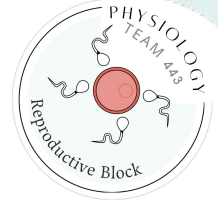








L4-Puberty in male and Female

Reproductive physiology



Objectives



-  Define Puberty.
-  Recognize the physiology of puberty related to changes in
-  hypothalamic-pituitary-gonadal axis.
-  Describe the physical changes that occur at puberty in boys and girls.
-  Recognize the influencing factors leading to puberty.
-  Describe the pathophysiological conditions associated with puberty.



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This Lecture was presented by:
PROF. MOHAMMED ALOTAIBI & Dr. Laila Al Dokhi.



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﴿يَا أَيُّهَا النَّاسُ اتَّقُوا رَبَّكُمُ الَّذِي خَلَقَكُمْ مِنْ نَفْسٍ وَاحِدَةٍ وَخَلَقَ مِنْهَا زَوْجَهَا وَبَثَّ مِنْهُمَا رِجَالًا كَثِيرًا وَنِسَاءً وَاتَّقُوا اللَّهَ الَّذِي تَسَاءَلُونَ بِهِ وَالْأَرْحَامَ إِنَّ اللَّهَ كَانَ عَلَيْكُمْ رَقِيبًا﴾

ثم حض المؤمنون على ما يوصلهم إلى الفلاح - وهو: الفوز والسعادة والنجاح، وأن الطريق الموصلى إلى ذلك لزوم الصبر، الذي هو حبس النفس على ما تكرهه، من ترك المعاصي، ومن الصبر على المصائب، وعلى الأوامر الثقيلة على النفوس، فأمرهم بالصبر على جميع ذلك. والمصابرة أي الملازمة والاستمرار على ذلك، على الدوام، ومقاومة الأعداء في جميع الأحوال. والمرابطة: وهي لزوم المحل الذي يخاف من وصول العدو منه، وأن يراقبوا أعداءهم، ويمنعهم من الوصول إلى مقاصدهم، لعلمهم بفلحون: يفوزون بالمحبوب الديني والدنيوي والأخروي، وينجون من المكروه كذلك. فعلم من هذا أنه لا سبيل إلى الفلاح بدون الصبر والمصابرة والمرابطة المذكورات، فلم يفلح من أفلح إلا بها، ولم يفت أحدا الفلاح إلا بالإخلال بها أو ببعضها. والله الموفق ولا حول ولا قوة إلا به.

[تفسير السعدي]

Puberty

Definition: Physiological transition from childhood (juvenile) to adulthood.

Characteristics of Puberty

At puberty:

The primary sexual organs mature (gonads).
(Testis, ovaries)

The adolescent experiences
the adolescent **growth spurt**.

Growth spurt = زيادة في الطول

HPG axis matures.
(Hypothalamus pituitary gonadal axis)
-GnRH → FSH, LH → Estrogen, Testosterone

The secondary sexual
characteristics develop.

