



Reproductive System Module

Session - 10 –Birth

Lecture 1: Parturition

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Objectives

- Define the stages of labour
 - Describe the processes necessary to create a birth canal and its clinical assessment
 - Describe the function and mechanisms of cervical ripening
 - Describe the properties of uterine smooth muscle which facilitate labour
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- Describe the normal physiological processes which initiate labour
 - Describe the immediate physiological changes in the neonate which enable independent life.
 - How to differentiate between true and false labour.

Parturition

Pregnancies end with the expulsion of the products of conception.

In humans, if this occurs after 24 weeks of gestation the process is called **labour**.

Before that time, it is commonly called spontaneous **abortion**.

The biological term for process of labour is **parturition**.

Labour that occurs **before the 37th week** of gestation is known as **premature or preterm labour**.

The expulsion of the fetus requires a number of processes:

1-The creation of a birth canal

- o The release of the structures which normally retain the fetus in utero
- o The enlargement and realignment of the cervix and vagina

2- Expulsion of the fetus

3- Expulsion of the placenta and changes :to minimize blood loss from the mother

These processes are known as the first, second, and third stages of labour

First Stage

•Creation of birth canal

Onset of labour → Full cervical dilation.

The onset of labour can be defined as regular contractions bringing about progressive cervical change.

It is divided into latent & active phases.

- Latent Phase :Onset of labour → ~4cm dilation (slow)
- Active Phase: ~4cm dilation → 10cm dilation (full dilatation)
(Faster rate of cervical change, 1-1.2cm/hour)
 - Regular uterine contractions

Second Stage

•Expulsion of fetus

- Relatively rapid
 - Up to 1-2 hour but can be very fast
- Urge to bear down

Third Stage

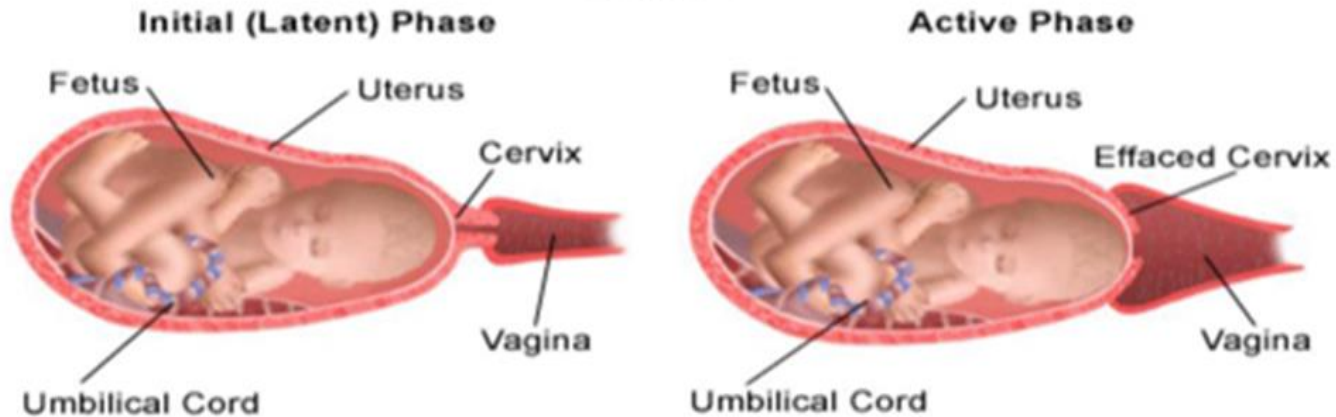
•Expulsion of placenta

- Expulsion of placenta :Sheared off by strong contractions of the uterus
- Contraction of uterus :Compresses blood vessels to reduce haemorrhage ,Lasts between 5 and 15 minutes.

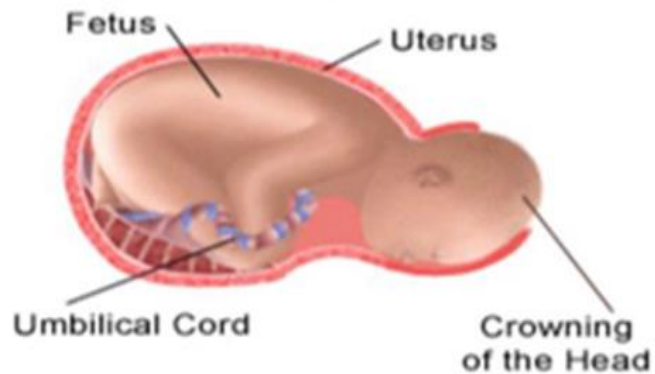
'Latent phase' is the time between the onset of regular painful contractions and 3-4 cm

'Active phase' and describes the time between the end of the latent phase (3-4 cm dilatation) and full cervical dilatation (10 cm)

