Physiology 435 team

#7 Physiology of labor

Objectives:

- Definition of labor.
- Factors that trigger the onset of labor.
- Hormonal changes that precede and accompany labor
- Phases of uterine activity
- Clinical stages of labor.

Important
Males notes
Females notes
Extra

Resources:435 male's & female's slides.
Editing file: Here

Revised by
خولة العماري & هشام الغفيلي

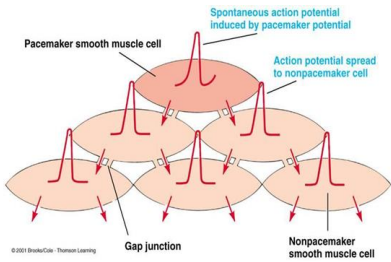
Introduction to Parturition(labor)

Definition of labor:

- Uterine contractions that lead to expulsion of the fetus to extrauterine environment.
- Towards the end of pregnancy the uterus become progressively more excitable and develops strong rhythmic contractions that lead to expulsion of the fetus.ايش سبب خروج البيبي الانقباضات القويه من الرحم
  - Labor is a process which happens at the end of a pregnancy (usually week 40) normally 37-40 weeks.

Normal uterine contraction:

كل الارحام يصير لها انقباضات تلقائية خفيفه متقطعه سواء رحم حامل ولا رحم غير حامل



- Uterus is spontaneously active.contract & relax by its own without any hormonal or neural stimuli. اعيد واقول هذي الانقباضات التلقائية تحدث في جميييع الارحام رحم حامل او غير حامل, التغيرات بالهورمونات الي تسبب الولاده تتحكم **بقوه** الانقباضات
- Spontaneous depolarization induced by :**pacemaker cells**(kajal like cells).ا
- **Gap junctions** spread depolarization. Connexin 43 (a protein responsible for gap junctions)

Factors that trigger the onset of labor:

- Exact trigger is unknown, but at least two major categories of effects lead up to the intense contractions responsible for parturition:
  1) Hormonal changes. Increase the POWER of contraction
  2) Mechanical changes. Cause GRADULL contraction of the uterus

1) Hormonal changes:

Increased ratio of estrogens to progesterone

Functions of Progesterone:

Progesterone inhibit uterine contractility by:

- ↓GAP junctions
- ↓ Oxytocin receptors
- ↓prostaglandins
- ↑resting membrane Potential(making the uterine ms more difficult to excite).

Functions of Estrogen:

Estrogen stimulate uterine contractility by:

- ↑GAP junctions **with onset of labour** NOT before قبل الولاده بيشتغل الاستروجين على اماكن اخرى غير الرحم زي الثدي يخليه يكبر وهكذا..
- ↑Oxytocin receptors
- ↑Prostaglandins

From 7th month till term: term=birth

- Progesterone secretion remain constant. but the sensitivity of receptor to progesterone will decrease therefore the uterine relaxation will decrease.
- Estrogen secretion continuously increase.
- Increase estrogen/progesterone ratio(at least partly responsible for the increased contractility of the uterus)

Oxytocin

at the last few months of pregnancy:

- Dramatic(considerable) ↑ of oxytocin RECEPTORS,leads to: **GRADUAL** transition from passive relaxed to active excitatory muscle (↑responsiveness).

at labor:

- Increase in Oxytocin SECRETION from post. pituitary. but not before labor قبل الولاده بتزيد الريسبترز فقط
- Oxytocin increase uterine contractions by:
  - Directly on its receptors.
  - Indirectly by stimulating prostaglandin production.

Prostaglandins

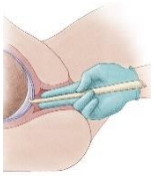
- Central role in **INITIATION** & progression of human labor.
- Locally produced (intrauterine).
- Oxytocin and cytokines stimulate its production. عملية الحمل تعبر انفلاميشن تفرز سايتوكاين هذي السايتوكاين تحفز تصنيع البروستاقلاندن
- Prostaglandin stimulate uterine contractions by:
  - Direct effect:
    - Through their own receptors.
    - Upregulation of myometrial gap junctions.عشان يخلي الاكشن بوتنشل ينتقل بسرعه
  - Indirect effect: Upregulation of oxytocin receptors.

في تعاون بين البروستاقلاندن والاوكسيتوسن كلهم يزيدون بعض.