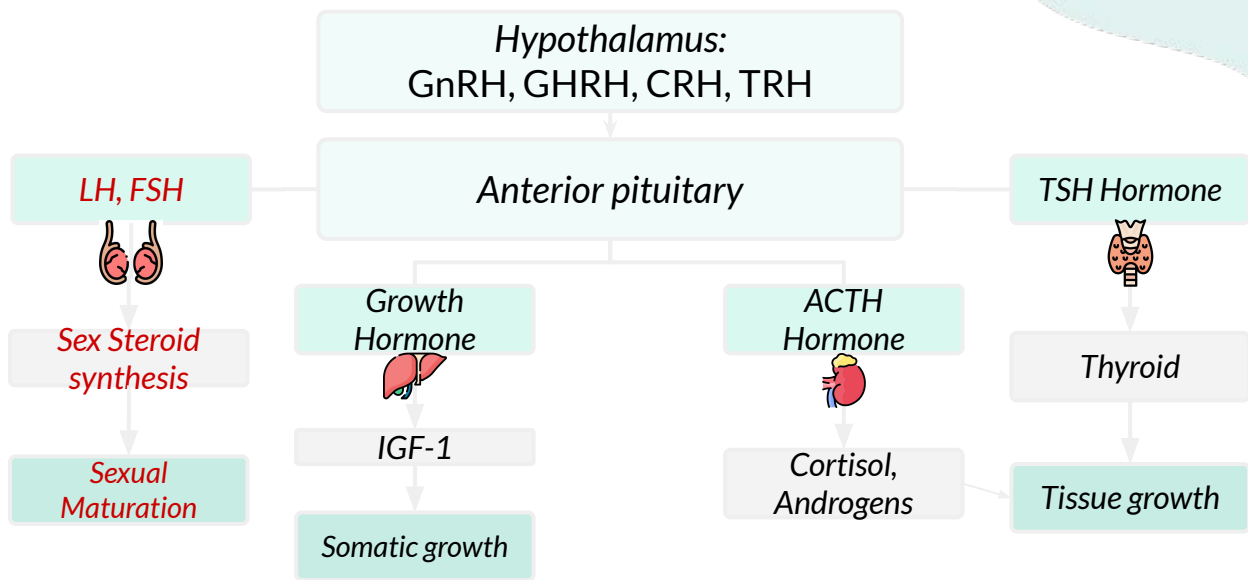
secondary characteristic comes from
hormones that released from primary sex
organ after complete maturation of HPA.

The adolescent achieves
the ability to procreate.

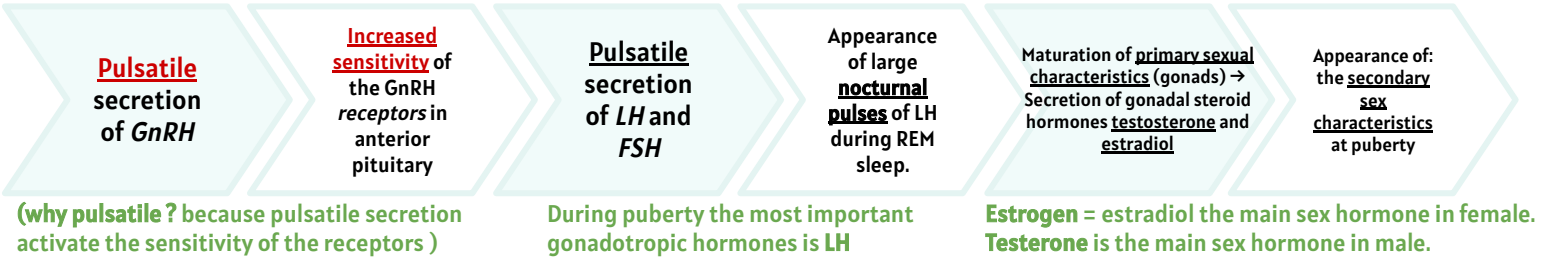
Terms and Events

Arche = Development

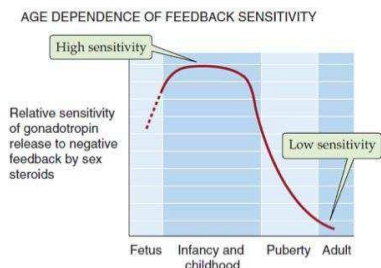
Thelarche	Development of <u>breast</u> . (First sign of puberty in girls.)
Pubarche	Development of pubic and axillary <u>hair</u> . (Due to androgen.)
Menarche	The <u>first</u> menstrual period. (only first others know as menstrual.)
Adrenarche	The onset of an increase in the secretion of <u>androgens</u> ; responsible for the development of pubic/axillary hair, body odour and acne.
Gonadarche	Maturation of gonadal function. (Spermarche=first spermatogenesis)



