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Mat No: 18/ENG08/011

Course Title: Human Physiology II

Course code: PHY 212

QUESTION:

Physiological adaptation of a woman to pregnancy

Pregnancy is a unique period in a woman's lifetime. A number of anatomic, physiologic, biochemical and psychological changes take place.

Some of them which are:

- **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. 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.

Vascular spider nevi and palmar erythema happen also during pregnancy. Chloasma and other pigmented lesions can happen as a result of increased melanocyte stimulating hormone activity which in turn is a result of increased estrogen and progesterone levels.

Skin pruritus affects a number of women and it may be related to increased retention of bile salts in the skin secondary to estrogen effects.

- **Changes in Gastrointestinal system**

Nausea and vomiting are the most frequent complaints involving the gastrointestinal system and usually happen in early pregnancy while heartburn happens 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 which may lead to constipation.

The liver is affected significantly by pregnancy. Cholestatic jaundice is considered to be the result of estrogen effect on elimination of bilirubin by the liver

Pregnancy increases the size and decreases the motility of the gall bladder. The decreasing motility and increase in volume, combined with changes in the bile's composition.

- **Cardiovascular changes**

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

1. Blood volume

Significant increases in the blood volume start taking place in the first trimester and continue until the mid-third trimester, at approximately the 32nd to the 34th week. Beyond this point in gestation, the blood volume plateaus

The average absolute increase in blood volume during pregnancy is about 1600 ml and in terms of percent change one should expect a 40 to 50 percent increase above pre-pregnancy levels. The increase in the blood volume is achieved by a combination of increases in the plasma volume and the RBC mass

The calculated plasma volume expansion is approximately 1300 ml and the volume of the RBC increases about 400 ml. This discordance in the change between the cellular elements of the blood and the liquid portion leads to the so called "physiologic anemia of pregnancy"

The increase in blood volume with pregnancy appears to serve the essential physiologic needs of both the mother and fetus. It ensures adequate supplies required for normal fetal growth and oxygenation even under circumstances that affect the maternal cardiac output (inferior vena cava compression). This

increased blood volume also helps normal pregnant women to withstand hemorrhage equal to the volume of blood added to the circulation during the course of the normal pregnancy without any signs of de-compensation.

2. Cardiac output

It is generally accepted that cardiac output begins to rise during the first trimester, probably around the tenth week of pregnancy and continues to rise up until the 24th week of gestation. Once it reaches the peak it stays rather stable.

Cardiac output is a product of stroke volume and pulse rate. The rise in cardiac output early in pregnancy is disproportionately greater than the increase in heart rate, and therefore is attributable to augmentation in stroke volume. As pregnancy advances, heart rate increases and becomes a more predominant factor in increasing cardiac output. At the late stages of pregnancy, the stroke volume declines to normal, non-pregnant values.

3. 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.

4. The heart

A number of changes happen to the heart and are unique to pregnancy. Increasing intra-abdominal contents displace the heart upward with some forward rotation. As a result the anterior posterior diameter and the cardiothoracic ratio are increased. The overall dimensions of the heart are increased during pregnancy as a result of increased diastolic heart volume without any change in the ventricular wall thickness.

5. 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.

- **Physiological respiratory changes**

1. Anatomic changes:

Mucosal edema and hyperemia secondary to capillary engorgement are common findings in the nasopharynx and the tracheal bronchial tract. In fact the majority of pregnant women have redness and swelling of the lungs that at times can produce changes in the voice

2. During pregnancy the functional residual capacity of the lungs is decreased. The reduction has been attributed to the elevation of the diaphragm from the enlarging uterus. This effect is counterbalanced by a proportional increase in inspiratory capacity that results in an unchanged vital capacity. Overall the respiratory changes in pregnancy reflect a tendency to assure plenty oxygen supply to the fetus and able opportunity to eliminate waste.

- **Changes in Reproductive system**

The genital organs undergo significant changes with increased vascularity of the cervix and increased mucous formation by the cervical glands due to increased levels of estrogen. The vulva and the vagina are also edematous and present increased desquamation and transudation. This leads to an increase in the secretions from the vagina manifesting as increased leukorrhea. The secretions of the vagina are acidic because of the conversion of an increased amount of glycogen in the vaginal epithelial cells by Doderlein's Bacilli into lactic acid.

Pubic pain is also noted and may be secondary to increased joint motility that happens secondary to progesterone's relaxing effect on the pubic symphysis cartilage

- **Muscular Skeletal and neurologic symptoms**

A number of women may experience backache in the upper back, which is secondary to muscle tension from increasing breast size and discomfort. Most women, however, experience low back pain secondary to muscular fatigue and strain that is caused by the changes in body balance from the growing uterus. Several patients also may experience pressure on nerve roots that in turn may lead to muscular spasms and pelvic joint pains secondary to bone ligament relaxation from the sex hormones. The changes that happen on the ligaments and the cartilage of the pelvic bones secondary to the sex hormones may also lead some women to present with gait alterations. Finally, a number of women may experience paresthesias (numbness and tingling of fingers and toes).