Oxytocin plasma concentration is the same early in pregnancy and in late pregnancy, So why we don't have contraction in early pregnancy? Because we don't have the receptors for oxytocin.

Last few weeks of pregnancy, oxytocin receptors gradually increase and peak at labor.

2) Mechanical changes:

Stretch of the uterine muscle:	Stretch of the cervix:
○ Simply stretching smooth muscle organs usually increases their contractility. أي عضلة بالعالم لمن تعملها سترتش تسوي كونتراكشن, تذكروا البالون اذا شديتوه وش يصير؟ علاطول بعدها بيصير للبالونه انقباض ○ Examples of mechanical stretch eliciting uterine contractions: ■ Fetal movements. كل مازادت حركة الجنين بتسبب سترتش للرحم مؤديا الى زيادة الكونتراكشن ■ Multiple pregnancy . الي تحمل بتوأم بتزيد نسبة انها تولد مبكر, بسبب زيادة السترتش للرحم مؤديا الى زيادة الكونتراكشن	○ stretching or irritating the uterine cervix is particularly important in eliciting uterine contractions ***(Positive feedback mechanism)*** بنشرحها بتفاصيل بالصفحتين الجايه دونت ووري ○ Examples of mechanical changes stretching or irritating the uterine cervix: ■ Fetal head. بنشرحها تحت بس بقولها باختصار عند اقتراب الولاده بيوصل راس البيبي للسرفس سيؤدي الى تمدد للسرفكس تمدد السرفكس يحفز افراز الاوكستوسن,الاوكستوسن يسبب كونتراكشن للرحم  ■ Membrane sweeping & rupture is a method used to try to start labor اذا وصلت الحامل للشهر العاشر وماولدت نسوي هالطريقه. The health care provider puts her finger into the cervix→stretch of the cervix→uterine contraction→labor

Mechanics Of Labor

Uterine contractions:

During pregnancy	Towards end of pregnancy
In 2nd trimester there is Periodic episodes of weak and slow rhythmic(intermitted) uterine contractions called **(Braxton Hicks)** بالشهر السادس يحدث انقباضات متقطعه لتهيأة الرحم للولاده	1) Uterine contractions become ***progressively stronger***. 2) Uterine contractions change ***suddenly***, within hours, to become ***strong contractions**** leading to: cervical stretching and force the baby through the birth canal.

Very imp point

*** The positive feedback theory:**

what suddenly changes the slow weak rhythmicity of the uterus into strong labor contractions?????We do not know However, The positive feedback theory is suggested

Labor contractions obey all the principles of ***POSITIVE FEEDBACK,*** always there's positive feedback there's NO negative feedback

2 known types of positive feedback increase uterine contractions during labor:

1) Stretching of the cervix causes the entire body of the uterus to contract.

2) Stretching of the cervix also causes the pituitary gland to secrete **oxytocin.** بنشرحها بتفاصيل احسن تحت

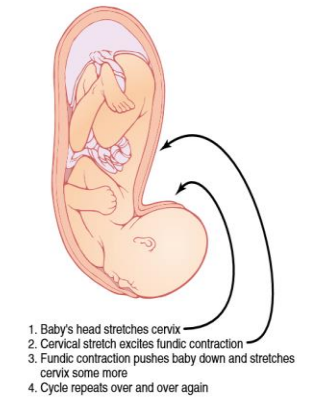
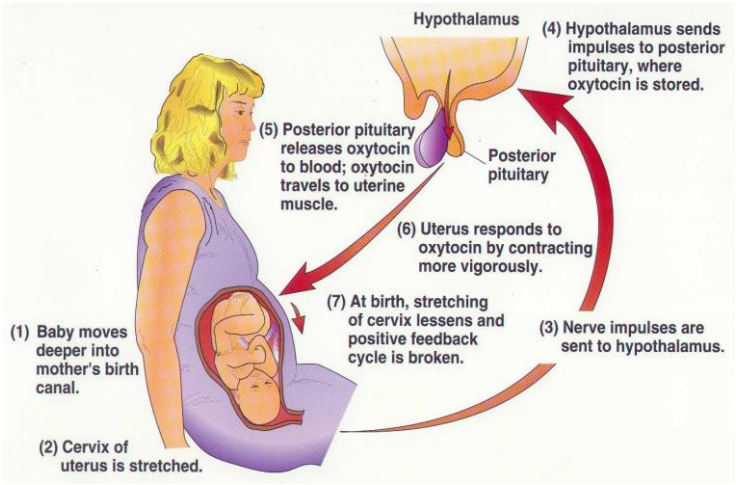


Figure 82-9 Theory for the onset of intensely strong contractions during labor.

