

- Pregnancy is a physiological state that increases the risk of mortality & morbidity in a lady.
- It is a state of smooth muscle relaxation due to the effect of progesterone hormone [keep this in mind throughout this Lec].

Physiological Changes in Pregnancy

* Changes aim:

- (1) To meet demands
(↑ O₂ and nutrients delivery
↑ waste excretion)
- (2) To prevent complications

Dr Oqba Al-Kuran

Consultant Maternal Fetal Medicine

* Additional important notes are added to each system by the doc, check them in the last 2 pages in this file



Edited by:
Laila
NazzaL

Cardiac

* changes in CVS:

- Changes begin early in gestation. → bcz it is related to progesterone (and not only the size of baby).
- Peripheral vaso-dilatation (PVD) leads to a fall in SVR.
- CO increases by 40% during pregnancy (20% by 8 wks)
- Increase in the stroke volume.
- Increase in the heart rate.
- Max CO is at 20-28 wks.
- CO falls minimally at term.
- The heart is physiologically dilated and myocardial contractility is increased during pregnancy.
- Labour is associated with a further increase in the CO, → In labour you have the large uterine myocardium contracting.. it is a strenuous exercise that requires a lot of O₂!
- 15% in the first stage,
- 50% in the second stage.
- CO returns to normal by 2 weeks of delivery.

Vascular

BP is directly proportional to the systemic vascular resistance and cardiac output.

- Vasodilatation is probably the primary change in pregnancy.

BP drops from the beginning of pregnancy peaks at 22-24 weeks to go back to pre-pregnancy level at term, due to increase in CO.

BP measurements:

Phase V (disappearance) rather than IV (muffling) Korkotkoff sounds.

Sitting/Lying 30 degrees tilt

BP falls immediately after delivery then goes up to peak at day 3-6.

BP may go up transiently during labour.

[If we measure it while supine, we might have "supine hypotension syndrome", where the uterus will compress IVC and decrease the venous return]
[when the uterus contracts, it squeezes the blood back into circulation, BP↑]

Respiratory

- * 40-50% increase in minute ventilation, mostly due to:

Increase in tidal volume.

Hyperventilation leading to:

- Reduction in PaCO₂
- Compensatory fall in serum bicarbonate.

- * Pulmonary vascular resistance decreases

- * Increase in:

- O₂ consumption by 20%.
- Metabolic rate by 15%.

Decrease in:

Functional residual capacity. **FRC**

No change in:

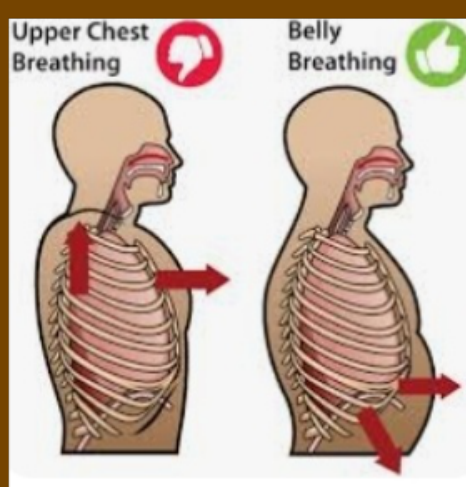
Respiratory rate.

Vital capacity.

FEV₁.

Peak expiratory flow rate (PEFR).

PaO₂.



Skeletal muscle

Harder

Thoracic Breathing

Smooth muscle

Involuntary

Easier.

Abdominal Breathing

→ ↑ amount of air exchange per minute.

* pregnant ladies find it hard to breathe abdominally as the uterus prevents the diaphragm from going down, so they try to have thoracic breathing which is harder along with two enlarged breasts on their chests, that's why pregnant ladies are breathless.

Renal system

Anatomical changes

* Dramatic dilatation in the renal collecting system.

More on the right (gravid uterus compresses more on the right).