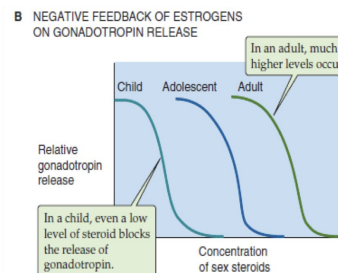
Hormonal Changes



- ➔ In young children, **low gonadotropins** and increased sensitivity of GnRH receptors to low gonadotropins **cannot** initiate gonadal function. (Very low LH , FSH → Can't stimulate gonads).
- ➔ Puberty is associated with activation of the HPG
- ➔ Between 9 -12 yrs, blood levels of **LH** and **FSH** **increase**.
- ➔ High levels of LH and FSH **initiate gonadal development** (nocturnal GnRH pulsatility LH secretion precedes phenotypic changes by several years).
بمعنى أن ظهور الخصائص الشكلية، سيقوم إرتفاع في الهرمونات
- ➔ **First phenotypic changes:** (breast development 🍊 / testicular enlargement 🍈)
- ➔ Menstruation begin (between **8-14 years old**) in girls. (Faster in girls)
- ➔ Spermatogenesis begin (between **9-14 years old**) in boys



Increased sensitivity of the GnRH receptors to very low gonadotropins before puberty

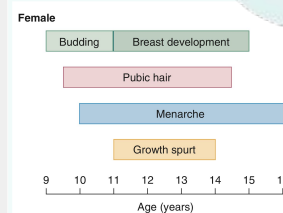


Important:
 -At childhood the low conc. of sex hormones can block the hypothalamus .why? due to high sensitivity to these hormones.
 -As child grow the sensitivity decreases more and more

Major Events in puberty

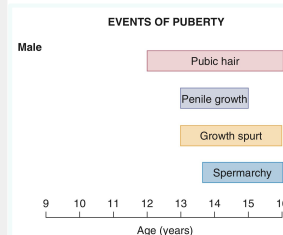
Female ♀

- ❖ **thelarche is usually the first sign in most girls (breast enlargement).**
- ❖ **Menarche usually occurs 2-3 yrs after thelarche .**
- ❖ Pubic hair growth dependent on increased secretion of adrenal androgens (**adrenarche**).
- ❖ Growth spurt and closure of the epiphyses typically begin and end earlier in girls than in boys. (**WHY? Because of Estrogen**)



Male ♂

- ❖ **First signs is testicular enlargement.**
- ❖ Leydig cell proliferation in the testes, and increased synthesis and secretion of testosterone.
- ❖ There is Growth of the testes, largely because of an *increased number of seminiferous tubules*.
- ❖ There is Growth of the accessory organs (such as the prostate), and the penis.
- ❖ There is a pronounced linear growth spurt.
- ❖ As plasma levels of testosterone increase, facial, pubic, and axillary hair appears, growth of the penis, lowering of the voice, and initiation of spermatogenesis (**spermarche**).



-Dr: growth spurt and closure of the epiphyses typically begin and end earlier in girls than in boys , **why?** because of Estrogen , estrogen closes the epiphyseal plate , but in male formation of estrogen requires aromatisation step to convert testosterone into estrogen.
 -Why thelarche happens before menarche ? the one which responsible for fat deposition is **estrogen** → Enlargement of breast.

Physical changes

→ **Five stages from childhood to full maturity.**

Tanner Scale (I – 5): Reflect the progression in changes of the:

External genitalia, breast, and pubic hair.

→ Secondary sexual characteristics

- Mean age **11** years in **girls**
- Mean age **11.5 – 12** years in **boys**

Physical changes: Tanner Scale

-Dr focused on what **highlighted in red** and also he mentioned that "you need to know the **testicular volume** in each stage"
 -Dr said you don't need to memorize everything just know the important features for each stage.