Initiation of Labor:

1) Baby moves deeper into mother's birth canal. the stimulation from the fetal side is more powerful to start the labor
2) Cervix of uterus is stretched.
3) Afferent impulses to hypothalamus.
4) Hypothalamus sends efferent impulses to posterior pituitary, where oxytocin in stored.
5) Posterior pituitary releases oxytocin to blood; oxytocin stimulate the fundal part of the uterus to contract.
6) Contractions start at the fundus and spreads to the lower segment
    - NOTE: The intensity of contractions is **STRONG** at the **fundus** but weak at the lower segment the contraction of the fundus should be the STRONGEST.
7) Positive feedback mechanism continues to cycle until interrupted by birth of baby.



Facts about Labor Contraction:

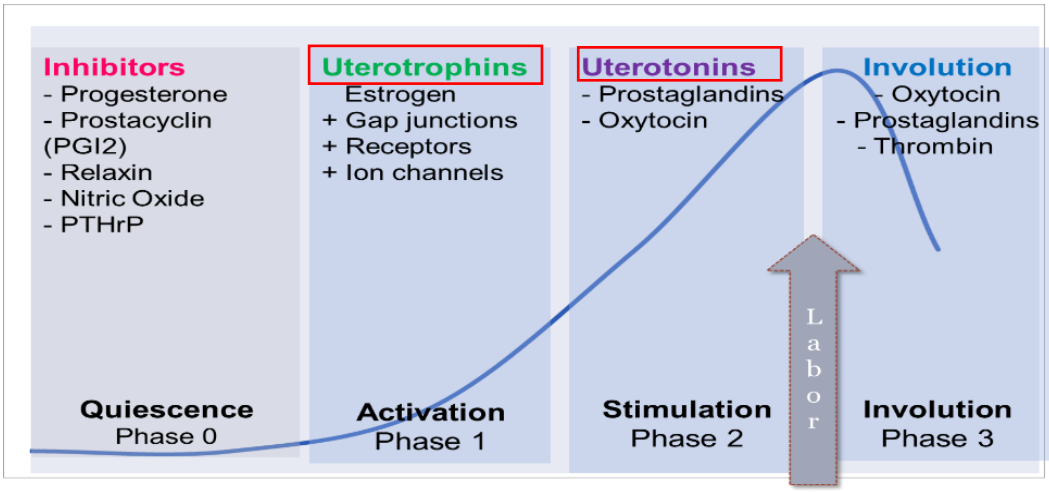
- **In the early part of labor,** the contractions might occur only once every 30 minutes.
- **As labor progresses,** the contractions finally appear as often as once every 1 to 3 minutesand the intensity of contraction increases greatly, with only a short period of relaxation between contractions.
- The combined contractions of the uterine and abdominal wall muscle during delivery of the baby cause a downward force on the fetus. فإذا وصل البيبي للسيرفكس عشان يطلع بسهوله قل للام plz help me!!, plz push ur abdomen!! plz push push
- **Rhythmical contractions** allows blood flow ,It is من نعم الله that the contractions of labor occur intermittently, because strong contractions impede or sometimes even stop blood flow through the placenta and would cause death of the fetus if the contractions were continuous.

Phases of Parturition (Uterine activity)

