be taken into consideration:

<table>
<thead>
<tr>
<th>Trait</th>
<th>Before respiration</th>
<th>After respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape of the chest</td>
<td>Flat.</td>
<td>Arched/ drum shaped.</td>
</tr>
<tr>
<td>Position of the Diaphragm</td>
<td>At the level of 4&lt;sup&gt;th&lt;/sup&gt; / 5&lt;sup&gt;th&lt;/sup&gt; rib.</td>
<td>At the level of 6&lt;sup&gt;th&lt;/sup&gt; / 7&lt;sup&gt;th&lt;/sup&gt; rib.</td>
</tr>
<tr>
<td>Lungs: Volume</td>
<td>Quite small.</td>
<td>Large, fill the chest.</td>
</tr>
<tr>
<td>Lungs: Margin</td>
<td>Sharp.</td>
<td>Rounded.</td>
</tr>
<tr>
<td>Lungs: Consistency</td>
<td>Dense, firm, non-crepitant, liver like.</td>
<td>Soft, elastic, spongy and crepitant.</td>
</tr>
<tr>
<td>Colour</td>
<td>Reddish brown.</td>
<td>Light red/ pink.</td>
</tr>
<tr>
<td>Cut section</td>
<td>Little frothless blood exudes on pressure.</td>
<td>Abundant frothy blood exudes on section.</td>
</tr>
<tr>
<td>Expansion of air sac</td>
<td>Not inflated, marked with shallow furrows.</td>
<td>Inflated, raised slightly above the surface.</td>
</tr>
<tr>
<td>Weight</td>
<td>1/70&lt;sup&gt;th&lt;/sup&gt; of the body weight. (30-40 gm)</td>
<td>1/35&lt;sup&gt;th&lt;/sup&gt; of the body weight (60-66 gm), due to air and inflow of pulmonary blood.</td>
</tr>
<tr>
<td>Floatation</td>
<td>Whole and parts sink in the water.</td>
<td>Expanded areas or whole floats in the water.</td>
</tr>
</tbody>
</table>
HYDROSTATIC TEST
This is the most commonly done clinical test to know whether respiration has taken place or not. The specific gravity of the unrespired lung is >1 (1.04–1.05) while that of respired lung is <1 (0.94). Due to this fact, respired lung would float in water while unrespired lung would sink.

Procedure:
- First, both the lungs are removed along with trachea and larynx and are put in a glass vessel. It is to be noted whether they float or sink.
- Then they are separated and are individually tested whether they float or not.
- The lungs are cut into small pieces and are put to test for floatation.
- If these pieces float, they are squeezed between thumb and index finger in water to look for small air bubbles which come out.
- If the pieces continue to float and exude air, it means respiration has taken place.
- If some pieces sink and others float, it means feeble respiration has taken place.

False positive and false negative results:

False Negative Cases:
The lungs which have been expanded with air may sink due to following reasons:
1. Diseases like bronchopneumonia may cause lungs to become heavy as the air in the alveoli may be replaced with acute oedema or pus.
2. Diseases like atelectasis may cause nonentry of air into alveoli although air has entered into the respiratory column.
3. Due to feeble respiration, sometimes air may not be able to reach the alveoli, so the lungs are not expanded although the child has respired.

False Positive Cases:
The unexpanded lungs in these cases may float due to following reasons:
1. Putrefaction: Putrefactive gases may cause floatation of the lungs. Signs of putrefaction on the rest of body may also be seen.
2. Artificial respiration: If a child has not started taking respiration immediately, he is put on artificial respiration and air is made to enter
the lungs forcefully. This air, after entering alveoli, may cause floatation of lungs later on when the child is declared dead.

**When hydrostatic test is not needed?**

In the following conditions, there is no need to conduct a hydrostatic test:

1. When foetus is below 180 days of gestation.
2. When there are congenital malformations which make life impossible, like monster child.
3. Signs of intrauterine maceration seen.
4. The umbilical cord is separated and a scar formed.
5. Stomach has presence of food/ milk or water can be demonstrated in small intestine.

