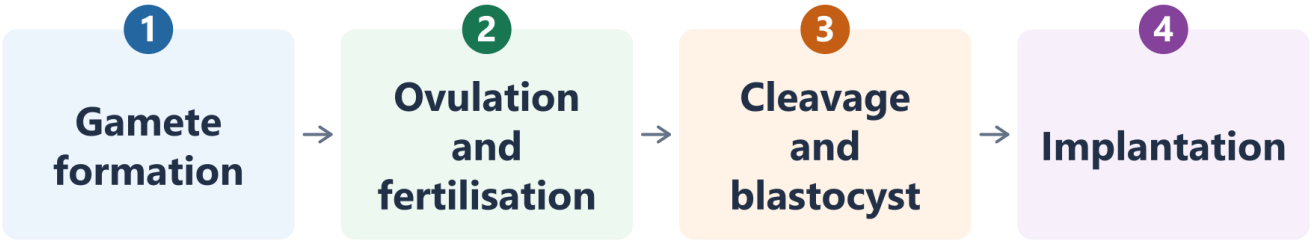
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Obstetrics & Gynaecology - Topic 3 - Physiology of conception

How Conception Becomes Possible

The Reproductive Sequence

- Conception requires healthy gametes, ovulation, sperm transport, fertilisation, early embryo development and successful implantation.
- The ovaries and endometrium prepare together through coordinated hormonal changes.
- A problem at any step can reduce fertility even when the other steps are normal.



Hormonal Control

Hypothalamus and Pituitary

- The hypothalamus releases gonadotrophin-releasing hormone in pulses, which stimulate the anterior pituitary.
- The pituitary releases follicle-stimulating hormone and luteinising hormone, usually abbreviated as FSH and LH.
- These hormones support follicular growth, steroid production, ovulation and corpus-luteum function.
- Continuous suppression of this signalling pathway can prevent ovulation, which explains the action of some hormonal treatments.

