

Definitions related to labor & delivery, prodromal changes preceding labor, onset of labor theories & diagnosis and normal uterine action

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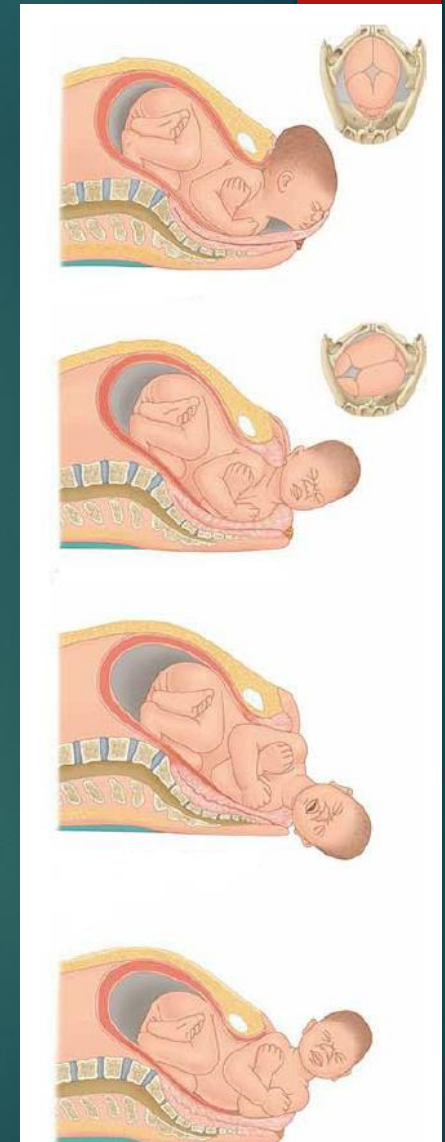
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- ▶ **Labor** is a process characterized by forceful and painful uterine contractions leading to cervical dilation and cause the fetus to descend through the birth canal. It takes place during the last few ours of pregnancy. (After the age of viability).



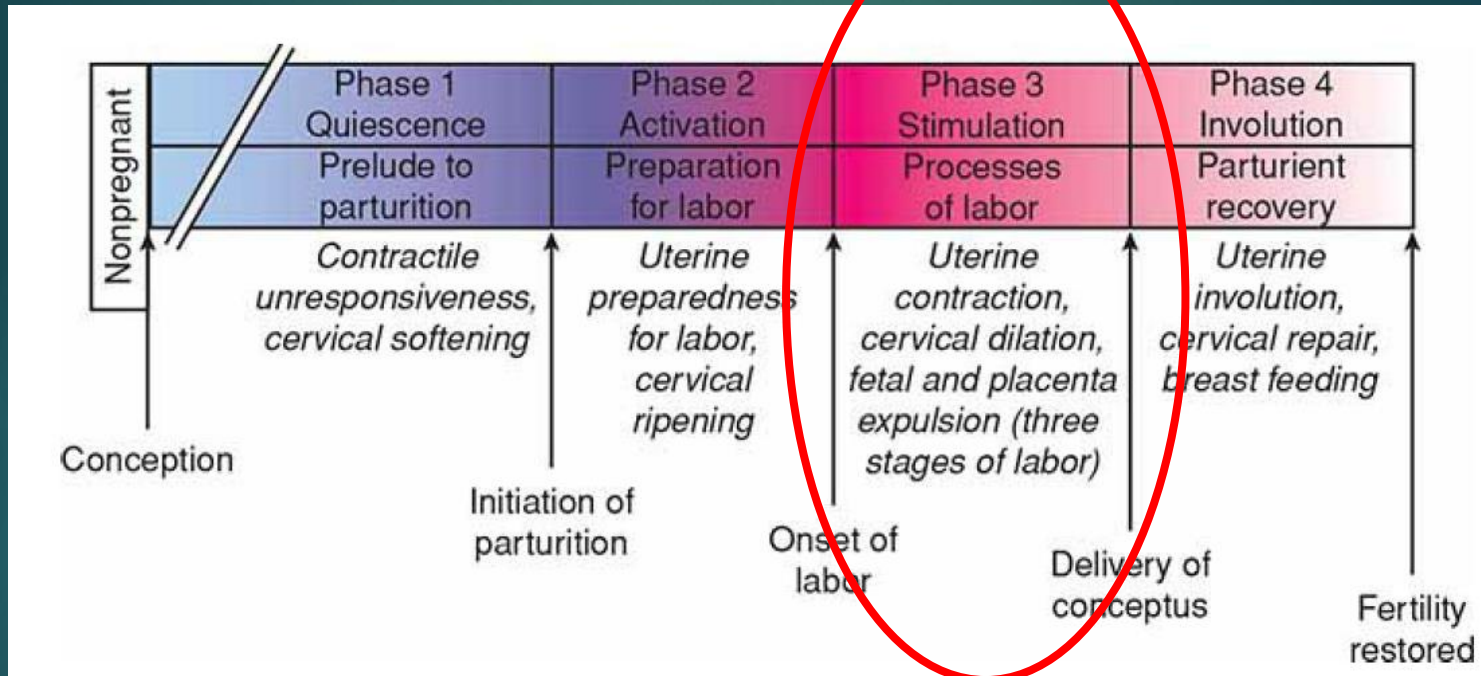
- ▶ Extensive preparations take place in both the uterus and cervix long before the onset of labor.
- ▶ These changes are described as phases and continue after delivery in order to bring uterus and cervix back to their pre-pregnancy state.
- ▶ These are called phases of parturition.



- ▶ Linguistically, labor and parturition are very close in meaning.
- ▶ From an obstetric point of view, labor constitutes only one phase of the phases of parturition.
- ▶ Importantly do not confuse phases of parturition with clinical stages of labor or with phases of the first stages of labor.



