The luteal phase of estrous cycle

- The luteal phase consists of three major processes. They are:

1) The transformation of follicle cells into luteal cells after ovulation (luteinization).

2) Growth and development of the corpus luteum so that it produces high quantities of progesterone (diestrus).

3) Destruction of the corpus luteum (luteolysis) resulting in a subsequent follicular phase.

- The luteal phase lasts from the time of ovulation until regression (luteolysis) of the corpus luteum (CL) near the end of the estrous cycle. It includes metestrus and diestrus. The dominant ovarian hormone during the luteal phase is progesterone.

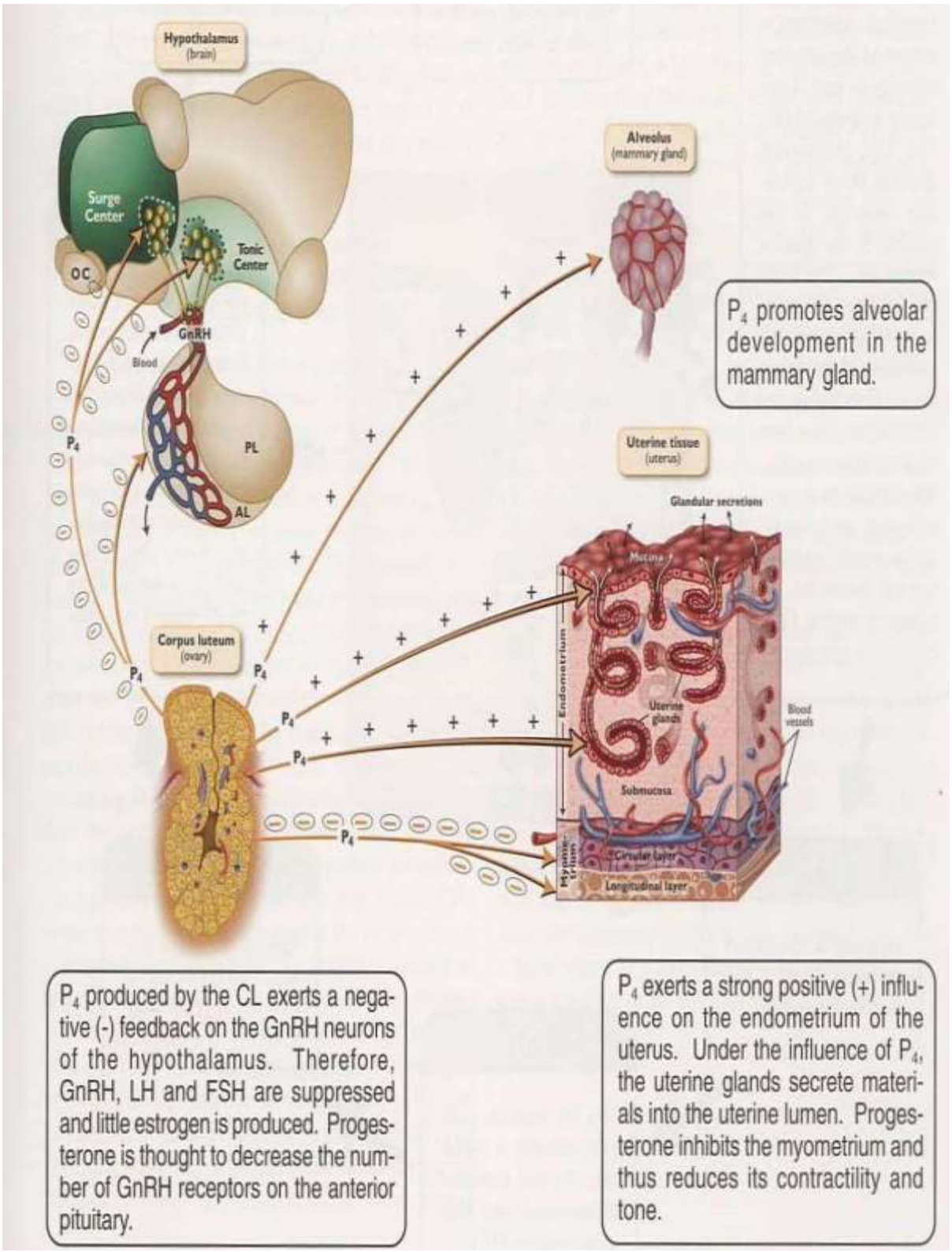
- When the follicle ruptures at ovulation, blood vessels within the follicular wall also rupture. This vascular breakage results in a structure with a "bloody" clot-like appearance.

- This structure is called the **corpus hemorrhagicum** because of its hemorrhagic (bloody) appearance when viewed from the surface of the ovary. Corpora hemorrhagica can be observed from the time of ovulation until about day 1 to 3 of the estrous cycle.

