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QUESTION

Elucidate the physiological adaptation of the female to pregnancy

During pregnancy, the changes are noticed in various organs, body weight, the metabolic activities and functional status of different physiological systems in the mother.

- **STRUCTURAL CHANGES**

- Various structural changes are noticed in the primary sex organs, accessory sex organs and in the mammary glands during pregnancy.

1. Ovaries

- Follicular changes do not appear in ovary and ovulation does not occur because the

secretion of FSH and LH from anterior pituitary is inhibited. Corpus luteum enlarges and secretes a large quantity of progesterone and little estrogen, which are essential for maintaining the pregnancy. It continues for 3 months and then, corpus luteum degenerates. By this time placenta develops fully and takes over the function of secreting estrogen and progesterone. It continues throughout the period of pregnancy thus inhibiting the secretion of FSH and LH.

2. Uterus

- When the fetus grows, uterus undergoes changes in volume, size, shape and weight.
 - o Volume
 - Volume of uterus increases gradually due to fetal growth. From almost zero volume, uterus reaches about 5 to 7 liters at the end of pregnancy. Out of this, 50% Of the volume is due to the fetus and rest is due to the placenta, amniotic fluid, etc.
 - o Size
 - Size of the uterus also increases due to:
 - Hyperplasia (increase in number of cells) of myometrium
 - Hypertrophy (increase in size of the cells) of myometrium
 - Growth of fetus.
- o Shape

- The shape of non-pregnant uterus is pyriform. As the fetus grows, at the 12th week of pregnancy, it becomes globular. Then, once again it becomes pyriform gradually.

- o Weight

- Non-pregnant uterus weighs about 30 to 50 g. The weight increases as the pregnancy advances. At the end of pregnancy, the uterine weight increases to about 1,000 to 1,200 g.

- o **Histological changes**

- Endometrium shows formation of decidua, which is the bed for the fertilized ovum during the initial stages of pregnancy. Later, by the end of 3 months, three layers of decidua are formed:

- a. Decidua basalis, which is the maternal part

- b. Decidua capsularis that surrounds fetal sac

- c. Decidua parietalis, which lines rest of uterine wall. After the 3rd month, the decidua capsularis and parietalis fuse together.

3. Vagina

Vagina increases in size and its color changes to violet due to increased blood supply. There is deposition of glycogen in the epithelial cells.

4. Cervix

In cervix, the number of glands, blood supply and mucus secretion increase. The tough cervix becomes soft and it is closed by mucus plug.

5. Fallopian Tube

The number of epithelial cells and blood supply increase in fallopian tubes.

6. Mammary Glands

Size of the mammary glands increases because of development of new ducts and alveoli, deposition of fat and increased vascularization. Pigmentation of nipple and areola occur

INCREASE IN BODY WEIGHT

Average weight gained by the body during pregnancy is about 12 kg. Approximate weight of various structures, which adds to the weight gain:

1. Fetus : 3.5 kg

2. Amniotic fluid : 2.0 kg

3. Placenta : 1.5 kg

4. Increase in maternal : 5.0 kg

body weight

If proper prenatal care is not taken, the body weight increases greatly by about 20 to 30 kg.

METABOLIC CHANGES

The metabolic activities are accelerated in the body

due to increased secretion of various hormones like thyroxine, cortisol and sex hormones.

1. Basal Metabolic Rate

Increase in the secretion of various hormones especially thyroxine increases the basal metabolic rate by

about 15% in the later stages of pregnancy.

2. Protein Metabolism

The anabolism of proteins increases during pregnancy. Positive nitrogen balance occurs. The deposition of proteins increases in the uterus.

3. Carbohydrate Metabolism

Blood glucose level increases leading to glucosuria. Ketosis develops either due to less food or more vomiting. Because of all these reasons, there is hyperplasia of beta cells of islets of Langerhans in pancreas leading to increase in secretion of insulin. In spite of this, there is possibility of developing diabetes in pregnancy or latent diabetes after delivery.

4. Lipid Metabolism

During pregnancy, there is deposition of about 3 to 4 kg

of fat in the maternal body. It also increases the blood cholesterol level and ketosis.

5. Water and Mineral Metabolism

Estrogen and progesterone are secreted by corpus luteum in the first trimester and by placenta later. These hormones increase the retention of sodium and water. Secretion of aldosterone increases during pregnancy. Aldosterone in turn increases the reabsorption of sodium from renal tubules. Apart from water and sodium retention, there is retention of calcium and phosphorus as well. Calcium and phosphorus are necessary for the growing fetus.

