URO-GENITAL SYSTEM

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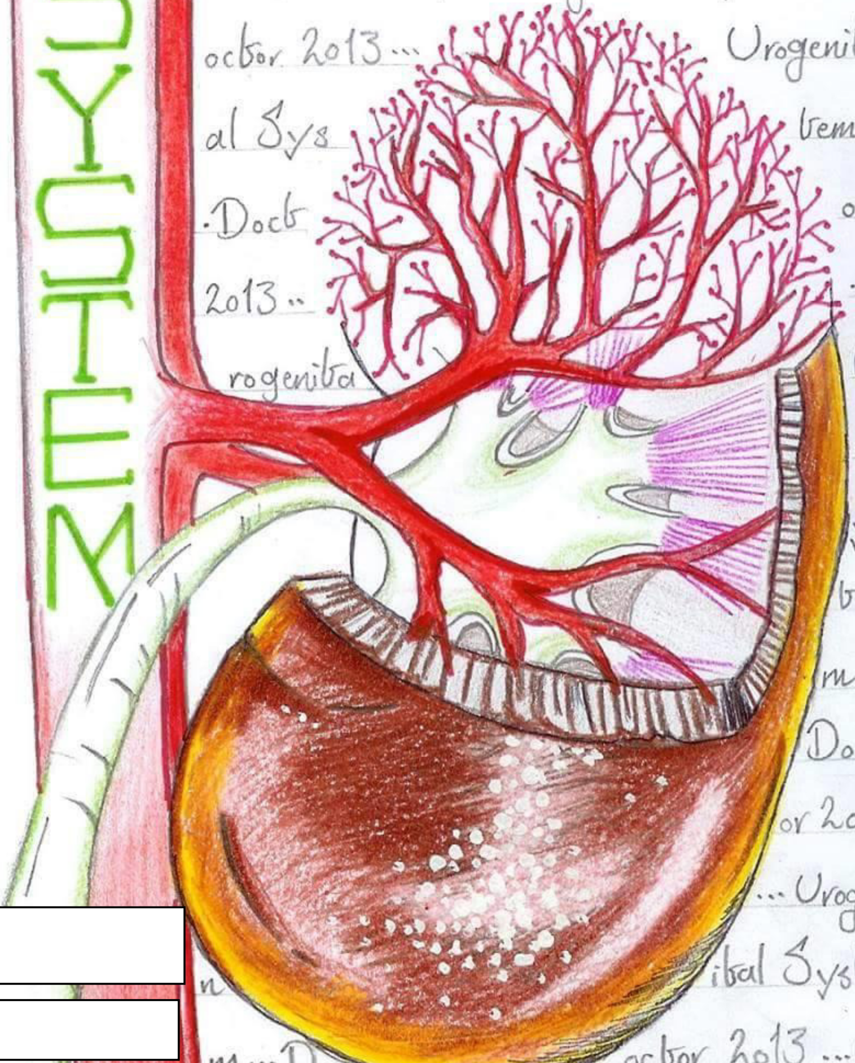

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Female reproductive system

There weren't any writers for this sheet so I took part of last year's sheet and added the extra information. I wrote this in less than two hours so I apologize for any grammatical mistakes, but then again you probably don't care trololol

- Ovarian Steroids

- Females have two important cells: Theca cells and granulosa cells, These two cells function as one unit – similar to the cells in the male; leyding cells and Sertoli cells. Theca cells are affected by LH and produce progesterone and weak androgens (androstenedione and testosterone). Androstendeione then passes into granulosa cells. Granulosa cells are affected by the two gonadotropin hormones; FSH and LH.

LH affects the granulosa cells to produce progesterone (important in the luteal phase). Progesterone is not converted to androgens because the necessary enzymes are lacking.

Progesterone passes to theca cells too

Under the effect of FSH, Granulosa cells convert androstenedione (coming from theca cells) and testosterone to

1) estradiol under the effect of aromatase enzyme

2) estrons are converted to estradiol, then estradiol diffuses to the circulation to its targets. So the two cells; theca cells and granulose cells function as one unit as we said earlier. If we separate either theca cells or granulose cells, the whole hormone production will not be produced.

These are the functions of these two types of cells: production of female as well as male hormones, their actions differ in each respective reproductive system, i,e in females they produce mainly estrogen, estradiole and estron.

Brain Centers and Hormonal Regulation

Brain centers are affected by factors (similar to males) and they respond by producing gondotropins or dopamine.