- After ovulation the theca interna and the granulosal cells of the follicle undergo a dramatic transformation known as luteinization. **Luteinization** is the process whereby cells of the ovulatory follicle are transformed into luteal tissue. This transformation is governed by LH.

- The primary target organs for progesterone are the hypothalamus, the uterus and the mammary gland, see figure (1).

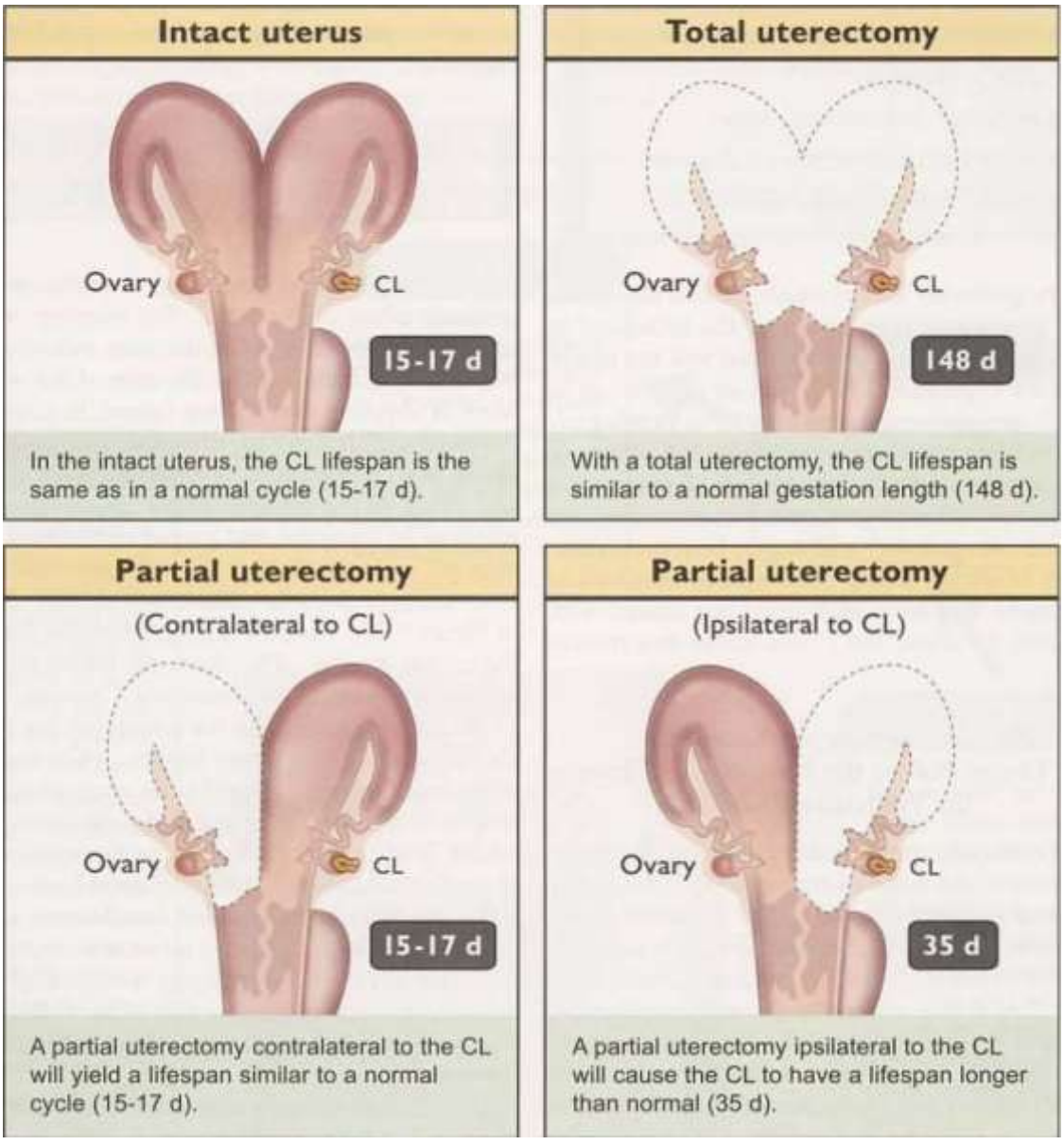
Figure (1). Progesterone (P 4) has Many Physiological Effects



Luteolysis

- Luteolysis means disintegration or decomposition (lysis) of the corpus luteum. It occurs during a one-to-three day period at the end of the luteal phase. Luteolysis is a process whereby the corpus luteum undergoes irreversible degeneration characterized by a dramatic drop in blood concentrations of progesterone. The hormones controlling luteolysis are **oxytocin** and **progesterone** from the corpus luteum and **$PGF_{2\alpha}$** produced by the uterine endometrium.