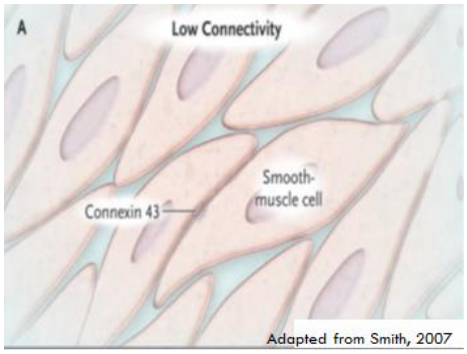
هي عباره عن التغيرات الي تحدث بالرحم من فترة الحمل الى بعد الولاده مقسمه على 4اطوار ...الفكره بسيطه جدا ومنطقيه يعني **بطور0** الي هو بالشهور الاولى من الحمل ايش تتوقعون حال الرحم فيها؟؟اكيد انه منبسط وريلاكسد عشان يسمح للجنين انه ينمو , **الطور 1** يحدث بالشهور الاخيره من الحمل هنا يبدأ الرحم يسوي انقباضات متقطعه لتهيئة الرحم للولاده تحت تأثير الاستروجين, قبل الولاده بأيام ندخل **عالطور 2** هنا تزيد الانقباضات وفترة الراحه بين كل انقباضه وانقباضه بتقل مؤديا الى الولاده, **طور 3** يبدأ بعد الولاده ويستمر تقريبا 40 يوم ايام النفاس ايش يصير فيه؟؟ ببدايته اول مايطلع البيبي مباشره يفرز الاوكستوسن والبرستاقلاندين يعمل على انقباض الرحم اكثر عشان تطلع كل المشيمه من الرحم و يمنع النزيف وايضا ترتفع مستويات الثرومبين عشان يقلل وقت النزيف بنهايه هذا الطور يرجع الرحم لحجمه الطبيعي كما كان قبل الولاده ...بس خلصنا في ابسط من كذا!!!

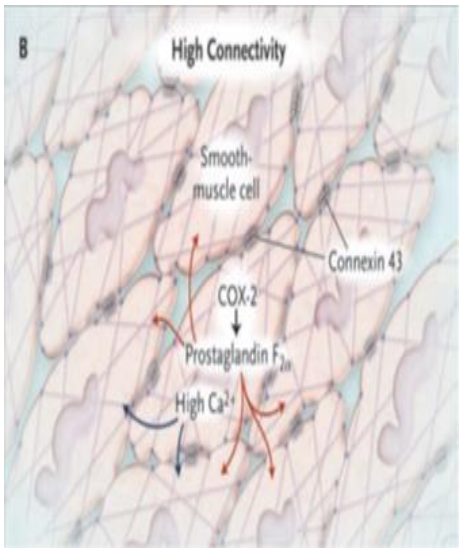
(In parturition there are 4 phases and 3 clincal stages)

هاه ايش الفرق بين الفيزس والستيجس ؟؟, الفيزس التغيرات الي تحدث على مستوى الخليه أما الستيجز هي التغيرات الاكلينيكيه الي نشوفها في الولاده من أول مايتوسع عنق الرحم الى خروج البيبي والمشيمه



Phase 0 (Quiscent)	Phase 1 (Activation)	Phase 2 (Stimulation)	Delivery	Phase 3 (Uterine Involution)

Phase 0
Quiscent
(هادي inactive)
	• Occurs during **early pregnancy** (بداية الحمل) there's no any stimulation.
	• Increase in cAMP level. cuz relaxation of sm
	• Increase in production of:
	  ○ Prostacyclin (PGI_2): cause uterine relaxation.
	  ○ Nitric oxide (NO): cause uterine relaxation.
	  ○ PTHrP :produce from placenta to inhibits uterine contraction.
		

Phase 1
Activation
	• Occurs in **third trimester.**
	• Promote a switch from quiescent to active uterus. Due to release of **UTEROTROPHINS**[1] (estrogens)
	• Increase excitability & responsiveness to stimulators by:
	  ○ GRADULL Increase expression of gap junctions عشان يسمح للكونتراكشن يقوى
	  ○ Increase G protein-coupled receptors:
	  ■ Oxytocin receptors
	  ■ Increase Prostaglandin receptors.
		

Phase 2
Stimulation
	• Occurs in **last** 2-3 gestational weeks. (starts hours or days before labor) and ends by delivery.
	• Increase in synthesis of **UTEROTONINS**: (hormones which make contraction)
	  ○ Cytokines.
	  ○ Prostaglandins.
	  ○ Oxytocin.
	- this phase Includes **2 stages:** Stage 1 &Stage 2 بنشرح وش معنى الستيجز تحت
	- This phase followed by delivery	

