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NURSING

PHYSIOLOGY

Elucidate the 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). 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 there 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.

Cardiovascular System

During pregnancy progesterone levels increases. 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.

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.

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.

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.

Changes in the Uterus, Cervix and Vagina

After conception, the uterus provides a nutritive and protective environment in which the fetus will grow and develop. It increases from the size of a small pear in its non-pregnant state to accommodate a full-term baby at 40 weeks of gestation. The tissues from which the uterus is made continue to grow for the first 20 weeks, and it increases in weight from about 50 to 1,000 gm (grams). After this time, it doesn't get any heavier, but it stretches to accommodate the growing baby, placenta

and amniotic fluid. By the time the pregnancy has reached full term, the uterus will have increased to about five times its normal size:

In height (top to bottom) from 7.5 to 30 cm

In width (side to side) from 5 to 23 cm

In depth (front to back) from 2.5 to 20 cm.

The cervix

The cervix remains 2.5 cm long throughout pregnancy. In late pregnancy, softening of the cervix occurs in response to increasing painless contractions of its muscular walls.

The vagina

The vagina also becomes more elastic towards the end of pregnancy. These changes enable it to dilate during the second stage of labour, as the baby passes down the birth canal. (You will learn all about this in the next Module on Labour and Delivery Care.)

Changes in posture and joints

A pregnant woman's entire posture changes as the baby gets bigger. Her abdomen transforms from flat or concave (dished) to very convex (bulging outwards), increasing the curvature of her back. The weight of the fetus, the enlarged uterus, the placenta and the amniotic fluid (the bag of waters surrounding the baby), together with the increasing curvature of her back, puts a large strain on the woman's bones and muscles. As a result, many pregnant women get back pain. Too much standing in one place or leaning forward can cause back pain, and so can hard physical work. Most kinds of back pain are normal in pregnancy, but it can also be a warning sign of a kidney infection. In addition, progesterone causes a loosening of ligaments and joints throughout the body. Pregnant women may be at greater risk of sprains and strains because the ligaments are looser, and because their posture has changed.

Changes in body weight during pregnancy

A woman vomiting due to morning sickness

Continuing weight increase in pregnancy is considered to be one favourable indication of maternal adaptation and fetal growth. However, routine weighing of the mother during pregnancy is not now thought to be necessary, because it does not correlate well with pregnancy outcomes. For example, there can be a slight loss of weight during early pregnancy if the woman experiences much nausea and vomiting (often called 'morning sickness'). A woman who is pregnant with more than one baby will have a higher weight gain than a woman with only one fetus. She will also require a higher calorie diet.

A lack of significant weight gain may not be a cause for concern in some women, but it could be an indication that the fetus is not growing properly. Doctors and midwives may refer to this as intrauterine growth restriction (IUGR) of the fetus.

Changes in Blood volume

Blood volume (the total volume of blood in the circulation, measured in litres) increases gradually by 30-50 % in the pregnant woman, so by full term she has about 1.5 litres more blood than before the pregnancy. A higher circulating blood volume is required to provide extra blood flow through the placenta, so nutrients and oxygen can be delivered to the fetus. The increase in blood volume is caused by two changes:

Increase in the volume of blood plasma (the fluid part of the blood).

Increase in the number of red blood cells in the circulation.

The volume of blood plasma increases after about the sixth week of pregnancy. It reaches its maximum level of approximately 50% above non-pregnant values by the second trimester, and maintains this until full term. The total volume of red cells in the circulation increases by about 18% during pregnancy, in response to the extra oxygen requirements made by the maternal, placental and fetal tissues. Red blood cells contain the oxygen-carrying substance called haemoglobin, which is rich in iron. Taking iron supplements during pregnancy can result in a much greater increase in red blood cells, up to 30% more than non-pregnant levels

Changes in Blood pressure in pregnancy

We said earlier that progesterone causes the ligaments and joints to loosen during pregnancy. It also acts with some other natural chemicals in the body to cause the muscular walls of the blood vessels to relax slightly. The result is that there is less resistance to the flow of blood around the body, because the same volume of blood is circulating in slightly wider blood vessels. Blood pressure (BP) refers to how hard the blood is ‘pushing’ on the walls of the major blood vessels as it is pumped around the body by the heart

Other physical changes are:

Changes in the skin

Changes in the woman’s hormones, and mechanical stretching of her growing abdomen and breasts, are responsible for several changes in the skin during pregnancy.

Linea nigra

This dark line may appear between the umbilicus (belly-button) and the symphysis pubis (pubic bone); in some pregnant women it may extend as high as the sternum (the bone between the breasts). It is a hormone-induced excess production of brown material (pigment) in the skin cells in this area. After delivery, the line begins to fade, though it may never completely disappear.

Mask of pregnancy (chloasma)

Some women produce a brownish pigmentation of the skin over the face and forehead, known as the ‘mask of pregnancy’ (or chloasma). It gives a bronze look. It begins about the 16th week of pregnancy and gradually increases, but it usually fades after delivery.

Stretch marks

As the woman’s weight increases, stretching of the skin occurs over areas of maximal growth — the abdomen, thighs and breasts. Pink or brownish stretch marks may appear in some women, which can be quite dramatic. They usually fade after delivery, although they never completely disappear.

Sweat glands

Activity of the sweat glands throughout the body usually increases during pregnancy, which causes the woman to perspire (sweat) more profusely than usual, particularly in hot weather or during physical work.

Changes in the breasts

In early pregnancy, the breasts may feel full or tingle, and they increase in size as pregnancy progresses. The areola around the nipples (the circle of pigmented skin) darkens and the diameter increases. The Montgomery's glands (the tiny bumps in the areola) enlarge and tend to protrude (stick out more). The surface blood vessels of the breast may become visible due to increased circulation, and this may give a bluish tint to the breast.

Clinical Relevance

Gestational Diabetes Mellitus (GDM)

Usually as pregnancy progresses there is an increase in insulin resistance however, normally this can be counteracted by increasing insulin production. In a woman with gestational diabetes this compensatory increase in insulin levels does not occur which results in a high blood sugar levels.

Oedema in pregnancy

Important! If a pregnant woman experiences severe oedema, including swelling of the face, this is a danger sign that requires immediate referral to the nearest health facility.

A combination of the slight increase in the permeability of the smallest of blood vessels (they allow more fluid to leak out into the tissues), the additional weight of the uterus, and the downward force of gravity, slow down the rate at which blood is pumped back to the heart from the lower half of the body. Fluid often collects in the tissues of the legs and feet of pregnant women after the first trimester, instead of

being absorbed into the blood circulation. The swelling caused by this collection of fluid is called oedema.

It is a common condition in pregnant women, particularly if they stand for a long time during the day. Oedema of the hands may also occur. Advise the woman to rest frequently and to elevate (raise) her feet and legs while sitting. This will improve the return of blood to her heart and decrease swelling of the legs