Phases of parturition



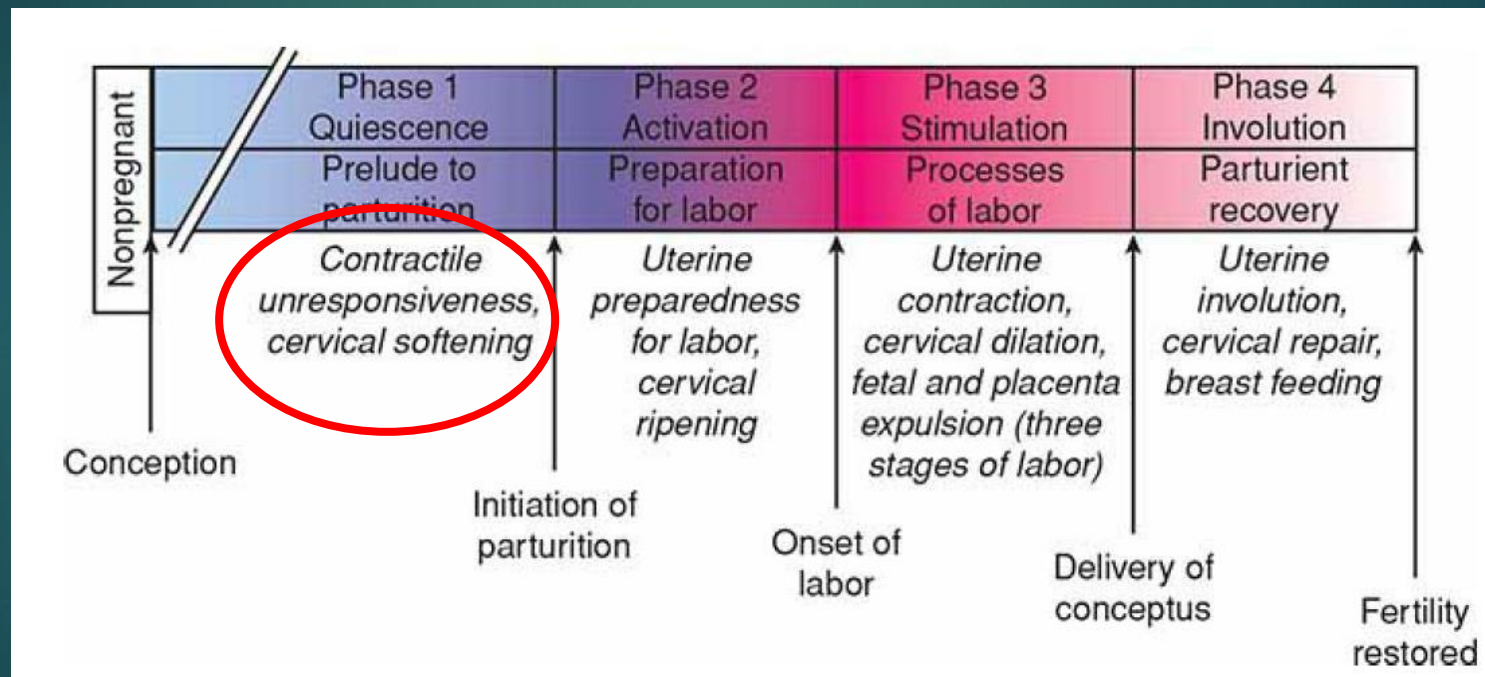
Phase I: Quiescence stage:

- ▶ It's considered as a prelude to parturition.
- ▶ Characterized mainly by uterine quiescence and cervical softening.
- ▶ This phase starts even before implantation and comprises nearly 95% of the whole duration of pregnancy.



Phase I: Quiescence stage:

- ▶ The main features of this phase are:
 - A. Myometrial Relaxation
 - B. Cervical softening



Phase I: Quiescence stage:

A- Myometrial relaxation is due to:

- ▶ Actions of **estrogen** and **progesterone** via intracellular receptors,
- ▶ Myometrial-cell plasma membrane receptor-mediated **increases** in cyclic adenosine monophosphate (cAMP),
- ▶ **Generation** of cyclic guanosine monophosphate (cGMP),
- ▶ Other systems, including modification of **myometrial-cell ion channels**.



Phase I: Quiescence stage:

A- Myometrial relaxation (Cont.)

- ▶ the myometrial cells undergo a phenotypic modification to a noncontractile state, and uterine muscle is rendered unresponsive to natural stimuli.
- ▶ Concurrently, the uterus must initiate extensive changes in its size and vascularity to accommodate fetal growth and prepare for uterine contractions.



Phase I: Quiescence stage:

A- Myometrial relaxation (Cont.)

- ▶ The myometrial unresponsiveness of phase 1 continues until near the end of pregnancy.
- ▶ That said, some low-intensity myometrial contractions are felt during the quiescent phase, but they do not normally cause cervical dilation.
- ▶ These contractions are common toward the end of pregnancy, especially in multiparas, and are referred to as Braxton Hicks contractions or false labor



Phase I: Quiescence stage:

B-Cervical softening:

- ▶ It's initial stage of cervical remodeling
- ▶ It is characterized by greater tissue compliance, yet the cervix remains firm and unyielding.
- ▶ This maintenance of cervical anatomical and structural integrity is essential for pregnancy to continue to term.
- ▶ Hegar (1895) first described palpable softening of the lower uterine segment at 4 to 6 weeks' gestation, and this sign was once used to diagnose pregnancy.



Phase I: Quiescence stage:

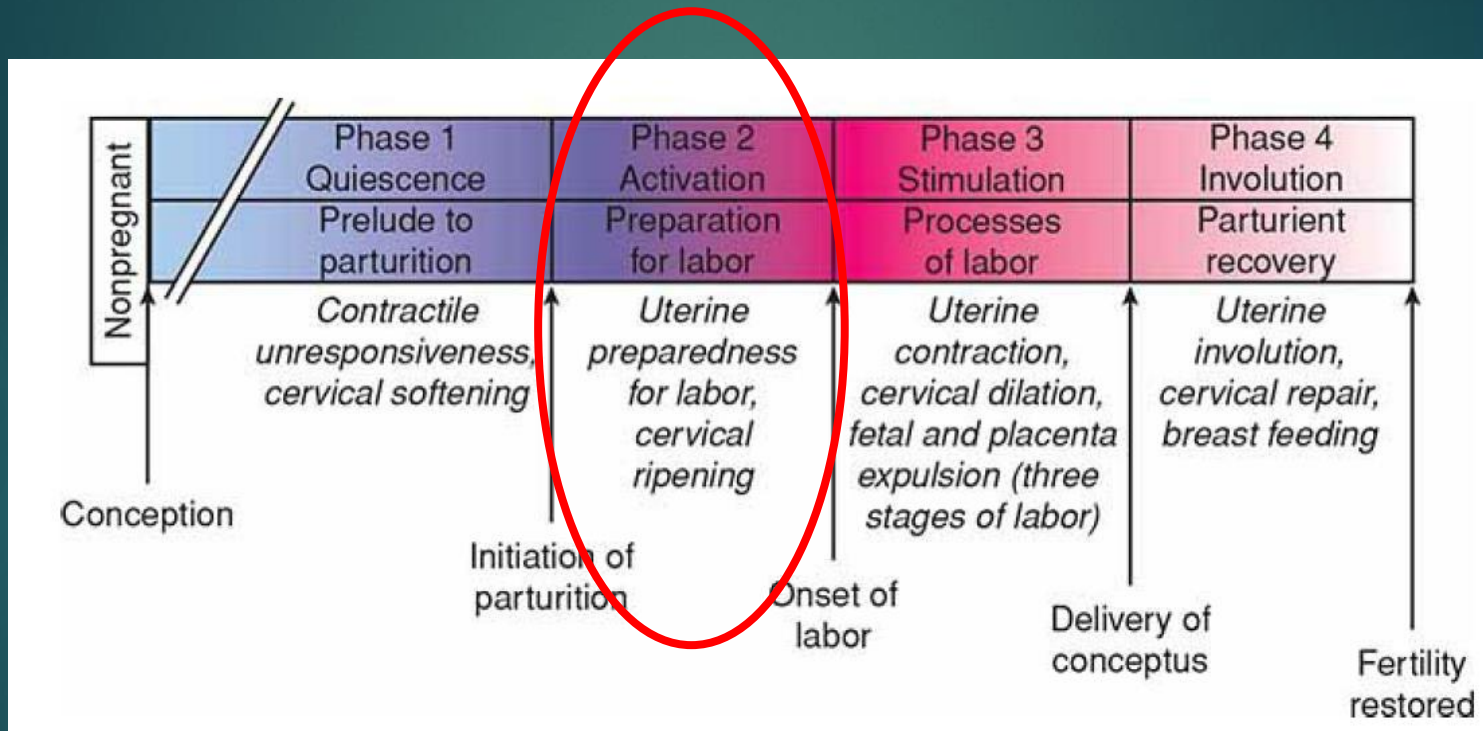
B-Cervical softening: (Cont.)

► It is the result of

1. increased vascularity,
2. cellular hypertrophy and hyperplasia,
3. and slow, progressive compositional and structural changes in the extracellular matrix.
 - This is mainly due to changes in collagen which is the main structural protein in the cervix.
 - Collagen undergoes conformational changes that alter tissue stiffness and flexibility



Phase II: Preparation for labor:



Phase II: Preparation for labor:

- ▶ Called uterine awakening or activation phase.
- ▶ This phase 2 of parturition is a progression of uterine changes during the last few weeks of pregnancy.
- ▶ Importantly, shifting events associated with phase 2 can cause either preterm or delayed labor.



Phase II: Preparation for labor:

- ▶ Changes happening during phase II:
 - A. Progesterone withdrawal.
 - B. Myometrial changes.
 - C. Cervical ripening.



Phase II: Preparation for labor:

A. Progesterone withdrawal.

- ▶ Classic progesterone withdrawal resulting from decreased secretion does not occur in human parturition.
- ▶ However, the myometrium and cervix become refractory to progesterone's inhibitory actions (Functional withdrawal).
- ▶ This is supported by studies using progesterone-receptor antagonists. However, exact mechanisms how it is achieved is an active area of research.



Phase II: Preparation for labor:

B. Myometrial changes.

▶ Molecular changes:

- ▶ There's a shift in gene expression levels of key factors primarily 1- Increase number of oxytocin receptors & 2- Increase in gap junctions between myometrial cells. (So myometrium is more excitable)

▶ Structural changes:

- ▶ Formation of the lower uterine segment from the isthmus which often lead to descent of the fetal head through the pelvic inlet—so-called lightening



Phase II: Preparation for labor:

c. Cervical ripening.

- ▶ Cervical modifications during phase 2 principally involve connective tissue changes—termed *cervical ripening*.
- ▶ The transition from the softening to the ripening phase begins weeks or days before labor.
- ▶ These changes eventually leads to the cervix yielding and dilating from forceful uterine contractions.



Phase II: Preparation for labor:

c. Cervical ripening.

- ▶ During this transformation, the total amounts of glycosaminoglycans, (which are large linear polysaccharides), and proteoglycans, (which are proteins bound to these glycosaminoglycans) in cervical matrix **increase**.
- ▶ For example, Hyaluronan (which is a high-molecular-weight polysaccharide) is a hydrophilic, space-filling molecule, and thus greater hyaluronan production during cervical ripening is thought to increase viscoelasticity, hydration, and matrix disorganization.



Phase II: Preparation for labor:

c. Cervical ripening.

- ▶ Collagen undergoes changes due to rapid turnover leading to loss of mature crosslinks between collagen fibers leading to loose connective tissue.



