OBSTETRICS AND GYNECOLOGY

1 MENSTRUAL CYCLE & TESTS FOR OVULATION

Anatomy of Female Reproductive System

00:00:20

- The body of the uterus is known as the Corpus

Parts	Length
Uterus (Nulliparous)	7 to 8 cm
Uterus (Multiparous)	8 to 10 cm
Cervix	3.5 to 4 cm
Short cervix	<2.5 cm
Fallopian Tube	7 to 12 cm
Vagina (Anterior fornix)	7 cm
Vagina (Posterior fornix)	9 cm

Important Information

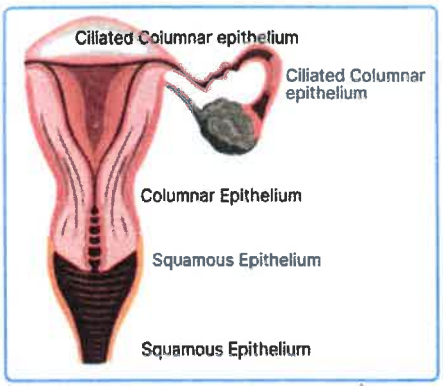
- After delivery, the uterus will never come back to the prepregnant size (Multiparous uterus)

Cervix	Nulliparous women	Multiparous women
		
	Circular	Transverse

Fallopian Tube

- Uterus has the microvilli
- Starting of the cervix: Internal OS
- Opening of the cervix: External OS

Parts	Epithelium
Fallopian tube	Ciliated columnar epithelium
Uterus	Ciliated columnar epithelium
The early part of the cervix	Ciliated columnar epithelium
Histological internal OS	Columnar epithelium
Cervix (Transformation zone)	Squamous epithelium
Vagina	Squamous epithelium



Rupture of the follicle

↓

The oocyte moves to the Fallopian tube.

↓

The fallopian tube acts as a clasp.

↓

The oocyte is clasped by the fimbriae.

↓

Oocyte moves in the Fallopian tube by peristaltic movements and Cilia.

Cervix

Anatomical internal OS	Ciliated columnar epithelium
Histological internal OS	Columnar epithelium

- Transformation zone: Columnar epithelium changes to squamous epithelium
  - Other Name: Squamo columnar junction
  - Location: 1.7 to 2.3 cm from external OS
- Human papillomavirus will affect the changes from columnar to squamous
- Screening: Pap smear
  - Should have the component of the transformation zone

Important Information
1st site for the formation of abnormal squamous cells (Ca cervix) is the Transformation zone

Importance of the Epithelium

- Isthmus of the cervix: Between Anatomical internal OS and histological internal OS
  - Length: 0.5 cm (Nonpregnant)
- Full-term pregnant women have upper and lower segment
  - Lower segment (Isthmus): 7 cm in size
  - The upper segment will contract
  - Lower segment will retract

00:15:30

Ovary

- Has a set number of follicles
- Size: 3×3.5×2.5 cm
- Volume: 3×3.5×2.5 x 5/9
- It has one dominant follicle with oocyte
- Oocyte has one egg for each month
- Many small fluid-filled follicles are present (6 to 7/ month)
  - Other Name: Antral follicles
- Primordial follicles (100 to 1000)
  - 1000 follicles are recruited every month

→ To give 6 or 7 Antral follicles

1000 primordial follicles
↓
6 to 7 Antral follicles
↓
1 dominant follicle
↓
1 Egg

Primordial Follicles 00:16:43

- The follicle is the master of the uterus
- 6 to 7 million primordial follicles at 20 weeks of intrauterine life
- 1 to 2 million primordial follicles at birth
- 3 to 4 lakhs at puberty
- Menstrual life: 12 to 50 years
  - Around 38 years
- Pregnancy: 20 to 25 years
- 1000 PF per month = 12000 PF per year
- 12000 ×38 = 4,56,000 (Utilized in 38 years)
- Dominant follicle has granulosa cells.
- Granulosa cells will produce the estrogen
  - Androgens are converted to estrogen
  - By aromatization
- Estrogen acts on the uterus and causes the proliferation of the endometrial gland
- Life of the Oocyte: 24 to 48 hours

Important Information
The chances of pregnancy are less after 35 years, and above 40 years, the chances of abortion are higher.

