



# PHYSIOLOGICAL CHANGES DURING PREGNANCY

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# INTRODUCTION

- **During pregnancy there is progressive anatomical and physiological changes not only confined to the genital organs but also to all systems of the body. This is principally a phenomenon of maternal adaptation to the increasing demands of the growing fetus.**



# CHANGES IN GENITAL ORGANS

## VULVA:

- Becomes edematous and hyperemic
- Superficial varicosities may appear

## VAGINA:

- Walls becomes hypertrophied
- Edematous and more vascular
- Increased blood supply of the venous plexus gives bluish discoloration (Jacquemiers sign)



# Contd..

- **Secretion becomes copious, thin and curdy white**
- **pH becomes acidic due to increased in lacto bacillus acidophilus**
- **The acidic pH prevents multiplication of pathogenic organisms**



# Changes in uterus



# Contd...

- In length from 6.5 to 32 to 35 cm.
- (b) In depth from 2.5 to 22 cm.
- (c) In width from 4 to 24 cm.
- (d) In weight from 50 to 1000 grams.
- (e) In thickness of the walls from 1 to 0.5 cm.





## CONTD..

- **Hypertrophy and hyperplasia of the muscles**
- **This hypertrophy is influenced by the hormones estrogen and progesterone**
- **The muscle fibers further elongate and becomes thinner at term**
- **It measures about 1.5cm or less**



Contd..

**The muscle fibers  
are arranged as:**

- 1. Outer –  
longitudinal**
- 2. Inner –circular**
- 3. Intermediate-  
criss-cross  
fashion**





# Contd..

## SHAPE:

- **Non pregnant pyriform shape is maintained in early months**
- **It becomes globular at 12 weeks**
- **Oval by 28 weeks**
- **Spherical beyond 36 weeks**



## POSITION:

- Normal anteverted position is exaggerated up to 8 weeks
- As the uterus enlarges it usually rotates to the right (dextro-rotation)
- Cervix is deviated to the left side(levo rotation)

## CONTRACTIONS:

- Braxton hicks contractions which are irregular, infrequent, spasmodic and painless without any effect on the dilatation of the cervix



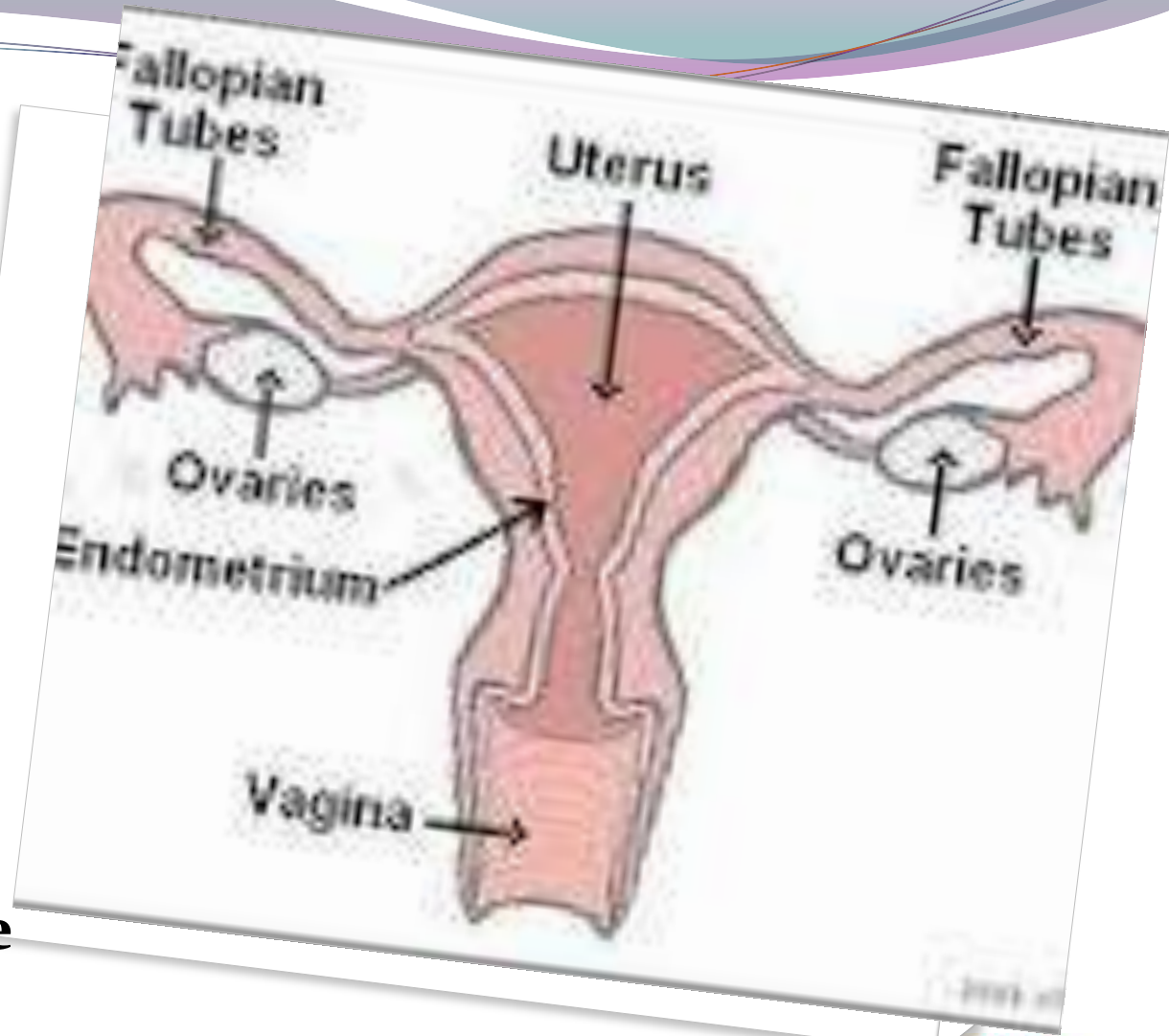
## **ENDOMETRIUM:**

- **The decidua is the endometrium of the pregnant uterus**
- **Three layers are developed:**
  - 1. Superficial compact layer(decidual cells, gland ducts and dilated capillaries)**
  - 2. Intermediate spongy layer(uterine glands, decidual cells and blood vessels)**
  - 3. Thin basal layer(basal portion of the glands)**