Phase II: Preparation for labor:

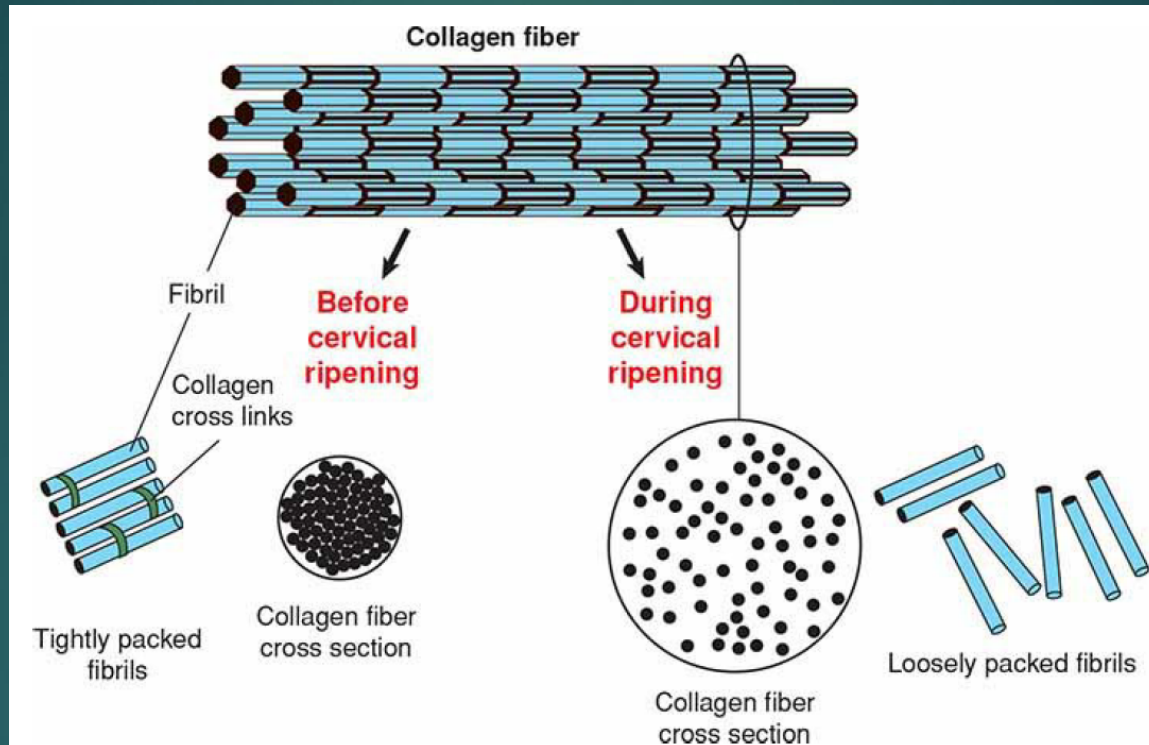


FIGURE 21-9 The collagen fiber architecture is reorganized in phases 1 and 2 of parturition to allow a gradual increase in mechanical compliance of the cervix. A collagen fiber is made up of many fibrils. Fibril size and packing are regulated in part by small proteoglycans such as decorin and by the density of collagen cross-links. In phase 1, fibril size is uniform and fibrils are well organized, although a decline in cross-link density aids softening. During cervical ripening in phase 2, fibril size is less uniform, and spacing between collagen fibrils and fibers is greater and disorganized.



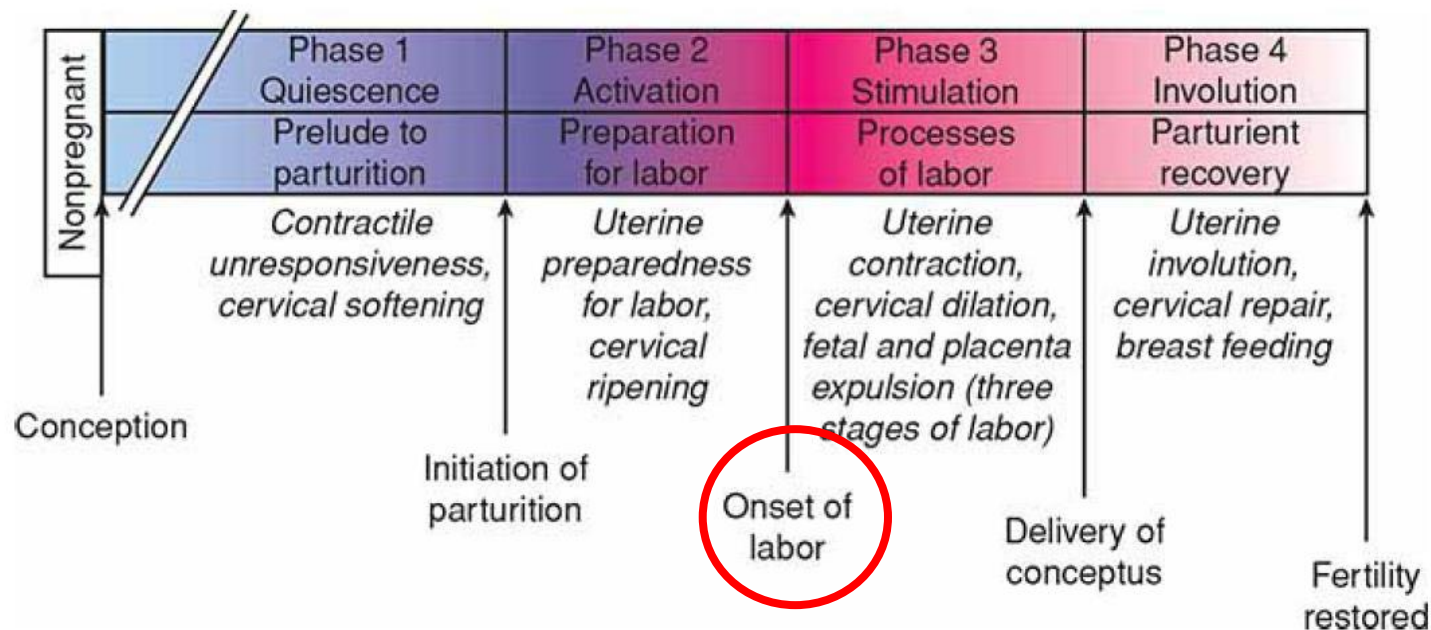
Phase II: Preparation for labor:

c. Cervical ripening.

- ▶ No therapies prevent premature cervical ripening. In contrast, treatment to promote cervical ripening for labor induction includes direct application of prostaglandins PGE2 and PGF2α.
- ▶ Prostaglandins likely modify extracellular matrix structure to aid ripening.
- ▶ Also administration of progesterone antagonists causes cervical ripening.



Onset of labor



Mechanisms behind the onset of labor:

- ▶ Until now there is no single theory that can fully explain the exact mechanism behind the onset of labor.
- ▶ It is suggested that number of different physiologic changes take place by the end of pregnancy culminating towards kicking the beginning of true labor.