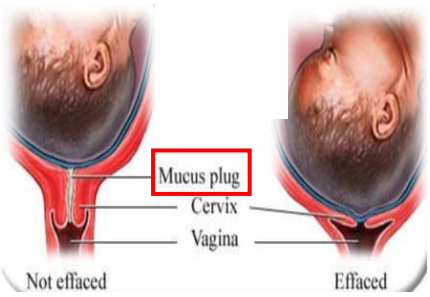
delivery		

Phase 3
Uterine Involvement
رجوع الرحم لحجمه الطبيعي تحدث في فترة النفاس
	• Occurs after delivery.
	• **Pulsatile** release of oxytocin. & prostaglandin contract the uterus to prevent postpartum hemorrhage,also thrombin level will elevate to prevent prolonged bleeding سبحان الله
	• Delivery of the placenta.
	• Involution of the uterus: رجوع الرحم لحجمه الطبيعي
	  ○ Occurs in 4-5 weeks after delivery. يعني بعد النفاس تقريبا بيرجع لحجمه الطبيعي
	  ○ Lactation helps in complete involution.	

Plz know that In the exam they will not ask you (phase 1, phase 2….) they will say quiescence, activation, stimulation and involution.

[1] Means hormone cause effect on uterus

Clinical Stages of Labor

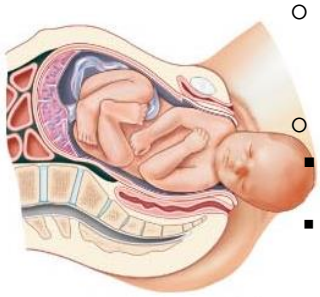


قبل مانبدأ نتكلم عن الستيج شوفوا الصورة الي عالجنب هالصورتين صورة لرحم في بداية الحمل والثانيه بنهايته..الي ابيكم تنتبهون له الي هو ميوكس بلوق هذا المخاط يسكر السيرفكس مايخلي الراس يطلع, فأول علامة اذا شافتها الحامل تعرف انها بتولد الي هي خروج الميوكس بلوق(السائل المخاطي)ليش خرج لان السيرفكس توسع صار Effaced(thin)

Stage 1: Dilation

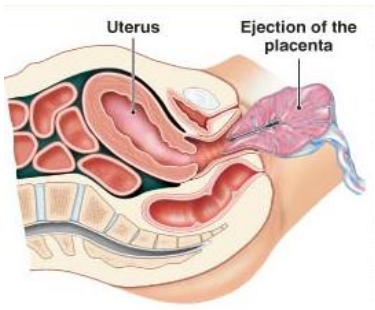
- **Cervix** becomes **dilated.**
- Full dilation is 10 cm.
- Uterine contractions begin and increase.
- Cervix softens and effaces (thins).
- The amnion ruptures ("breaking the water") مع الكونتراكشن القوي راس الجنين بيشق الكيس الامنيوتي فتخرج موية الرأس
- Longest stage at 6–12 hours

A very very very important stage. **Stage 2: Explusion** خروج الجنين بالكامل من الرحم



- Infant passes through the cervix and vagina.
- Can last as long as 2 hours, but typically is 50 minutes in the first birth and 20 minutes in subsequent births.
- **Fetal positions:**
  - vertex position: Normal delivery is head first بالميه من الحريم 99د. الوضعيه الافضل والي تصير
  - breech presentation: When the baby enters the birth canal with the buttocks or feet first.

Stage 3: Placental stage after the delivery



- Delivery of the placenta
- Usually accomplished within 15 minutes after birth of infant لما يطلع الجنين تقعد عندي البلاسنتا دقايق جوا الرحم.. فلا تقعد تسحب البلاسنتا عشان تطلع خلها تطلع من نفسها خلال 15 دقيقه , وايضا اذا خرجت البلاسنتا جدا مهم للطبيب انه يتأكد مافي بقايا بلاسنتا بارحم لازم كلها تطلع من الرحم..
- Afterbirth—placenta attached to the fetal membranes are delivered.

- All placental fragments should be removed to avoid **postpartum bleeding**

SUMMARY

- ## labor:

Uterine contractions that lead to expulsion of the fetus to the extrauterine environment.
Spontaneous depolarization of pacemaker cells → gap junctions spread depolarization

.

