



# Ovulation

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# Ovulation


- Mammalian ovary can ovulate at any point except at hilus.
- In mare, limited to ovulation fossa.
- In cattle, sheep and mare occurs at random between the two ovaries.

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- Three major changes that a preovulatory follicle undergoes:
    - Cytoplasmic and nuclear maturation of oocyte.
    - Disruption of cumulus cell cohesiveness among cells of granulosa cell layer.
    - Thinning and rupture of external follicular wall.

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- After the ovulatory surge of gonadotropins, blood flow increases to all classes of follicles.
  - The follicle destined to ovulate, receives the largest volume of blood in absolute terms.

# Cellular events during ovulation

- Before ovulation, all tissue layers are broken down-
  - Surface epithelium
  - Collagen rich tunica albugenia
  - Theca interna
  - Thin basement lumina
  - Membrana granulosa

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- Follicular elasticity increases during growth, which is required for corpus luteum organisation.
  - Enlarging follicle protrudes out from the ovarian surface, its vascularity increases except at its centre.

# Oocyte

- Cumulus cells anchored in zona pellucida remain, form corona radiata.
- Cumulus cell dissociation frees oocyte from granulosa layer and meiosis resumes 3 hrs after Gonadotropin surge.
- Cumulus cells secrete glycoproteins, which form viscous mass enclosing oocyte and corona.
- As follicle ruptures, viscous mass spreads over ovarian surface to facilitate “pick up”.

## Granulosa Cells

- Granulosa layer completely dissociates only at follicular apex, finally disappears.
- About 2 hrs before ovulation, granulosa cell growth processes penetrate through basal lamina, preparing invasion of theca cells and blood vessels into granulosa.
- Associated with production of Early Pregnancy Factor.



## Theca cells

- In a few hours before ovulation, follicular volume increases causing elasticity of the follicle.
- Invasive oedema of theca cells and collagen fiber dissociation causes looser cohesion of the theca externa.

## Apex changes

- Rupture involves interaction of ovarian epithelium and underlying follicular wall.
- Wall of the follicle apex becomes exceedingly thin in an area called stigma.
- Stigma thins out, bulges on ovarian surface and becomes avascular.

# Mechanisms of Ovulation

- Ovulation occurs in response to a combination of physiologic, biochemical and biophysical mechanisms:
  - Neuroendocrine/Endocrine mechanisms  
GnRH, Steroids and PGs
  - Neurobiochemical/Pharmacological mechanisms
  - Neuromuscular and neurovascular mechanism and enzymatic interactions.

- A gonadotrophin-induced pre ovulatory increase in follicular prostaglandins, produced by granulosa cells is needed for ovulation.
- PGs may stimulate ovarian contractions and activate thecal fibroblasts to proliferate and release proteolytic enzymes.
- Steroids, esp. progesterone, may also be involved.

# Biochemical Mechanisms

- Preovulatory gonadotropin surge induces immediate and temporary rise in progesterone and related progestins.
- Later, Estradiol and PGs secretion are augmented.
- $P_4$  stimulates collagenase activity in follicular wall.
- Inhibition of progesterone synthesis prevents ovulation.
- $PGF_{2\alpha}$  causes follicular rupture and  $PGE_2$  causes remodelling of follicular layers forming CL.

# Neuromuscular Mechanisms

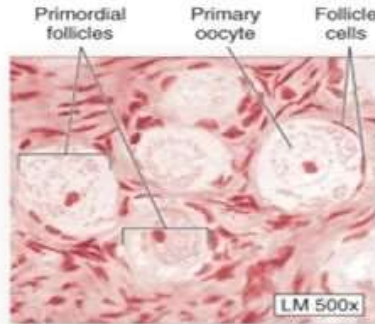
- Ovarian stroma and concentric layers of theca externa contain smooth muscle cells innervated by autonomic nerve terminals.
- Ovarian contractions facilitate follicular rupture.
- After rupture,  $\text{PGF}_{2\alpha}$  stimulates the thecal neuromuscular system causing extrusion of the oocyte.