Ovulation

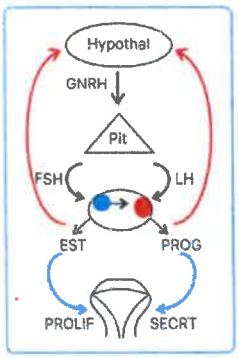
Ovulation of the follicle around the 14th day of the menstrual cycle
↓
Oocytes will be released into the fallopian tube.
↓
Shrinkage of the follicle forms the corpus luteum (Yellow color body)
↓
The Corpus luteum will produce progesterone.
↓
Progesterone will make the endometrial glands secretory.
↓
Fertilization will occur at the site of the ampulla.
↓
The embryo will reach the uterine cavity on 3rd to 4th day.
↓
Implantation occurs on the 6th day after ovulation or fertilization – earliest
↓
It can also occur from the 6th to the 10th day of ovulation (20 to 24 days of the menstrual cycle)

Explanation of the Flow Chart

PYQ: NEET PG 2019

- Mediobasal nucleus of the hypothalamus releases GnRH
- Pulsatile release of GnRH

Once in 60 minutes in the follicular phase	Once in 90 minutes in the luteal phase



- Gnrh acts on the pituitary and releases the FSH and LH
- FSH acts on the ovaries
- Theca cells in the ovary produce the androgens
- Androgens get into the follicles
- Androgens are converted to estrogens by aromatase
- Estrogen stimulates the uterus and causes the proliferation of endometrium
- Estrogen also gives negative feedback to the brain to stop the release of FSH
- Required amount of Estrogen: 150 to 200 pg of estradiol
- Negative feedback of FSH causes the positive feedback of the LH
- LH acts on the corpus luteum and makes the endometrium secretory

Purposes of FSH	Produce estrogen
Purposes of LH	Produce progesterone

Follicular Stimulating Hormone

00:31:57

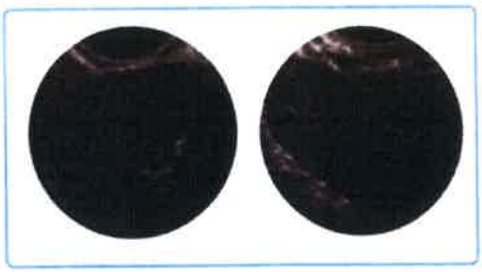
PYQ: AIIMS 2018

- Normal level: 2 to 6 IU
- Purpose: Produce Estrogen
- Suggestive of menopause: >10 IU
- Diagnostic of menopause: >40 IU
- Premature ovarian failure: FSH >40 IU in <40 years

Antral Follicles

00:35:35

- Investigation: Follicular monitoring by USG
- Follicular monitoring: 9 to 10 days of menstrual cycle
- Mature follicle: 15 to 20 mm
- Antral follicular count: 6 to 7 follicles per ovary
- Only one will become the dominant follicle



Ovarian Reserve

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- Other Name: Capacity to Conceive

Features	Young women	Older women
Ovarian Size	3×3.5×2.5 cm	Smaller
Serum FSH	2 to 6 IU	>10 IU
Serum estradiol	150 to 200 pg	<150 to 200 pg
Antral follicular count	6 to 7 follicles per ovary	≤3 per ovary
Anti-mullerian hormone (Granulosa)	2 to 6 ng per ml	</=1 ng per ml

- Poor ovarian reserve: If the younger women have values equal to older women
- Less Inhibin B is also a parameter of poor ovarian reserve
- Faster treatment: IVF

Important Factors of Ovarian Reserve

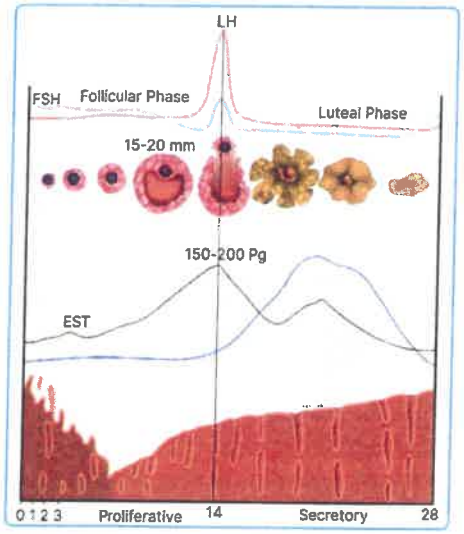
- Serum FSH
- Antral follicular count
- Anti-Mullerian hormone (Single best parameter)

Menstrual Cycle Chart

00:43:20

PYQ: FMGE 2023 PYQ: FMGE 2019, 2020, 2021

- Cycle starts with bleeding – Day 1
- Initially, FSH is high, decreases in mid, and again increases at last
- Heartbeat of infant: 5 weeks and 3 days
- FSH: Recruit 7 or 8 Antral follicles
- Low FSH will maintain the growth of one follicle (Size 15 to 20 mm)
- Estrogen levels will be increased (150 to 200 pg)
- So it is known as the proliferative phase
  - Other Name: Follicular Phase
- LH surge will occur as the estrogen gives singles to the brain
- Follicle will become shrink and become corpus luteum
- Corpus luteum will produce the progesterone
  - The size of the glands is not increased
- Hence, it is known as the secretory phase
  - Other Name: Luteal Phase
- Corpus luteum also secrete some amount of estrogen
- Corpus luteum reduces in function by day 24 and is lost by day 28.
- That endometrium will degenerate and shed.