**Why proof of breathing is not proof of livebirth?**

Because the child may breathe:

1. When it is in the uterus, if there is rupture of membrane. *(Vagitus Uterinus)*
2. When its head is in the vagina *(Vagitus vaginalis)*
3. When its head is protruding from the outlet.
4. In the newborn child, the respiration may not be strong/ deep enough as to expand the air cells.
5. Some air may pass into the alveolar cells, but it may not be sufficient enough as to distend the fibrous tissue.
6. The child may live for many hours or even days with only small of its lung tissues expanded.

*But one thing has to be noted that once the air cells are distended, they never return to the foetal state.*

**Determining the extent of respiration: Microscopic examination of lungs:**

- At full term, the foetal lung is almost *completely atelectatic*.
- But some of lung tissues are partly expanded by the amniotic fluid.
- *This partly expanded tissue is not stained by H & E stain (as the air expanded tissues do).*
- In a child, who has breathed, *diffuse atelectasis may be seen.*
- But if a child lived for only few minutes, microscopy can’t always provide clear evidence of extrauterine respiration.
- *If a child had struggled for breathing, it may result into:*
1. Incomplete lung expansion,
2. Cyanosis
3. Petechial hemorrhage
4. Oedema of mediastinum.

**CHANGES IN STOMACH AND SMALL INTESTINE**

- When respiration is established and the child begins to cry, a small amount of air enters into the **stomach** within **5–15 minutes** of birth.
- This small amount of air can be detected in the **small intestine** after **1–2 hours**.
- A portion of this air also passes into the **large intestine** after a gap of **5–6 hours**.
- The air in stomach, small intestine and large intestine can be demonstrated by **Breslau’s second life test**.
- Here the stomach and intestines are removed after tying double ligatures at each end. They float in water if respiration takes place. They sink if respiration doesn’t take place.
- Stomach shows **mucus, saliva and air** in case of respiration takes place, but **only mucus** if respiration doesn’t take place.
- **This test is useless if putrefaction has started or an effort has been made to give artificial respiration.**
- If water or food is detected in stomach or small intestine, it is proved that the child has lived for some time.

If born alive, how long did the child survive?

<table>
<thead>
<tr>
<th>Factors</th>
<th>Time</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in the skin</td>
<td>At first</td>
<td>Bright red</td>
</tr>
<tr>
<td></td>
<td>1\textsuperscript{st}-2\textsuperscript{nd} day</td>
<td>Vernix caseosa covers the skin, axilla, inguinal region, neck, buttock.</td>
</tr>
<tr>
<td></td>
<td>2\textsuperscript{nd}-3\textsuperscript{rd} day</td>
<td>Brick red/yellow.</td>
</tr>
<tr>
<td></td>
<td>1 week</td>
<td>Normal.</td>
</tr>
<tr>
<td>Caput succedaneum*</td>
<td>At the time of birth</td>
<td>Prominent.</td>
</tr>
<tr>
<td></td>
<td>1\textsuperscript{st}-3\textsuperscript{rd} day</td>
<td>Disappears.</td>
</tr>
<tr>
<td>Umbilical cord</td>
<td>At the time of birth</td>
<td>Umbilical cord is cut.</td>
</tr>
<tr>
<td></td>
<td>2 hours</td>
<td>Clotting at cut end stops.</td>
</tr>
<tr>
<td></td>
<td>12-24 hours</td>
<td>Cord starts drying.</td>
</tr>
<tr>
<td></td>
<td>36-48 hours</td>
<td>An inflammatory ring forms at its base.</td>
</tr>
<tr>
<td></td>
<td>3-4 days</td>
<td>It starts falling off.</td>
</tr>
</tbody>
</table>
5-6 days  It finally falls off leaving an ulcer.
10-12 days  Healing of ulcer and scar formation.
Before birth  In severe anoxia and breech presentation.
1-2 days after birth  It is completely excreted from the large intestine.
10 hours  Contraction of umbilical artery starts.
3rd day  Umbilical arteries are closed.
4th day  Umbilical veins and ductus venosus are closed.
10th day  Ductus arteriosus is closed.
3rd month  Foramen ovale is closed.
24 hours  Nucleated RBCs disappear from circulation.
3rd month  Foetal Hb is decreased to 7-8% from 80-90%.