♀		♂	
Stage	Physical Development (Girls)	Stage	Physical Development (Boys)
B1 (breast) PH1 (pubic hair)	Prepubertal. No glandular breast tissue palpable, just an elevation of breast papilla No pubic hair.	G1 (genitals) PH1	Prepubertal. Testicular volume < 3 mL No pubic hair.
B2 PH2	Breast budding with elevation of breast and papilla as a small mound (1st pubertal sign in girls). Downy soft pubic hair. Growth spurt (between stage 2-3)	G2 PH2	Enlargement of testicular volume (3-6 mL) (1st pubertal sign in boys). Little or no change in penile size. Downy soft pubic hair.
B3 PH3	further enlargement of breast and areola. Darker, coarser and curled hair.	G3 PH3	Testicular volume 8-12 mL Penile lengthening. Darker, coarser, and curled hair. Growth spurt (between stage 3-4)
B4 PH4	Projection of areola and papilla to form a "double mound" above the level of the breast. More dense hair that fills the entire triangle overlying the pubic region and external genitalia and no spread to the inner thigh. Menarche (between stage 4-5)	G4 PH4	Testicular volume 12-15 mL Penile lengthening and broadening. Terminal hair that fills the entire triangle overlying the pubic region and external genitalia and no spread to the inner thigh.
B5 PH5	Mature breast. Loss of double mound due to the projection of papilla only and recession of the areola to the level of the breast. Dense hair that extends beyond the inguinal area into the inner thigh.	G5 PH5	Testicular volume > 15 mL Adult genitalia. Terminal hair that extends beyond the inguinal area into the inner thigh.

If you want mnemonic, your finger [HERE](#) please!!

Puberty

Puberty usually completed within **3 - 4** years of onset.

You need to differentiate between these terms.

Timing of puberty

Describes how mature a child is relative to his/her **peers** at the same age and sex (early, on time, or delayed).

Tempo

Describes **how quickly or slowly** a child progresses throughout the stages of puberty to the complete development (slow, average, or fast).

Factors that Influence Puberty

These factors are important.

Genetics factors

50-80% variation in pubertal timing.

Environmental factors

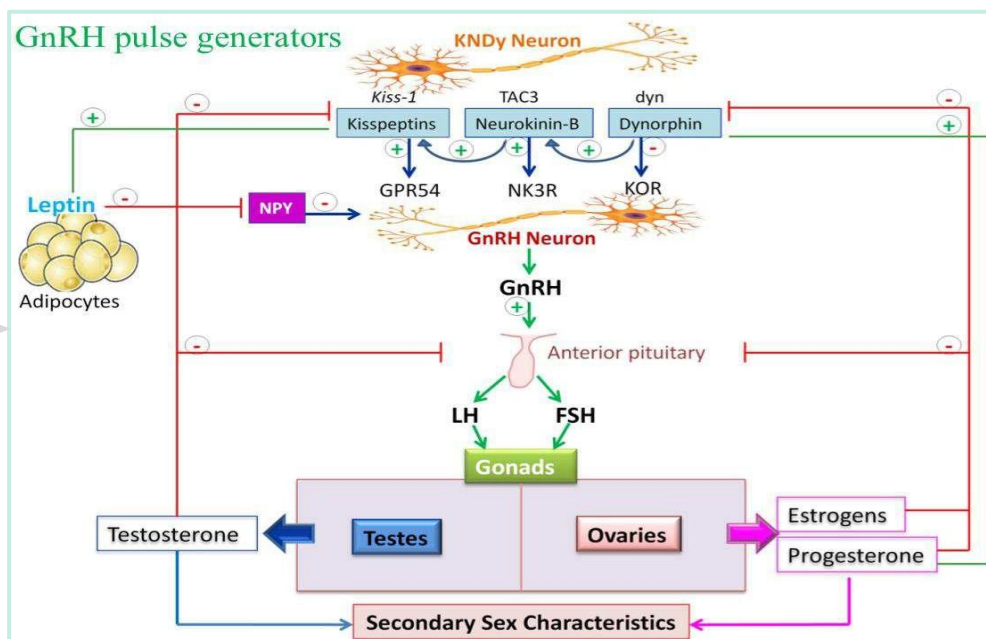
Geographical differences, psychosocial stresses, endocrine disruptor from pollutants, and exposure to chemical and industrial compounds.