Mechanisms behind the onset of labor:

1- Uterine stretch:

- ▶ With continuing fetal growth as the pregnancy advances towards its end there is significant stretch of uterine muscles.
- ▶ This leads to activation of uterine muscles through:
 1. increased expression of gap junction molecules, namely connexin-43.
 2. Increased expression of oxytocin receptors.
 3. Levels of gastrin-releasing peptide, a stimulatory agonist for smooth muscle, are also augmented by stretch in the myometrium.



Mechanisms behind the onset of labor:

1- Uterine stretch (cont.):

Clinical clues for a role of stretch come from:

1-Multifetal pregnancies have greater risk for preterm labor than singleton ones.

2-Preterm labor is more common in pregnancies complicated by polyhydramnios.

(Although the mechanisms causing preterm birth in these two examples are debated, a role for uterine stretch must be considered).



Mechanisms behind the onset of labor:

2- Fetal Endocrine Cascades:

- ▶ Human fetal hypothalamic pituitary-adrenal-placental axis is considered a critical component of normal parturition.
- ▶ Premature activation of this axis is considered to prompt many cases of preterm labor (Challis, 2000, 2001).
- ▶ Steroid products of the human fetal adrenal gland are believed to have effects on the placenta and membranes that eventually **transform the myometrium from a quiescent to a contractile state.**



Mechanisms behind the onset of labor:

2- Fetal Endocrine Cascades (cont.):

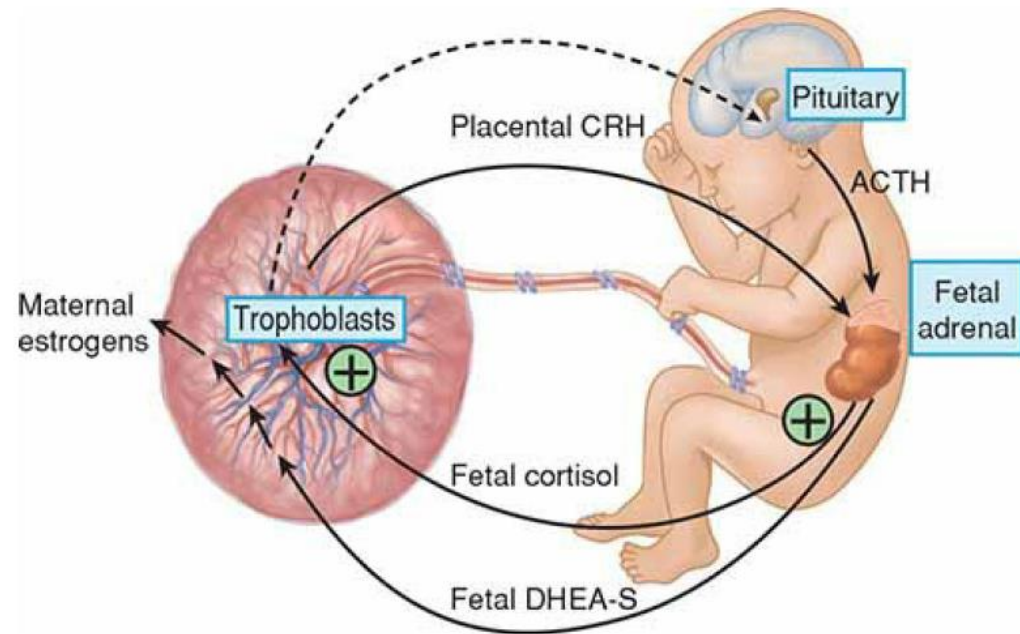


FIGURE 21-10 The placental–fetal adrenal endocrine cascade. In late gestation, placental corticotropin-releasing hormone (CRH) stimulates fetal adrenal production of dehydroepiandrosterone sulfate (DHEA-S) and cortisol. The latter stimulates production of placental CRH, which leads to a feed-forward cascade that enhances adrenal steroid hormone production. ACTH = adrenocorticotrophic hormone.



Mechanisms behind the onset of labor:

2- Fetal Endocrine Cascades (cont.):

- ▶ In pregnancies in which the fetus can be considered “stressed” from various complications, concentrations of CRH in fetal plasma, amniotic fluid, and maternal plasma are greater than those seen in normal gestation.
- ▶ For example, placental CRH content is fourfold higher in placentas from women with preeclampsia than in those from normal pregnancies.



Mechanisms behind the onset of labor:

2- Fetal Endocrine Cascades (cont.):

- ▶ In contrast, pregnancies where there's inherited placental sulfatase deficiency or fetal anencephaly with adrenal hypoplasia, these are associated with prolonged pregnancy.
- ▶ This is attributable to anomalous fetal brain-pituitary-adrenal function



Mechanisms behind the onset of labor:

3- Other possible mechanisms:

- A. **Fetal Lung Surfactant:** Surfactant protein A (SP-A) is primarily secreted in the lungs to induce lung maturity but is also expressed in the decidua and membranes and was found to stimulate myometrial contractility.
- B. **Platelet-Activating Factor:** Secreted by fetal lung and was found to have uterotonic effect.
- C. **Fetal-Membrane Senescence:** It's a physiological aging process that occurs toward the end of pregnancy. It starts by sterile inflammation of the cells which triggers a cascade of inflammatory markers ending by triggering onset of labour.



Diagnosis of the onset of labour



Diagnosis of the onset of labour

- ▶ Back to definition: “Process characterized by forceful and painful uterine contractions leading to cervical dilation and cause the fetus to descend through the birth canal.”
- ▶ Diagnosis of the onset of labour is by diagnosing true labour pains.



Diagnosis of the onset of labour

• True labour pains	• False labour pains
<ul style="list-style-type: none">• Regular with increasing frequency and intensity by time.• Strong and painful not relieved by sedation, rest or walking.• Causes cervical changes and dilatation.• Show usually present.• Fetal head usually engaged	<ul style="list-style-type: none">• Irregular rhythm.• Pain stops by sedation, walking or rest.• Not associated with cervical dilatation.• No show is present.• No change in station of fetal head.• These are usually referred to as Braxton-Hicks contractions.