# Neuroendocrine Control

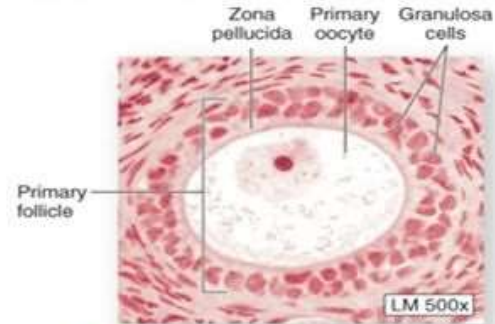
- Preovulatory gonadotropin surge occurs at the start of estrus when  $P_4$  falls to minimal and  $E_2$  reaches highest level.
- $E_2$  acts on both pituitary and hypothalamus.
- $E_2$  increases sensitivity of the pituitary gonadotropin-producing cells to the competent hypothalamus hormone GnRH.

# Oocyte Maturation

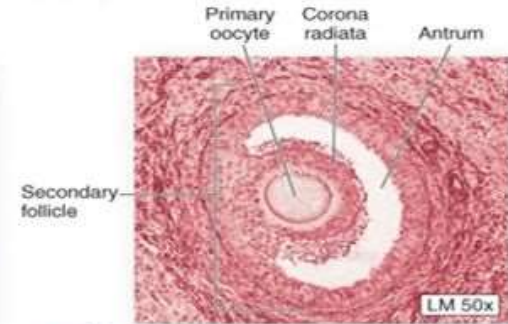
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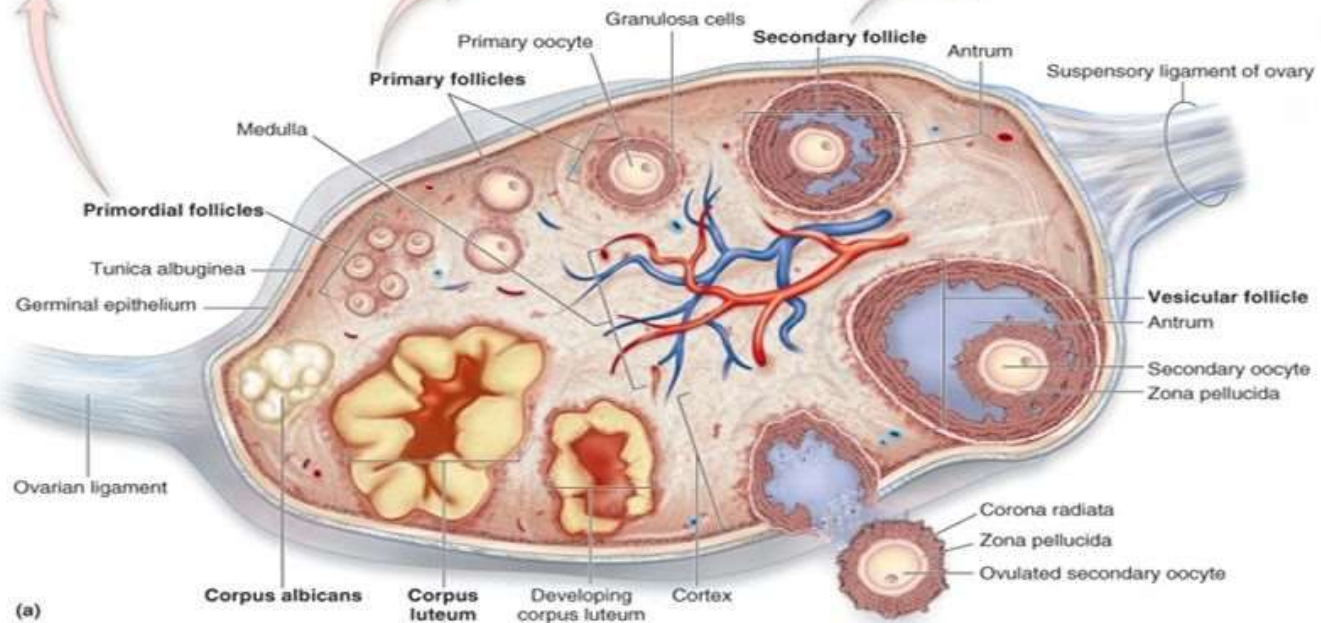
(b) Primordial follicles



