Anterior pituitary gland (II)

By

Dr. Amr Medhat Abbas

Professor of Medical Physiology

Learning outcomes:

- **At the end of the lecture, you will be able to:**

1. Explain the disorders of growth hormone.
2. Explain the source, functions, control of secretion and disorders of prolactin.
3. Explain the source, structure, types and functions of MSH.
4. Explain the panhypopituitarism.

Disorders of growth hormone (GH)

- **Gigantism:** ↑ secretion of GH **before union** of epiphysis.
- **Acromegaly:** ↑ secretion of GH **in adults after union** of epiphysis.
- **Dwarfism:** ↓ secretion of GH **in children**.

Gigantism

-Def: A disease resulting from ↑ secretion of GH before union of epiphysis.

-Cause: tumour or hyperplasia of somatotrope cells.

-Characters:

1. Marked elongation of **bones**, but in a **relative proportion** (span does not exceed the height). The final height may reach 2.6 meters.


BEAR
POWER

2. Overgrowth of **soft tissues** **e.g** muscles and viscera.
3. **Hyperglycemia** and increased **metabolic rate**.
4. **Hypogonadism:** overgrowing somatotropes encroach on gonadotropes cells ➔ ↓ gonadotropins ➔ gonads and accessory sex organs are **under developed**.

5. **Headache** and **visual disturbances** due to local pressure of the growing tumour on the sella tursica and optic chiasma, respectively.

6. **Mentally retarded** and unless treated, **die** before the age of 20 years.

Acromegaly

-Def: A disease resulting from ↑ secretion of GH in adults after union of epiphyses.

-Characters:

1. **Bones** become thick and deformed.
2. **Muscles** and **viscera** enlarge.

3. General coarsening of features due to:

- Thickening of **skin** and **subcutaneous tissues**.
- Enlargement of **head, hands and feet**.
- **Lower jaw** hypertrophies and protrude forward (prognathism) and **teeth** become widely separated.

