

## ➤ PREGNANCY and BIRTH

### **If a woman does not become pregnant then:**

The corpus luteum will degenerate. **The corpus luteum can only survive for about two weeks in the absence of a pregnancy.** As progesterone release from the corpus luteum increases, the progesterone inhibits the release of LH from the anterior pituitary. LH from the anterior pituitary is required for the maintenance of the corpus luteum. Basically, the corpus luteum self-destructs if a pregnancy does not occur. If the corpus luteum degenerates (dies), then progesterone secretion decreases and the endometrium breaks down (menstruation occurs). **So, menstruation occurs due to a decrease in progesterone secretion.** Progesterone is required for the development and maintenance of a pregnancy.

### **If a woman becomes pregnant then:**

The corpus luteum will survive for the first 6-10 weeks of a pregnancy. If a pregnancy occurs, then the corpus luteum will be maintained and continue to secrete progesterone.

**Progesterone secretion is required for the maintenance of a pregnancy.** So, during pregnancy progesterone levels are high but because of negative feedback LH release from the anterior pituitary is low. **If the oocyte is fertilized and implants in the endometrium then the developing embryo will secrete hCG (human Chorionic Gonadotropin).** hCG is the hormone that is tested for to determine if a woman is pregnant because it is only produced by a developing embryo. **hCG can replace LH (which is not secreted during a pregnancy) to stimulate the corpus luteum to produce progesterone for the first 6-10 weeks of a pregnancy.** After the first trimester, the embryo and placenta will have developed enough to produce their own progesterone to maintain the pregnancy. The placenta also secretes increasing amounts of estrogen (mainly **estriol**) during a pregnancy.

Progesterone is required for the development and maintenance of a pregnancy because it:

1. inhibits the contractions of the uterine myometrium. In a non-pregnant woman, the myometrium rhythmically contracts. Progesterone secretion in a pregnant woman prevents these contractions to help keep the embryo/fetus in the uterus.
2. maintains the uterine endometrium in a secretory, nutrient rich state to support the developing embryo/fetus.

Estrogen (estriol) is required for the development and maintenance of a pregnancy because it:

1. maintains the secondary sexual organs and secondary sexual characteristics of the mother since the ovary is basically non-functional during most of the pregnancy. The high FSH and LH levels secreted from placenta prevent the release of FSH and LH from the anterior pituitary of the mother so that the ovary is no longer stimulated. A woman does not ovulate or experience menstrual cycles while she is pregnant (this is called **pregnancy amenorrhea**).
2. stimulate breast tissue (mammary gland) growth in preparation for lactation.
3. will eventually override the effects of progesterone and help stimulate the contractions of the myometrium at the time of birth (parturition).

### ➤ IMPLANTATION

During the first few days following fertilization, the **embryo** travels from the region of the Fallopian tube near the ovary toward the uterus due to the movement of cilia and fluid through the Fallopian tubes. At the same time, the embryo undergoes its first cell division and subsequent cell divisions (or **cleavages**) until a solid ball of cells, called a **morula**, is formed about 2-3 days post-fertilization.

As the embryo travels through the Fallopian tube, the endometrium of the uterus is in its **secretory phase**. During the secretory phase, the endometrium becomes richly vascularized and stores glycogen and other nutrients that will help nourish the embryo during its initial stages of development.

By about the **seventh day post-fertilization**, the morula has hollowed out to form a **blastocyst**. A blastocyst is a fluid filled ball of cells with a small group of cells in the interior at one end. The outer layer of cells around the outside of the blastocyst are called the **trophoblast**. The trophoblast cells secrete enzymes that help break up the endometrium and allow the blastocyst to implant in the endometrium. The group of cells inside the blastocyst is called the **inner cell mass**. Some of the cells in the inner cell mass will eventually become the embryo proper. That is, the head, trunk, and limbs of the embryo. The blastocyst **implants** (buries itself) into the uterine endometrium about seven to ten days after fertilization. The trophoblast cells will give rise to the chorion of the placenta while the inner cell mass will become the embryo itself.

### ➤ PLACENTATION (formation of a placenta)

By 12 days post-fertilization, a **placenta** begins to form. The placenta is formed from trophoblast cells and uterine endometrial cells. So, the placenta is formed from both maternal and embryonic tissues. The maternal tissue is called the **decidua** and the embryonic tissue is called the **chorion**. As the placenta develops, finger-like projections called **villi** extend into pools of maternal blood. Nutrients, oxygen, carbon dioxide, and waste products (e.g. urea) are exchanged across the villi of the placenta. The mother supplies the embryo with oxygen and nutrients and waste products flow from the embryo across the placenta and into the maternal blood. The mother's liver and kidneys will remove the embryonic waste products from her body and she will breathe out the carbon dioxide through her lungs.

