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**COURSE : HUMAN PHYSIOLOGY**

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**QUESTION: Elucidate the physiological adaptations of the female to pregnancy**

Increases in blood sugar, breathing, and cardiac output are all expected changes that allow a pregnant woman's body to facilitate the proper growth and development of the embryo or fetus during the pregnancy.

Maternal physiological changes in pregnancy are the adaptations during pregnancy that a woman's body undergoes to accommodate the growing embryo or fetus. These physiologic changes are entirely normal, and include behavioral (brain), cardiovascular (heart and blood vessel), hematologic (blood), metabolic, renal (kidney), posture, and respiratory (breathing) changes. Increases in blood sugar, breathing, and cardiac output are all expected changes that allow a pregnant woman's body to facilitate the proper growth and development of the embryo or fetus during the pregnancy. The pregnant woman and the placenta also produce many other hormones that have a broad range of effects during the pregnancy.

During pregnancy, the pregnant mother undergoes significant anatomical and physiological changes in order to nurture and accommodate the developing foetus. These changes begin after conception and affect every organ system in the body.

1. For most women experiencing an uncomplicated pregnancy, these changes resolve after pregnancy with minimal residual effects. It is important to understand the normal physiological changes occurring in pregnancy as this will help differentiate from adaptations that are abnormal.

Plasma volume increases progressively throughout normal pregnancy.

2. Most of this 50% increase occurs by 34 weeks' gestation and is proportional to the birthweight of the baby. Because the expansion in plasma volume is greater than the increase in red blood cell mass, there is a fall in haemoglobin concentration, haematocrit and red blood cell count. Despite this haemodilution, there is usually no change in mean corpuscular volume (MCV) or mean corpuscular haemoglobin concentration (MCHC).

The platelet count tends to fall progressively during normal pregnancy, although it usually remains within normal limits. In a proportion of women (5–10%), the count will reach levels of  $100\text{--}150 \times 10^9$  cells/l by term and this occurs in the absence of any pathological process. In practice, therefore, a woman is not considered to be thrombocytopenic in pregnancy until the platelet count is less than  $100 \times 10^9$  cells/l. Pregnancy causes a two- to three-fold increase in the requirement for iron, not only for haemoglobin synthesis but also for the foetus and the production of certain enzymes. There is a 10- to 20-fold increase in folate requirements and a two-fold increase in the requirement for vitamin B12.

Changes in the coagulation system during pregnancy produce a physiological hypercoagulable state (in preparation for haemostasis following delivery).

3. The concentrations of certain clotting factors, particularly VIII, IX and X, are increased. Fibrinogen levels rise significantly by up to 50% and fibrinolytic activity is decreased. Concentrations of endogenous anticoagulants such as antithrombin and protein S decrease. Thus pregnancy alters the balance within the coagulation system in favour of clotting, predisposing the pregnant and postpartum woman to venous thrombosis. This increased risk is present from the first trimester and for at least 12 weeks following delivery. In vitro tests of coagulation [activated partial thromboplastin time (APTT), prothrombin time (PT) and thrombin time (TT)] remain normal in the absence of anticoagulants or a coagulopathy.

Venous stasis in the lower limbs is associated with venodilation and decreased flow, which is more marked on the left. This is due to compression of the left iliac vein by the left iliac artery and the ovarian artery. On the right, the iliac artery does not cross the vein.

Hormonal changes during pregnancy

The hormonal and physiological changes that come with pregnancy are unique.

Pregnant women experience sudden and dramatic increases in estrogen and progesterone. They also experience changes in the amount and function of a number of other hormones. These changes don't just affect mood. They can also:

- create the “glow” of pregnancy
- significantly aid in the development of the fetus
- alter the physical impact of exercise and physical activity on the body

Estrogen and progesterone changes

Estrogen and progesterone are the chief pregnancy hormones. A woman will produce more estrogen during one pregnancy than throughout her entire life when not pregnant. The increase in estrogen during pregnancy enables the uterus and placenta to:

- improve vascularization (the formation of blood vessels)
- transfer nutrients
- support the developing baby

In addition, estrogen is thought to play an important role in helping the fetus develop and mature.

Estrogen levels increase steadily during pregnancy and reach their peak in the third trimester. The rapid increase in estrogen levels during the first trimester, may cause some of the nausea associated with pregnancy. During the second trimester, it plays a major role in the milk duct development that enlarges the breasts.

Progesterone levels also are extraordinarily high during pregnancy. The changes in progesterone cause a laxity or loosening of ligaments and joints throughout the body. In addition, high levels of progesterone cause internal structures to increase in size, such as the ureters. The ureters connect the kidneys with the maternal bladder.

Progesterone is also important for transforming the uterus from the size of a small pear — in its non-pregnant state — to a uterus that can accommodate a full-term baby.