What is the “Show”?

- ▶ It's the extrusion of the mucus plug that had previously filled the cervical canal during pregnancy and is referred to as “show” or “bloody show.”
- ▶ Its passage indicates that labor is already in progress or likely will ensue in hours to days.



Criteria of Normal labour

1. Spontaneous onset.
2. Single.
3. Living.
4. Vertex.
5. Term baby (37-42 ws).
6. Through the birth canal (i.e. vaginal delivery)
7. Maximum 24 hrs. from onset to delivery.
8. No complications to the mother or the fetus.
9. No or minimal intervention.
10. Some consider a smooth puerperium a criteria for normal labor.



Normal Uterine Action



Normal Uterine Action:

► Criteria of normal uterine action :

1. **Involuntary** and, for the most part, independent of extrauterine control and neural blockade from epidural analgesia does not diminish their frequency or intensity.
2. **Rhythmic** with The interval between contractions narrows gradually from approximately 10 minutes at the onset of first-stage labor to as little as 1 minute or less in the second stage. Periods of relaxation between contractions, however, are essential for fetal welfare. Unremitting contractions compromise uteroplacental blood flow sufficiently to cause fetal hypoxemia.



Normal Uterine Action:

- ▶ Criteria of normal uterine action :

3. **Enhanced by mechanical stretching of the cervix**, a phenomenon known as the Ferguson reflex (Ferguson, 1941). Unknown mechanism, and release of oxytocin has been suggested but not proven. However, manipulation of the cervix and “stripping” the fetal membranes is associated with a rise in blood levels of prostaglandin F2 α metabolites, a possible cause of enhanced uterine contraction.



Normal Uterine Action:

- ▶ Criteria of normal uterine action :
 4. During active labor, the anatomical uterine divisions that were initiated in phase 2 of parturition into distinct lower and upper uterine segments become increasingly evident. The upper segment is firm during contractions, whereas the lower segment is softer, distended, and more passive.



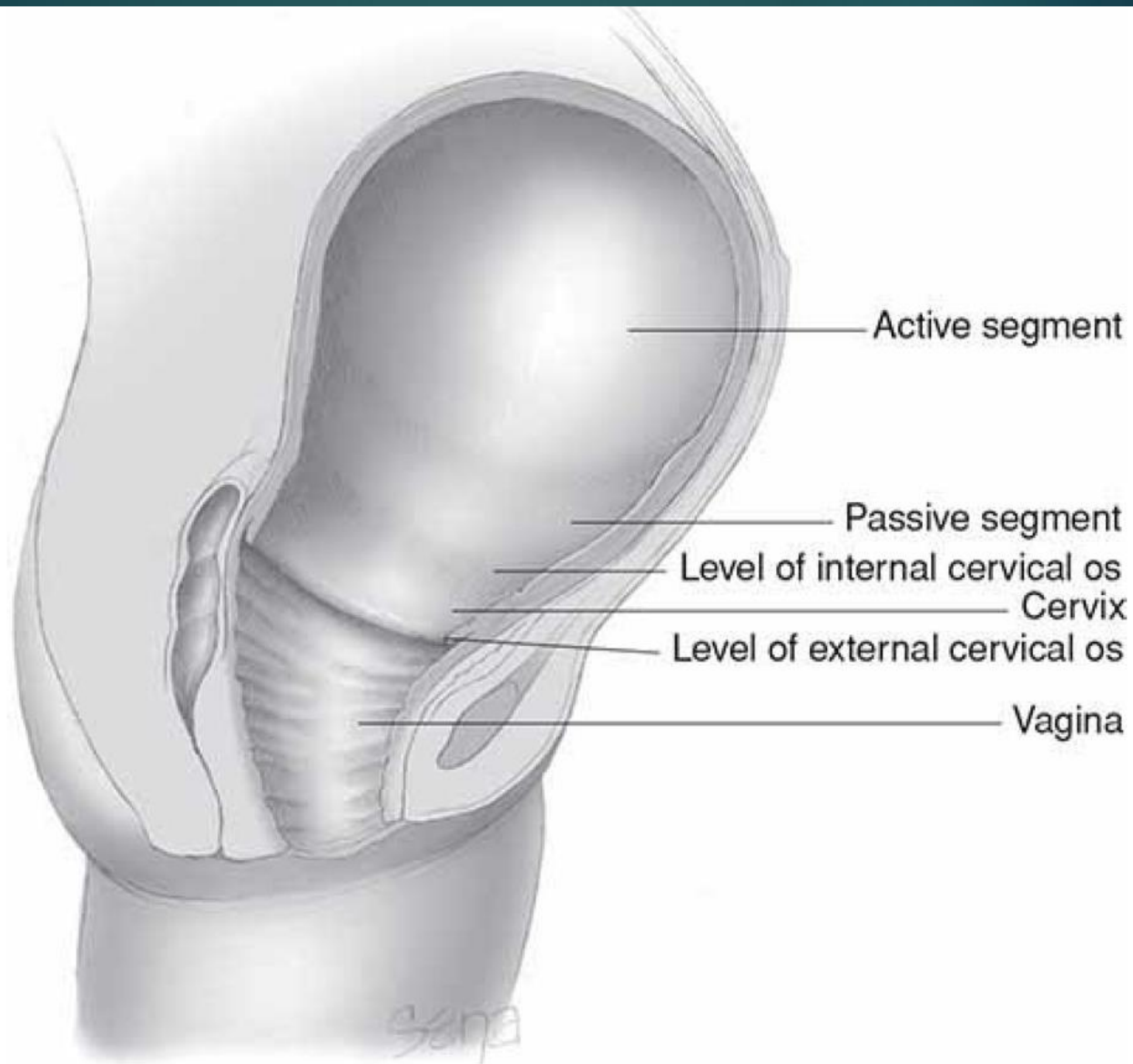


FIGURE 21-12 The uterus at the time of vaginal delivery. The active upper segment retracts around the presenting part as the fetus descends through the birth canal. In the passive lower segment, there is considerably less myometrial tone.