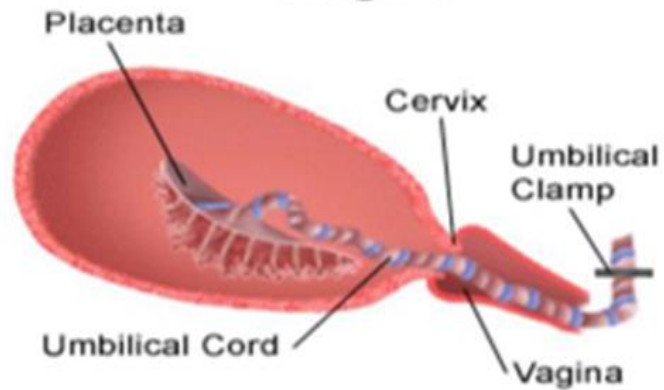
Stage 1



Stage 2



Stage 3



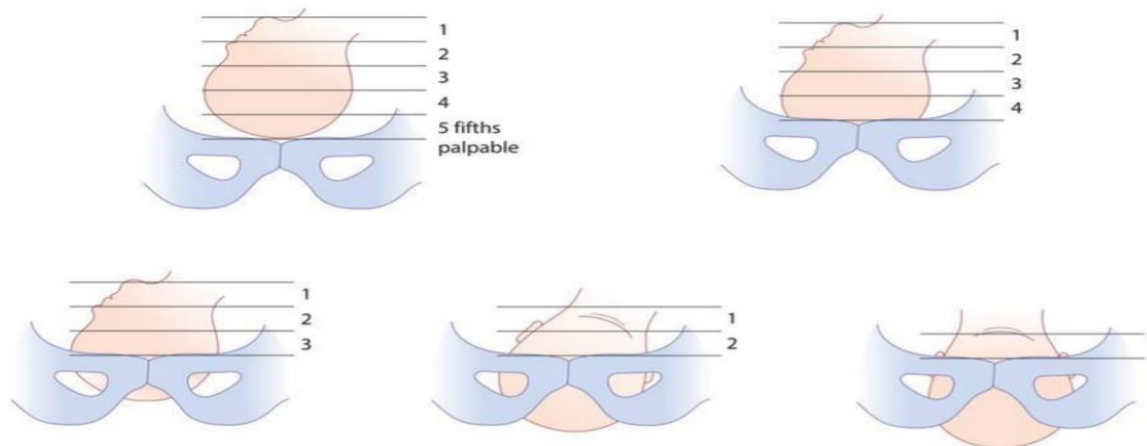
The mechanism of labour

This refers to the series of changes in position and attitude that the fetus undergoes during its passage through the birth canal.

Mechanism of labour

(Engagement → Descent → flexion → internal rotation → extension → external rotation → Delivery of the shoulders and fetal body)

Engagement: Also termed **lightening or dropping**: to have occurred when the widest part of the presenting part has passed successfully through the inlet. Engagement has occurred in the vast majority of nulliparous women prior to labour, usually **by 37 weeks'** gestation, but not so for the majority of multiparous women (which some time occur during first stage of labour).



Palpation of the fetal head to assess engagement.



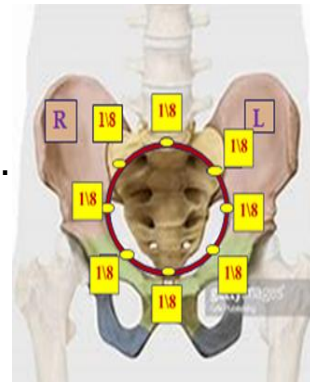


Descent: Descent of the fetal head is needed before flexion, internal rotation and extension, can occur During the first stage and passive phase of the second stage of labour, (occurs as a result of uterine contractions).

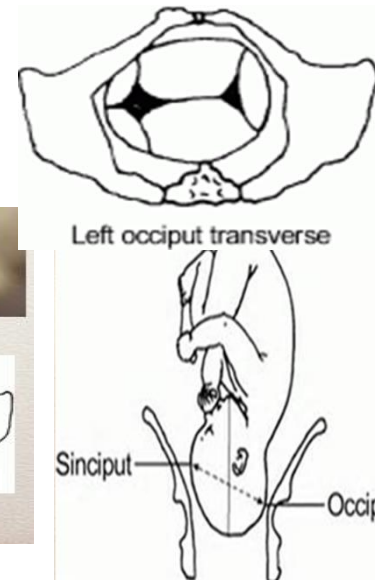
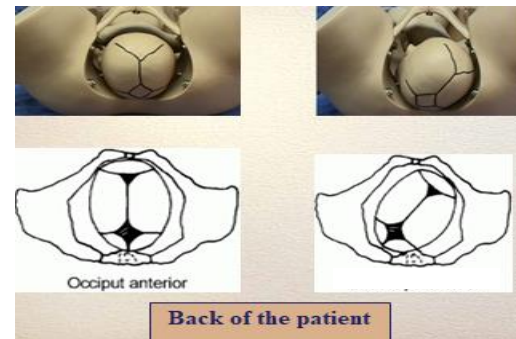
In the active phase of the second stage of labour, descent of the fetus is assisted by voluntary efforts of the mother using her abdominal muscles and the Valsalva manoeuvre ('pushing').



Flexion: The fetal head is not always completely flexed when it enters the pelvis. As the head descends into the narrower mid pelvis, flexion occurs. This passive movement occurs, in part, due to the surrounding structures and is important in reducing the presenting diameter of the fetal head.

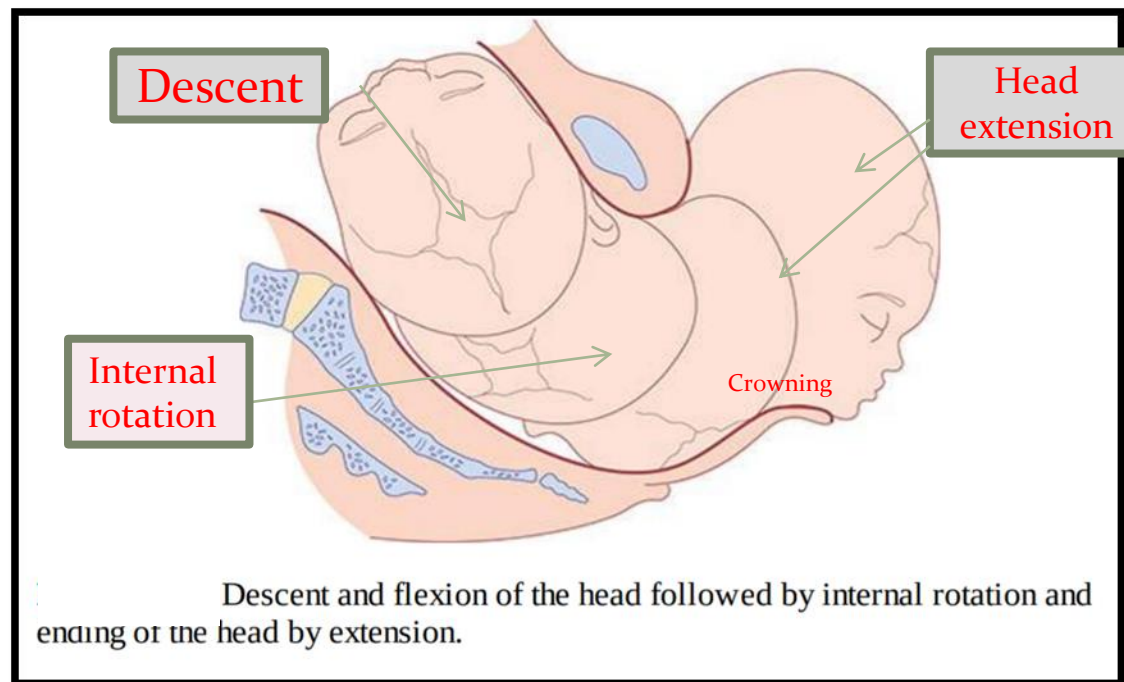


Internal rotation: If the head is well flexed, the occiput will be the leading point, and on reaching the sloping gutter of the levator ani muscles it will be encouraged to rotate anteriorly so that the sagittal suture now lies in the **AP** diameter of the pelvic outlet (i.e. the widest diameter).