CHANGES IN PHYSIOLOGICAL SYSTEMS

1. Blood

The blood volume increases by about 20% or about 1 L. This increase is mainly because of increase in plasma volume. It causes hemodilution. Because of great demand for iron by the fetus, the mother usually develops anemia. It can be rectified by proper prenatal care and iron replacement.

2. Cardiovascular System

Cardiac output

Generally, cardiac output increases by about 30% in the first trimester. After the 3rd month, cardiac output starts decreasing and reaches almost the normal level in the later stages of pregnancy.

Blood pressure

Arterial blood pressure remains unchanged during the first trimester. During the second trimester, there

is a slight decrease in blood pressure. It is due to the diversion of blood to uterine sinuses. And, hypertension develops if proper prenatal care is not taken.

Pre-eclampsia

Pre-eclampsia is the hypertensive disorder of pregnancy. It is otherwise known as toxemia of pregnancy. About 3% to 4% of the pregnant women suffer from this. It usually occurs during last trimester of pregnancy.

Cause for hypertension

1. Release of vasoconstrictor substances from placenta
2. Hypersecretion of adrenal hormones and other hormones, which cause vasoconstriction
3. Development of autoimmune processes induced by the presence of placenta or fetus.

Other symptoms associated with hypertension

1. Decreased blood flow to kidney and thickening of glomerular capillary membrane, leading to reduction in GFR and urinary output

2. Retention of sodium and water

3. Decreased urinary output along with retention of sodium and water results in increased extracellular fluid volume and edema

4. Excretion of proteins through urine

Eclampsia

Eclampsia is the serious condition of pre-eclampsia characterized by severe vascular spasm, dangerous hypertension and convulsive muscular contractions almost like seizures. It occurs just before, during or

immediately after delivery. It leads to death, if timely treatment is not given.

Features of eclampsia

1. Spasm of blood vessels

2. Very severe hypertension

3. Renal failure

4. Liver failure

5. Heart failure

6. Convulsions

7. Coma.

Treatment for eclampsia

Treatment should be immediate. It includes administration of quick acting vasodilator drugs or termination of pregnancy.

3. Respiratory System

Overall activity of respiratory system increases slightly. Tidal volume, pulmonary ventilation and oxygen utilization are increased.

4. Excretory System

Renal blood flow and GFR increase resulting in increase in urine formation. It is because of increase in fluid intake and the increased excretory products from fetus. The urine becomes diluted with the specific gravity of 1,025. In the first trimester, the frequency of micturition increases because of the pressure exerted by the uterus on bladder.

5. Digestive System

During the initial stages of pregnancy, the morning sickness occurs in mother. It involves nausea, vomiting and giddiness. This is because of the hormonal imbalance. The motility of GI tract decreases by progesterone and constipation is common. Indigestion and hypochlorhydria (decrease in the amount of hydrochloric acid in gastric juice) also occur.

6. Endocrine System

i. Anterior pituitary

During pregnancy, the size of anterior pituitary increases by about 50%. And secretion of corticotropin, thyrotropin and prolactin increases. However, the secretion of FSH and LH decreases very much. It is because of negative feedback control by estrogen and progesterone, which are continuously secreted from corpus luteum initially and placenta later on.

ii. Adrenal cortex

There is moderate increase in secretion of cortisol, which helps in the mobilization of amino acids from the mother's tissues to the fetus. Aldosterone secretion also increases. It reaches the maximum at the end of

pregnancy. Along with estrogen and progesterone, aldosterone is responsible for the retention of water and sodium.

iii. Thyroid gland

The size and the secretory activity of thyroid gland increase during pregnancy. The increased secretion of thyroxine helps in the preparation of mammary glands for lactation. It is also responsible for increase in basal metabolic rate.

iv. Parathyroid glands

Parathyroid glands also show an increase in the size and secretory activity. Parathormone is responsible for maintenance of calcium level in mother's blood in spite of loss of large amount of calcium to fetus.

7. Nervous System

There is general excitement of nervous system during Pregnancy. It leads to the psychological imbalance

such as change in the moods, excitement or depression in the early stages of pregnancy. During the later months of pregnancy, the woman becomes very much excited because of anticipation of delivery of the baby, labor pain, etc.