The stages and physiology of normal labour

Definition of labour

1. Labour is defined as the onset of painful, regular contractions, more than one every ten minute, with progressive cervical effacement and dilatation accompanied by descent of the presenting part.

2. Another definition is the process by which the fetus is expelled from the uterus.

The physiology of labour

- The mechanism responsible for initiating human parturition is still unknown.
- Although much is understood about the physiology of labour in humans, the initiating biological event is still unclear.
- It is certainly true however that the uterine body and cervix undergo a number of changes in preparation for labour which start a number of weeks before its onset.
- The onset of labour occurs when those factors which inhibit contractions and maintain a closed cervix diminish and are succeeded by the actions of factors which do the opposite.
- Both mother and fetus make contribution to this.

The myometrium

- Myometrial cells contain filaments of actin and myosin, which are the two key proteins for contraction.
- The interaction of myosin and actin brings about contraction, while their separation brings about relaxation, under the influence of intracellular free calcium.
- An increase in intracellular free calcium brings about contraction. Prostaglandins and oxytocin increase intracellular free calcium (so they stimulate uterine contraction).
- Beta-adrenergic compounds and calcium channel blockers decrease intracellular calcium (they inhibit uterine contraction).
**The uterine segments:**
During labour the uterus may be divided into two functional segments.

1. **The upper segment (upper part of the uterus or body of the uterus)**
   - This contract strongly, and with each successive contraction the smooth muscle fibers become shorter and thicker,
   - This powerful segment draws the weaker, thinner and more passive lower part of the uterus up over it’s contents and so will pull up and then dilate the cervix.

2. **The lower uterine segment:**
   - This consist of the lower part of the body of the uterus and the cervix,
   - It can contract but is relatively passive compared with the upper segment.

**Uterine contraction and retraction**

**Retraction** is the progressive shortening of the uterine smooth muscle cells in the upper portion of the uterus as labour progresses.

- It is a major feature of uterine contractility during labour.
- After the cells contract they relax but they do not return to their original length.
- This result in the development of the thicker, active, contracting segment in the upper portion of the uterus.
- At the same time the lower segment of the uterus becomes thinner and more stretched.
- Eventually this results in the cervix being taken up into the lower segment of the uterus and forming a continuum with the upper uterine segment.
- This retraction has the advantage that with each contraction and retraction the uterine cavity becomes progressively smaller and the fetus pushed down
- if contraction was followed by complete relaxation no progress would happened
- In the third stage of labour after the placenta is expelled, retraction enables to close the blood sinuses at the placental bed and prevent excessive blood loss.
- The cervix effaces and then dilates and the fetus descends in response to this directional force.
- It is essential that the myocytes of the uterus contract together in a coordinated fashion.
- There is cell-to-cell communications by means of gap junctions, which facilitate the passage of electrical current between cells.
- These gap junctions are absent for most of the pregnancy but appear in significant numbers at term.
- These gap junctions increase in size and number with the progress of labour and allow greater coordination of myocyte activity.
- Prostaglandins stimulate their formation, while b- adrenergic compounds possibly do the opposite.
- A uterine pacemaker from which contractions originate probably does exist but has not been demonstrated histologically.
- In labour, the lower uterine segment, cervix, vagina, pelvic floor and vulval outlet are dilated until there is one continuous birth canal.
- Uterine contractions are involuntary in nature and there is relatively minimal extra-uterine neuronal control.
- The frequency of contractions may vary during labour and with parity.
- They occur at intervals of 2-4 minutes.
- Their duration also varies during labour, from 30-60 seconds or occasionally longer.

**The cervix:**
- The cervix contains muscle cells and fibroblasts separated by a ground substance made up of extracellular matrix molecules.
- Interaction between collagen, fibronectin and dermatin sulphate during the earlier stages of pregnancy keep the cervix closed.
- Contractions at this point do not bring about effacement and dilatation.
- Under the influence of prostaglandins there is certain changes in the cervix which brings about softening and effacement which happened near the onset of labour.

**Softening of the cervix occurs by:**

1. Destruction of collagen fibers.
2. A decrease in dermatine sulphate, which has strong affinity for collagen.
3. An increase in hyaluronic acid.

All these changes happened within the cervical tissues.

**Hormonal factors:**
- Progesterone maintain uterine quiescence by suppressing prostaglandin production, inhibiting communication between myometrial cells and preventing oxytocin release.
- Oestrogen opposes the action of progesterone.
- Prior to labour, there is a reduction in progesterone receptors and an increase in the concentration of oestrogen relative to the progesterone.
- Prostaglandin synthesis by the chorion and the decidua is enhanced, leading to an increase in calcium influx into the myometrial cells.
- This change in the hormonal milieu also increases gap junction formation between individual myometrial cells, creating a functional syncytium, which is necessary for coordinated uterine activity.
- The production of ACTH by the placenta increases in concentration towards term and potentiates the action of prostaglandins and oxytocin on myometrial contractility.
- The fetal pituitary secretes oxytocin and the fetal adrenal gland produces cortisol, which stimulates the conversion of progesterone to oestrogen.

