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ANATOMY

PHS 204

**QUESTION: Discuss the lactation and gestation period in a normal female.**

**LACTATION**

Lactation is the secretion of milk from the mammary glands of the postpartum female breast in response to an infant sucking at the nipple. Breast milk provides ideal nutrition and passive immunity for the infant, encourages mild uterine contractions to return the uterus to its pre-pregnancy size, and induces a substantial metabolic increase in the mother, consuming the fat reserves stored during pregnancy.

**STRUCTURE OF THE LACTATING BREAST**

Mammary glands are modified sweat glands. The non-pregnant and non-lactating female breast is composed primarily of adipose and collagenous tissue, with mammary glands making up a very minor proportion of breast volume. The mammary gland is composed of milk-transporting lactiferous ducts, which expand and branch extensively during pregnancy in response to estrogen, growth hormone, cortisol, and prolactin. Moreover, in response to progesterone, clusters of breast alveoli bud from the ducts and expand outward toward the chest wall. Breast alveoli are balloon-like structures lined with milk-secreting cuboidal cells, or lactocytes, that are surrounded by a net of contractile myoepithelial cells. Milk is secreted from the lactocytes, fills the alveoli, and is squeezed into the ducts. Clusters of alveoli that drain to a common duct are called lobules; the lactating female has 12–20 lobules organized radially around the nipple. Milk drains from lactiferous ducts into lactiferous sinuses that meet at 4 to 18 perforations in the nipple, called nipple pores. The small bumps of the areola (the darkened skin around the nipple) are called Montgomery glands. They secrete oil to cleanse the nipple opening and prevent chapping and cracking of the nipple during breastfeeding.

**PHYSIOLOGY OF LACTATION**

The pituitary hormone prolactin is instrumental in the establishment and maintenance of breast milk supply. It also is important for the mobilization of maternal micronutrients for breast milk.

Near the fifth week of pregnancy, the level of circulating prolactin begins to increase, eventually rising to approximately 10–20 times the pre-pregnancy concentration. We noted earlier that, during pregnancy, prolactin and other hormones prepare the breasts anatomically for the secretion of milk. The level of prolactin plateaus in late pregnancy, at a level high enough to initiate milk production. However, estrogen, progesterone, and other placental hormones inhibit prolactin-mediated milk synthesis during pregnancy. It is not until the placenta is expelled that this inhibition is lifted and milk production commences.

After childbirth, the baseline prolactin level drops sharply, but it is restored for a 1-hour spike during each feeding to stimulate the production of milk for the next feeding. With each prolactin spike, estrogen and progesterone also increase slightly.

When the infant suckles, sensory nerve fibers in the areola trigger a neuroendocrine reflex that results in milk secretion from lactocytes into the alveoli. The posterior pituitary releases oxytocin, which stimulates myoepithelial cells to squeeze milk from the alveoli so it can drain into the lactiferous ducts, collect in the lactiferous sinuses, and discharge through the nipple pores. It takes less than 1 minute from the time when an infant begins suckling (the latent period) until milk is secreted (the let-down).

The prolactin-mediated synthesis of milk changes with time. Frequent milk removal by breastfeeding (or pumping) will maintain high circulating prolactin levels for several months. However, even with continued breastfeeding, baseline prolactin will decrease over time to its pre-pregnancy level. In addition to prolactin and oxytocin, growth hormone, cortisol, parathyroid hormone, and insulin contribute to lactation, in part by facilitating the transport of maternal amino acids, fatty acids, glucose, and calcium to breast milk.

**PREGNANCY**

Pregnancy is the time from fertilization of an egg, also known as conception, to birth. Getting pregnant and growing a human from scratch is a very complicated biological process that takes a lot of resources. As a result, pregnancy can have a wide range of effects on the mother, both physically and emotionally.

Each egg that is released during a menstrual cycle travels to the uterus. However, unlike unfertilized eggs that proceed unaltered and then disintegrate when they get there, a fertilized egg develops into a tiny human embryo on the way. On reaching the uterus, the embryo implants itself in the uterine wall, develops into a fetus, and steadily grows, until about nine months later it is ready to emerge into the outside world as a newborn baby.

**SIGNS AND SYMPTOMS**

If you are fertile, sexually active, and become pregnant, the first thing you are likely to notice is a late or missing menstrual period. Fertilization of an egg triggers changes in the production of various hormones almost immediately, and hormone changes evolve and persist throughout your pregnancy to help you grow a healthy baby. Unfortunately, these changes may also cause unpleasant side effects. As a result, in addition to a missed period, many women experience tender, swollen breasts, fatigue, nausea and vomiting, or morning sickness during the first few weeks of becoming pregnant.

**PHYSIOLOGICAL CHANGES THAT OCCUR DURING PREGNANCY**

**Hormonal:** The menstrual cycle refers to the normal changes in your ovaries and uterus that make an egg accessible for fertilization and prepare your uterus for pregnancy. It typically occurs once every 28 days. If you are ovulating normally, an egg, or ovum emerges from one or other of your ovaries, leaving behind a structure called the corpus luteum. This structure produces large amounts of progesterone and estrogen, hormones that help prepare your uterus for implantation of a fertilized egg. If the egg is not fertilized, the corpus luteum degenerates, causing progesterone and estrogen levels to drop, and menstruation to begin. If the ovum is fertilized, on the other hand, the corpus luteum remains intact and continues to maintain the hormone levels you need to keep your uterus baby-friendly. Eventually, the placenta develops the ability to secrete the necessary hormones itself, and the corpus luteum typically disappears after 3 to 4 months.

