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**Question**

Elucidate the physiological adaptations of female to pregnancy

**Answer**

Various parts of the body have to adapt to the demands of pregnancy, these parts are:

* In the Endocrine Gland
* In the Respiratory System
* In the Cardiovascular System
* In the Urinary System
* In the Gastrointestinal System
* There are also changes in the blood (Haemolitic changes)

**In the Endocrine System**

It has been observed that during pregnancy a woman experiences changes in her endocrine system. All through pregnancy there is an increase in the progesterone and oestrogen levels; the oestrogen which is produced by the placenta and the progesterone which is produced by the corpus luteum and later by the placenta. The increase in levels of oestrogen results in an increase in hepatic production of Thyroid Binding Globulin (TBG). As is expected, more free T3 and T4 bind to the TBG, therefore causing more thyroid stimulating hormone to be released from the anterior pituitary gland. Hence, the free T3 and T4 levels remain unchanged, but the total T3 and T4 levels rise.

Thyroxin is an essential part of the foetus’s neural development, but the foetal thyroid gland will not function until the second trimester of gestation. Therefore, there is an increase T3 and T4 levels in the mother to ensure that there is a constant supply of thryoxin to the foetus in the early stage of pregnancy.

In the pregnancy, mainly during the second trimester, it has been observed that there is an increase of human placental lactogen, prolactin, cortisol levels along with the increase in the levels of progesterone and oestrogen. These are anti-insulin hormones therefore, they increase insulin resistance in the mother and reduce peripheral uptake of glucose. This is to ensure that there is a continuous supply of glucose for the foetus. The mother therefore switches to an alternative source of energy provided by lipids. The increase in lipolysis means that there is an increase in free fatty acids in the plasma which provide substrate for maternal metabolism. The breakdown of lipids can result in ketogenesis, therefore, pregnancy is associated with an increased risk of ketoacidosis.

**In the Respiratory System**

It is anatomically proven that the growth of the foetus during pregnancy causes upward displacement of the diaphragm. This however, does not cause a decrease in the total lung capacity significantly since there is an increase in the transverse and anterior-posterior diameters of the thorax. During a pregnancy, a woman faces an increase in their metabolic rate which leads to the demand for oxygen increasing. There is an increase in the tidal volume and the minute ventilation rate to help the mother meet the increased demand of oxygen.

It has been observed that many women experience problems such as hyperventilation during pregnancy. It is thought that the reason for this occurrence is the increase in production of carbon dioxide and the increase in the respiratory drive caused by progesterone. This hyperventilation results in a respiratory alkalosis with a compensated increase in renal bicarbonate excretion.

**In the Cardiovascular System**

As been discussed above, during pregnancy there is an increase in progesterone levels. The Progesterone acts so as to decrease systemic vascular resistance in pregnancy which therefore leads to a decrease in diastolic blood pressure during the first and second trimester of pregnancy. In response to this, the cardiac output increases by about 30-50%. An increase in blood pressure in pregnancy might be an indication of pre-eclapmsia. The pregnancy results in the activation of the renin-angiotensin system. Which leads to an increase in the level of sodium and water retention. Which means that there is an increase in the total blood volume.

**In the Urinary System**

The Increase in cardiac output during pregnancy causes an increase in renal plasma flow which increases the GFR by about 50-60%. Which means that there is an increase in renal excretion. So during pregnancy the levels of urea and creatinine will be lower. The Progesterone affects the urinary collecting system, which causes relaxation of the ureter (resulting in hydro-ureter). There is also relaxation of the muscles of the bladder. Both of these changes, cause urinary stasis which predisposes a woman to UTIs, commonly pyelonephritis.

**In the Gastrointestinal System**

It has been observed that the growth of the uterus causes a number of anatomically related changes to the Gastro-Intestinal Tract(GIT). One of the anatomically related changes would be the upward displacement of the stomach as the uterus grows. Which leads to an increase in the intra-gastric pressure which would predispose the mother to getting symptoms of reflux, along with symptoms such as nausea and vomiting. The appendix may also move to the upper right quadrant of the abdomen as the uterus enlarges.

The increase observed in progesterone during pregnancy results in smooth muscle relaxation. This decreases gut motility. Although, it allows for more time for nutrient absorption, this can lead to constipation. Increase in progesterone also causes relaxation of the gallbladder, thus biliary tract stasis may occur. This predisposes the mother to getting gallstones.

**The Haematological Changes**

In pregnancy, it has been observed that there is an increase in fibrinogen and clotting factors in the blood and a decrease in fibrinolysis. Additionally, due to an increase in progesterone levels, stasis of blood and venodilation occurs. All these factors written above increase the risk of thromboembolic disease in pregnant women. Warfarin cannot be given to pregnant women to counteract this, due to the fact that it can cross the placenta and it is a teratogen. Low Molecular Weight Heparin (LMWH) is usually considered the anticoagulant of choice during pregnancy if it is necessary to give the mother anticoagulant drug. During pregnancy there is an increase in plasma volume significantly. However, the mass of red cells does not increase by as much. This therefore results in a physiological delusional anaemia.