*It is an area of soft swelling that **forms in the scalp over the presenting part of head in vertex presentation.** The scalp in this area is swollen 3-4 times due to congestion and oedema due to interference of venous blood flow produced by the rigid cervical ring.

**It is the earliest stool of an infant.** It is composed of materials ingested during the time infant spends in the uterus; i.e. intestinal epithelial cells, mucus, amniotic fluid, bile, water and lanugo (hair). It contains 2 types of bacteria: lactobacillus and enteric bacteria. It is green and acidic in nature.

**Cephal-haematoma:**
- It is a localized collection of blood deep to the scalp, **between the periosteum and bone surface.**
- **It is usually limited to the periosteal sheath of a single bone, commonly involving the right parietal bone.**
- It is rare, occurring <1% of newborns.
- It increases in size in 1-2 days as more blood accumulates, but gradually shrinks in subsequent weeks.

**CAUSES OF DEATH**
The cause of death could be natural, accidental, or homicidal.

1. **Natural Causes**

The following are the natural causes:
(a) **Immaturity:** It is one of the commonest reasons where child is born before full gestation.
(b) **Congenital diseases:** Death could be due to syphilis or plague.
(c) **Malformations**: Monster child like acephalous or anacephalus may not survive longer.

(d) **Haemorrhage**: Haemorrhage occurring due to *placenta previa* or any other reason from uterus, umbilical cord or vagina can cause death of foetus or mother.

(e) **Rh incompatibility**: This is also one of the reasons for death.

2. **Accidental Causes**

Accidental death of the child can occur during birth or after that. During birth, death may occur due to:

(a) **Prolonged labour**

(b) **Prolapse of cord**

(c) **Strangulation** due to knots around the neck by umbilical cord.

(d) **Inadequate pelvis**: Pelvis size may be smaller, or the child is bigger.

(e) **Injuries**: Heavy *blows on the abdomen* of a pregnant woman can cause death of foetus. In such cases, the woman may start bleeding immediately after the blows. Child may get injured while coming out of pelvis. Child may get injuries sometimes, *if delivered by forceps.*

(f) **Death of mother**: If mother dies accidentally during labour or otherwise, child in the uterus would die if not taken out immediately. The child may die after birth because of following reasons:

a) **Suffocation**: The child may die of suffocation if respiratory passages are not clear due to presence of blood, meconium or liquor amnii. *Suction should be initiated immediately to save the child.* A child may also die of suffocation, if he/she is wrapped closely in clothes.

b) **Precipitate labour**: In this, a *child is born without the mother’s knowledge* and child may fall on ground or lavatory pan and may get injuries. Such labour is possible in a *multiparous woman with a roomy pelvis,* or if the child is quite small and can come out without effort. It is not common.

3. **Homicidal causes**

The child may die because of:

1. **Act of Commission**: When wilful mechanical violence is used to kill the child or the child is poisoned.

2. **Act of Omission**: It is due to neglect of the child.
ACT OF COMMISSION

(a) **Suffocation**: On birth, the child is killed by applying pressure by a pillow or soft tissue or introducing *foreign body in the respiratory passage*. The child may also die if the mother overlays intentionally over the child. The child may also be suffocated while applying pressure on chest.

(b) **Strangulation**: It is also a common method of killing a small child. A ligature like pyjama, tape or any cord may be used. Sometimes, umbilical cord is used to strangulate, to mimic natural death. Child may well be throttled.

(c) **Drowning**: In some communities the child, especially a female child, is killed by plunging the face into milk so that milk is aspirated into respiratory passage causing death. This custom is called “*Dudh Pita Karna*.”

Sometimes, a live child may be thrown in a river or pond to kill him/her, or a child may be thrown into water often first killing him/her by strangulation or suffocation.