Extension : Following completion of internal rotation, the occiput is beneath the symphysis pubis. The well-flexed head now extends and the occiput escapes from underneath the symphysis pubis and distends the vulva. This is known as '**crowning**' of the head.

The head extends further and the occiput underneath the symphysis pubis face and chin appear in succession over the posterior vaginal opening and perineal body. (there is a risk of perineal and vaginal tear)



Restitution: When the head is delivering, the occiput is directly anterior. As soon as it crosses the perineum, the head aligns itself with the shoulders, which have entered the pelvis in the oblique position. This slight rotation of the occiput through one-eighth of the circle is called 'restitution'.

External rotation : In order to be delivered, the shoulders have to rotate into the direct AP plane (remember, the widest diameter at the outlet). When this occurs, the occiput rotates through a further one-eighth of a circle to the transverse position. This is called external rotation

Delivery of the shoulders and fetal body : When restitution and external rotation have occurred, the shoulders will be in the AP position. The anterior shoulder is under the symphysis pubis and delivers first, and the posterior shoulder delivers subsequently.

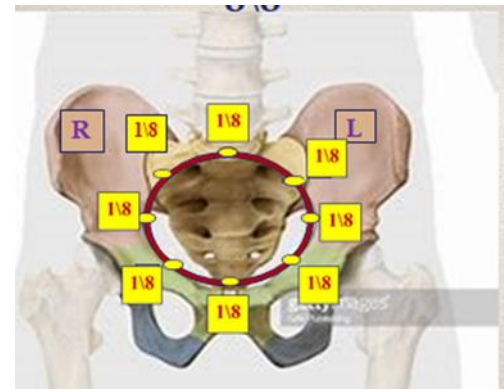


Figure 12.17 External rotation of the fetal head as the anterior shoulder rotates forward to pass under the suprapubic arch.

For most of the pregnancy the uterus and cervix have a containment function

The fetus is normally retained in the uterus by the cervix and relative quiescence of the myometrium.

Uterine Smooth Muscle

The myometrium is made up of bundles of smooth muscle cells. During pregnancy, the myometrium gets much thicker due primarily to increased cell size (10 fold) and glycogen deposition.

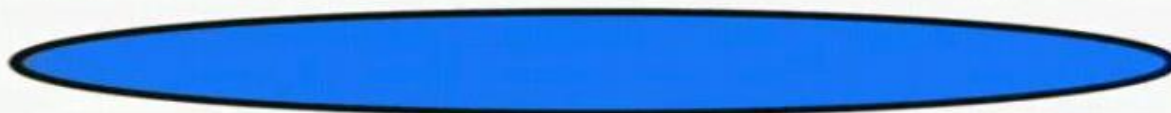
Uterine smooth muscle cell growth occurs by both HYPERTROPHY & HYPERPLASIA.

HYPERTROPHY:

Cells ↑ 10 times size.



Uterine smooth muscle cell: **Non-Pregnant**



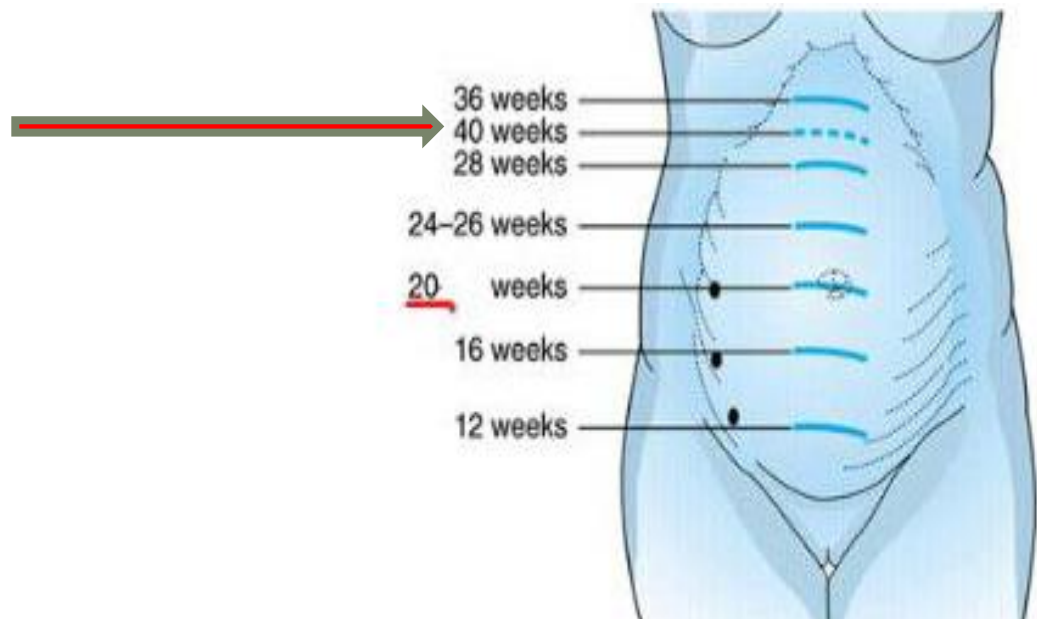
Uterine smooth muscle cell: **PREGNANT**

The fetus, placental membranes and uterus increase dramatically in size during gestation.

The uterus first becomes palpable at around **12 weeks** of gestation, by **20 weeks** it has reached the level of the **umbilicus**, by **36 weeks** it reaches the **xiphisternum**.