Normal Uterine Action:

- ▶ This mechanism is necessary because if the entire myometrium, including the lower uterine segment and cervix, were to contract simultaneously and with equal intensity, the net expulsive force would markedly decline. Thus, the upper segment **contracts**, **retracts**, and **expels** the fetus. In response to these contractions, the softened lower uterine segment and cervix dilate and thereby form a greatly expanded, thinned-out tube through which the fetus can pass.



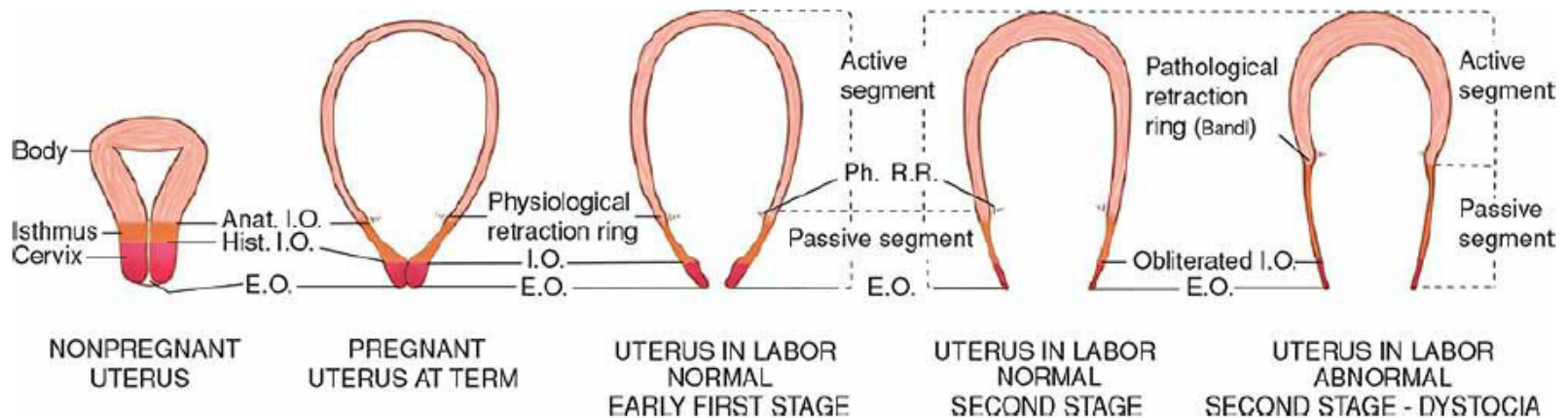


FIGURE 21-11 Sequence of development of the segments and rings in the uterus at term and in labor. Note comparison between the uterus of a nonpregnant woman, the uterus at term, and the uterus during labor. The passive lower uterine segment is derived from the isthmus, and the physiological retraction ring develops at the junction of the upper and lower uterine segments. The pathological retraction ring develops from the physiological ring. Anat. I.O. = anatomical internal os; E.O. = external os; Hist. I.O. = histological internal os; Ph.R.R. = physiological retraction ring.



Normal Uterine Action:

5. Changes in Uterine Shape:

Each contraction gradually elongates the ovoid uterine shape and thereby narrows the horizontal diameter. This change creates a greater fetal axis pressure, that is, the smaller horizontal diameter serves to straighten the fetal vertebral column. This presses the upper pole of the fetus firmly against the fundus, whereas the lower pole is thrust farther downward. The lengthening of the ovoid shape has been estimated at 5 to 10 cm.



Ancillary Forces

- ▶ After the cervix is dilated fully, the most important force in fetal expulsion is produced by maternal intraabdominal pressure.
- ▶ Contraction of the abdominal muscles simultaneously with forced respiratory efforts with the glottis closed is referred to as pushing. The force is similar to that with defecation, but the intensity usually is much greater.
- ▶ Weak pushing down leads to prolonged descent during labor as in paraplegic women and in those with a dense epidural block.
- ▶ It exhausts the mother, and its associated elevated intrauterine pressures may be harmful to the fetus.



Cervical Changes

- ▶ As the result of contraction forces, two fundamental changes—effacement and dilation—occur in the ripened cervix.
- ▶ *Cervical effacement* is “obliteration” or “taking up” of the cervix. It is manifest clinically by shortening of the cervical canal from a length of approximately 3 cm to a mere circular orifice with almost paper-thin edges.