## ISTHMUS:

- Isthmus hypertrophies and elongates to about 3 times its original length
- Beyond 12 weeks it unfolds from above, downwards until it incorporates into the uterine cavity



## CERVIX

- There is hypertrophy and hyperplasia of tissues and glands
- Vascularity increased and these leads to softening of the cervix (Goodell's sign) which is evident at 6 weeks
- The secretion is copious and tenacious called as physiological leucorrhoea of pregnancy



## FALLOPIAN TUBE

- The total length is increased
- The tube becomes congested
- Muscles undergo hypertrophy

## OVARY:

- The growth and function of the corpus luteum reaches its maximum at 8<sup>th</sup> week and measures about 2.5cm and becomes cystic.
- Both the ovarian and uterine cycles of the normal menstruation remain suspended.

### How Fertility Drugs Work





# BREASTS:

Illustration of breast tissue before pregnancy

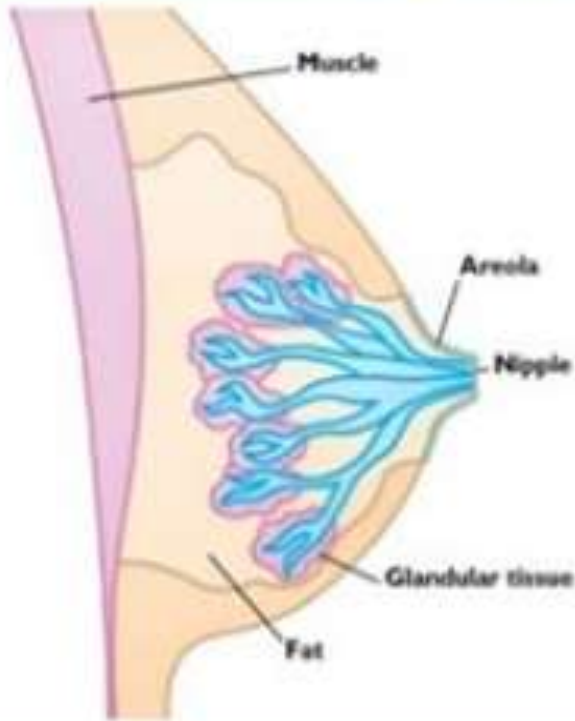
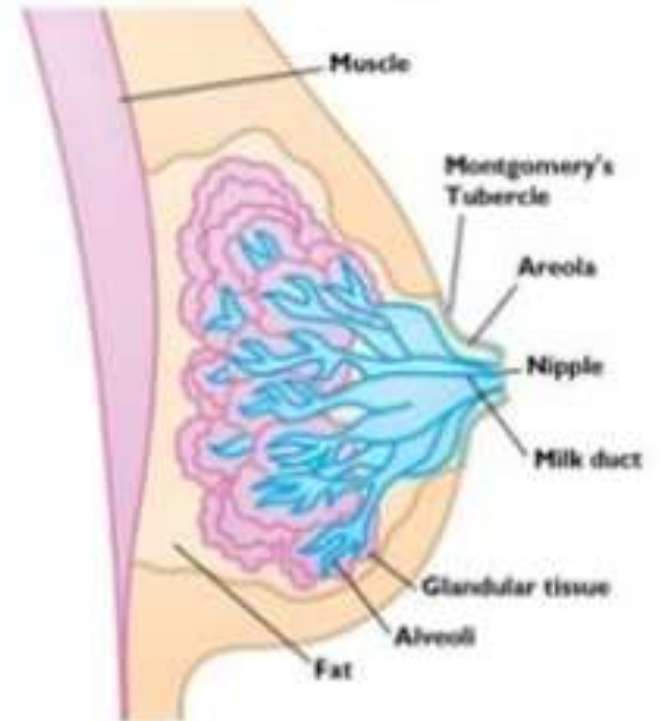


