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Physiological adaptations of the female to pregnancy

#### Changes in the endocrine System

During pregnancy a woman experiences a change in her endocrine system. Throughout pregnancy the levels of progesterone and oestrogen increase; the oestrogen being produced by the placenta and the progesterone being produced by the corpus luteum and later by the placenta. Increase in oestrogen levels results in an increase in hepatic production of thyroid binding globulin (TBG). As a result, more free T3 and T4 bind to the TBG, this causes more thyroid stimulating hormone to be released from the anterior pituitary gland. Therefore, the free T3 and T4 levels remain unchanged – but the total T3 and T4 levels rise.

Thyroxin is essential for foetus's neural development, but the foetal thyroid gland is not functional until the second trimester of gestation. Hence, increasing T3 and T4 levels in the mother ensures that there is a constant supply of thyroxin to the foetus early in pregnancy.

During pregnancy, mainly during the second trimester, there is an increase of human placental lactogen, prolactin, cortisol levels along with the increase in progesterone and oestrogen levels. These are anti-insulin hormones therefore, they increase insulin resistance in the mother and reduce peripheral uptake of glucose. This ensures that there is a continuous supply of glucose for the foetus. The mother switches to an alternative source of energy which is 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 thus, pregnancy is associated with an increased risk of ketoacidosis.

#### Changes in the cardiovascular System

As discussed above, during pregnancy progesterone levels increase. Progesterone acts to decrease systemic vascular resistance in pregnancy which 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 could be an indication of pre-eclampsia. Pregnancy results in the activation of the renin-angiotensin system. This leads to an increase in sodium levels and water retention. This means that the total blood volume increases.

#### Changes in the respiratory System

Anatomically, the growth of the foetus during pregnancy causes upward displacement of the

diaphragm. This however, does not decrease the total lung capacity significantly since there is also an increase in the transverse and anterior-posterior diameters of the thorax. In pregnancy a woman faces an increase in their metabolic rate which leads to an increased demand for oxygen. The tidal volume and the minute ventilation rate increases to help the mother meet the oxygen demands.

Many women experience hyperventilation during pregnancy. It is thought that the reason for this is the increased carbon dioxide production and the increased respiratory drive caused by progesterone. This hyperventilation results in a respiratory alkalosis with a compensated increase in renal bicarbonate excretion.

### Changes in the gastrointestinal System

The growth of the uterus causes a number of anatomical changes related to the gastrointestinal tract. One of these would be the upward displacement of the stomach as the uterus grows. This would lead 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 right upper quadrant of the abdomen as the uterus enlarges.

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

### Changes in the urinary System

Increased cardiac output during pregnancy causes an increase in renal plasma flow which increases the GFR by about 50-60%. This would mean that there is an increase in renal excretion. So in pregnancy the levels of urea and creatinine will be lower.

Progesterone affects the urinary collecting system causing relaxation of the ureter (resulting in hydroureter). There is also relaxation of the muscles of the bladder. Both of these changes causes urinary stasis which predisposes a woman to UTIs, commonly pyelonephritis.

### Haematological Changes

In pregnancy 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 increase the risk of thromboembolic disease in pregnancy. Warfarin can not be given to pregnant women to counteract this as 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 the plasma volume increases significantly. However, the red cell mass does not increase by as much. This results in a physiological dilutional anemia