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DEPARTMENT: **BIOMEDICAL ENGINEERING**

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COURSE TITLE: **HUMAN PHYSIOLOGY II**

QUESTION

Elucidate the Physiological adaptations of the female to pregnancy?

PREGNANCY

Pregnancy, also known as gestation, is the time during which one or more offspring develops inside a woman.

Physiological changes occur in pregnancy to nurture the developing foetus and prepare the mother for labour and delivery. Some of these changes influence normal biochemical values while others may mimic symptoms of medical disease. It is important to differentiate between normal physiological changes and disease pathology.

SKIN CHANGES

A number of changes take place in the skin of pregnant women. Mechanical stretching of the skin over the abdomen and breasts can lead to striae (stretch marks). The increased levels of estrogen and progesterone have also been implicated. Usually striae remain permanently with some change in color. Prevention may be achieved with moisturizing creams, especially those containing lanolin and other oily substances. It should be realized, however, that striae may develop despite any preventative measures.

CHANGES IN THE GASTROINTESTINAL SYSTEM

Nausea and vomiting are the most frequent complaints involving the gastrointestinal system and usually happen in early pregnancy while heartburn happen primarily in late pregnancy. The gums become hyperemic and edematous during pregnancy and tend to bleed. The muscular wall of the esophagus is relaxed and this may cause reflux, which in turn can lead to esophagitis and heartburn. The stomach and the intestines have decreased motility presumably due to the effect of progesterone on smooth muscle contractility.

CARDIOVASCULAR CHANGES

Of all changes that happen in pregnancy, the single most important is the one involving the cardiovascular system. Adequate cardiovascular adaptation secures good placental development and thus appropriate fetal growth. In brief, the cardiovascular changes involve a substantial change in the blood volume, cardiac output, heart rate, systemic arterial blood pressure, systemic vascular resistance, oxygen consumption and alterations in regional blood flow of various organ systems.

What changes in cardiac output occur during labour?

Cardiac output increases most during contractions. Increases in autotransfusion from contracting uterus, further increase in blood may be auto transfused as placenta delivered. Pain/anxiety and sympathetic nerve stimulation also increases HR and poss BP.

How does oxygen consumption change during pregnancy and why?

Increases (250 -> 300ml/min resting) to maintain foetal metabolic requirements.

How does RBC volume, plasma volume, total blood volume and cardiac output change during pregnancy?

RBC blood volume decreases in first 10 weeks and then increases, although not as much as the other factors. Plasma volume may increase as much as 45% (rises most in 1st trimester). Total blood volume starts to increase in 1st trimester and expands rapidly during 2nd trimester, before rising at a lower rate in 3rd trimester. CO: Increases (mainly in 1st trimester).

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HEART RATE DURING NORMAL PREGNANCY

The baseline heart rate increases by about 10 to 20 beats per minute. This increase starts early in pregnancy and gradually continues to go upward with the highest values achieved at term. Some investigators, however, suggested that the total increase happens early in pregnancy and remains so throughout the remainder of gestation. In twin gestations, the rise of the heart rate is more pronounced and it can reach as much as 40 percent above the non-pregnant state. A change also from the supine position to the lateral position may cause the heart rate to drop slightly.

What effect does this have on the heart rate?

Systolic and diastolic BP falls resulting in increased heart rate.

BLOOD PRESSURE

A slight decrease in the systolic arterial blood pressure and a significant decrease in the diastolic pressure have been observed to occur in normal pregnancy. This decrease becomes evident in the late first trimester and continues throughout most of the second trimester. The lowest values are noted in mid pregnancy and there after the blood pressure returns toward non-pregnant levels before term. The degree of change in the blood pressure parameters has been found to be affected by parity, smoking, preexisting hypertension, maternal age and ethnic background. In the typical normal pregnancy, the mean arterial pressure (diastolic plus 1/3 of the difference between systolic and diastolic) is less than 85 mm of mercury. Studies have found that when the mean arterial blood pressure in the mid second trimester is higher than 90 mm of mercury, there is increased perinatal mortality and morbidity.

How does blood pressure change in pregnancy and why?

Dip in blood pressure around 17-24w due to decrease in peripheral vascular resistance (falls by 50% in early pregnancy). Returns to normal in late 2nd trimester.

How does posture affect cardiac output and blood pressure measurements in the pregnant woman?

Enlarged uterus can compress vena cava and impede venous return causing reduced CO and BP (maternal hypotension) and dizziness. Pregnant women should not be supine for BP measurements.

How does Hb concentration change during pregnancy?

Hb concentrations fall from around 150g/l pre-pregnancy to 120g/l during the 3rd trimester (physiological anaemia of pregnancy - dilutional anaemia).

Why does plasma volume increase in early pregnancy?

Vasodilation leads to decreased peripheral vascular resistance. Activation of RAAS: retention of Na and total increase in body water.

How are platelets and tPA affected by pregnancy?

Increased platelet production and decreased platelet count (reflects increased activity and consumption), inhibition of fibrinolysis via decreases in tPA.

RESPIRATION

How does pregnancy affect alveolar ventilation, minute ventilation, tidal volume and respiratory rate?

Alveolar ventilation increases, minute ventilation increases, tidal volume increases and respiratory rate slightly increases.

What is a major physical change in pregnancy that affects the heart?

Elevation of the diaphragm causes the heart axis to deviate left. The expanding uterus also decreases residual volume, expiratory reserve volume and total lung capacity, and increases tidal volume.

What changes occur in the kidney during pregnancy?

Increase in length, dilation of renal calyces, pelvis and ureter mainly due to action of progesterone to relax SM, increased CO -> increased renal plasma flow and GFR.

How does renal function change?

Renal compensation (HCO_3^- loss, H^+ retention)

Increase in urea, creatinine, urate clearance and excretion of bicarbonate causing a slight decrease in the plasma concentrations.

How long does it take the physiological adaptations in pregnancy to return to normal?

CDV changes quite quick: blood volume (72hrs), HR and CO (2wks), proteins and lipids (2-3w). Structural changes take longer (e.g. urinary system takes > or 3 months to shrink back down to normal).