### ➤ PREGNANCY

**hCG (human Chorionic Gonadotropin)** is secreted from the chorion of the embryo shortly after fertilization. hCG is required to maintain progesterone secretion by the corpus luteum for the first 6-10 weeks of a pregnancy. Many women experience nausea and/or vomiting during the first trimester of a pregnancy. hCG or other steroids secreted by the embryo may affect the vomiting center (in the medulla of the mother's brain) to cause morning sickness.

**Human gestation usually lasts about 38 weeks** (40 weeks from the last menstrual period). During pregnancy, as the embryo/fetus grows, the uterus grows significantly. The **fetal-placental unit** (the decidua and the chorion together) will secrete increasing amounts of **estriol** (a type of estrogen) and **progesterone**.

#### **The fetal-placental unit works as follows...**

Cholesterol from the mother's blood travels to the placenta where it is converted into progesterone. The progesterone is carried by the fetal blood to the adrenal cortex of the fetus where it is converted into dehydroepiandrosterone (DHEA). This DHEA is carried to the fetal liver and converted into 16-hydroxy-DHEA sulfate which is carried back to the fetal placenta. 16-hydroxy-DHEA is converted into estriol by the placenta. (see fig. 8-17 in Jones)

Among other effects, the estriol is required to maintain the mother's secondary sexual organs and sexual characteristics. The progesterone is required to maintain the endometrium in a secretory state and to inhibit the contractions of the uterine myometrium (uterine muscles) in order to retain the embryo/fetus within the womb.

The breasts will enlarge (in response to estriol and progesterone stimulation) and begin to produce milk (in response to increased prolactin release from the anterior pituitary of the mother).

Weight gain during pregnancy is due to the growth of the fetus, the uterus, and the placenta as well as an increase in blood and amniotic fluid volume.

Adjustments are made in a number of maternal physiological systems to accommodate the increased metabolic demands of pregnancy. **The maternal blood volume increases by over 30%. Respiratory activity increases by about 20%.**

The frequent need to urinate during pregnancy is caused by increased urine output and the fact that anatomically the uterus sits above the urinary bladder. As the uterus and fetus grow more pressure is placed on the bladder. Pressure is also placed on the intestines and colon and this can lead to gas pains and/or constipation.

A woman does not experience menstrual cycles while she is pregnant (**pregnancy amenorrhea**) because there is an embryo/fetus in the uterus and the mother's blood progesterone level is quite high. The increased progesterone level prevents LH and FSH release by negative feedback and thus the woman does not menstruate or ovulate while she is pregnant.

### ➤ **PARTURITION (BIRTH)**

**Parturition and labor involve three steps:**

- 1. dilation and effacement of the cervix.**
- 2. contractions of the myometrium that are sufficient enough to expel the fetus.**
- 3. expulsion of the placenta (afterbirth).**

During the last trimester of a pregnancy, the cervix begins to soften and the myometrium becomes more excitable (it contracts more readily). A hormone made by the ovary and the placenta called **relaxin** will help relax the cervix as well as the pubic symphysis (the cartilage that connects the pubic bones in the front of the pelvis).

The onset of true labor is characterized by the onset of rhythmic, coordinated contractions of the myometrium. As labor progresses, the contractions increase in frequency and intensity to force the fetus from the uterus. A number of endocrine factors may stimulate the contractions. **Oxytocin** release from the maternal posterior pituitary appears to play a role in stimulating the contractions of the myometrium in the uterus. A synthetic form of oxytocin called **Pitocin** can be given to women to induce labor. The exact mechanisms that cause the contractions are still under investigation and a current subject of some controversy.

While **progesterone** inhibits the contractions of the uterus, the following hormones stimulate the contractions of the uterus:

- 1. oxytocin (from maternal pituitary)**
- 2. estriol (an estrogen from the placenta)**
- 3. prostaglandins (made by the uterus)**

Fetal stress and/or a placental “clock” which is partially determined by the ratio of estrogen and progesterone made by the placenta initiate an increase in CRH release from the fetal brain that stimulates the release of ACTH from the fetal pituitary. This ACTH causes cortisol to be secreted by the fetal-placental unit and changes the ratio of estrogen and progesterone such that the estrogen level is now higher. This increases the sensitivity of the uterus to oxytocin (from maternal pituitary) and prostaglandins (from uterus) to initiate labor. As the fetus moves more and the fetal ejection reflex is stimulated there is an increase in oxytocin release from the maternal pituitary by **positive feedback**. This increase in oxytocin causes further uterine contractions leading to the expulsion of the fetus and eventually the afterbirth (see. Fig. 9-3 in Jones text).

After parturition, the uterus shrinks to its normal size (this is called **involution**) due to the decrease in steroid production. Generally, involution occurs faster in mothers who breast-feed their infants. **As a baby suckles, there is an increase in oxytocin release** that stimulates contractions of the myometrium and enhances involution. Involution is usually complete in about four weeks in mothers who nurse. A vaginal discharge called **lochia** continues for a number of weeks following birth as the remnants of the placenta are discharged.