Important Information

Secretion and stabilization of the endometrial glands are brought about by the corpus luteum

Menstrual Cycle: Of Sexually Active Women

00:49:24

Implantation of the embryo will occur on the 6th day after ovulation or fertilization

↓

The embryo is implanted in the secretory endometrium

↓

Corpus luteum will work only for 10 days

↓

Early cells of the placenta: Syncytiotrophoblasts will produce the HCG

↓

Human chorionic gonadotropin will protect the corpus luteum from degeneration

↓

It helps to maintain the pregnancy

- Alpha unit of TSH = Alpha unit of LH = Alpha unit of HCG
- Corpus luteum maintains the pregnancy for 12 weeks
  - In the 6th week, the placenta will form
    - → It will maintain the pregnancy till delivery
  - Decrease in the corpus luteum will occur after 6th week
- Luteoplacental shift: at 6th week
- HCG will be increased till the 66th day of the pregnancy (9 weeks and 3 days)
- HCG causes hyperemesis gravidarum.

Tests of Ovulation 00:56:57

- Effects of progesterone
- Basal body temperature raises up to 0.5 degrees F from baseline
- Serum progesterone: >3ng per ml on day 21 of menstrual cycle
- Serum or urinary LH: >15 IU

Follicular Monitoring by USG

- Usual method in OPD

In the initial days, 6 to 7 Antral Follicles

↓

After the 9th day, one follicle will become dominant.

↓

Around the 14th day, the dominant follicle will be around 15 to 20 mm in size.

↓

Transvaginal sonography is performed from the 9th day.

↓

Follicular growth is assessed for every alternative day.

↓

Shrinkage of the follicle is an indication of ovulation.

Endometrial Biopsy	• Effects of progesterone is seen
	• Histopathology examination:
	  ○ Secretory changes
	  ○ Appropriateness of the secretory changes
	• Mainly, premenstrual endometrial biopsy is recommended
	• Effects of the ovulation are adequate on the endometrium
	• Luteal Phase defect: Lag of ≥2 days in observed and expected changes
	  ○ Known cause of infertility
	• CBNAAT can be done on endometrial biopsy

Mittelschmerz	• Mid-cycle pain due to the ovulation • Sharp pain in the abdomen • It is an unreliable test
Laparoscopy	• Best and direct evidence of ovulation
Cervical mucus studies	• Loss of spinbarkiet and fern tree pattern is seen on the 14th day • Spinbarkiet and fern tree patterns are seen due to high estrogen • Loss of spinbarkiet & fern tree pattern suggest ovulation

2 AMENORRHEA & PCOS

Amenorrhea

PYQ: FMGE 2020, 2021

Delayed periods

- No periods till 13 years
- If Secondary sexual characters are present, then no periods till 15 years.

Primary amenorrhea

Examination

- Do a pregnancy test
  ↓
- If the pregnancy test is negative
  - Breast development
  - Axillary and pubic hair
  - Vagina development
- Per vaginal examination: Rule out absent uterus
  ↓
- Hormonal tests
  - FSH
  - LH
  - TSH
  - Prolactin
  - Karyotype (if required)
- USG: to rule out Mullerian abnormality

Causes

Secondary sexual characters present

- Absent uterus: Mayer Rokitansky Kuster Hauser (MRKH) Syndrome
- Uterus present

PYQ: INICET 2023

Anatomical defects

- Imperforate hymen
- Transverse vaginal septum
- Cervical atresia

Normal anatomy

- Hypothyroidism
- Hyperprolactinemia
- Hypergonadotropic condition (pure gonadal dysgenesis)
- Hypogonadotropic condition (chronic malnutrition, anorexia, chronic illness)

Asynchronous types

- Androgen insensitivity (testicular feminization syndrome)

Secondary sexual characters absent

- Hypergonadotropic hypogonadism (high LH & FSH)
  - Primary ovarian failure

→ Gonadal dysgenesis (Turner syndrome)
→ FSH and LH receptor defect
→ Galactosemia (high concentrations of galactose and metabolites are detrimental to ovarian Stroma and follicles)

- Hypogonadotropic hypogonadism (low LH & FSH)
  → Physiological delay
  → Kallman syndrome
  → CNS tumors

Secondary amenorrhea

- No periods for 6 months (negative pregnancy test)
- Rule out
  - Hypothyroidism
  - Hyperprolactinemia
- If Thyroid and Prolactin levels are normal

PYQ: FMGE 2022

↓

Progesterone challenge test (given for 5 or 6 days and stopped)

↓

- If periods begin: PCOD
- If no periods: Problem with estrogen

Then,

Estrogen + Progesterone challenge (21 days E + 5 or 6 days P)