Malnutrition and strenuous physical activity

Delay puberty. **Due to absence of fat tissue (explained next point)**

Obesity

Permissive role in regulating the timing of puberty. e.g. **Leptin** hormone regulates appetite & metabolism through hypothalamus. **More fatty tissues more leptin, leptin stimulates hypothalamus to release GnRH then LH, FSH → puberty**



Leptin acts in both the hypothalamus and the pituitary (through interneuronal pathways involving Neuropeptide Y and Kisspeptin) to stimulate the release of GnRH, leading to increased secretion of LH & FSH. As a result this will cause decrease food intake and increase thermogenesis and reproduction.

Pubertal disorders

1- Early / precocious puberty

Precocious onset of puberty is defined as **occurring younger than 2 years before the average age**, often before 8 years of age in girls and before 9 years of age in boys

Central Precocious Puberty (Gonadotropin-dependent)

- Idiopathic central precocious puberty.
- CNS tumours.
- CNS congenital abnormalities.
- Infectious or post-infectious conditions of hypothalamus.

Pseudoprecocious (Peripheral) Puberty (Gonadotropin-independent)

- Congenital adrenal hyperplasia (CAH).
- Gonads or adrenal glands tumors
- FSH and LH are suppressed. *due to -feedback*
- No spermatogenesis or ovarian development. *Due to absence of FSH, LH.*
- *Simply releases of sex hormone without activation of HPA.*

2- Delayed puberty

Initial physical changes of puberty are not present.

- **by age 13 years in girls (or primary amenorrhea at 15.5-16y)**
- **by age 14 years in boys.**

Pubertal development is inappropriate.

- The interval between first signs of puberty and menarche in girls/completion genital growth in boys is **> 5 years.**

1-Gonadal Failure *Hypergonadotropic Hypogonadism*

- Turner syndromes, **Klinefelter syndrome**
- Chemo / Radio therapies
- Gonadal damage secondary to trauma, tumors, surgical removal, and infectious or autoimmune diseases.
- Congenital gonadal dysgenesis or cryptorchidism. (*Cryptorchidism leads to degenerative testis.*)
- FSH, LH and androgen receptor gene mutations

2-Gonadal Deficiency: *Hypogonadotropic Hypogonadism*

- Idiopathic
- FSH and LH gene mutations from pituitary gonadotropes.
- CNS congenital anomalies and panhypopituitarism.
- Low FSH and LH levels.
- KiSS-1 or GPR54 gene mutations.

Q. A. MCQs

A baby is born with a penis, a scrotum with no testes, no vagina, and XX chromosomes. This condition is referred to as hermaphroditism. Which of the following could cause this abnormality?

Abnormally high levels of human chorionic gonadotropin production by the trophoblast cells	The presence of a testosterone-secreting tumor in the mother's right adrenal gland	Abnormally high levels of luteinizing hormone in the maternal blood	Abnormally low rates of estrogen production by the placenta
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A 12-year-old girl presents to her pediatrician's office because she has not yet begun her menstrual periods and she lacks breast development. After evaluation, she is found to have Turner's syndrome. Which of the following best describes a patient with Turner's syndrome?

It is not associated with hypothyroidism.	The most common karyotype is 45,X/46,XX mosaicism.	Ovarian dysgenesis (streak ovary) is characteristic.	It is not associated with renal abnormalities.
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A 14-year-old boy is brought to the clinic by his parents who are concerned because he has not yet begun puberty. Laboratory results indicate hypogonadism secondary to failure of the hypothalamic-pituitary-gonadal axis. Which of the following are possible adverse effects of the treatment for this patient's condition?

Anemia	Decreased serum LDL cholesterol levels	Increased spermatogenesis	Premature closing of the epiphyseal plates
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Want Explanation ? [Your Finger HERE!](#)

Leaders

Rafan Alhazzani

Fahad Almughaiseeb



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