Written by Aseil Khatib

FSH, LH and prolactin are released from the anterior pituitary under the effect of the hypothalamus, as we know prolactin inhibits pregnancy but this isn't 100% correct, only happens 50% of the time. (unknown why)

Ovaries are regulated by FSH and LH in order to produce the main hormones estrogen and androgens. The ovaries produce both estrogen in the form of estradiol and estron, and androgens. Both FSH and LH regulate follicular steroidogenesis, androgen and estradiol secretion. LH regulates the secretion of progesterone from the corpus luteum, this is very important in the luteal phase. There are also three polypeptide hormones produced by the ovaries; inhibin, activin and follistatin. All these hormones function **at the level of FSH**. "**Only**" Inhibin inhibits FSH totally while follistatin reduces FSH secretion, that is similar to the feedback control. Regarding activin and inhibin binding proteins, activin is not found with inhibin at the same time. Anyway, these three hormones secreted by granulose cells affect FSH.

* So we conclude FSH is either inhibited (by inhibin), reduced (by follistatin) or activated (by activin)! *

There are many isoforms of inhibin because of the difference in the subunits and they are produced by "other" tissues including the pituitary glands, brain, adrenal glands, kidney, bone marrow, corpus luteum and the placenta. But the whole activity of inhibin is primarily confined to the reproductive system. Activin is produced in the same tissues as inhibin and also has many isoforms.

Primary sex organs: two ovaries (one is sufficient for pregnancy just like the testis in males). They function in the production of hormones and ova. Estrogens are called "**female hormones**" (as they are responsible for the beauty and attractiveness of women) while progesterone or progestins are called "**pregnancy hormone**" since without progesterone no pregnancy takes place.

Estrogen at puberty is responsible for the **development and maintenance** of secondary sexual characteristics as well as secondary sex organs (which include the vagina, uterus, and mammary glands).

There are two cycles in the female reproductive system; the ovarian and the uterine cycles which take place typically every 28 days from puberty till menopause, and

they do not stop unless there is pregnancy or a disease. The two cycles occur at the same time and the **ovarian cycle dominates** the uterine cycle. So if we prevent the ovarian cycle, the uterine cycle does not appear.

Ovarian cycle: changes in ovaries

Uterine cycle: changes in the uterus

At the 30th week of gestation 7 million ova are present in the two ovaries. (in fetal life)

2 million are activated and the others degenerate.

Only 300,000 – 400,000 ova reach puberty during all the reproductive years (13-50) years and even before 13 and after 50. Statistics revealed that the average age of menopause is around 55 yrs – even at age 55 or 60 some women got pregnant. While menopause age in Uganda is from (38-40)years. *irrelevant*

About 450 follicles develop in a lifetime (i.e try to ovulate), 1 each month, and usually the two ovaries alternate in ovulation, but sometimes the two ovaries ovulate, or one ovary ovulate two ova, or one ovary ovulate one ovum which further divides into two producing identical twins.

At menopause few of the follicles remain and sometimes all of them get degenerated. Now, throughout the reproductive life (90-95)% of all follicles are primordial follicles.

Women in their 40-50s having lived hard lives and married late, or are exposed to chemicals or drugs, will have children with problems.

In fetal life and childhood some primordial follicles develop all the way to later stages. However, all these follicles undergo atresia. “One” of the primary follicles continues to grow and becomes dominant.

Activation of the primordial follicles is **genetically determined** two to three days before the end of the previous cycle. So even if there aren't any hormones (just like in the menses phase where we have low levels of all hormones), the primordial follicles can still be activated, but the difference is that the continuation of the process needs hormones, if there aren't any the follicles will become atretic.

The follicles which are exposed to FHS continue to become primary follicles, now why does only one follicle grow/dominate? Since one of them becomes richly vascularized in comparison to the others and is more sensitive to FSH.

Estrogen produced by the dominant follicle has two functions:

1- reduces FSH level (-ve feedback)

2- increases the number of receptors on the same follicle for FSH, so that it becomes very sensitive to FSH even if its concentration is very low while the other follicles degenerate since they need a lot of FSH.

Ovarian cycle is divided into 3 phases; follicular (13days), ovulation (at 14 day) and luteal phase (13 days) considering a typical cycle. Follicular phase in which the follicles develop. Ovarian phase in which one follicle ovulates and the luteal phase in which the corpus luteum "remnant of the ovulated follicle" is formed. If there is pregnancy, the corpus luteum continues to grow otherwise it is converted to corpus albicans (regresses and disappears).