Progesterone

Uterine compression.

physiologic changes

• Renal plasma flow (RPF) increases in early pregnancy, (60-80% by the 2nd TM).

• RPF decreases in the 3rd TM but still is 50% higher than pre-pregnancy at term.

There is a fall in serum urea and creatinine due to:

Increase in GFR ✓

Increase creatinine clearance by 50%. ✓

Protein excretion increases. (300mg instead of 150mg).

* Physiological Na and water retention during pregnancy, 80% of women develop oedema.

mostly dependent edema in her legs.

maybe her hands also involved

But face ⇒ mostly preclampsia

[Volume expansion]

→ In pregnancy we have more production of coagulation factors to prevent complications after delivery, and to prevent thromboembolic accidents during preg. the volume of blood expands to prevent stasis of clotting factors.

Hepatobiliary system

Increased liver metabolism.

Total serum protein concentration decreases due to:

20-40% fall in albumin concentration.

Dilution.

Fibrinogen production is dramatically increased. [Remember, pregnancy is a hypercoagulable state]

Rise in almost all the binding proteins including:

Ciruloplasmin.

TBG.

SHBG.

CBG.

Transferrin.

Rise in Alkaline phosphatase, 3-4 times the normal value.

ALT and AST slightly fall.

[Due to smooth muscle relaxation in the gall bladder]

Gastro-intestinal tract

Due to progesterone effects:

- * Decreased lower oesophageal pressure
- * Decreased gastric and gut peristalsis.
- * Delayed gastric emptying.

Causing Common symptoms of Constipation.

esp morning sickness. ← Nausea. Due to hyperthyroid state [HCG β -subunit resembles that in TSH]. Vomiting.

* Hyperemesis Gravidarum:
Intractable N & V that causes electrolyte disturbances in pregnancy.

Skin

- Increased pigmentation:
Begins in 1st TM and fades after delivery.
Melasma: patches of pigmentation on the face.

- Spider naevi.

- Palmer erythema

- Hair fall, happen 2-20 weeks post partum, recovers in 6 months. *caused by falling estrogen levels.*

- Stria gravidarum, new ones are pink, old ones are white.

- Pruritus.

* pregnancy causes darkening in the following areas:

- Linea alba → Linea nigra

- Nipple-areolar complex

Sugar control

Physiological insulin resistance and glucose intolerance.

Fasting levels are decreased

⇒ Post prandial levels are increased.

* Glucose intolerance increases progressively by advancing gestation. ✓

This is a result of the anti insulin hormones secreted by the placenta:

- HPL. *Human placental lactogen*.
- Glucagon
- Cortisol.

Normal women double their insulin production during pregnancy, and diabetic women require more insulin.

Renal threshold for glucose falls.

* In pregnancy, the body tries to preserve sugar for the baby, that's why insulin resistance increases. and mother's cells mostly depend on gluconeogenesis.

Thyroid

TBG increases.

Total T3, T4 increase but the free fraction remains constant, or slightly falls in the 2nd and 3rd TM

hCG has thyrotropic activity..

serum concentration of TSH falls in the 1st TM as hCG increases.

Hyperemesis gravidarum is often associated with biochemical thyrotoxicosis., high T4 low TSH.

Pregnancy is associated with a state of relative Iodine deficiency because:

Active transport to the fetoplacental unit.

Increased renal excretion (increase two folds).

Increased GFR.

Reduced Tubular reabsorption.

Thyroid uptake from the blood triples, if there is a dietary deficiency goiter results.

Coagulation

* Pregnancy is a hypercoagulable state:

There is around 50% increase in the levels of the following factors

X

IX

VIII

VII

II (Prothrombin)

Fibrinogen.

Fibrinolytic activity is reduced.

Endogenous anticoagulants decrease:

Anti-Thrombin III

Protein S.

* The hypercoagulable state extends to 6 weeks post partum.

* Clotting tests remain normal. → tests are normal so the trigger is normal, BUT once they coagulate it is very potent!