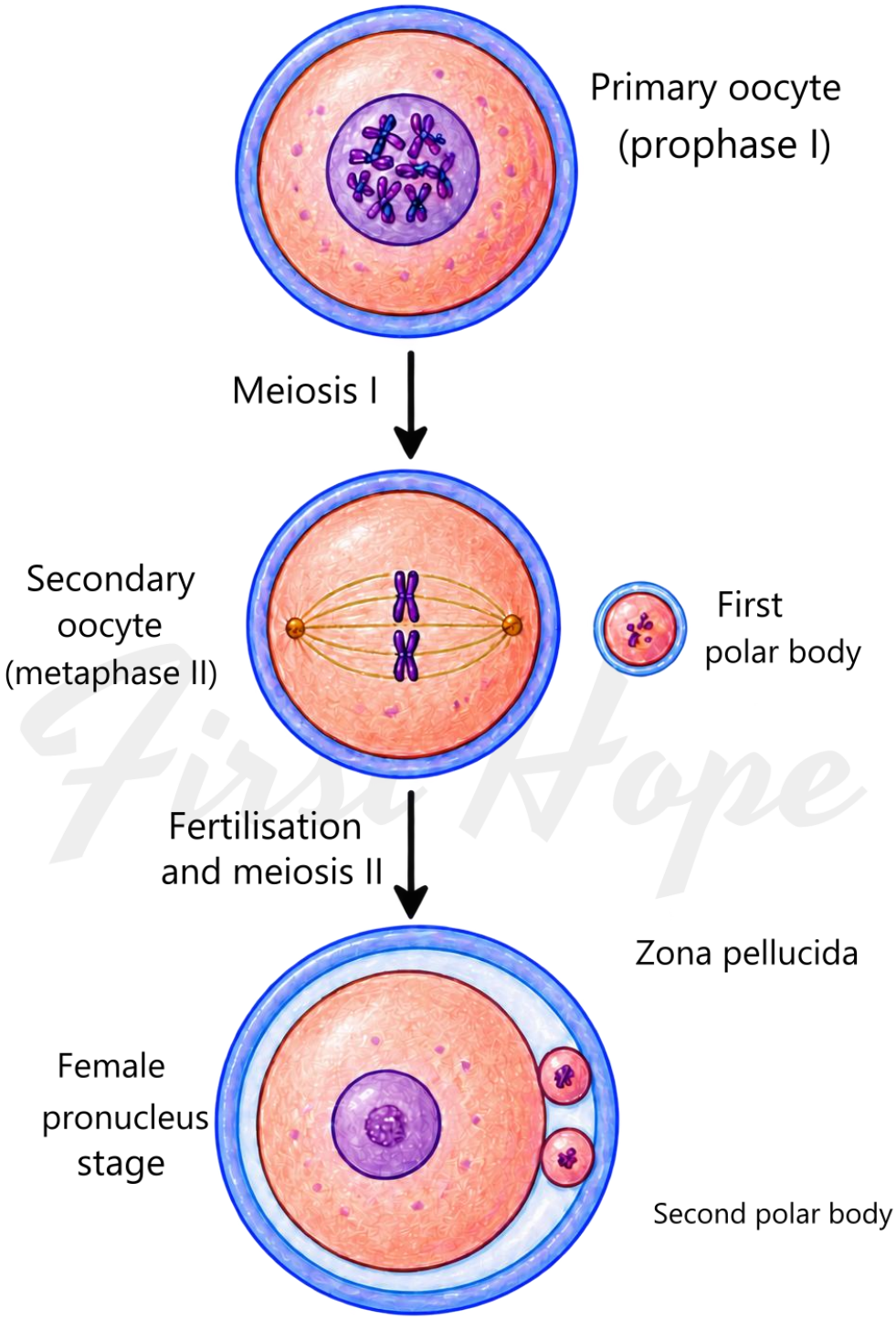
Ovarian Feedback

- Oestradiol, progesterone and inhibins regulate gonadotrophin secretion through feedback mechanisms.
- For most of the cycle, ovarian hormones limit excessive FSH and LH release through negative feedback.
- Sustained high oestradiol before ovulation switches the feedback response and helps trigger the LH surge.
- The timing and pattern of secretion matter, so a single hormone value must be interpreted with the cycle stage.

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Formation of Gametes

Stages of Oocyte Development



Oocyte maturation includes arrest in prophase I and metaphase II before fertilisation allows completion of meiosis

1. Before Birth

- Oogonia multiply and develop into primary oocytes during fetal life.
- Primary oocytes begin meiosis and remain arrested in prophase I within primordial follicles.
- The ovarian follicle pool declines over time because most follicles undergo atresia rather than ovulation.

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2. Follicular Development

- After puberty, follicles are recruited through a sequence of growth stages, and usually one becomes dominant in an ovulatory cycle.
- The oocyte is surrounded by granulosa cells and a glycoprotein coat called the zona pellucida.
- Fluid collects within the developing follicle to form an antrum.
- Theca cells respond mainly to LH and provide androgen substrate, which granulosa cells convert to oestrogens under FSH influence.

3. Meiotic Completion

- The preovulatory LH surge helps the selected primary oocyte complete meiosis I.
- This produces a secondary oocyte and the first polar body, with unequal division of the cytoplasm.
- The secondary oocyte begins meiosis II and arrests in metaphase II before it is released at ovulation.
- Fertilisation normally triggers completion of meiosis II and formation of a second polar body.
- Failure of correct chromosome separation can produce an aneuploid gamete and increases the risk of an abnormal conception.

Spermatogenesis

Production and Maturation

Cell Division and Sperm Formation

- Spermatogenesis begins at puberty and takes place in the seminiferous tubules of the testes.
- Spermatogonia divide to maintain the cell population and produce cells that enter meiosis.
- Meiosis produces haploid spermatids, which then change shape during spermiogenesis to become spermatozoa.
- A sperm develops an acrosome, a condensed nucleus, a midpiece rich in mitochondria and a flagellum.