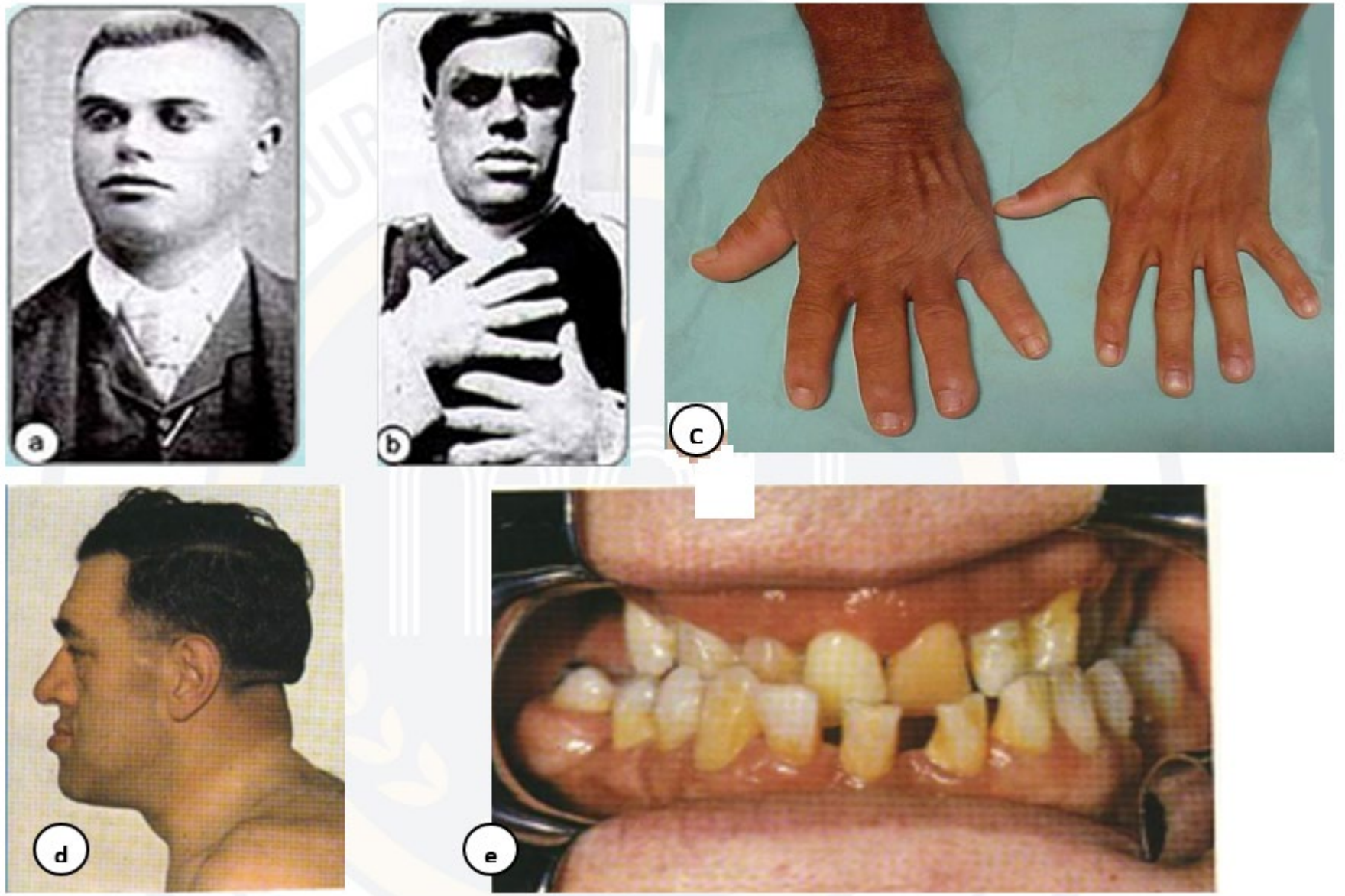

Fig. : ***Acromegaly in an adult. a) Normal subject before acromegaly; b) The same subject after development of acromegaly; c) Enlargement of hands in acromegaly; d) Coarseness of the facial features; e) Protruded mandible and separated teeth.***

4. **Kyphosis** due to thickening of the vertebrae.

5. **↑ BMR**.

6. **Hyperglycemia** and **glucosuria**.

7. **Hypogonadism**.

8. **Headache** & **vomiting** due to ↑ intracranial tension (ICT).

9.Visual disturbances due to pressure on optic chiasma.

10.Gynecomastia and **galactorrhea** due to:

- Lactogenic effect of GH.
- Secretion of prolactin by tumour cells.

11.Hirsutism.

- Treatment: Surgical removal of tumour or destruction by irradiation.

Dwarfism

- Def: ↓ secretion of GH in children.

-Characters:

1. **↓ bone growth** → **proportionate** reduction of all body features → short stature.
2. **↓ soft tissues growth**. **Mild obesity** is common. Patient looks much **younger than his age**.

3. **↓ metabolic rate**.

4. **Hypoglycemia** due to lack of insulin antagonism from G.H.

5. **Mental growth** is normal.

6. **Sexual maturation** is reached (Dwarfism + hypogonadism = **Infantilism**).

Physiology of growth

- Body growth is a **continuing process** throughout childhood and adolescence.
- It is **rapid** in **first 2 years** of life, and **less** during **middle years** of **childhood**.
- **Later**, there is a **2nd phase of rapid growth** at puberty followed by **cessation** of growth when adult height is reached.

- Factors affecting growth:

1.Hormones:

a)Growth hormone: promotes **growth** in **infancy**, where its plasma level is elevated.

b)Thyroid hormone:

- Stimulate **physical growth** by potentiating the action of **somatomedins**.
- Essential for **mental** and **sexual** growth.

c) Insulin:

- Potentiate **growth**.
- Importance for formation of **somatomedins**.
- **Juvenile DM → stunted growth**.

d) Glucocorticoids:

- **Physiological** conc → **facilitate growth**.
- **Pharmacological** doses → inhibiting GH → **↓ growth**.

e)Androgens and estrogens:

- Responsible for **2nd phase of rapid growth** at puberty due to their **anabolic** effect.
- Growth is **initially stimulated** then **stops** as they cause fusion of epiphyseal cartilage of long bones.

f)Parathormone and vit D → essential for normal skeletal ossification.

2.Extrinsic factors:

a)**Balanced diet** rich in proteins and vitamins is necessary for growth.

b)**Stress** **e.g.** infections ➔ suppression of growth.

3.Genetic factors: *determines:*

a) Growth rate.

b) Age of puberty.

c) Adult height.

Prolactin (Lactogenic hormone) (Mammotropin)

- **Nature:** **polypeptide** hormone (**198** amino acids) [similar to GH].
- **Source:** **mammotrope** cells.
- **Plasma conc:**

Men = **5**ng/ml. **Women** = **8**ng/ml.