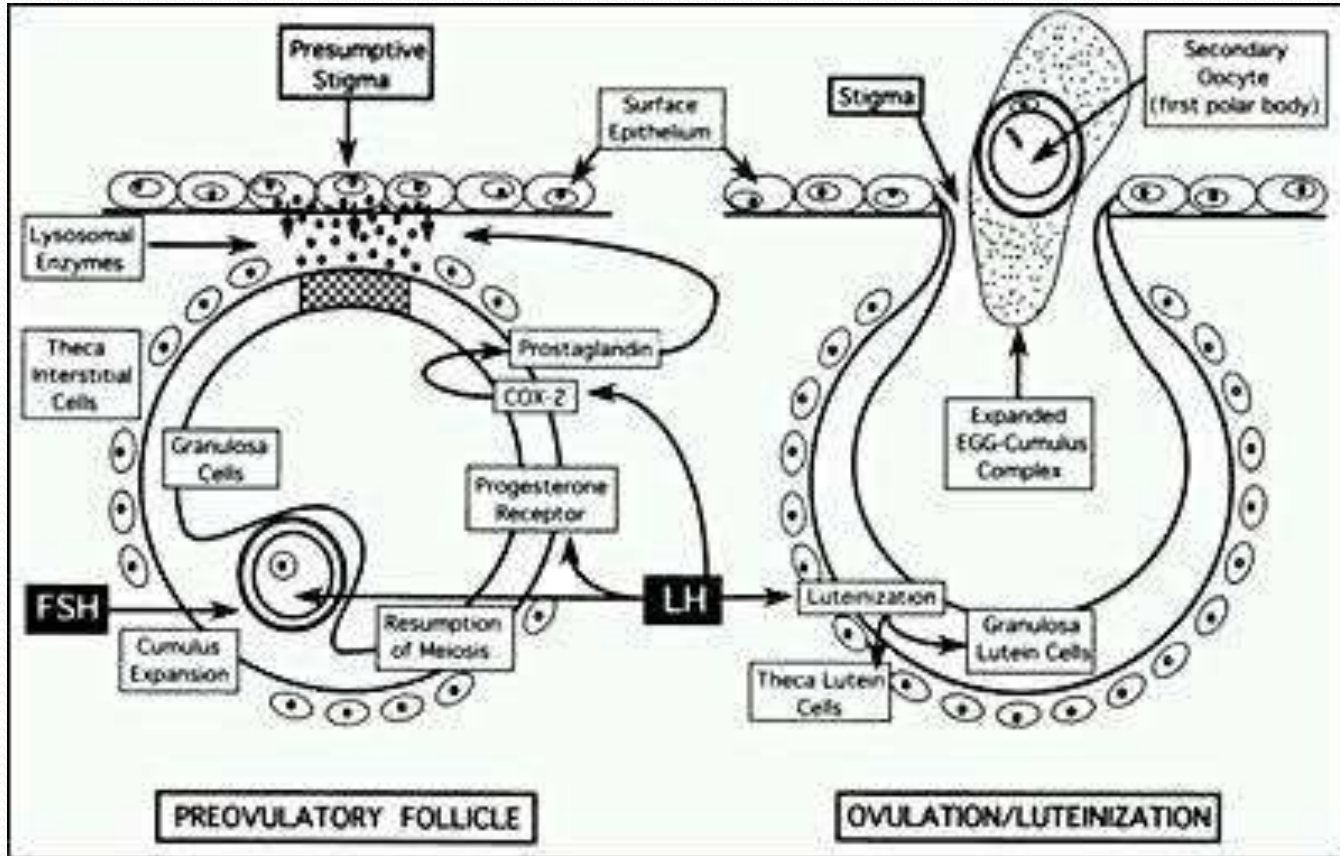
(c) Primary follicle



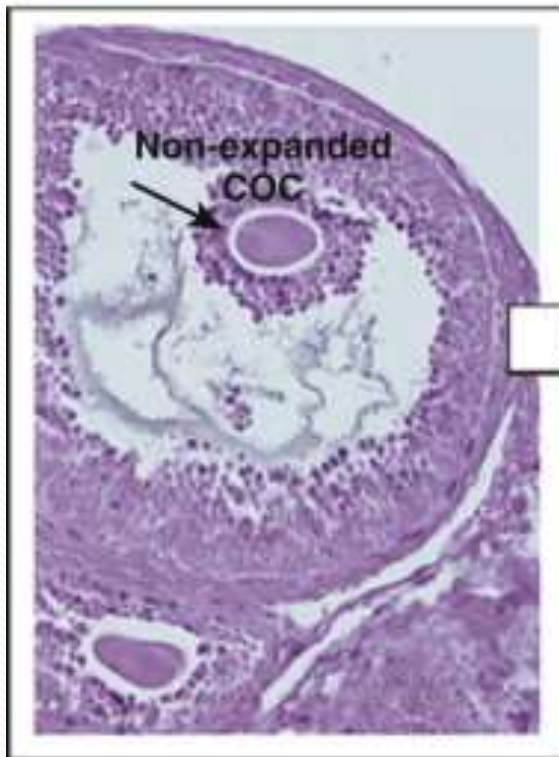
(d) Secondary follicle