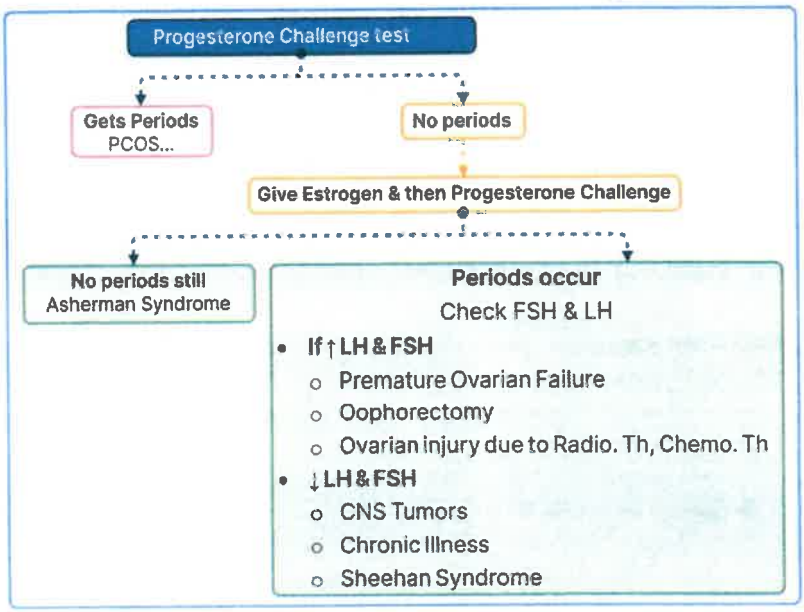
↓

Menstruation may be seen.

↓

- If no periods - Destruction of the endometrial lining
  - Classical sign of Asherman's syndrome
- If periods begin
  - High LH and FSH and no ovarian response
    → Premature ovarian failure (before 40 years)
    → Post ovarian injury
    – Radiotherapy
    – Chemotherapy
    → Oophorectomy
  - Low LH and FSH and no ovarian response
    → CNS tumors
    → Chronic illness
    → Sheehan's syndrome

PYQ: NEET PG 2021



Causes

- Pregnancy
- Hypothyroid/Pituitary tumors
- Chronic illnesses
- Hyperprolactinemia
- Empty sella syndrome
- Thyroid disease
- PCOS/CAH
- POI
- Cushing's syndrome

POLYCYSTIC OVARIAN DISEASE

- Other Name: PCOS
- Initially diagnosed in 1930
- Diagnosed by Doctor Stein and Levinthal
- Women: 15% or ⅛th
- Most common endocrine disorder of women of reproductive age
- Most common cause of Hirsutism

Diagnosis

- Diagnostic criteria: Rotterdam criteria (2003)

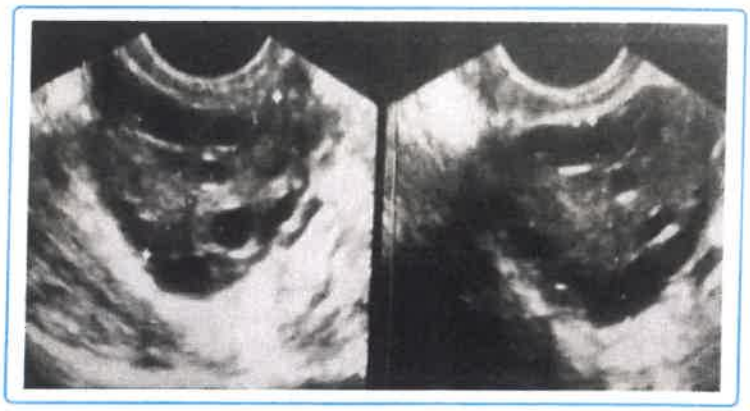
PYQ: NEET PG 2023

Anovulation	Hyperandrogenism Clinical Lab parameters: Increased testosterone	USG features of PCOD

- If any two criteria are seen, then it is diagnosed as PCOD

Sonographic Criteria for PCOS

PYQ: FMGE 2020, 2023



- It has no cyst
- Enlarged ovary with a chain of small follicles i.e. necklace of chain appearance.
- Shape: ring of pearl

PYQ: FMGE 2022

- Presence of 20 or more Follicles in either ovary measuring 2 to 6 mm in diameter (Less than 9 mm): Antral size follicles
- Thick stroma
- Increased ovarian volume: >10 ml
- A single ovary meeting these criteria is sufficient to affix the PCOS morphology

PCOS Phenotypes

- Most common: Type 1

Type 1	Type 2	Type 3	Type 4
• Hyperandrogenism • PCO morphology • Anovulation	• Hyperandrogenism • Anovulation	• Hyperandrogenism • PCO morphology	• Anovulation • PCO morphology