Illustration of breast tissue in late pregnancy

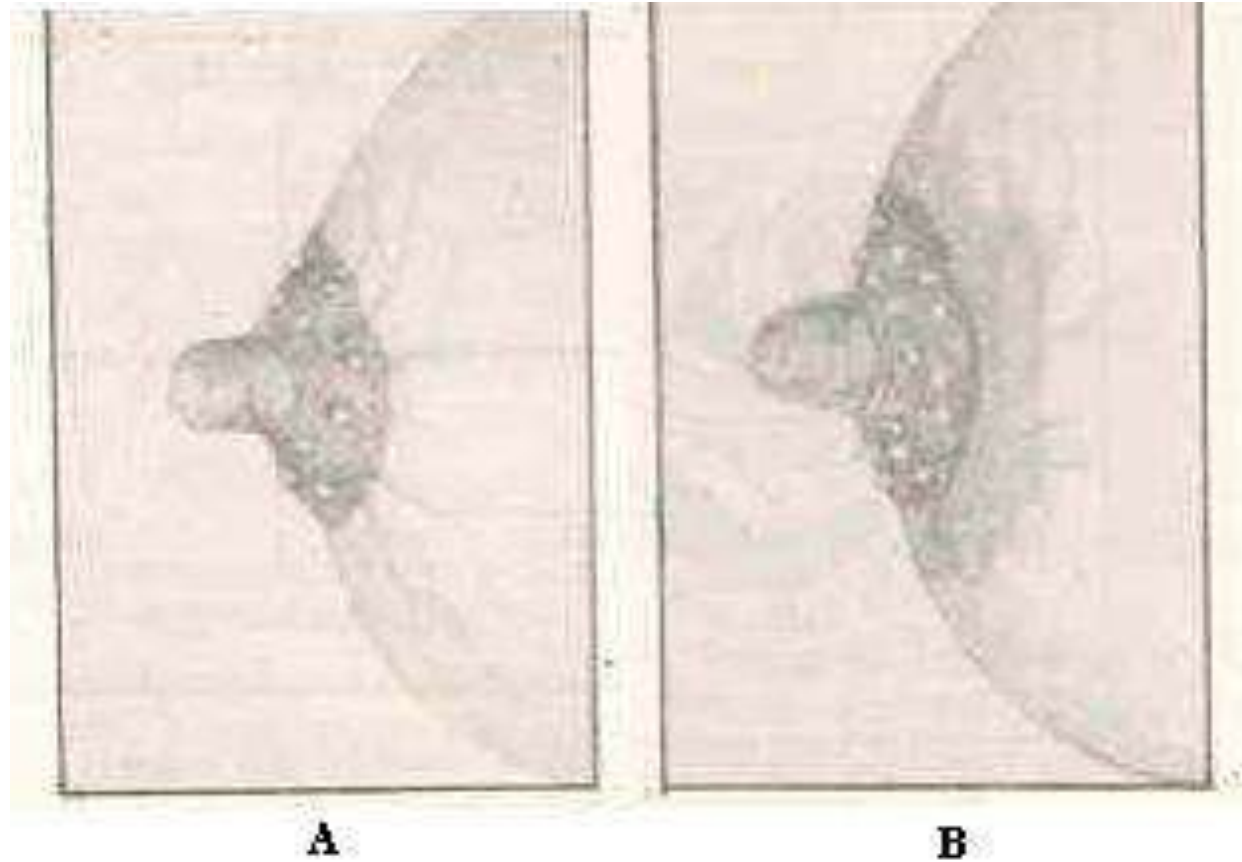


# **BREASTS**

- **Increased size of the breasts.**
- **Myo epithelial cells become prominent.**
- **Evidence of striae due to stretching of cutis.**
- **Vascularity is increased**
- **Auxillary tail (prolongation of the breast tissue)**
- **NIPPLES AND AREOLA:**
- **Nipples becomes larger, erectile and deeply pigmented.**
- **Sebaceous glands becomes hypertrophied and called Montgomery's tubercles.**
- **An outer zone of less marked and irregular pigmented area appears is called secondary areola.**



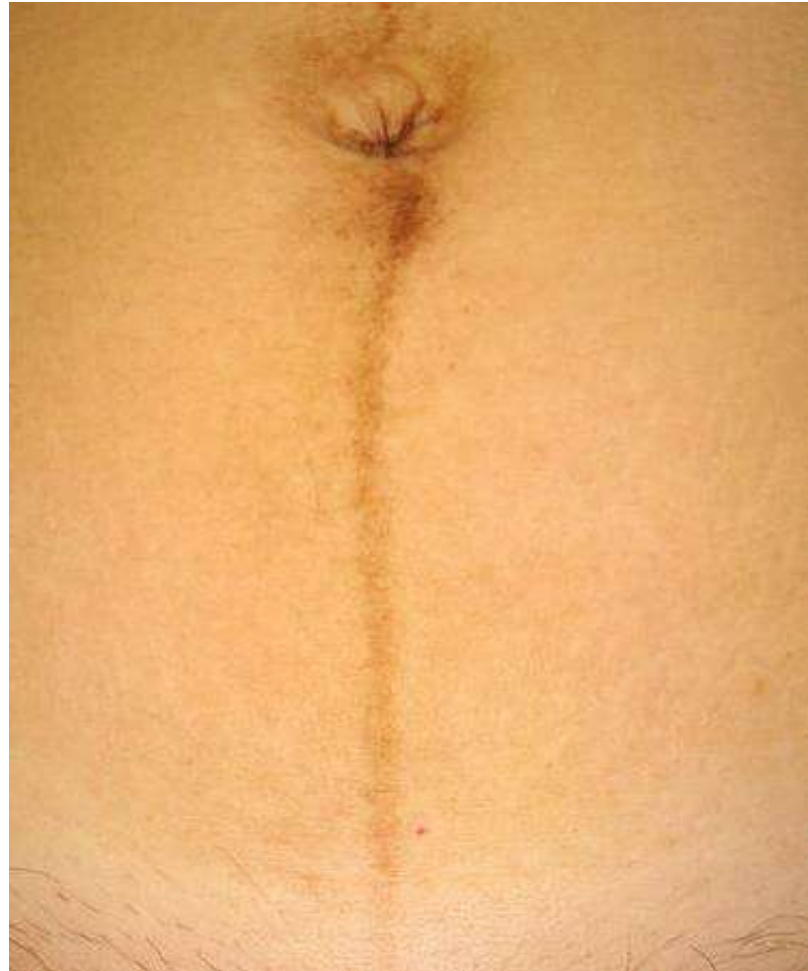
# AREOLA



- BREAST CHANGES DURING PREGNANCY**
- (a) Pronounced pigmentation of the areola and nipple**
  - (b) Appearance of secondary areola, development of Montgomery's tubercles and increased vascularity**



# SKIN CHANGES- LINEA NIGRA



# STRIAE GRAVIDARUM





# CHLOASMA





## Cutaneous changes

- **Pigmentation** occurs through out the body

### Face:

- **Chloasma gravidarum** or pregnancy mask present around the cheeks, forehead and around the eyes.