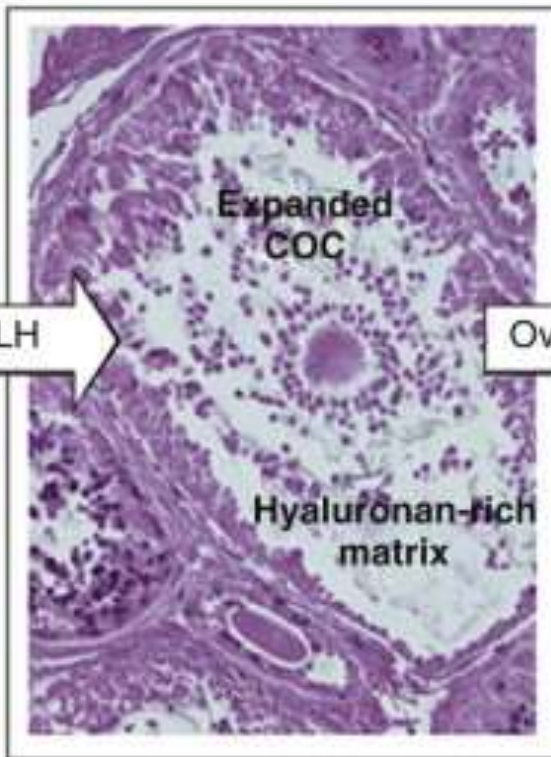




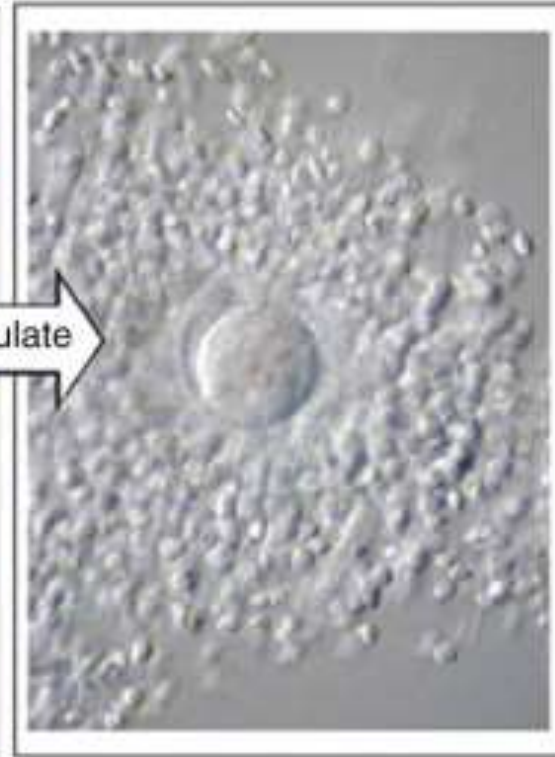
Preovulatory follicle