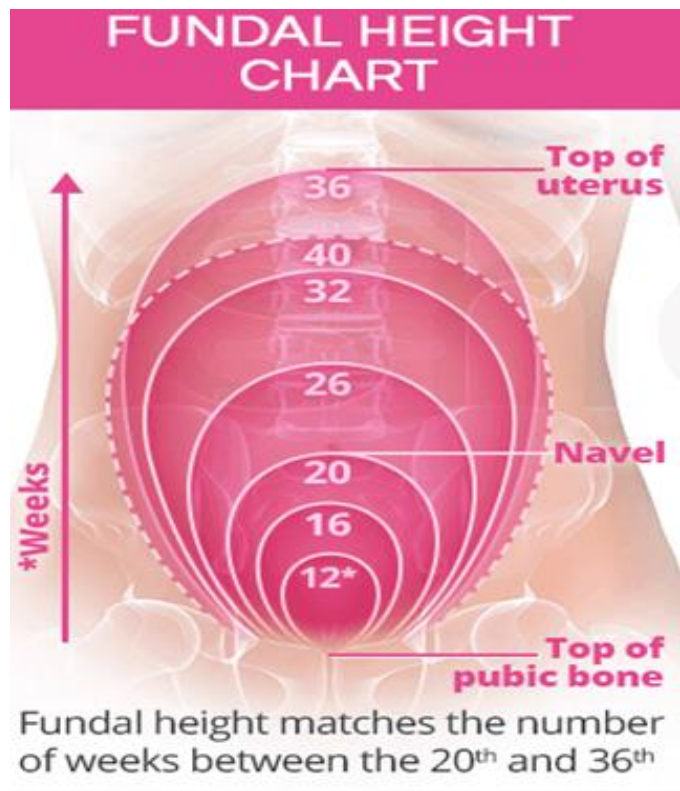
The girth at the umbilicus remains at about 60cm average until 24 weeks gestation, then increases by about 2.5cm per week till term, when it should be about 100cm.

Because engagement and descent of fetal head



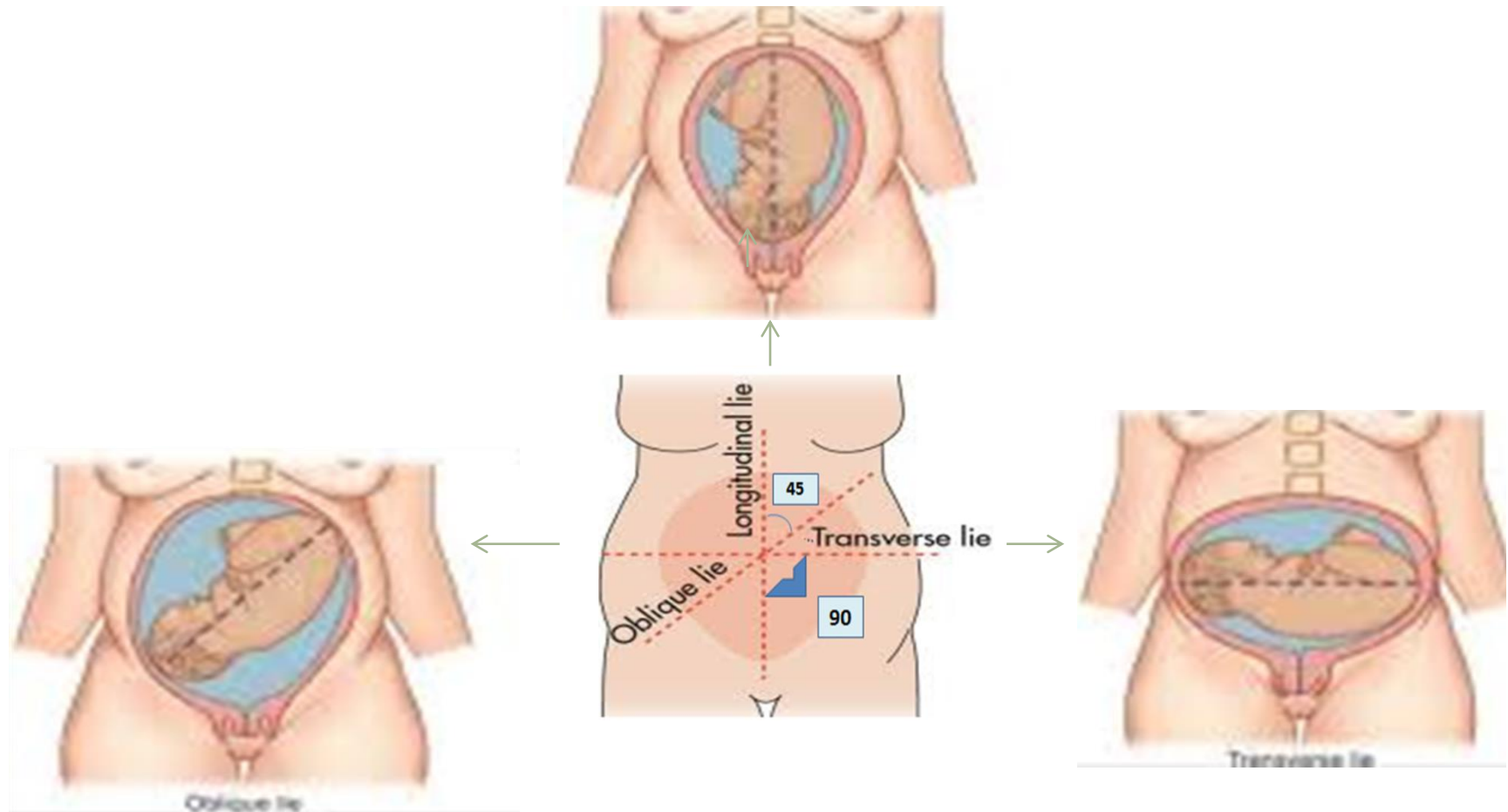


Fundal Height Measurement



The clinical management of labour depends crucially on the lie, presentation, and position of the fetus

Fetal lie :Refers to the relationship between the long axis of the fetus with respect to the long axis of the mother. The possibilities include **normal lie (longitudinal lie)**, or **abnormal lies (transverse lie, oblique lie, and unstable lie)**



The commonest lie is longitudinal .The fetus normally has a flexed attitude.

- **TYPICAL FETAL ATTITUDE**

- **universal flexion** with head flexed over chest, arms & legs flexed in front of the body and back curved forward



Flexed attitude



A



Extended attitude

B

The presentation of the fetus: describes which part is adjacent to the pelvic inlet. If the baby lies longitudinally the presenting part may be the **head (cephalic) or the breech (podalic)**.

The presenting part may be in a variety of positions which affects the diameter of presentation.

Size of the birth canal:

Most commonly the baby lies longitudinally, in a cephalic presentation, well flexed so that the vertex presents to the pelvic inlet. In this case the diameter of presentation is typically

9.5cm. The birth canal therefore needs to have a diameter of about **10cm** for the fetus to pass through. This required diameter may change with different positions.

The birth canal diameter cannot extend beyond the limits determined by the pelvis.