(d) **Mechanical violence**: The child may be killed by hitting her/his head with an object causing *fractures or head injury*. The fracture/dislocation of neck may be caused by forcibly rotating the head of the child. The child may also be killed by inflicting fatal injuries by sharp-edged weapon.

(f) **Poisoning**: A small child can easily be killed by giving poisons such as *opium*.

ACT OF OMISSION

Failure to take proper precautionary steps during child birth is act of omission. The following are some of the examples:

(a) **Omission to take proper medical care**. It is presumed that the woman who is going to deliver has contacted a medical practitioner or paramedical staff in advance to take care of her and her baby during delivery.

(b) **Omission to ligate the cord after the cord is cut**, otherwise haemorrhage may bleed the child to death.

(c) **Omission to remove child from the discharges** from mother and failure to remove the discharges present in respiratory passages by suction.

(d) Omission to protect from cold or heat of the *environment*.  

(e) Omission to provide proper *food and care* to the newborn child.
VARIOUS SYNDROMES: (1) BATTERED BABY/ CHILD ABUSE SYNDROME

A battered child is one who has received repetitive physical injuries as a result of non-accidental violence caused by a parent/ guardian.

Features:
1. **Age:** The age of the child is usually *less than 3 years.*
2. **Sex:** Slightly more in *males.*
3. **Family history:** These children usually come from problem families having multiple problems like:
   - Parental maladjustment,
   - Foster parents,
   - Alcoholism,
   - Lower socio-economic status of family etc.
4. **Position in family:** The child may be the *youngest/ eldest* among children. (coming from pregnancy before marriage/ failure of contraception respectively)
5. **Mother:** Usually the mother is pregnant/ in premenstrual phase in time of battering.
6. **Injuries seen:** They usually have multiple injuries of various durations *often progressing from minor to more severe.* It suggests that the child has been beaten many a times over a certain period of time. They may have multiple rib injuries, multiple bruises over various parts of the body.

(2) MUNCHAUSEN’S SYNDROME BY PROXY

**Munchausen’s syndrome** is feigning illness/ injury and going from hospital to hospital for unnecessary investigations and treatment. The person is aware that he is acting an illness, but he can’t stop that act.

**Munchausen’s syndrome by proxy** means the mother brings her child to doctors by producing induced signs and symptoms of an illness. The child is frequently admitted to hospital for non-existing conditions.

**Method of stimulation/ production of illnesses:**
1. The mother pricks her finger and adds blood to the urine of child and takes the sample to the doctor.
2. The mother gives insulin to her child and takes her to the hospital reporting hypoglycaemia.
3. A pillow/ towel is put over the face of child and face is pushed into bed.
4. Vomiting produced by Ipecac.
5. Diarrhoea produced by laxatives.
6. CNS depression produced by Barbiturates.
7. Rash produced by scratching.

(3) SUDDEN INFANT DEATH SYNDROME (COT/ CRIB DEATH)

It is defined as sudden and unexpected death of a healthy infant, whose cause of death remains unexplained even after a complete autopsy. It is one of the major natural causes of death in infants of first 6 months of life.

Features
1. **Incidence:** .06% of livebirths.
2. **Age:** Majority between 1-7 months, *with a peak at 2-3 months.*
3. **Sex:** Slightly increased for male.
4. **Twins:** There is 3 fold increased risk for twins.
5. **Time of death:** Death occurs during sleep with *a peak in early mornings.*
6. **Socio-economic status of family:** Usually low.

RELEVANT LAWS

1. **Section 317 of the I.P.C.** provides punishment for a maximum term of *seven years or fine, or both,* for any person who exposes a new born child to any place with the *intention of abandoning* it and death does not supervene. The offender would be punished for murder if death occurs.

2. **Section 318 of the I.P.C.** defines punishment for a maximum of *2 years* or fine or both in cases where the mother is *charged with concealment of birth* by secretly burying or otherwise disposing off the dead body of the newborn child.