❑ Functions:

1. Development of breast:

a) **Pre & post pubertal:** Prolactin (with estrogen, progesterone, cortisol & GH) ➔ stimulation of proliferation & branching of **milk ducts** in female breast.

b) **During pregnancy:** Prolactin (with estrogen & progesterone) ➔ development of **milk alveoli**.

c) **After labor:** Prolactin stimulates **milk synthesis and secretion**.

2. **Inhibits LHRH release** → ↓ LH → prevent ovulation in women. This accounts for amenorrhea during postpartum lactation.

3. **Stimulates lymphocyte proliferation**.

❑Control of Prolactin secretion:

1.Hypothalamic control:

- **PRH** ➔ increase prolactin.
- **PRIH** (similar to **dopamine**)➔ decrease Prolactin.

2. Drugs:

- **L-DOPA** → ↑ dopamine → ↓ Prolactin.
- **Apomorphine and bromocriptine** → stimulate dopamine receptors → ↓ Prolactin.
- **Chlorpromazine** → block dopamine receptors → ↑ Prolactin.

3. Feed back mechanism:

- Prolactin → ↑ dopamine release at median eminence → ↓ prolactin (***–ve FB***).

4. Pregnancy:

- Prolactin increase during pregnancy.
- **Cause:** ↑ estrogen → stimulate hyperplasia of prolactin producing cells.

5. Suckling:

- Sucking of the offspring ➔ stimulation of nipples ➔ afferent impulses arise from receptors in nipple ➔ inhibition of PRIH ➔ ↑ prolactin.

6. Others:

- Sleep, stress, oxytocin, VIP, subs. P and AII ➔ ↑ prolactin.

❑ Disorders of prolactin:

- **Decrease prolactin** ➔ inability to lactate in women.
- **Increase prolactin:**
  - **Cause:** hypothalamic dysfunction or pituitary tumour.

- **Characters:** increase prolactin ➔ -ve FB effect on gonadotropin (Gn) ➔

Women	Men
- Anovulation.	- ↓ Testosterone.
- Amenorrhea.	- ↓ Sperm production. - Impotence.
- Infertility.	- Infertility.
- Galactorrhea.	- Breast development and lactation.
- ↓ libido.	- ↓ libido.

Melanocyte stimulating hormone (MSH) (Melanotropin)

- **Nature:** polypeptide hormone

- **Source:** anterior pituitary.

- **Importance:** It controls the ***skin color*** by alteration of the dispersion of ***melanin*** containing granules in the melanocytes of the skin in response to the amount of light to which the animal is exposed.

- **Types:** alpha, beta and gamma. **Gamma MSH** is secreted by corticotrope cells which secrete ACTH. **Beta MSH** is secreted by human pituitary gland.

- **Structure:** Each of the 3 types of MSH is formed of a sequence of amino acids which is structurally similar to part of the 39 amino acid polypeptide chain of ACTH. This explains the marked **MSH activity of ACTH**.

- e.g. in hypofunction of suprarenal cortex (Addison's disease) ➔ ↑ ACTH level due to ↓ cortisol release ➔ hyperpigmentation of skin & mucous membranes.

Panhypopituitarism (Simmond's disease)

- Cause: destruction of anterior lobe of pituitary gland → severe ↓ of its hormones → atrophy of the thyroid and supra-renal glands & of the gonads.

- Manifestations:

1. **In children:** infantilism **i.e.** failure of growth and of sexual maturity.

2. **In adults:** the lack of trophic hormone ➔ hypofunction of their target glands together with relative hyperinsulinism.

a) ***Hypofunction of thyroid gland*** (Myxoedema).

b) ***Hypofunction of adrenal cortex*** (hypocortisism or "Addison's disease').

c) ***Hypofunction of gonads*** (hypogonadism).

d) Loss of weight and sever wasting of muscle (cachexia) due to:

* Loss of appetite (anorexia).
* Absence of anabolic effect of growth hormone and androgens.

e)Premature senility (progeria): The skin becomes dry and wrinkled with early graying of hair so that the patient looks older than his age.

f) ***Hypoglycemia*** due to relative ↑ in insulin level due to lack of antagonistic hormones.

g)Skin colour becomes lighter due to anemia and ↓ ACTH and beta-MSH.

References

1. Costanzo, Linda S. "BRS Physiology (Board Review Series)." (2018).
2. Ganong, William F. "Review of medical physiology." (2020).
3. Hall, John E and Hall, Micheal E. “Guyton and Hall Textbook of medical physiology." (2021).