Venous stasis in the lower limbs associated with venodilatation and decreased flow, which is more marked in the left side.

→ Ladies with increased risk factors of thrombosis are given prophylactic anti-coagulants post-partum

Risk of coagulation post partum > during preg.

Pituitary and adrenal

The volume of the anterior pituitary increases progressively during pregnancy by up to 35%.

Post partum involution is slower if the mother breast feeds.

Prolactin level increases up to 10X, and return to normal by 2 weeks post partum.

LH, FSH levels are suppressed.

The placenta produces the following:

hPL, this resembles GH

Specific placental GH.

ACTH

CTH

Pituitary secretion of ACTH remain unchanged.

Free and bound cortisol levels increase. ↑ Na⁺ & water retention

Diurnal variation is maintained in pregnancy.

Levels of angiotensin II is increased 2-4X.

Plasma rennin activity is also increased 2-4X.

Plasma and urinary levels of aldosterone is increase 3 folds in the 1ST tm and 10 folds by the 3rd TM.

→ So it does not stay high, bcz prolactin is needed to initiate lactation, once initiated then its levels go down.

↑ Edema

Sheehan's syndrome (SS) is **postpartum hypopituitarism caused by necrosis of the pituitary gland**. It is usually the result of severe hypotension or shock caused by massive hemorrhage during or after delivery. Patients with SS have varying degrees of anterior pituitary hormone deficiency.

Additional notes on CVS changes:

Blood pressure changes throughout according to gestational stage:

- BP readings are decreased from the beginning of preg to 20-24 weeks of gestation
- then it rises up to pre-pregnancy values at around 36 weeks
- Immediately after Labour BP readings will go down
- within 5 days after Labour, BP goes back to pre-pregnancy readings



Applications

* BP of 90/50 is considered normal in pregnancy (Especially 20-24 weeks of gestation)

so if a lady has 125/85 [in 20 weeks of gestation] then this is high.

* If a patient on BP medications, we might stop it shortly after Labour as her BP will drop physiologically immediately after birth.

Additional notes on renal system

2 changes in the renal system:

1) Anatomical

- Ureters are dilated due to smooth muscle relaxation, so physiological mild to moderate hydronephrosis might happen in pregnancy. However this might invite bacteria and progresses to UTI and hydronephrosis causing pain

2) Functional

- ↑ Renal Plasma Flow (RPF) by around 80% because we have high metabolic rate, and need to clean the toxins
- that's why kidneys will leak more substances like (protein, creatinine, urea)
- ⇒ In normal people, glucose in urine is less than 150 mg/day, while in pregnant ladies, we accept up to 300 mg/day
- bcz of ↑ RPF, hyperdynamic flow.

Side note:

ESR: Erythrocyte sedimentation rate
it measures how quickly RBCs settle at the bottom of a test tube that contains a blood sample. Normally RBCs settle relatively slow. A faster than normal rate may indicate inflammation or cancer or other conditions

ESR is not used in pregnancy as a marker of inflammation or infection as ESR is normally increased in pregnancy. why: In pregnancy fibrinogen will increase, serving as positive charge between the negatively charged RBCs, thus facilitating its sedimentation.

Instead, CRP is the marker used.

Liver

* Physiological volume expansion of plasma in pregnancy will dilute the proteins and hormones, so the liver will increase its metabolic rate & production of proteins to keep the concentration of free portions enough to preserve the function

⇒ SO, ↑ total protein and hormone binding proteins (↑ production)

• ↓ in concentration of proteins (due to dilution)

Skin

* Striae develop in pregnancy due to enlarged uterus and breakage of collagen.

Primi gravida: new breakage
↓
Inflammation
↓
pink

Multi para: no new breakage
↓
white

* If a lady is multipara, with pink stria?
↳ sth is larger than her usual pregnancies (twins, larger baby mass in ovary or uterus)