Figure (2). Effect of Uterectomy upon Estrous Cycle Duration in the Ewe

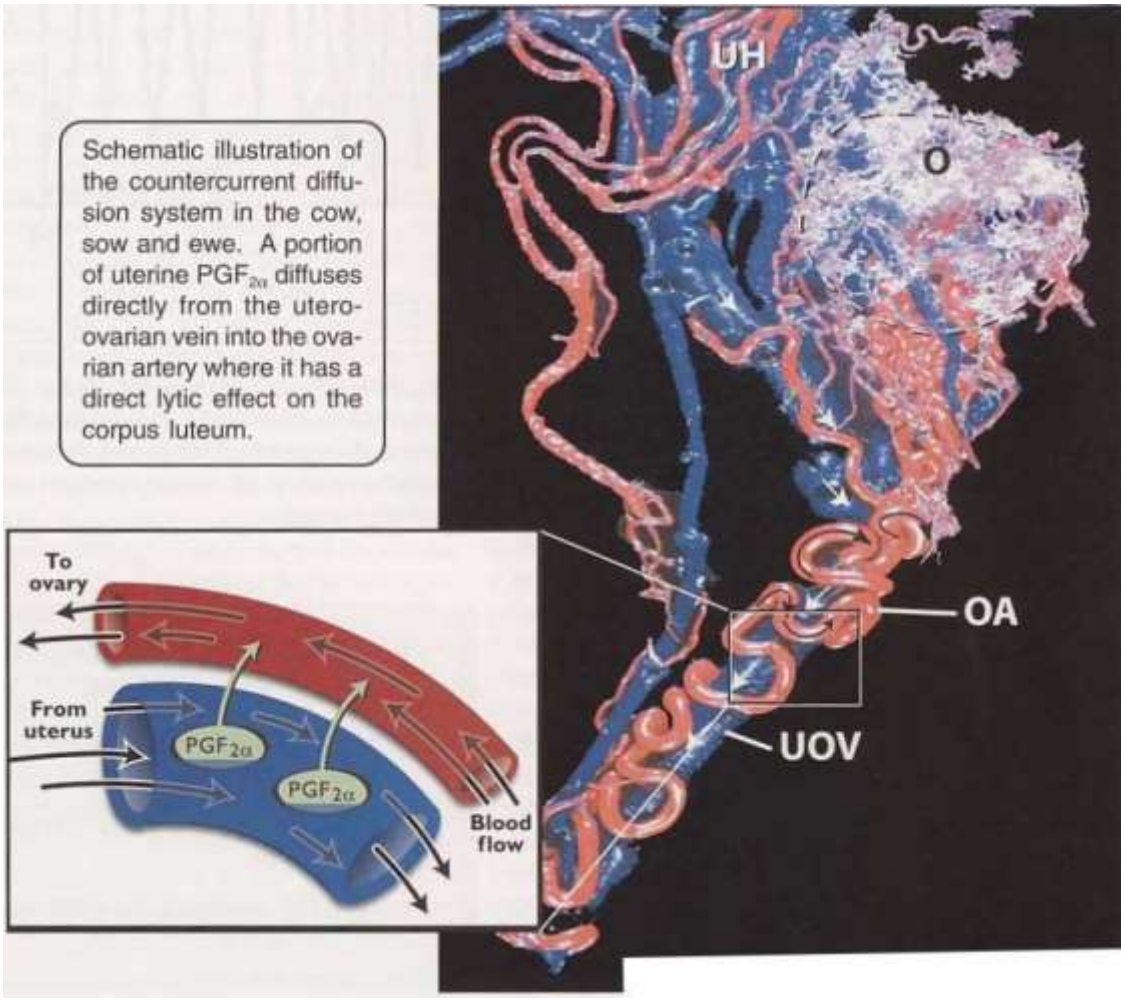


A vascular countercurrent diffusion system insures that $PGF_{2\alpha}$ will reach the ovary in sufficient quantities to cause luteolysis in. the ewe, cow and sow.

- Prostaglandin $F_{2\alpha}$ from the uterus is transported to the ipsilateral ovary through a vascular countercurrent exchange mechanism. A countercunent exchange system involves two closely associated blood vessels in which blood from one vessel flows in the opposite direction to that of the adjacent vessel.

- The ovarian artery lies in close association with the utero-ovarian vein (See Figure (3). By countercurrent exchange, $PGF_{2\alpha}$ is transferred across the wall of the uterine vein into the blood of the ovarian artery by passive diffusion.

Figure (3). The Utero-Ovarian Vascular Countercurrent Diffusion System



- In addition to progesterone, large luteal cells synthesize and secrete oxytocin. In fact, in the cow and the ewe the corpus luteum contains very large quantities of oxytocin. During the first half of the estrous cycle progesterone prevents secretion of $PGF_{2\alpha}$ by blocking the formation of oxytocin receptors in the uterus. After 10 to 12 days progesterone loses its ability to block formation of oxytocin receptors. Thus, oxytocin and $PGF_{2\alpha}$ stimulate each other in a positive feedback manner.