Softening of the pelvic ligaments may allow some expansion to occur

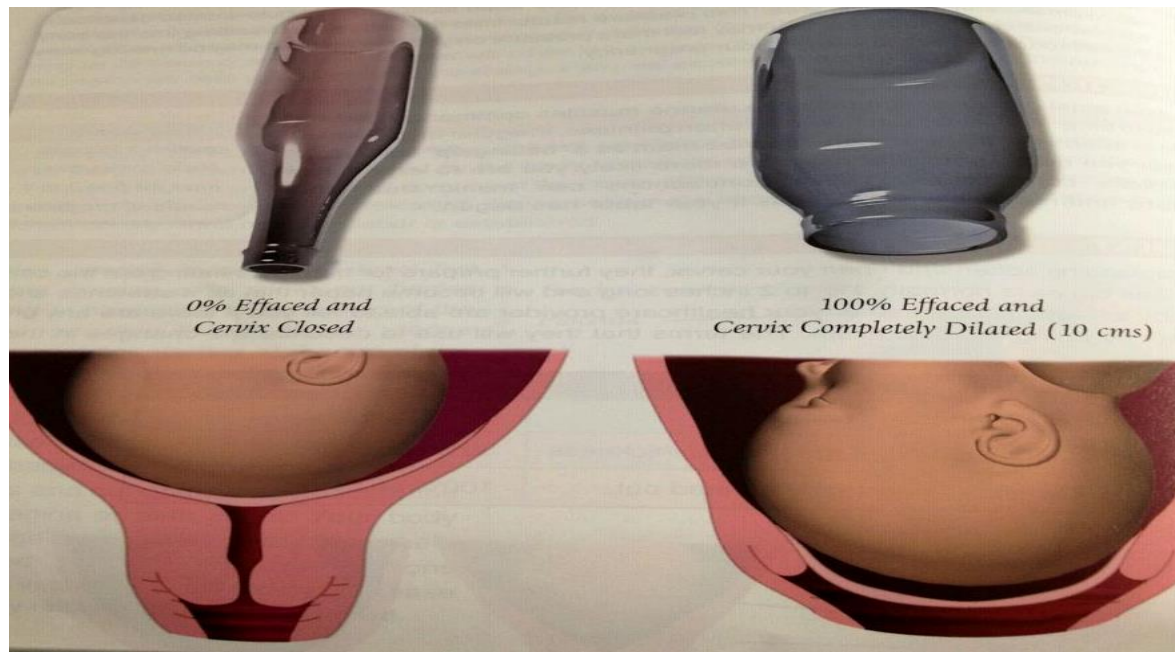


First stage of labour: the processes necessary to create a birth canal:

Expansion of Soft Tissues :

To create a birth canal the cervix must dilate and be retracted anteriorly. At some time during this process the fetal membranes rupture, releasing amniotic fluid.

Cervical dilatation is facilitated by structural changes known as cervical ripening, but produced by forceful contractions of uterine smooth muscle. These contractions first thin the cervix („**effacement**“) and then dilate it. The expansion is to ~10cm, and requires both structural changes and a lot of force.



Mechanisms of cervical ripening

Throughout pregnancy the cervix retains the fetus. It is made of tough, thick collagen, which is coiled to give greater structural strength.

The cervix needs to soften for birth to occur. This is called **Cervical Ripening** and is an essential part of labour. If the uterus applies force to an un-ripened cervix a great deal of damage can be done.

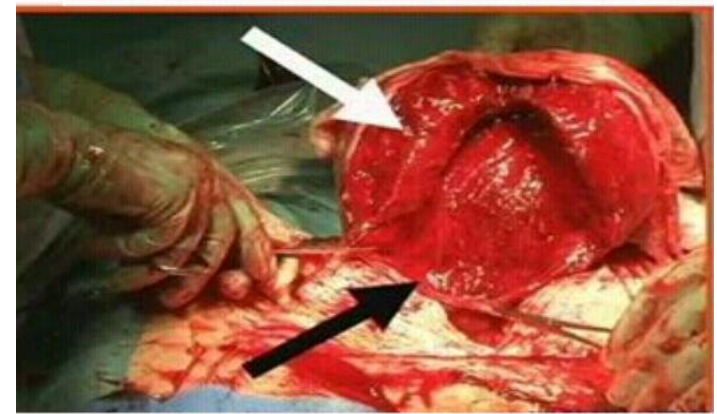
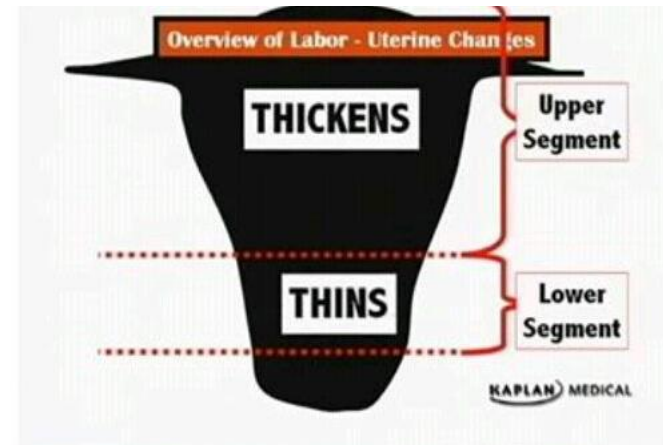
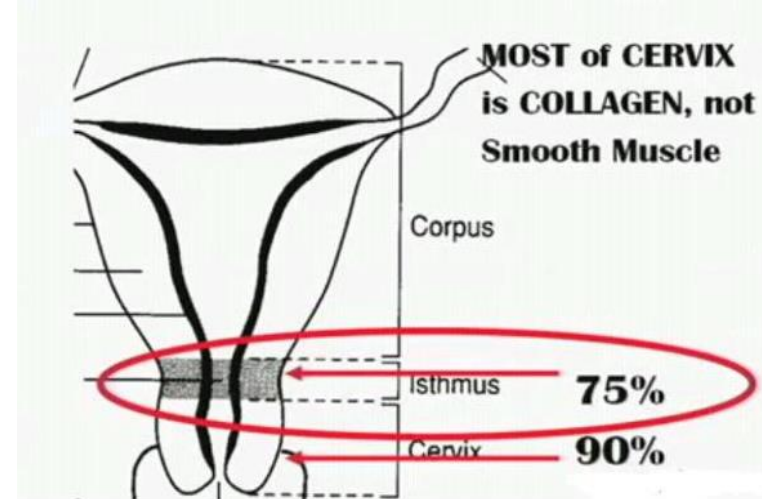
The upper segment

(mainly smooth muscles)

contracts & thickens while

the lower segment (mainly fibrous tissue)

does not contract so stretches & thins.