### Abdomen:

- **Linea nigra**- it is a brownish black pigmented area stretching from the xiphisternum to the symphysis pubis.
- **Striae gravidarum**- slightly depressed linear marks with varying length and breadth. Predominantly found in the abdominal wall below the umbilicus, thighs and breasts.
- Initially these are pinkish and after delivery it becomes glistening white in appearance and called **striae albicans**.
- Mild degrees of **hirsutism** is observed.



# WEIGHT GAIN



- **The total weight gain during pregnancy averages 11kg.**
- **This has been distributed in first trimester 1kg, 5kg in second and third trimester.**
- **Increased accumulation of fluid in the tissue spaces is due to haemodilution.**
- **Increased sodium retention is due to increased estrogen and progesterone.**
- **The amount of water retained during pregnancy at term is estimated to be 6.5 litres.**



# Weight gain

## Reproductive weight gain-6kg

- Fetus-3.3kg, placenta-0.6kg and liquor-0.8kg
- Uterus -0.9kg, breasts-0.4kg

## Maternal weight gain-6kg

- Increase in blood volume-1.3kg
- Increase in extracellular fluid-1.2kg
- Accumulation of fat and protien-3.5kg





## BODY WATER METABOLISM

- The amount of water retained is about 6.5 litres
- The water content of the fetus, placenta and amniotic fluid is 3.5 L.
- The causes of water and sodium retention are:
  - Changes in osmo regulation
  - Increased estrogen and progesterone
  - Increase in renin angiotensin activity and causes increased aldosterone.





# HAEMATOLOGICAL CHANGES

## BLOOD VOLUME

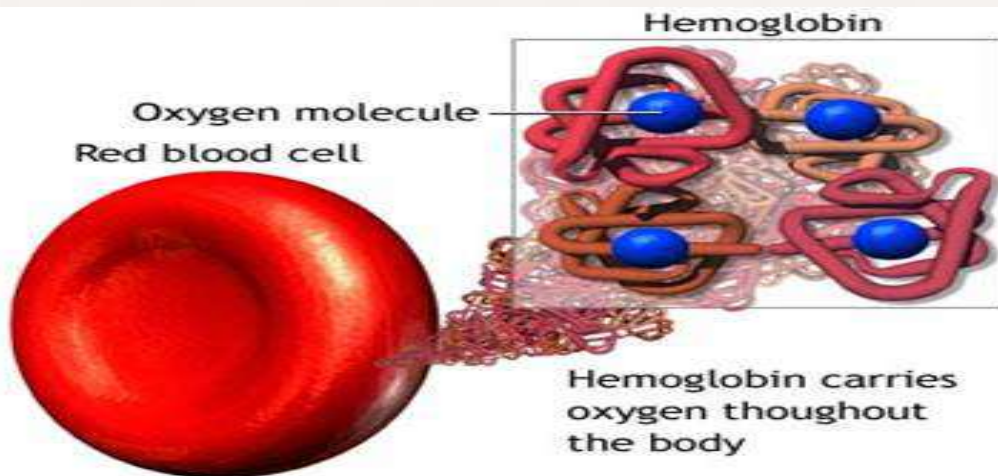
increases from 6<sup>th</sup> week and reaches maximum at 30-32 weeks. 4000-5500.

## PLASMA VOLUME:

Increases about 1.25 litres. From 2500 to 3750.

## RBC AND HAEMOGLOBIN

RBC Increases about 350ml 1400-1750 , HB increases about 18-20% 475-560.



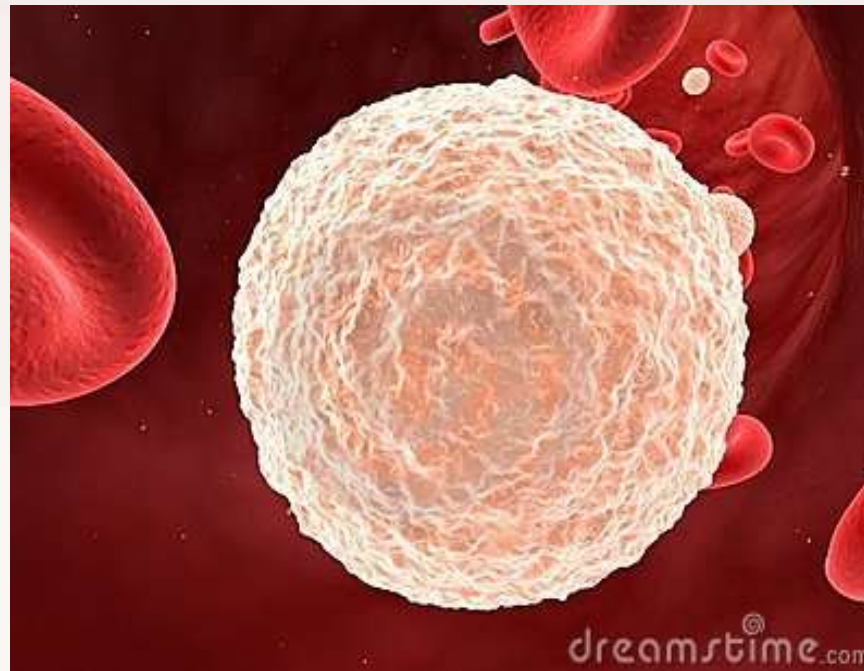




CONTD.....

LEUCOCYTES

Leucocytosis occurs to the extent of 10-15,000/cu.mm and even to 20,000/cu.mm





## CONTD....

- **TOTAL PROTEIN**

- Total plasma protein increases from 180gm to 230gm at term.

- **BLOOD COAGULATION FACTORS**

- It is a hypercoagulable state. Fibrinogen level is increased from 200-400mg to 300-600mg%.

- ESR rate is increased. Clotting factors increases.



# PHYSIOLOGICAL CHANGES

## □ CARDIO-VASCULAR SYSTEM (CVS)

Cardiac output increases by 40 to 50% at about 30-34 weeks.

