SECTION 7

Follicular Development & Corpus Luteum Function

Follicular Phase

Follicles grow at all times of cycle

Granulosa cells increase in numbers and layers of thecal cells grow and encompass periphery of follicle

Theca cells differentiate into

Theca externa

Connective tissue surrounding entire follicle

Theca interna

Inner layer of thecal cells next to basement membrane

Synthesizes androgens (T) under influence of LH

Androgens (T) pass across basement membrane to granulosa cells where they are converted to E2β under influence of FSH

(Figure 4-2)

Follicles undergo rapid maturation just before estrus
E2β concentration increase during follicular phase

Highest E2β concentrations occur at beginning of estrus

Estrus behavior occurs

Due to a local effect of E2β on central nervous system

P4 has synergistic action with E2β in inducing sexual receptivity

Increasing concentrations of E2β exert (+) feedback on hypothalamo-hypophyseal axis to cause surge of LH and FSH during estrus

Surges of LH and FSH are caused by GnRH

LH activates enzymes that digests connective tissue in wall of follicle resulting in ovulation

Ovulation occurs after LH peak in most domestic animals

Luteal Phase

Granulosa and theca cells differentiate into luteal cells

CL secretes P4 under influence of LH (luteotropic effect)

CL reaches maximum function (P4 secretion) and size during mid-luteal phase

13 to 17 days after ovulation secretion of P4 declines and CL regresses to become a corpus albicans

CL regression due to increased concentrations of PGF2_ produced by endometrium during late luteal phase (Figure 4-3)
Corpus Luteum Function

**OVULATION CAUSES CL FORMATION**

Caused by LH surge.

Livestock species are **Spontaneous ovulators**.

Ovulate whether mated by male or not.

Induced ovulators only ovulate if mated.

Mating causes the LH surge.

Ex. rabbits, cats, camels

Ovulation in relation to LH surge

Cow: 30 hrs after surge

Ewe: 24 hrs after surge

Sow: 40 hrs after surge, Ovulations take place over interval of several hrs.

Changes in Follicle during Ovulation

Blood flow increases and fluid builds up.

Increased production of Histamine and Prostaglandins.

Proteolytic enzymes produced and collagen in follicular wall starts to breakdown.

Basement membrane breaks down and capillaries contact granulosa cells.

Follicular cells stop producing estrogen.
Finally pressure builds up against weakened follicle wall and rupture occurs.

Formation of CL

The first structure formed is the corpus hemorrhagicum. Essentially a blood clot formed after follicles capillaries rupture.

In some species follicular cells produce oxytocin at this time.

Cells undergo a metamorphosis called Luteinization.

Cells change structurally and functionally as what was follicle becomes the CL.

2 cell types found in CL: LARGE AND SMALL

<table>
<thead>
<tr>
<th>SMALL</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>15% Progesterone Production</td>
<td>85% Progesterone Production</td>
</tr>
<tr>
<td>LH Receptors</td>
<td>No LH Receptors</td>
</tr>
<tr>
<td>No PGF2 Receptors</td>
<td>PGF2 Receptors</td>
</tr>
</tbody>
</table>
Makes No Protein | Makes Oxytocin and Relaxin
---|---
Hormones | Granulosa (probably)
Theca (probably) | Cell Size Increases
Numbers Increase | with CL age

CL will be regressed unless female becomes pregnant.

Progesterone production begins 1 or 2 days after estrus and peaks about 4 or 5 days after estrus.

Time of CL regression

Cow: 18-19 days after estrus

Ewe: 14-15 days after estrus

Sow: 15-16 days after estrus

Mare: 14-19 days after estrus

Injection of PGF2 alpha can cause earlier luteal regression.

In cows, ewes, and mares regression will not occur if PGF2 alpha given before days 4-5.

In sows regression will not occur if PGF2 alpha is given before day 12.
These are the times that PGF2 alpha receptors appear on the large luteal cells.

If the female is hysterectomized (uterus removed) the CL will be maintained for much longer.

The part of the Estrous cycle when CL is present is called the Luteal Phase.

During the luteal phase progesterone regulates the functioning of the reproductive system.

Progesterone suppresses LH pulse frequency so that no follicle develops enough estradiol secretion to cause a LH surge and ovulation.

P4 inhibits uterine contractions and stimulates uterine secretions to provide the proper nourishment for embryo.

P4 keeps cervical mucous thick.

Removal of P4 at CL regression allows LH to increase and rapid follicular development with increased estrogen secretion.

This is the follicular phase of the Estrous cycle.

Proposed mechanism of CL regression (Figure 4-4)

Mid to late diestrus non-ovulatory follicles secrete increasing concentrations of E2β

Endometrial cells stimulated by E2β to synthesize OT receptors

Oxytocin from CL (or posterior pituitary) stimulates secretion of arachidonic acid

Arachidonic acid stimulated by Prostaglandin Synthetase to produce PGF2
PGF2α secreted into uterine veins

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