Cell Support, Maturation and Chromosome Number

- Sertoli cells support developing germ cells, while LH stimulates Leydig cells to produce testosterone.
- Sperm acquire further functional maturity during epididymal passage before ejaculation.
- One primary spermatocyte can produce four haploid spermatids, whereas unequal oocyte divisions preserve most cytoplasm in one functional ovum.

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- Each mature gamete normally contains 23 chromosomes; fertilisation restores the usual diploid total of 46.

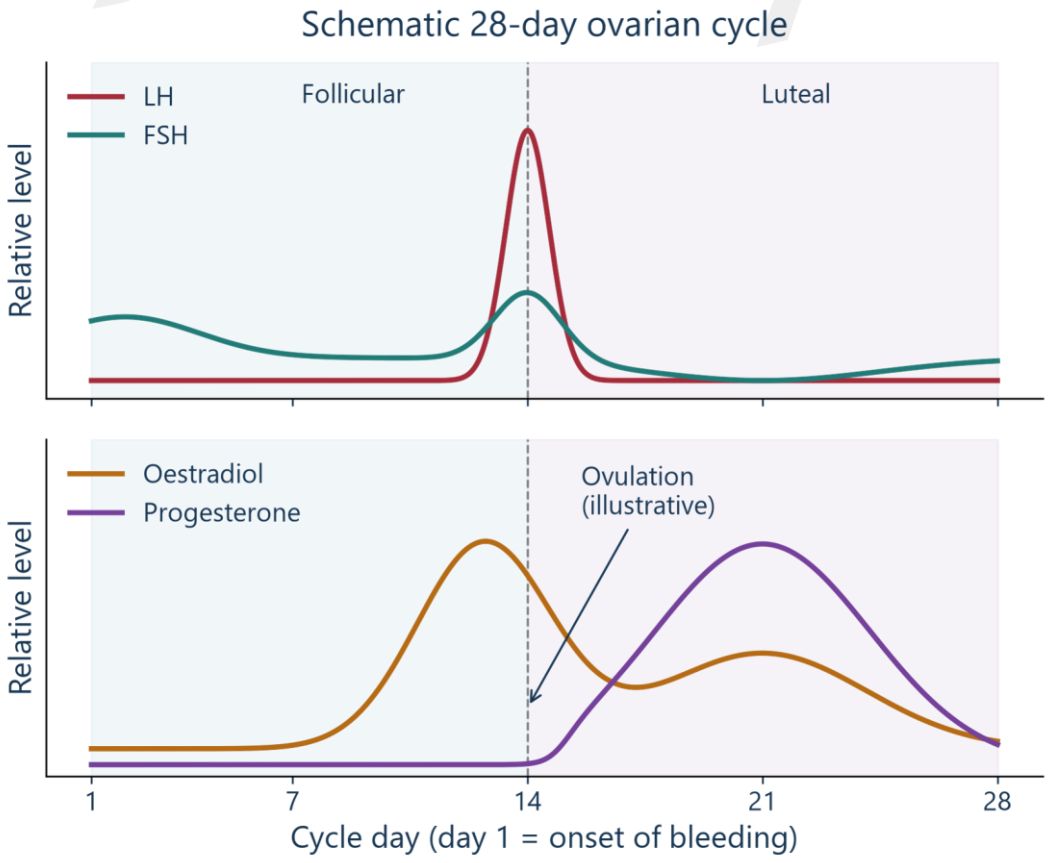
Clinical Relevance

- Fever, gonadal injury, some medicines and endocrine disorders can impair sperm production or function.
- Anabolic steroid use can suppress gonadotrophins and reduce sperm production despite an apparent increase in androgen exposure.
- A semen assessment examines more than count, because motility, morphology and the clinical context also matter.
- Infertility assessment should consider both partners rather than assuming that the woman is responsible.

