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PHARMACOLOGY

PHS 204

Question

I expect more on the physiology of lactation and details on the physiology of pregnancy in a normal woman.

PHYSIOLOGY OF LACTATION

Lactation is the secretion of milk from specialized glands (mammary glands) to provide nourishment to offspring. The normal physiology of lactation is a process that begins to take effect well before the initial latch of the new born infant. It requires the breast to change in composition, size, and shape during each stage of female development. The chief function of lactation is to provide nutrition and immune protection to the young after birth. In almost all mammals, lactation induces a period of infertility, which serves to provide the optimal birth spacing for survival of the offspring.

By the fifth or sixth month of pregnancy, the breasts are ready to produce milk. During the latter part of pregnancy, the woman’s breasts enter into the lacto genesis I stage. This is when the breasts make colostrum, a thick, sometimes yellowish fluid. At this stage, high levels of progesterone inhibit most milk production. It is not a medical concern if a pregnant woman leaks any colostrum before her baby’s birth, nor is it an indication of future milk production. Colostrum is the first milk a breastfed baby receives. It contains higher amounts of white blood cells and antibodies than mature milk, and is especially high in immunoglobulin A (IgA), which coats the lining of the baby’s immature intestines, and helps to prevent pathogens from invading the baby’s system. Secretory IgA also helps prevent food allergies. Over the first two weeks after the birth, colostrum production slowly gives way to mature breast milk.

The process of lactation and breastfeeding can be negatively affected by anything that interrupts the normal development of the female breast, or that interferes with the production of milk. In the post-partum period, some women may experience difficulty with lactation if they have inadequate milk production, poor milk extraction, and insufficient caloric intake to meet demands. Issues of concern regarding lactation include the infants inability to latch, nipple pain, mastitis, or plugged ducts. Normal lactation involves the female breast, anterior lobe of the pituitary, and the posterior lobe of the pituitary. The alveolar epithelial cells responsible for milk production are polarised, highly differentiated cells and their function is to accumulate, synthesise, package and export the components of milk.

PHYSIOLOGY OF PREGNANCY IN A NORMAL WOMAN

Pregnancy causes physiologic changes in all maternal organ systems; most return to normal after delivery. In general, the changes are more dramatic in multifetal than in single pregnancies.

Pregnancy alters the function of most endocrine glands, partly because the placenta produces hormones and partly because most hormones circulate in protein-bound forms and protein binding increases during pregnancy. The placenta produces the beta subunit of human chorionic gonadotropin (beta-hCG), a trophic hormone that, like follicle-stimulating and luteinizing hormones, maintains the corpus luteum and thereby prevents ovulation. Levels of estrogen and progesterone increase early during pregnancy because beta-hCG stimulates the ovaries to continuously produce them. After 9 to 10 weeks of pregnancy, the placenta itself produces large amounts of estrogen and progesterone to help maintain the pregnancy. The placenta produces melanocyte-stimulating hormone (MSH), which increases skin pigmentation late in pregnancy. The pituitary gland enlarges by about 135% during pregnancy. The maternal plasma prolactin level increases by 10-fold. Increased prolactin is related to an increase in thyrotrophic-releasing hormone production, stimulated by estrogen. The primary function of increased prolactin is to ensure lactation. The level returns to normal postpartum, even in women who breastfeed.

As pregnancy progresses, pressure from the enlarging uterus on the rectum and lower portion of the colon may cause constipation. GI motility decreases because elevated progesterone levels relax smooth muscle. Heartburn and belching are common, possibly resulting from delayed gastric emptying and gastroesophageal reflux due to relaxation of the lower oesophageal sphincter and diaphragmatic hiatus. Hydrochloric acid production decreases; thus, peptic ulcer disease is uncommon during pregnancy, and pre-existing ulcers often become less severe.

Lung function changes partly because progesterone increases and partly because the enlarging uterus interferes with lung expansion. Oxygen consumption increases by about 20% to meet the increased metabolic needs of the foetus, placenta, and several maternal organs. Considerable hyperaemia and oedema of the respiratory tract occur. Occasionally, symptomatic nasopharyngeal obstruction and nasal stuffiness occur, Eustachian tubes are transiently blocked, and tone and quality of voice change. Mild dyspnoea during exertion is common, and deep respirations are more frequent.

Changes in renal function roughly parallel those in cardiac function. Glomerular filtration rate (GFR) increases 30 to 50%, peaks between 16 and 24 weeks gestation, and remains at that level until nearly term, when it may decrease slightly because uterine pressure on the vena cava often causes venous stasis in the lower extremities.

Total blood volume increases proportionally with cardiac output, but the increase in plasma volume is greater than that in red blood cell (RBC) mass. With twins, total maternal blood volume increases more (closer to 60%). Iron requirements increase by a total of about 1 g during the entire pregnancy and are higher during the 2nd half of pregnancy—6 to 7 mg/day. The foetus and placenta use about 300 mg of iron, and the increased maternal RBC mass requires an additional 500 mg. Cardiac output (CO) increases 30 to 50%, beginning by 6 weeks gestation and peaking between 16 and 28 weeks (usually at about 24 weeks). It remains near peak levels until after 30 weeks. Then, CO becomes sensitive to body position. Positions that cause the enlarging uterus to obstruct the vena cava the most.

The increase in CO during pregnancy is due mainly to demands of the uteroplacental circulation; volume of the uteroplacental circulation increases markedly, and circulation within the intervillous space acts partly as an arteriovenous shunt. As the placenta and foetus develop, blood flow to the uterus must increase to about 1 L/min (20% of normal CO) at term. Increased needs of the skin (to regulate temperature) and kidneys (to excrete fetal wastes) account for some of the increased CO.