- ## Factors that trigger the onset of labor:

Exact trigger is unknown

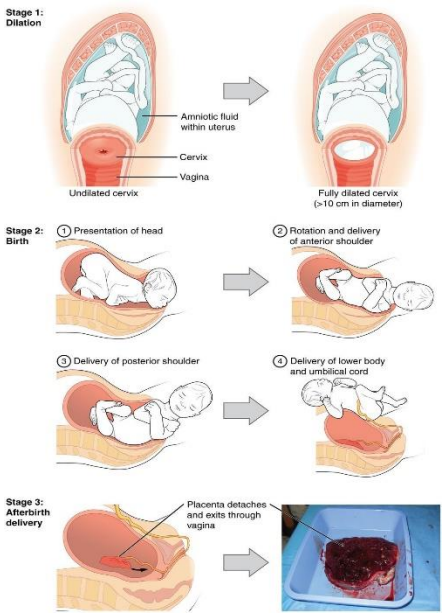
1- Hormonal changes :	2- Mechanical changes :
♦ **Estrogen → stimulates** uterine contractility by: ○ **increase** gap junction , oxytocin receptors & prostaglandins. ♦ **Progesterone → inhibit** uterine contractility by: ○ **decrease** gap junction , oxytocin receptors & prostaglandins. ○ **increase** resting membrane potential	♦ Stretch of the uterine muscle → Increases contractility by: ○ Fetal movements & Multiple pregnancy ♦ Stretch of the cervix → Increases contractility (Positive feedback mechanism) by: ○ Membrane sweeping & rupture ○ Fetal head

- ## Phases of uterine activity

Phase 0 (quiescence)	Phase 1 (activation)	Phase 2 (stimulation)	Phase 3 (uterine involution)
- during early pregnancy - Increase in cAMP level	- third trimester - switch from quiescent to active uterus	- last 2-3 gestational weeks	- 4-5 weeks after delivery - Lactation helps in complete involution
Increase in production of inhibitors : - Prostacyclin and Nitric oxide → uterine relaxation - PTHrP inhibits uterine contraction	- Increase expression of gap junctions - Increase G protein-coupled receptors: oxytocin & PG receptors	Increase in synthesis of uterotonins : - oxytocin - prostaglandins	- Pulsatile release of oxytocin - Delivery of the placenta

- ## Clinical Stages of Labor:

1) Dilation	- Cervix becomes dilated (Full dilation is 10 cm) - Longest stage at 6–12 hours - Uterine contractions begin - The amnion ruptures
2) Expulsion	- Infant passes through the cervix and vagina - 50 minutes in the first birth and 20 minutes in subsequent births - Normal delivery is head first (vertex position) - Breech presentation is buttocks-first
3) Placental	- Delivery of the placenta within 15 minutes after birth - All placental fragments should be removed to avoid postpartum bleeding



MCQs

1. occurrence of uterine involution :

a. 4-5 weeks before delivery
b. 4-5 months after delivery
c. 4-5 weeks after delivery
d. 4-5 months before delivery

2. which of the following stimulate prostaglandins production :

a. Prostacyclin
b. Cytokines
c. Estrogen
d. Nitric oxide

3. which of the following is longest stage of labor :

a. Dilation
b. Expulsion
c. Placental
d. All of them have same duration

4. stretch which of the following cause positive feedback mechanism :

a. fundus of uterine
b. body of uterine
c. cervix
d. viginal muscle

5. which of uterine phases have increasing of cAMP level :

a. phase 0
b. phase 1
c. phase 2
d. phase 3

6. Phase 1 of Parturition occurred in which trimester :

a. First
b. Second
c. Third
d. All of them.

7. Progesterone inhibits uterine contractility through :

a. Increase oxytocin receptors
b. Decrease oxytocin receptors
c. Increase GAP junctions
d. Increase PGs

8. During which stage of labor postpartum bleeding may happen if not accomplished probably :

a. Explusion
b. Dilation
c. Vaginal stage
d. Placental stage

9. Prostaglandin stimulate uterine contractions indirectly by:

a. Upregulation of oxytocin receptors
b. Downregulation of oxytocin receptors
c. Their own receptors
d. Upregulation of myometrial gap junctions.

10. Contraction during labor start at :

a. Body of uterus
b. Cervix of uterus
c. Fundus of uterus
d. Vagina.

Answer key:

1 (c) | 2 (b) | 3 (a) | 4 (c) | 5 (a) | 6 (c) | 7 (b) | 8 (d) | 9 (a) | 10 (c)

Physiology 435 team

Thanks to this amazing team!

روان الضويحي
رغدة القاسم
منيرة السلولي
نوف العبدالكريم
لينه الشهري

عمر آل سليمان
عمر العتيبي
حسن البلادي