Ovulation and the Menstrual Cycle

Reading the Cycle

- Day 1 is the first day of menstrual bleeding, and cycle length is measured from that day to the first day of the next period.
- A 28-day cycle is a teaching example rather than a requirement for normal reproductive function.
- Ovulation timing varies, and the follicular phase accounts for much of the variation in cycle length.



The hormone curves illustrate a 28-day ovulatory cycle; actual cycle timing varies between women and between cycles

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1. Follicular Phase

- FSH supports a group of developing follicles, while rising oestradiol promotes endometrial growth.
- The dominant follicle becomes better able to continue growing as FSH levels fall.
- Most other recruited follicles regress through atresia.
- Oestradiol also makes cervical mucus more watery and stretchable, which supports sperm passage.

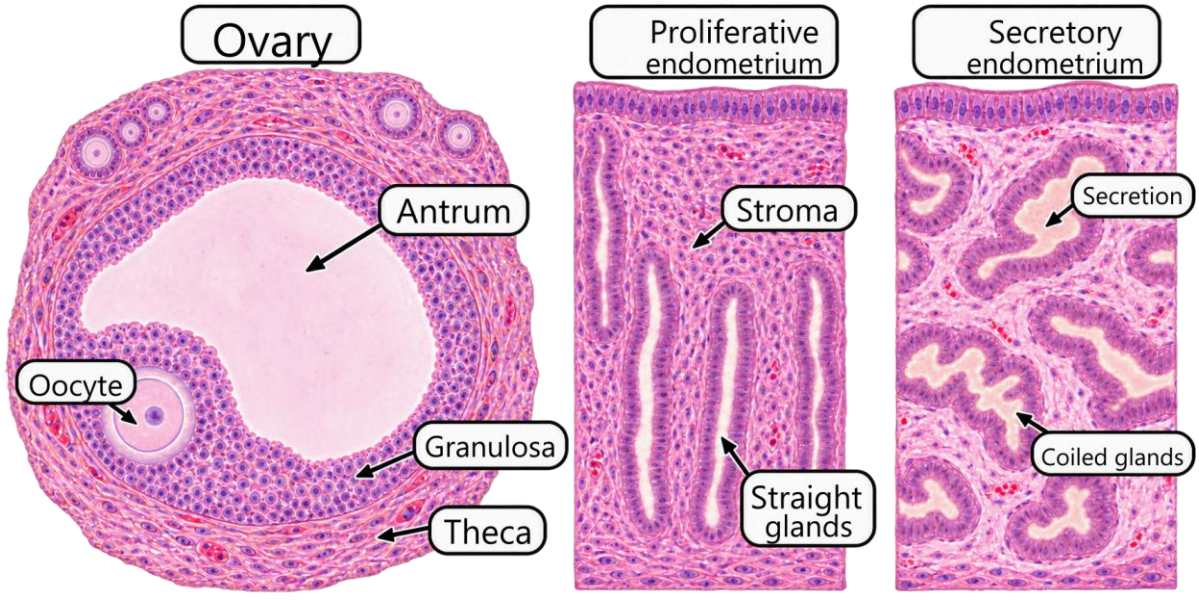
2. Ovulation

- The LH surge triggers final oocyte maturation, follicular changes and release of the secondary oocyte with surrounding cumulus cells.
- Ovulation usually follows the onset of the LH surge by roughly one to two days, but exact timing varies.
- The fimbriae and tubal movements help bring the oocyte into the uterine tube.
- Brief mid-cycle discomfort may occur, but severe or persistent pelvic pain requires assessment for another cause.

3. Luteal Phase

- The ruptured follicle forms the corpus luteum, which produces progesterone and some oestradiol.
- Progesterone converts the proliferative endometrium into a secretory lining prepared for implantation.
- Progesterone also produces a small rise in basal body temperature and makes cervical mucus less permeable to sperm.
- If pregnancy does not develop, the corpus luteum regresses and steroid levels fall.

Phases of the Endometrial Cycle



Follicular structure and endometrial glands change under the influence of ovarian hormones

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