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COLLEGE: MEDICINE AND HEALTH SCIENCES

DEPARTMENT: PHARMACOLOGY

COURSE CODE: PHS 212

COURSE TITLE: RENAL PHYSIOLOGY, BODY FLUID & TEMPERATURE REGULATION AND AUTONOMIC NERVOUS SYSTEM

DATE: 18$^{TH}$ MAY 2020 – 22$^{ND}$ MAY 2020

ASSIGNMENT: ELUCIDATE THE PHYSIOLOGICAL ADAPTATION OF THE FEMAL TO PREGNANCY

Maternal physiology 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 they include behavioural (brain), cardiovascular (heart and blood vessels), hormonal, 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 embroyo or fetus during pregnancy. The pregnant woman and the placenta also produce many other hormones that have a broad range of effects during pregnancy.

Hormonal changes that occur during pregnancy: An egg or ovum emerges from the ovaries leaving behind a structure called corpus luteum. The structure produces large amount of progesterone and estrogen; these hormone prepares the uterus for the implantation of a fertilized egg. If the egg doesn't get fertilized, the corpus luteum degenerates causing a drop in estrogen and progesterone level. But, if the egg is fertilized the corpus remains and continues to maintain the hormone level need to keep the uterus baby friendly. The placenta eventually develops and secretes the necessary hormones then corpus luteum disappears after 3 to 4 months. In addition to progesterone and estrogen, human chorionic gonadotropin hormone also spikes in the early pregnancy. The level of this hormone doubles, every two days in the first 10 weeks of pregnancy. It's primary role is to prevent menstruation and to prepare the placenta to connect to the fetus. The placenta supplies the fetus with nutrients and oxygen. it also removes toxic waste products.

Cardiovascular changes that occur during pregnancy: The heart adapts to the increased cardiac demand that occurs during pregnancy in many ways.

- Cardiac output( lit/min): 6.26
- Stroke volume (ml): 75
- Heart rate ( per min): 85
- Blood pressure: unaffected

The cardiac output increases throughout early pregnancy and peaks in the third trimester, usually to 30-50% above baseline. Estrogen mediates this rise in cardiac output by increasing the pre-load and stroke volume, mainly via higher overall blood volume. The heart rate increases but generally not above 100 beats/minute. Total systematic vascular resistance decreases by 20% secondary to the vasodilatory affect by progesterone. The systolic and diastolic blood pressure drops 10 -15 mmHg in the first trimester and then returns to baseline in the second half of pregnancy. All the cardiovascular adaptation can lead to common complaints such as palpitations, decreased exercise tolerance and dizziness. Uterine enlargement beyond 20 weeks size can compress the inferior vena cava which can decrease the return of blood into the heart or preload. This makes healthy pregnant patients in a supine position or prolonged standing can experience symptoms of hypotension.

Hematology changes that occur during pregnancy: During pregnancy, the plasma volume increases by 40 -50% and the red blood cell volume increases only by 20 – 30%. These changes occur mostly in the second

trimester and prior to 32 weeks gestation. Due to dilation, hamatocrit decreases while the erythropoietin increases throughout pregnancy and it reaches approximately 150 percent. The slight drop in hematocrit is most pronounced at the end of the second trimester and slowly improves when reaching term.

- Platelet and white blood cell count: The effect of pregnancy on platelet count is unclear. The white bold cell count increases with occasional appearance of myelocytes or metamyelocytes in the blood. During labor, there is rise in leukocyte count.
- Hyper-coagulability: A pregnant woman is hyper-coagualted leading to increased risk for developing blood clot and embolism. Women 4 – 5 times more likely to develop a clot during pregnancy and in the post natal period than when they are not pregnant. Hyper-coagulation in pregnancy protects women from hemorrhage at the time of miscarriage or childbirth. Factors that increase clot in pregnancy are baseline thrombophillia, caserean section, preeclampsia etc. clot usually develops in the left leg of left iliac/ femoral venous sytem.
- Edema: Edema or swelling of the feet is common during pregnancy, partly because of the enlarging uterus compresses the veins and lymphatic drainage from the legs.

Metabolic changes that occur during pregnancy: During pregnancy, both protein and carbohydrate metabolism are affected. An increased requirement for nutrients is given by fetal growth and fat deposition. Metabolic changes are caused by steroid hormones, lactogen and cortisol.

- Body weight: Some increase in weight gain is seen as normal during pregnancy because the enlarging uterus, growing fetus, placenta, amniotic fluid, normal increase in body fat, increase in water retention can all contribute to weight gain during pregnancy.
- Nutrition: All patients are advised to take prenatal vitamins to compensate for the increased nutritional requirements. The use of omega 3 fatty acids supports mental and development of infants. choline supplementation of research mammals support mental development that last throughout life.

Renal changes that occur during pregnancy: Progesterone causes many changes to the genitourinary system. A pregnant woman may experience an increase in the size of the kidney and ureter due to an increased blood volume and vasculature. Progesterone causes vasodilation and increased blood flow to the kidney due to the glomerular filtration rate (GFR) commonly increased by 50% returning to normal at postpartum. The increased GFR increases the excretion of protein, albumin and glucose. The increased GFR leads to increased urinary output which causes the women to experience increased urinary frequency. Progesterone also causes decreased motility of the ureter which can lead to stasis of the uterine and hence an increased risk of urinary tract infection.

Gastrointestinal changes that occur during pregnancy:The gastrointestinal changes are caused by enlarging of the uterus and hormonal changes of pregnancy. The elevated levels of the progesterone and estrogen mediate most of the functional changes of the GI system during pregnancy. Progesterone causes smooth muscle

relaxation which slows down GI motility and decreases lower esophageal sphincter (LES) tone. The increased occurrence of gallstone during pregnancy is due to the inhibition of gallbladder contraction and reduced billary transportation of bile which results in cholestasis of pregnancy. Nausea and vomiting of pregnancy commonly known as “morning sickness” is one of the common GI symptoms of pregnancy. It begins between the $4^{th}$ and $8^{th}$ weeks of pregnancy and usually subsides by the $14^{th}$ to $16^{th}$ weeks. The cause of nausea relates with the rise in the level of human chorionic gonadotropin, progesterone and the resulting relaxation of smooth muscle of the stomach. Constipation is another GI symptoms that occurs during pregnancy. It is associated with the narrowing colon as it gets pushed by the growing uterus found adjacent, it leading to mechanical blockade. Dietary craving is common in pregnancy, it is thought that certain foods might relieve nausea. Pica is the intense craving for un-usual materials such as clay and ice .

**Respiratory changes that occur during pregnancy**:There are various physiological changes that affect respiration. progesterone affects the respiratory physiology during pregnancy, increasing minute volume by 40% in the first trimester via an increase in tidal volume alone as the respiratory rate does not change during pregnancy. Oxygen consumption increases by 20% to 40% during pregnancy as the oxygen demand for the growing fetus, placenta and increased metabolism activity of the maternal organs all increase the pregnant person’s overall oxygen requirements.