Ovulatory follicle

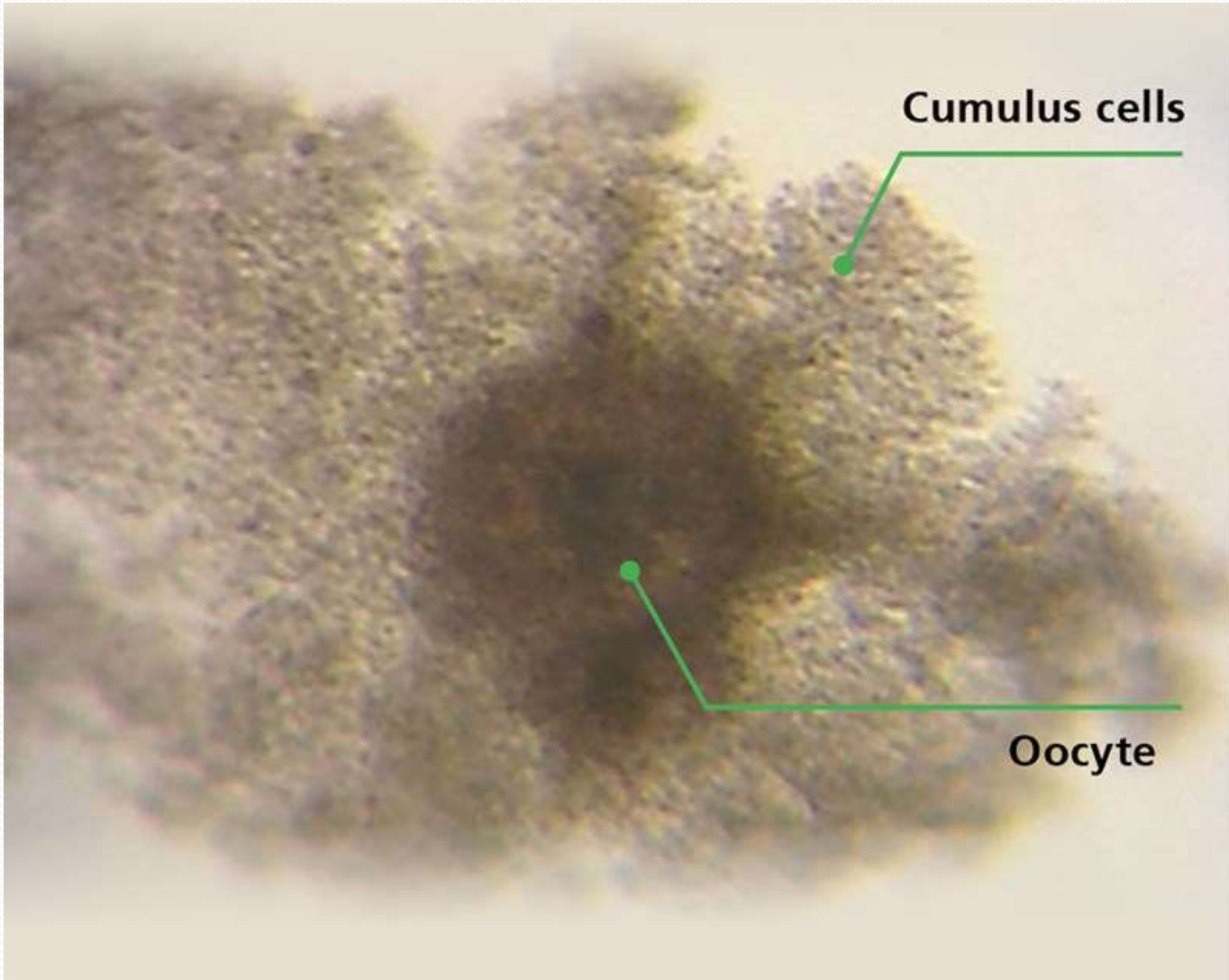


COC in oviduct



LH

Ovulate



Cumulus cells

Oocyte

**Thank  
You**