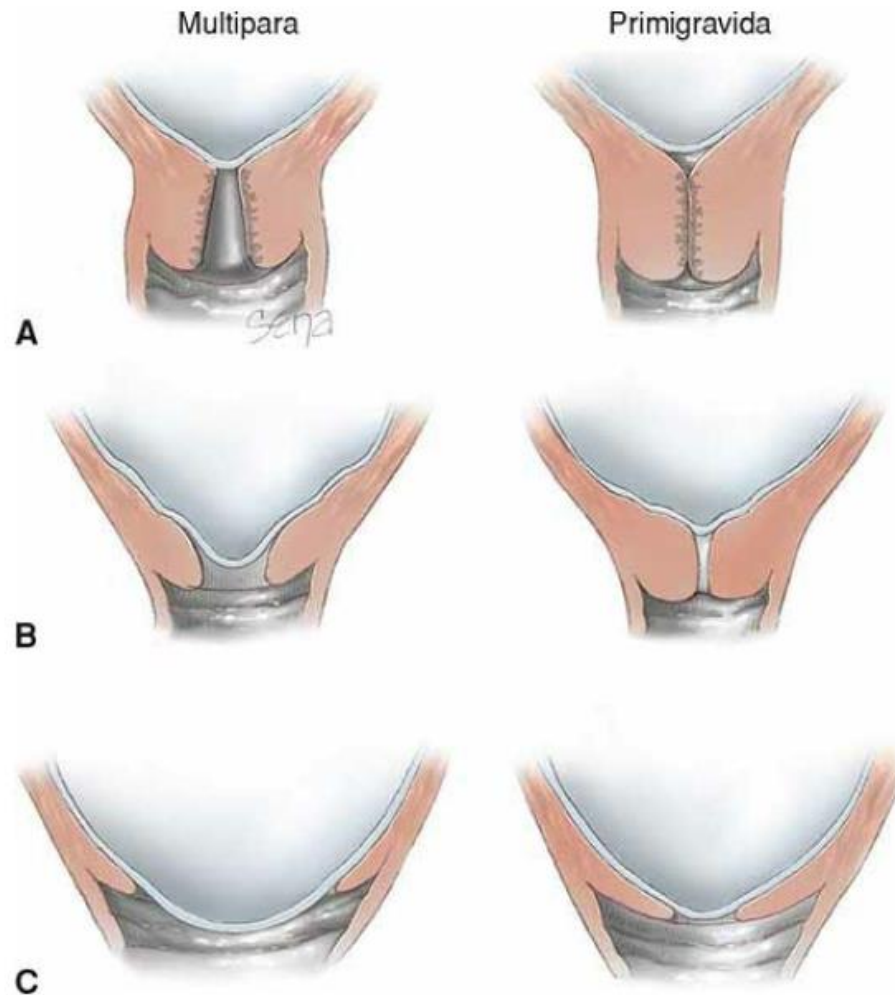


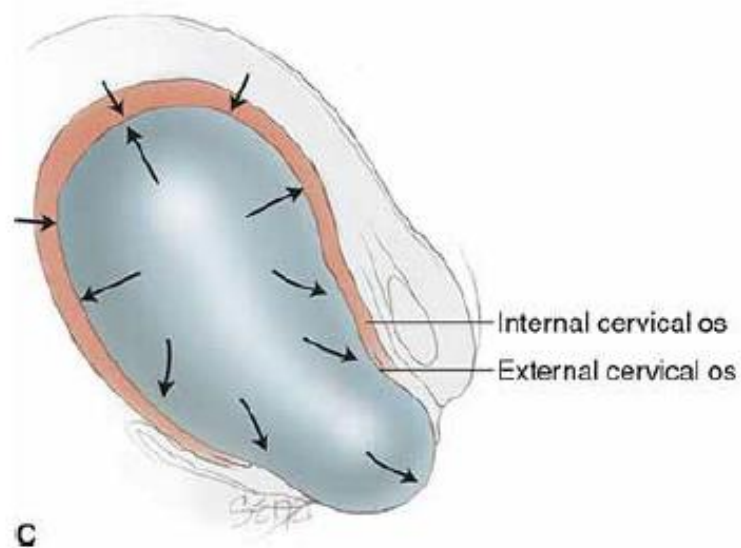
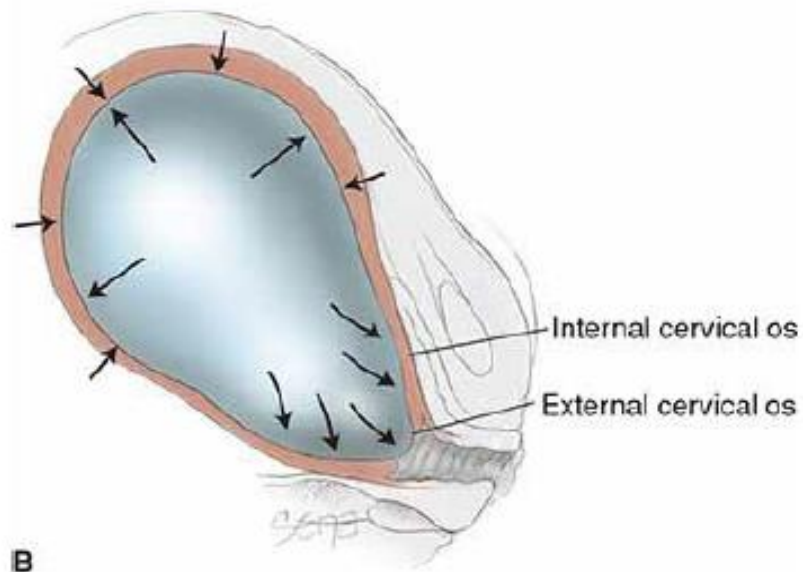
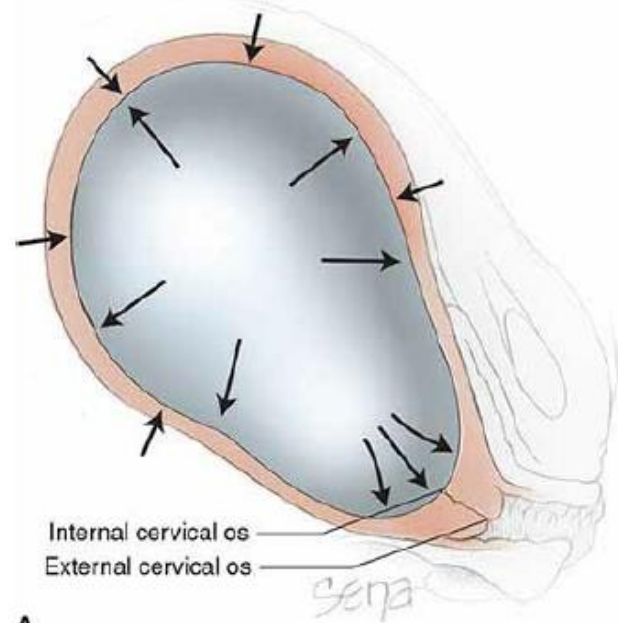
FIGURE 21-13 Schematic showing effacement and dilation. **A.** Before labor, the primigravid cervix is long and undilated in contrast to that of the multipara, which has dilation of the internal and external os. **B.** As effacement begins, the multiparous cervix shows dilation and funneling of the internal os. This is less apparent in the primigravid cervix. **C.** As complete effacement is achieved in the primigravid cervix, dilation is minimal. The reverse is true in the multipara.



Cervical Changes

- ▶ As uterine contractions cause pressure on the membranes, the hydrostatic action of the amniotic sac in turn dilates the cervical canal like a wedge. The process of cervical effacement and dilation causes formation of the forebag of amniotic fluid.
- ▶ This is the leading portion of fluid and amniotic sac located in front of the presenting part. If membranes are ruptured, the pressure of the presenting fetal part against the cervix and lower uterine segment is similarly effective as long as the presenting fetal part is well positioned against the cervix and lower segment.





Thank you