- Heart is pushed upwards and outwards with slight rotation to left.
- **Heart rate increases** by 10 beats per minute
- A systolic murmur is audible in pulmonary due to less viscosity
- **Blood volume increases** 30 to 50 percent





- ❑ **Blood pressure** decreases due to the smooth muscle relaxing effect of progesterone
  - ❑ Femoral venous pressure increases due to the pressure exerted by the gravid uterus on common iliac veins.
  
- ❑ **Decrease in arterial blood pressure**



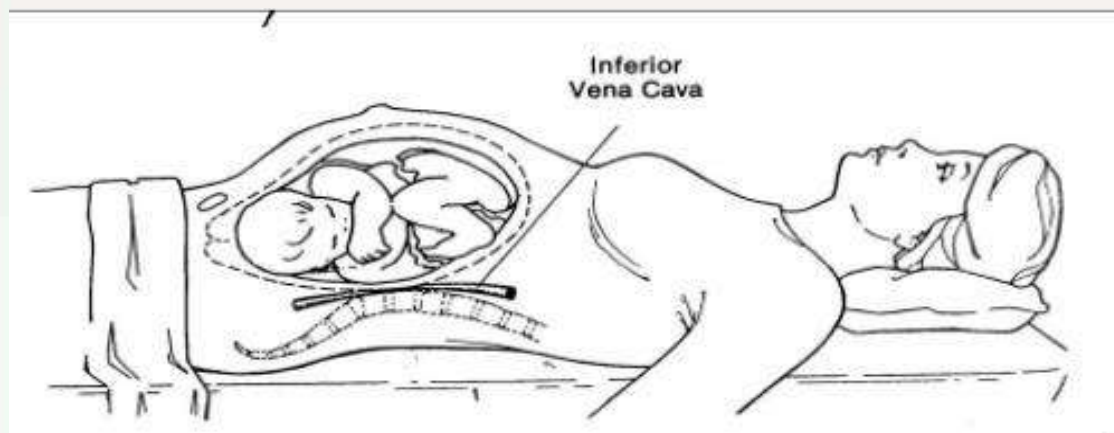




## SUPINE HYPOTENSION SYNDROME (POSTURAL HYPOTENSION)

**Aorto caval Compression:** the gravid uterus produces compression on IVC and thus produces circulatory arrest.

❑ The **supine position** should be avoided after the first trimester; this position results in a relative obstruction of venous return and therefore a decrease in cardiac output





## **REGIONAL DISTRIBUTION OF BLOOD FLOW**

**Uterine blood flow:  
Increased from 50ml to 750ml at term.**

**Pulmonary blood flow:  
6000ml+2500ml/min.**

**Renal blood flow:  
800ml+400ml/min.**

**Blood flow to skin and mucous membrane:  
500ml/min.**







# METABOLIC CHANGES

Total metabolism is increased due to the needs of the growing fetus.

- **PROTEIN METABOLISM:**

- Positive nitrogenous balance.

- At term the fetus and the placenta contains about 500gm and maternal weight gain is 500gm.

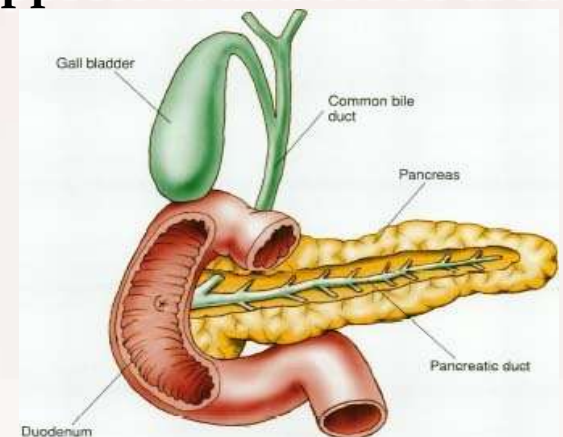
- Breakdown of amino acid to urea is suppressed and blood urea level falls to 15-20mg%.

- **CARBOHYDRATE METABOLISM:**

- Insulin secretion is increased.

- Plasma insulin level is increased

- Hyperplasia and hypertrophy of beta cells of pancreas.





# METABOLIC CHANGES

## **FAT METABOLISM:**

**An average of 3-4kg of fat is stored in pregnancy mostly in abdominal wall, breasts, hips and thighs.**

## **LIPID METABOLISM:**

**LDL and HDL level increases by 15% and 40%.**

## **IRON METABOLISM:**

**Iron is absorbed in ferrous form from duodenum and jejunum and is released as transferrin.**

**Iron is transported to fetus across the placenta.**

**Total iron requirement during pregnancy is 1000mg.**





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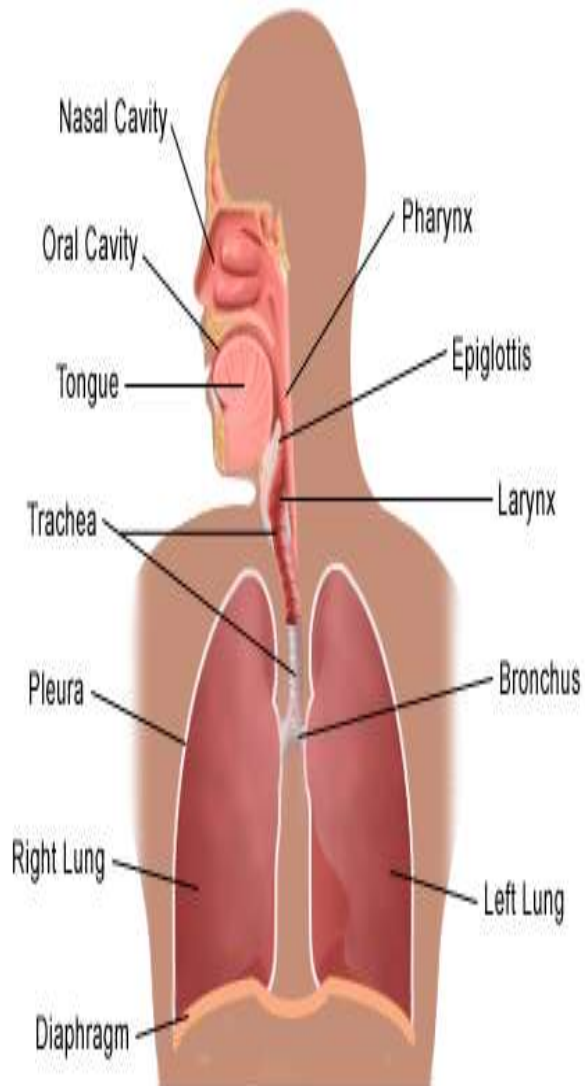
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# RESPIRATORY SYSTEM