In addition to progesterone and estrogen, human chorionic gonadotropin also spikes in early pregnancy. The levels of this hormone double every two days in the first 10 weeks of pregnancy. Its primary role is to prevent any further menstruation, and to prepare the placenta - the organ that connects the fetus to the uterus. The placenta allows the fetus to be supplied with nutrients and oxygen, as well as providing a route for the removal of toxic waste products.

**Immune tolerance:** Your growing fetus is a foreign object, something that your immune system is normally programmed to attack and reject. In order to prevent this from happening, as soon as the embryo becomes implanted in the uterine wall, a key pathway that usually triggers the launch of an immune attack is turned off, making this part of your immune system dormant, and preventing immune cells from targeting the fetus or placenta. In addition to making it possible for you to grow your baby, there can be secondary benefits of pregnancy-related changes in immune function. In particular, women suffering from diseases caused by immune disorders, such as rheumatoid arthritis, multiple sclerosis, and psoriasis, may find relief from disease symptoms during pregnancy due to increased levels of anti-inflammatory steroids that occur naturally.

**Cardiovascular:** During pregnancy, your cardiac output - the amount of blood your heart pumps around your body per minute - increases to meet the needs of the developing fetus, and to provide the volume of blood necessary to fill the uteroplacental circulation.

This is achieved by increasing the stroke volume, which is the amount of blood pumped out of your heart with each heartbeat. Your cardiac output peaks around week 24 of your pregnancy, when it is 30%-40% higher than normal. As the fetus grows, your uterus begins to crowd your aorta, the major artery that carries oxygenated blood to your tissues and organs and vena cava, the major vein that carries deoxygenated blood back to your heart. Sometimes, certain positions, such as lying on your back, puts excess pressure on these vessels, which can lead to a drop in blood pressure causing dizziness, fainting, and in some cases, even damage to the fetus. In addition, exercise or activities that change heart rate tend to put a greater demand on your cardiovascular system when you are pregnant than they normally would, and the large changes in cardiac output associated with pregnancy may add additional strain for women with pre-existing heart conditions, such as valvular heart disease, or coronary heart disease.

**Hematologic**: As cardiac output increases, blood volume increases to match. This is due to a 50% increase in the volume of your plasma (the clear, yellowish fluid of your blood), and a 20% increase in the number of red and white blood cells. Overall, this has the effect of diluting the blood, often resulting in “physiological anemia of pregnancy” (a relative deficiency of red blood cells). Iron requirements increase during pregnancy as the fetus and placenta grow, and as the red blood cell numbers rise. Iron is essential for red blood cell production, and supplements are often needed as the amount of iron absorbed from the diet and recruited from iron stores is often not enough. Several hormones are thought to play a role in changing blood composition to support pregnancy including the renin-angiotensin-aldosterone hormonal system, atrial natriuretic peptide, estrogen, and progesterone, although exactly how they do this is not clear. Whatever the mechanism, the increased blood volume is very important as it ensures that the extra blood needed to supply the growing uterus and placenta is available, and can help protect the mother against normal blood loss that occurs while giving birth.

**Metabolic**: Changes in metabolism during pregnancy alter the distribution of body fat, as well as how you digest and process food. While accumulating fats and nutrients is necessary for the healthy growth of your baby, metabolic changes can also affect the way in which medications are processed. As such, it is important to know how your pregnant body may respond to any drugs or homeopathic remedies you may be taking, and whether or not this could have an effect on your growing baby.

Body weight: Supporting the growth of a developing fetus takes a lot of energy, so it’s not surprising that more calories are required during pregnancy. In fact, after the first three months (trimester) your appetite generally increases so that you are consuming about 300 extra calories a day. Although in the first trimester you can expect to gain just a few pounds, it’s normal to gain about a pound per week for the rest of your pregnancy. In addition to weighing more, you can expect your breasts to grow around 1 to 2 cup sizes in preparation for breastfeeding.

**Gastrointestinal**: As your uterus grows, it puts pressure on your digestive organs including your colon, gallbladder, liver, and stomach. This can impair their function, and lead to constipation, gallstones, reduced bile transport, as well as a general slowing of the digestive process that is related to lower levels of the hormone gastrin. Gastrin stimulates the secretion of stomach acid, which in turn leads to the production of pepsin, an enzyme that digests proteins in your food - less gastrin leads to slower digestion. In addition to this, elevated progesterone levels during pregnancy slacken the cardiac sphincter, the “door” between your esophagus and stomach, making it open more easily. It is very common to experience heartburn due to acid reflux into your esophagus during the third trimester, as the cardiac sphincter cannot withstand the pressure that builds up in your stomach as your uterus grows. Its also worth noting that taking analgesics during pregnancy may not be for the best, as they can slow down gastric emptying even more, creating an even higher pressure that the cardiac sphincter must withstand.

**Musculoskeletal**: Numerous anatomical and physiological changes occur during pregnancy that strain the muscles and skeleton, particularly the pelvis, and which may lead to lower-back pain, leg cramps, and hip pain. One of the hormones responsible for musculoskeletal changes during pregnancy is relaxin, which softens your ligaments and cartilages tissues to help your body accommodate your growing baby. In addition to relaxin’s relaxing effects, the arrangement of the abdominal muscles themselves is particularly well adapted for childbearing. Unlike in men, where they form a “six pack”, women’s abdominal muscles are positioned to allow them to stretch around a baby-bump.