Cervical Ripening

- Cervix is made up of collagen in a proteoglycan matrix

- Ripening involves:

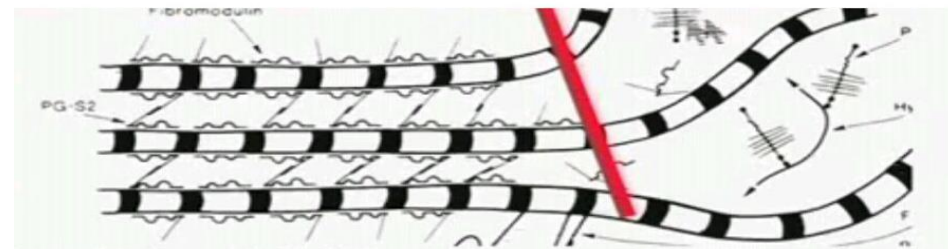
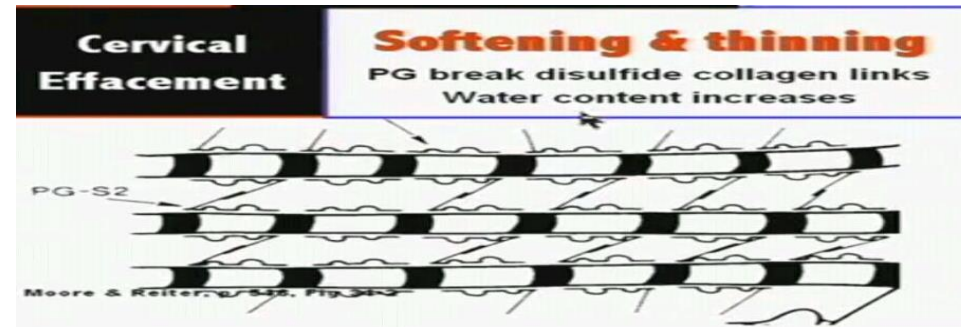
- Reduction in collagen production (Turnover altered)
- Increase in glycosaminoglycans (Disrupts the matrix) which decrease the aggregation of collagen fibers.
- Reduces aggregation of collagen fibres (Uncoils)
- Keratin sulphate increases at the expense of dermatan sulphate. In consequence collagen bundles „loosen“. There is also influx of inflammatory cells, and increase in nitric oxide output

- Ripening is triggered by Prostaglandins

- PG E2 and PGF2 α
- Locally diffused from the uterus



Once released the cervix is ready to be stretched



The myometrium is therefore always spontaneously motile. In early pregnancy contractions may occur every 30 minutes or so, but are of low amplitude.

As pregnancy continues, the frequency falls, with some increase in amplitude, producing noticeable „**Braxton-Hicks**“ contractions. None of these contractions are normally forceful enough to have any effect on the fetus.

The onset of labour is a relatively sudden increase in the frequency and force of contractions. Two hormones are implicated in this change:

Prostaglandins: These act by enhancing the release of calcium from intracellular stores

Oxytocin: This peptide hormone is secreted from the posterior pituitary gland under the control of neurons in the hypothalamus. It acts by lowering the threshold for triggering action potentials.

An intracellular apparatus containing actin and myosin, triggered by a rise in intracellular calcium concentration, generates force.

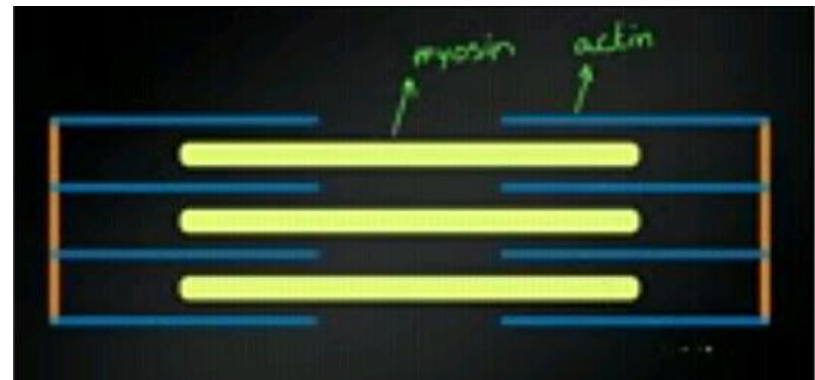
The rise in calcium concentration is produced by action potentials in the cell membrane.

Action potentials spread from cell to cell via specialized gap functions, allowing co-ordinated contractions to spread over the myometrium.

Some smooth muscle cells are capable of spontaneous depolarization and action potential generation,

and so can act as “**pacemakers**”

present in the body of the uterus near tubes.



The properties of uterine smooth muscle which facilitate labour

Uterine Contractions

The uterus contracts throughout pregnancy. *Progesterone suppresses the myometrium's contractions, preventing labour from occurring until the proper time.*

- Early
 - Low amplitude, every 30 minutes
 - Generally speaking, mother is not aware
- Late
 - Higher amplitude, less frequent
 - ‘**Braxton-Hicks**’ contractions

The contractions of the uterus are made more forceful and frequent by:

- Prostaglandins** ← as well as ripening the cervix
 - Increased intracellular $[Ca^{2+}]$ per action potential
- Oxytocin**
 - More action potentials
 - Threshold lowered

Prostaglandins

Biologically active lipids Local hormones

Produced mainly in the endometrium

Its synthesis is controlled by changing the release of phospholipase from liposomes