- **Elevation of the diaphragm- 4cm.**
- **Transverse diameter of the chest expands by 2cm.**
- **O<sub>2</sub> consumption of mother is increased by 20-40%.**
- **Arterial PaCO<sub>2</sub> falls and PaO<sub>2</sub> rises.**
- **ph raises and pregnancy is a state of respiratory alkalosis.**
- **The respiratory rate rises to 18 to 20 to compensate for increased maternal oxygen consumption, which is needed for demands of the uterus, the placenta, and the fetus.**

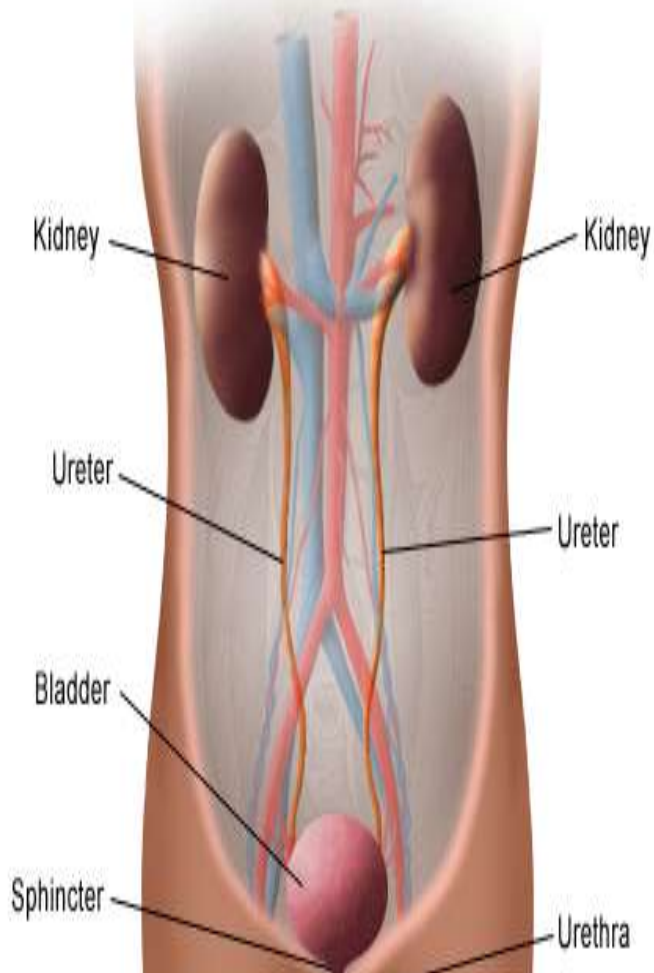






# URINARY SYSTEM

Front View of Urinary Tract



□ Dilatation of the ureter and the pelvis.

□ Kidneys enlarge in size by 1cm.

□ Increased renal blood flow by 50-75%

□ Increased GFR

□ Increase in urinary output

□ Frequent urination





## CONTD.....

- Ureter becomes atonic.
- There is marked hypertrophy of the muscle and the sheath of the ureter.
- Dilatation of the ureters causes the stasis between 20-24 weeks.
- The bladder mucosa becomes edematous and congested.
- Increased frequency of micturition noticed at early pregnancy (6-8 weeks) due to the following factors:
  - Changes in osmo regulation
  - Increased estrogen and progesterone
  - Increase in renin angiotensin activity







CONTD.....

**•The renin-angiotensin system (RAS) or the renin-angiotensin-aldosterone system (RAAS) is a hormone system that regulates blood pressure and water (fluid) balance.**





CONTD.....

•When blood volume is low, juxtaglomerular cells in the kidneys secrete renin directly into circulation. Plasma renin then carries out the conversion of angiotensinogen released by the liver to angiotensin I. Angiotensin I is subsequently converted to angiotensin II by the enzyme angiotensin converting enzyme found in the lungs.