Which of these hormonal steps initiates labour is unclear.

As labour becomes established, the output of oxytocin increases.

**The stages of labour**

Labour is divided into **three stages**.

**The first stage (stage of dilatation):**

From the onset of true labour until the cervix is fully dilated.

It is divided into **two phases**:

1. **The latent phase:**
   - Starts from onset of labour until the cervix reaches 3cm dilatation.
   - Lasts between 3-8 hours, shorter in multiparous women.
   - Contractions occurs at least twice every 10 minutes with each lasting > 20 seconds, not more than moderately strong and are quite well tolerated without analgesia.

2. **The active phase:**
   - From 3cm- full cervical dilatation (10cm), her the contractions becomes more frequent and stronger.
   - Contractions occurs 3 times every 10 minutes, with each lasting > 40 seconds.
   - The cervix should dilate at a rate of 1cm / hour or faster.
   - Last between 2-6 hours.

The duration of the 1st stage of labour in primipara patient range from 6-18 hours (average= 12 hours).

In multiparous women about 2-10 hours (average 5hours)-
The second stage: 
from full dilatation of the cervix until the fetus is born.

It is also divided into two phases:

1. The passive phase:
the time between full dilatation and the onset of involuntary expulsive contractions. There is no maternal urge to push and the fetal head is still relatively high in the pelvis.

2. The second phase is called the active phase, there is a maternal urge to push because the fetal head is low, causing a reflex need to bear down. Duration should last no longer than 2 hours in a primiparous and 1 hour in multiparous.

The third stage:
- from the birth of the fetus or fetuses until the placenta and membranes are delivered and the uterus has retracted firmly to compress the uterine blood sinuses.
- The placenta usually delivered within few minutes of the birth of the baby.
- A 3rd stage lasting more than 30 minutes considered abnormal.

Premonitory symptoms of labour:
1. Lightening:
In most primigravidae the presenting part sinks into the pelvis during the last 3-4 weeks of pregnancy which cause the uterine fundus to descend down and reduce the upper abdominal distension, making the woman more comfortable.

2. False pain:
Many women experience uterine contractions which are strong enough to cause pain, some days before labour starts. Such false pains differ from labour pain only in that they are less regular and are ineffective in dilating the cervix.

Symptoms and signs of labour
1. Painful uterine contractions.
2. Shortening and dilatation of the cervix.
3. Show
4. Rupture of membranes.
Loss of a show (a blood stained plug of mucus passed from the cervix). Or spontaneous rupture of membranes (SROM) does not define the onset of labour, although they may occur at any time.

**Uterine contractions:**
Throughout pregnancy there are painless irregular uterine contractions called *Braxton Hicks contractions.*

The contractions of labour characterized by:
1. Comes at regular interval.
2. Increase gradually in frequency, intensity and duration.

At the onset of labour the interval between contractions may be variable and can be as long as 20 minutes.

- Contractions are often preceded by backache and tend to increase in frequency and duration, becoming gradually more painful.
- Throughout the majority of labour they occur at intervals of 2-4 minutes.
- Their duration also varies during labour from 30-60 seconds.
- The intensity of uterine contractions is assessed by the amplitude of the intrauterine pressure generated with each contraction.
- In normal labour this intrauterine pressure averages between 30 and 60mmHg.
- The pain of labour has the same character as that of spasmodic dysmenorrhoea and the same cause which is *ischemia of the uterine muscles from compression of the blood vessels in the wall of the uterus.*
- The intermittent nature of the contractions is of great importance to both the fetus and the mother.
- During a contraction the circulation to the placental bed through the uterine wall is stopped.
- If the uterus contracted continuously the fetus would die from lack of oxygen.
- The interval between contractions allow the placental circulation to be re-established and
- Give the mother time to recover from the fatiguing effect of the contraction to avoid maternal exhaustion.
**Shortening and dilatation of the cervix:**
- At the beginning of labour the cervix of a nulliparous woman is thick-walled canal, of at least 2cm in length.
- When labour begins the contraction and retraction of the upper uterine segment stretches the lower uterine segment and the upper part of the cervix.
- As the internal os is pulled open, the cervix will dilate from above downwards, becoming shorter, until no projection into the vagina is felt but only a thick rim at the external os.
- So the whole cervix being taken up and its cavity made one with that of the body of the uterus.

**Evaluation of progress in labour:**
The progress in 1st stage of labour is evaluated by:
1. The rate of cervical effacement and dilatation.
2. The descent of the fetal head.

*The frequency and duration of uterine contractions alone is not an adequate measure of labour progress.*
- In the second stage of labour the cervix is fully dilated and progress is measured by the descent and rotation of the presenting part.