PHYSIOLOGY OF MENSTRUATION
Objectives

To know what is menstruation
To know the different phase of menstruation
To know the hormones that involved in menstrual cycle
Menstruation:

Shedding of the sloughed endometrium with mucous and blood through the vagina externally, following failure of fertilization or implantation.

It gives the most obvious external sign of normal cycle. The cycle depends on changes occurring within the ovaries and fluctuation in the ovarian hormones levels, that are themselves controlled by the pituitary gland and hypothalamus (hypothalamic – pituitary – ovarian axis).
NORMAL MENSTRUAL CYCLE

What is the mean duration of the MC?
Mean 28 days (only 15% of ♀)
Range 21-35

What is the average duration of menses?
2-7 days

When does ovulation occur?
Usually day 14
36 hrs after the onset of mid-cycle LH surge
Differentiation and onset of Meiosis I

Completion of Meiosis I and onset of Meiosis II

Entry of sperm triggers completion of Meiosis II

Diploid cell in embryo

2n

Primary oocyte
(arrested in prophase of Meiosis I; present at birth)

n
First polar body

Secondary oocyte
(arrested at metaphase of Meiosis II; released from ovary)

n
Second polar body

Ovum
(haploid)

Sperm

Ovulation

Ruptured follicle

Growing follicle

Mature follicle

Corpus luteum

Ovary
During the course of a normal menstrual cycle:
The ovaries go through 3 phases:
1. Follicular.
2. Ovulation.
3. Luteal.
The endometrium goes through 3 phases:
4. Proliferative.
5. Secretory.
Follicular phase

As FSH rises in the early days of the cycle (where estrogen and progesterone are low), this stimulates a cohort of follicles to grow.
TWO CELL THEORY

HYPOTHALAMUS
  ↓
GnRH
  ↓
PITUITARY

LH
  ↓
THECA CELLS
  ↓
cAMP
  ↓
ATP
  ↓
ANDROGEN

FSH
  ↓
GRANULOSA CELLS
  ↓
cAMP
  ↓
ATP
  ↓
AROMATASE
  ↓
A
  ↓
ESTROGEN
  ↓
OTHER TARGET ORGANS
The dominant follicle is the follicle with the most efficient aromatase activity and the highest concentration of FSH induced LH receptors.

This follicle will survive the decreasing levels of FSH while other follicles will become atretic.

Other factors involved in the regulation of folliculogenesis:
Inhibin, activin, IGF1, IGF2.
Ovulation:
The dominant follicle is around 20 mm in diameter.
- LH surge: ovulation follows it by 36 hours.
- Role of LH: triggers ovulation, resumption of miosis prior to the release of ovum, lutenization of the granulosa cells and formation of corpus luteum.
Physical release of the ovum occurs after breakdown of the follicular wall under the influence of LH, FSH and progesterone controlled proteolytic enzymes such as prostaglandins and plasminogen activators. Therefore the use of prostaglandin inhibitors can lead to failure of ovulation.
Luteal phase:

The remaining granulosa and theca cells will form the corpus luteum. The cells have vacuolated yellow appearance.

LH stimulate these cells to form progesterone to stabilize the endometrium.

The progesterone has its highest level in the mid luteal phase → suppress FSH and LH.

If no pregnancy → luteolysis.

With decrease in estrogen, progesterone and inhibin levels, FSH will be released from the negative feedback effect so that there will be gradual increase in FSH level and new cohort of follicles will enter a new cycle.
Endometrial changes during the menstrual cycle:

1. Proliferative phase:

   Estrogen → the epithelium lining the glands will change from a single layer of columnar cells to pseudostratified epithelium with frequent mitosis.

   The stroma will be infiltrated by cells from the bone marrow.

   The endometrial thickness will increase from 0.5 to 3.5 mm at the end of the proliferative phase.
2. Secretory phase:

Progesterone → the endometrial glands will become tortuous, fluid is secreted in the glandular cells and in the uterine lumen.

Progesterone will induce the formation of a temporary layer which is known as the decidua (stromal cells with increased mitotic activity and nuclear enlargement, generation of basement membrane.)
Prior to menstruation, 3 distinct layers of endometrium can be seen:

- Basalis. (25%)
- Stratum spongiosum. (edematous stroma)
- Stratum compactum. (with prominent decidualized stromal cells)
3. Menstruation:
Luteolysis → decreased estrogen and progesterone → vasoconstriction of spiral arterioles and distal ischemia → tissue breakdown and loss of the upper layer along with bleeding from fragments of the remaining arterioles.

Vaginal bleeding will cease when the endometrium begin to repair by stromal, glandular regeneration and and angiogenesis.

Hemostasis in the uterus differ in that it does not involve clot formation and fibrosis.
There are other factors which are involved in vessels constriction, initiating and controlling menstruation; these are prostaglandin F2α, endothelin 1 and platelet activating factor.

Progesterone withdrawal → increase endometrial prostaglandin synthesis and decreased prostaglandin metabolism; these prostaglandins may be balanced by the effect of vasodilatation agents such as prostacyclin and nitric oxide.
Estrogen causes:
- Mild myometrial contraction
- Rhythmic contraction in the fallopian tube.
- Production of thin elastic mucous that attracts sperm.
- In the vagina, causes cornification of its epithelium with increasing acidity.
Progesterone causes:

- Relaxation of the myometrium.
- The fallopian tube epithelium to be rich with nutrients for the zygote.
- Thick cervical mucous.
- In the vagina decrease cornification.
Changing hormone levels during the menstrual cycle.
THANK YOU