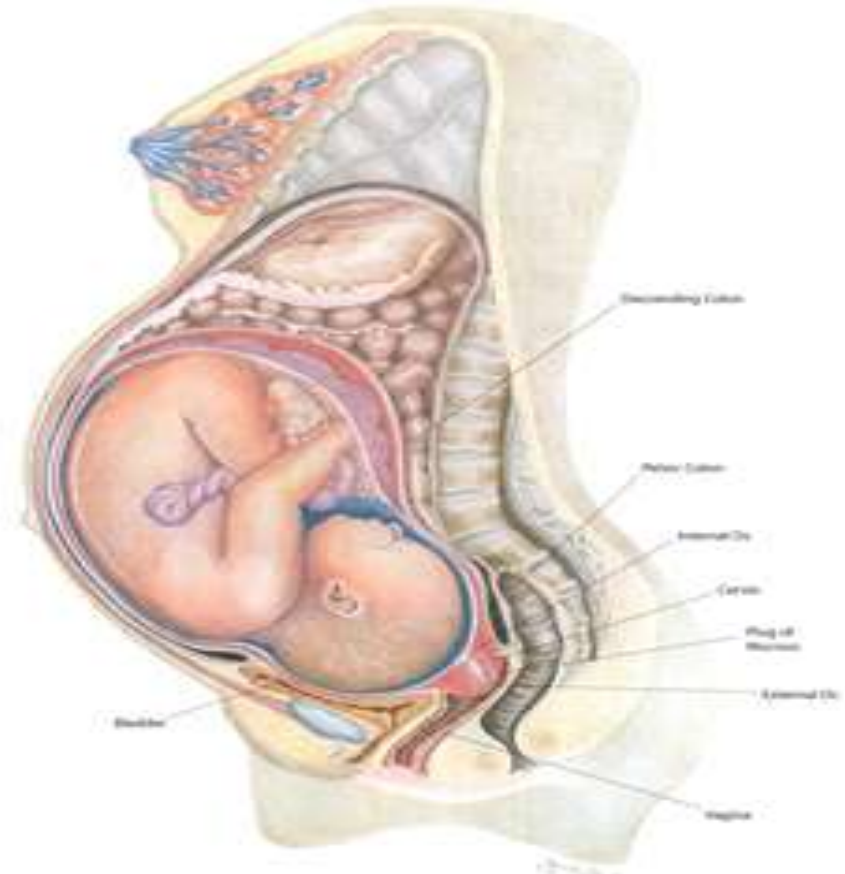
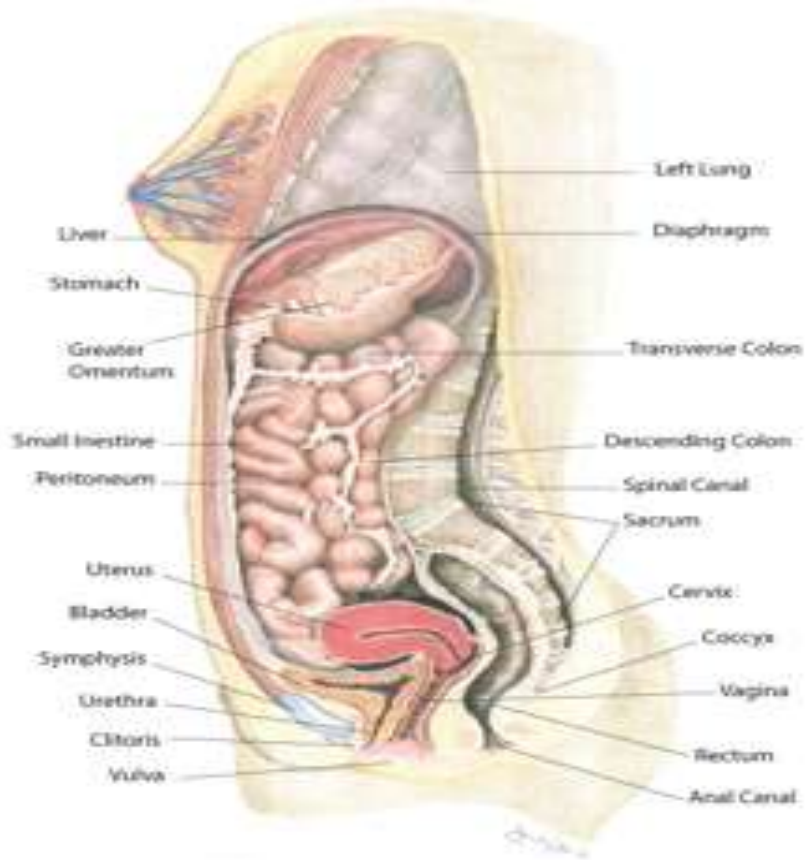
**CONTD.....**

**Angiotensin II is a potent vaso-active peptide that causes blood vessels to constrict, resulting in increased blood pressure. Angiotensin II also stimulates the secretion of the hormone aldosterone from the adrenal cortex. Aldosterone causes the tubules of the kidneys to increase the reabsorption of sodium and water into the blood. This increases the volume of fluid in the body, which also increases blood pressure.**

**If the renin-angiotensin-aldosterone system is abnormally active, blood pressure will be too high.**



# DIGESTIVE SYSTEM

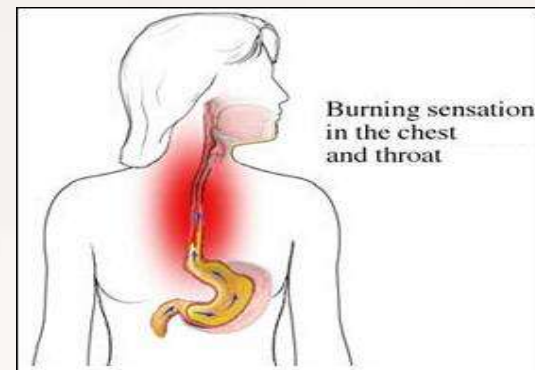




## GASTROINTESTINAL SYSTEM

- Gum bleeding
- Muscle tone and motility of the G.I are diminished.
- Cardiac sphincter is relaxed and regurgitation of acid content to esophagus is produced.
- Excessive salivation (**ptyalism**)
- Pica** (craving for non-food substances such as dirt or chalk)
- Peristalsis is slowed because of the production of the hormone progesterone

- Nausea
- Heartburn (**pyrosis**)
- Constipation







## NERVOUS SYSTEM

- Temperamental changes
- Nausea and vomiting
- Mental irritability
- Sleeplessness
- Depression
- compression of the median nerve leading to paresthesia in the hands and arms (carpal tunnel syndrome)
  
- compression of the lateral Cutaneous nerve of the thigh leading to paresthesia and sensory loss in the thighs.