Production is controlled by the **Oestrogen : Progesterone ratio**

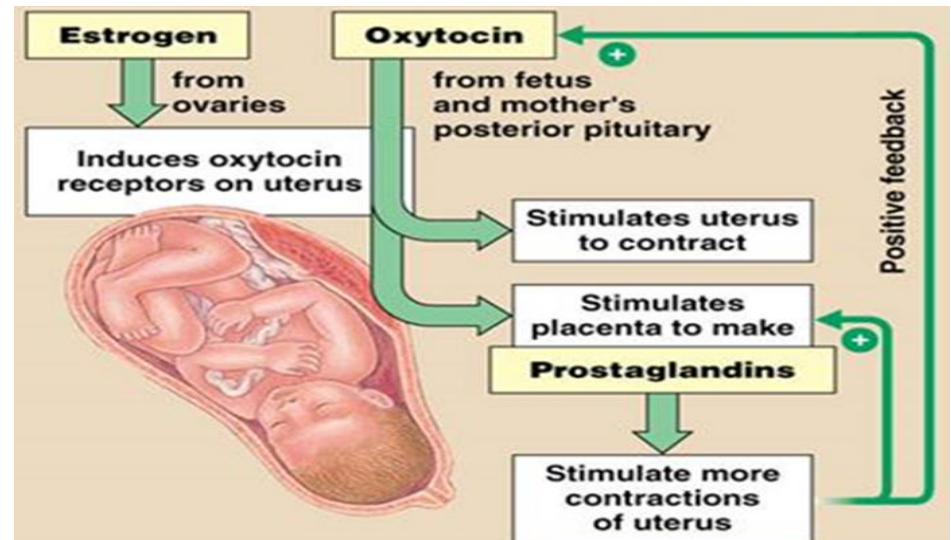
Progesterone > Oestrogen  Low Prostaglandins throughout pregnancy

Oestrogen > Progesterone  Increased Prostaglandins  End of pregnancy

PG release may also be stimulated by the action of oxytocin.

Oxytocin

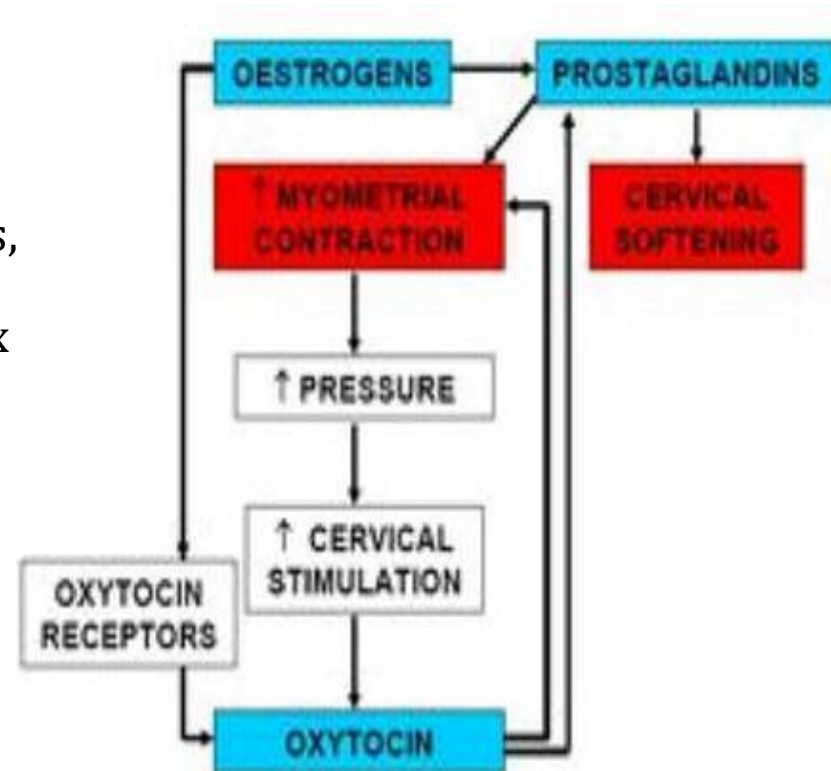
- Secreted by the Posterior Pituitary – Controlled by the hypothalamus (Neurosecretion)
- Acts by binding to smooth muscle receptors
 - More receptors if **Oestrogen more than Progesterone** making cells more sensitive to low circulating levels of oxytocin.
- The onset of labour is therefore associated with increased PG synthesis and release stimulating more forceful contractions in conjunction with increased sensitivity to oxytocin.
- Secretion of oxytocin is increased by afferent impulses from the cervix and vagina **“Ferguson Reflex”**. This “positive feedback” makes



Ferguson Reflex: is a neuroendocrine reflex comprising the self sustaining cycle of uterine contractions initiated by pressure at the **cervix or vaginal walls**.

Pressure to the internal end of the cervix by PG-induced contractions
stimulation of sensory receptors in the cervix and vagina

excitation passes via afferent nerves to the
Hypothalamus promoting massive oxytocin
release, which stimulates uterine contractions,
which in turn increases pressure on the cervix
(thereby increasing oxytocin release, etc.),
until the baby is delivered.



Brachystasis (retraction)

Uterine smooth muscle has another crucial property –brachystasis

It is a unique feature of uterine smooth muscle.

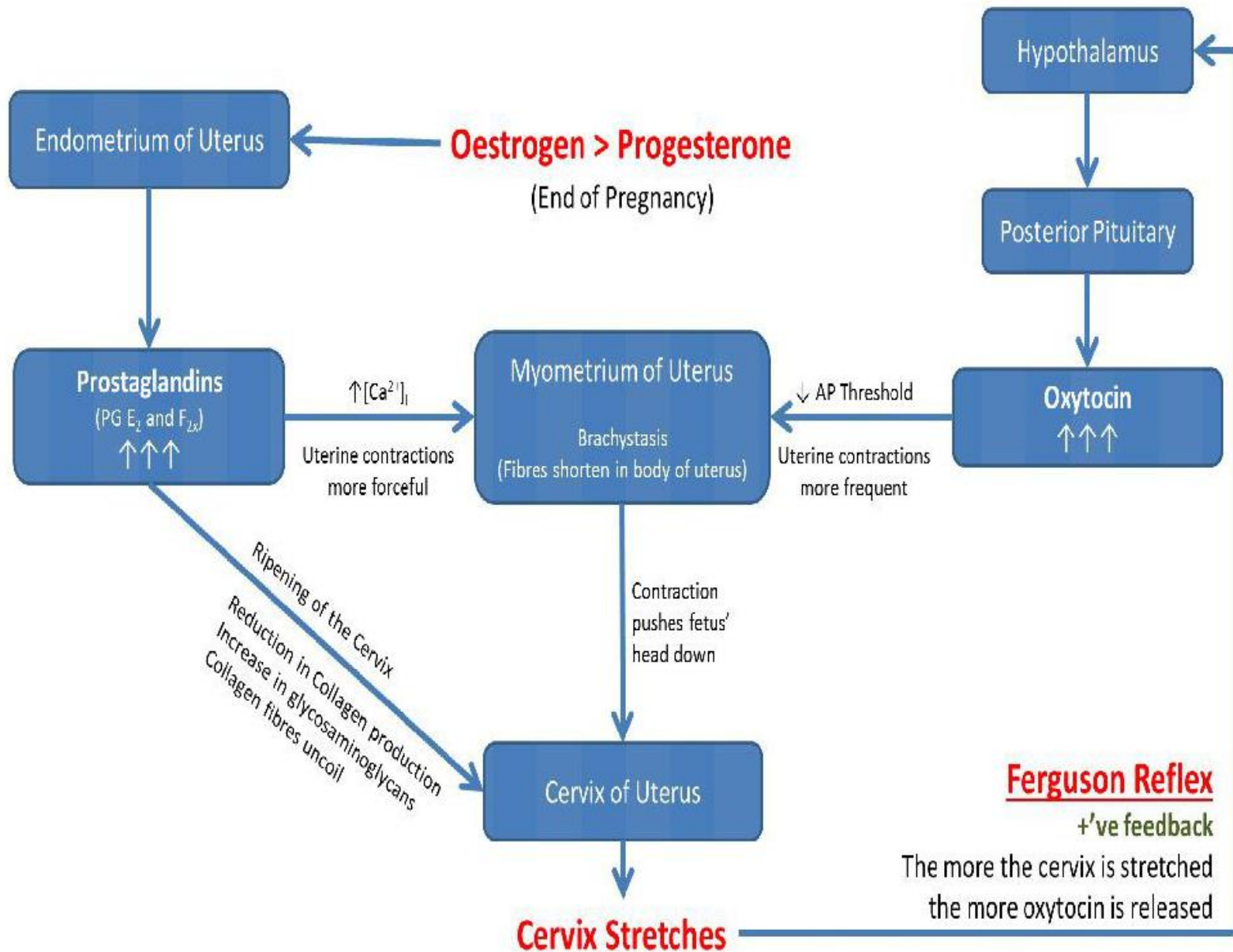
At each contraction muscle fibers shorten, but do not relax fully.