When looking at the hormonal level during the ovarian cycle, we notice that during the first 3-4 days, we have a low concentration of hormones. This explains why the follicles are activated genetically like we said earlier.

Before day 14, at day 12 specifically, estrogen level rises, usually estrogens inhibit LH, but in this case, when estrogens exceed a certain level, positive feedback occurs on LH.

Activin increases FSH, Progesterone increases but not significantly, it plays either a synergistic or permissive action to estrogen.

LH causes ovulation because of estrogen, if we inhibit LH, no ovulation, also if we inhibit estrogen, no LH and no ovulation.

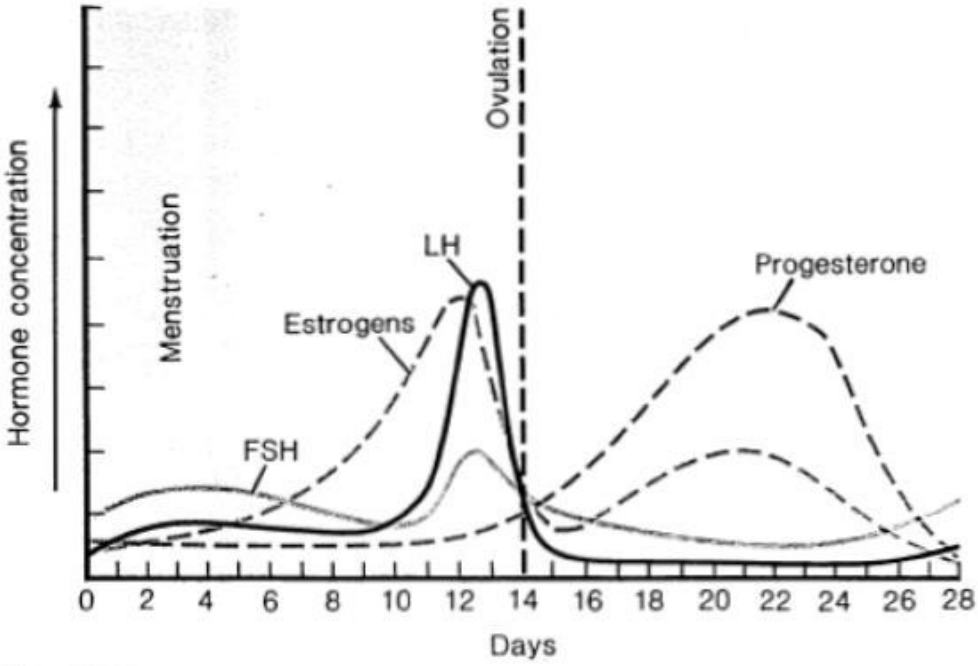

Figure 28-19
Tortora/Anagnostakos: Principles of Anatomy and Physiology, 5/e

Check out the level of hormones by the time of ovulation, after that we notice that progesterone rises significantly, while FSH and LH decrease again, estrogen isn't that important here either.

If a women gets pregnant, the corpus luteum will keep producing progesterone and estrogen and the cycle is maintained in the luteal phase, while if a women doesn't get pregnant we are back to our low hormonal level and the cycle continues.

In vitro fertilization, they use chemicals similar to FSH in order to produce about 40 follicles instead of 6-8 follicles (in the normal female reproductive system).

Now we have 4 ovarian proteins which are essential for ovulation:

1- Progesterone receptors

2- Cyclooxygenases which converts arachidonich acid into prostaglandins

3- cyclin D 2

4- transcription factor C\EBP (mechanism unknown)

If we remove any of these, no ovulation takes place.

What is released during LH surge (midcycle)?

Vasodilators (histamine, bradykinines, and PGs). When these vasodilators are produced, the graafian follicle becomes hyperemic, edematous and it swells.

Also another response to LH surge is the production of plasminogen activators (from theca externa and granulose of growing follicle) and lysosomal enzymes (which are produced by PGE and PGF). The plasminogen activators convert plasmingoen to plasmin (a lytic enzyme that works on the follicular wall and stimulates production of collagenase that digests the wall of the follicle).

The follicle must be exposed to an appropriate sequence of hormones in order for it to mature - first FSH, followed by estrogen, then LH,- for normal maturation and function.

It does not get easier, you just pretend to get used to it...