# LIVER AND GALL BLADDER





## CALCIUM METABOLISM

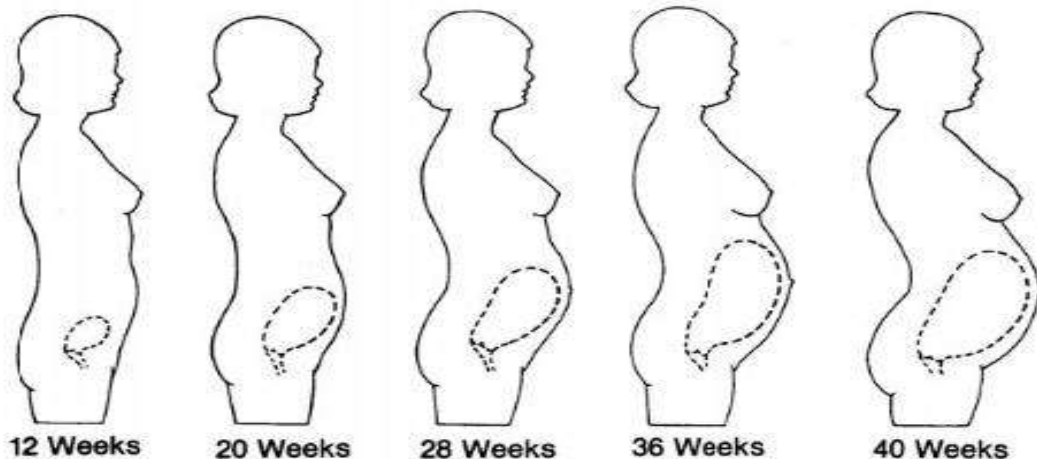
- ❑ increase in the demand of calcium to the extent of 28grams.
- ❑ daily requirement of calcium is 1 – 1.5 gm.
- ❑ Calcium absorption from intestine and kidneys becomes double

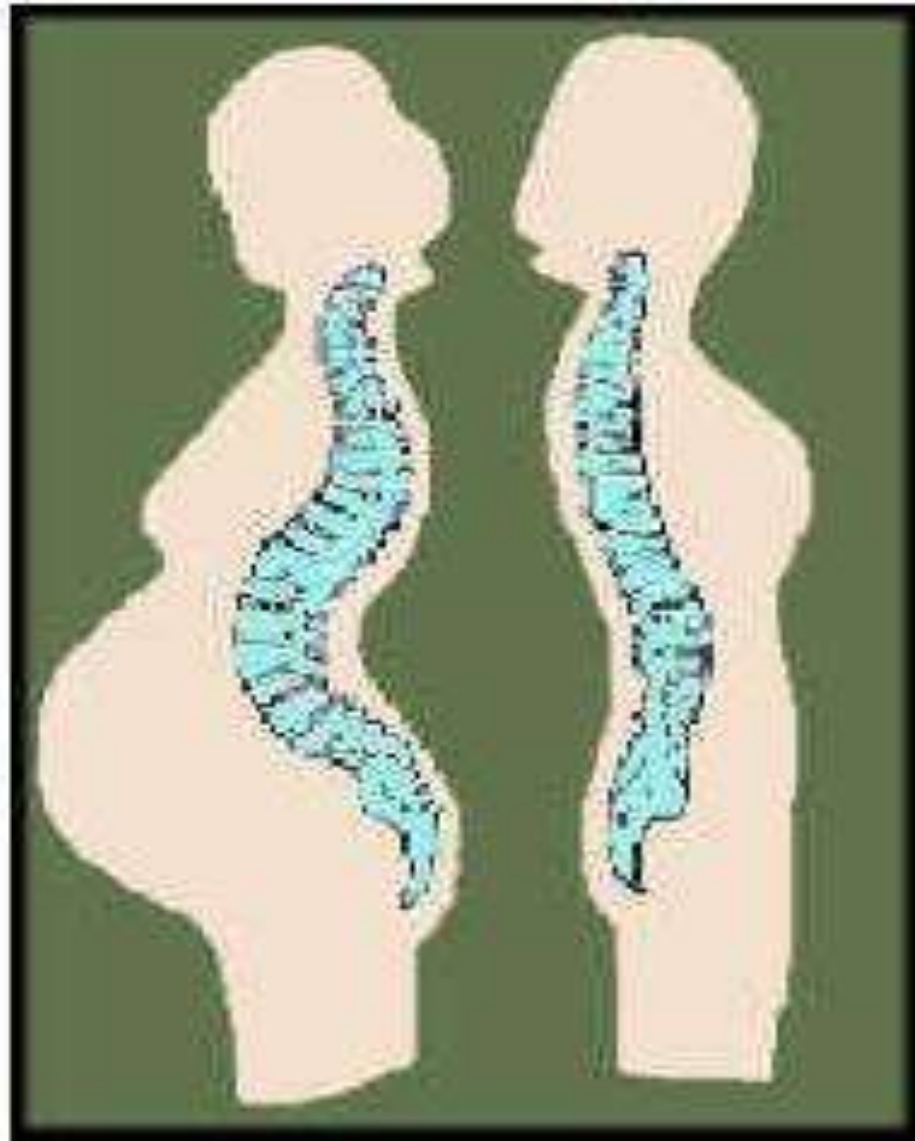




## SKELETAL SYSTEM

- Realignment of the spinal curvatures.
- "waddling" gait.
- Slight relaxation and increased mobility of the pelvic joints, which allows stretching at the time of delivery of the infant.
- Increased lumbar lordosis(exaggerated and increased forward curvature of thoracic spine and lumbar spine)





<http://www.moonrango.org/obgyn/pregnancy/backache.htm>



Thank  
You

A decorative floral arrangement in the bottom right of the 'Thank You' text. It features a large red flower, a blue flower, a yellow flower, and a dark blue flower, all with green leaves and stems. The text 'Thank You' is written in a purple, cursive font.