i.e. uterine smooth muscle relaxes less than it contracts.

The uterus, particularly the fundal region therefore shortens progressively. This pushes the presenting part into the birth canal and stretches the cervix over it.

Descent of the presenting part (commonly the fetal head)

therefore occurs progressively during labour, until it engages in the pelvis.



Initiation of Labour

All the evidence from animals suggests labour is initiated by an increase in prostaglandin production and oxytocin sensitively triggered by a fall in progesterone levels relative to oestrogen.

Oestrogen and progesterone are produced in the placenta. In some species it is well established that a fall in placental progesterone production and rise in oestrogen production is triggered by rising production of cortisol by the fetus as it matures.

The situation in humans is much less clear. Fetal cortisol does rise prior to birth, **but fetuses that do not produce cortisol are born.**

There is no clear evidence of pre-labour increases in plasma prostaglandins or changes in oestrogen progesterone ratio.

Prostaglandins will, however, induce labour.

The normal physiological processes which initiate labour

- ↑ Fetal Cortisol (?)
- Oestrogen > Progesterone
- ↑↑↑ Prostaglandins from Endometrium of Uterus

+ 've Feedback

Increased force of uterine contractions

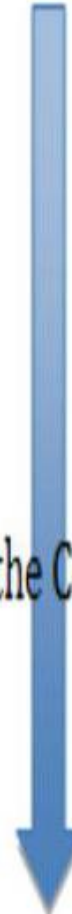
Cervix Stretched

- Oxytocin released from Posterior Pituitary under the Control of Hypothalamus

■ Ferguson Reflex

- Increased frequency of uterine contraction

- Cervix stretched more



Characteristics of True versus False Labor

| Characteristic | True Labor | False Labor |
|----------------------------|---------------------|------------------|
| Contractions | | |
| Rhythm | Regular | Irregular |
| Intervals | Gradually shorten | Unchanged |
| Intensity | Gradually increases | Unchanged |
| Discomfort | | |
| Location | Back and abdomen | Lower abdomen |
| Sedation | No effect | Usually relieved |
| Cervical dilatation | Yes | No |

As labour progresses increasingly forceful uterine contractions may temporarily reduce placental blood flow, and so reduce oxygen supply to the fetus.

This may lead to brief reductions in fetal heart rate that may be monitored. If the reductions in flow are greater than usual larger „dips“ occur, as the fetus becomes „distressed“.

The Second Stage of Labour

The first stage of labour ends when cervical dilatation reaches **10 cm**. The fetus is normally then expelled relatively quickly. The second stage of labour normally lasts up to **1 hour** in the multiparous woman and up to **2 hours** in primigravida.

The third stage of labour

After the neonate has been born the uterus continues to contract, though it is now contracting on nothing. The uterus contracts down hard, with its fibers shortening much faster.

This shears off and expels the placenta & membranes, normally 10 minutes after birth.

This leaves the maternal blood vessels which ran into the placenta exposed, giving the risk of haemorrhage.

Normal blood flow through this site is 500-800ml/minute (10-15% of cardiac output), so bleeding can be very severe.

The continued uterine contraction compresses the blood vessels (which run through the myometrium), closing them off and reducing haemorrhage. This effect can be enhanced by giving an oxytocic drug










The immediate physiological changes in the neonate which enable independent life

Multiple stimuli, such as a trauma from the birth and cold cause the neonate to take its first breath. This causes the fetal circulation to convert to adult circulation.

- Reduction in pulmonary vascular resistance
 - Blood fills lungs, increased return to LA
 - Pressure in LA > RA
 - Foramen ovale closes
- Increases arterial pO₂
 - Ductus Arteriosus contracts
 - The sphincter in the ductus venosus constricts, so that all blood entering the liver passes through the hepatic sinusoids.

Apgar Score

The condition of the neonate is scored by the Apgar Score, which is assessed as a number from **0-10**, normally soon after delivery, and a few minutes later.

| APGAR Test Scoring | | | |
|------------------------------|--|---|---|
| | Score 0 | Score 1 | Score 2 |
| A pppearance |  |  |  |
| | Blue all over | Blue only at extremities | No blue coloration |
| P ulse | No pulse | <100 beats/min. | >100 beats/min. |
| G rimace |  |  |  |
| | No response to stimulation | Grimace or feeble cry when stimulated | Sneezing, coughing, or pulling away when stimulated |
| A ctivity |  |  |  |
| | No movement | Some movement | Active movement |
| R espiration | No breathing | Weak, slow, or irregular breathing | Strong cry |

THANK YOU

