



Endocrine

434 Physiology team
presents to you:

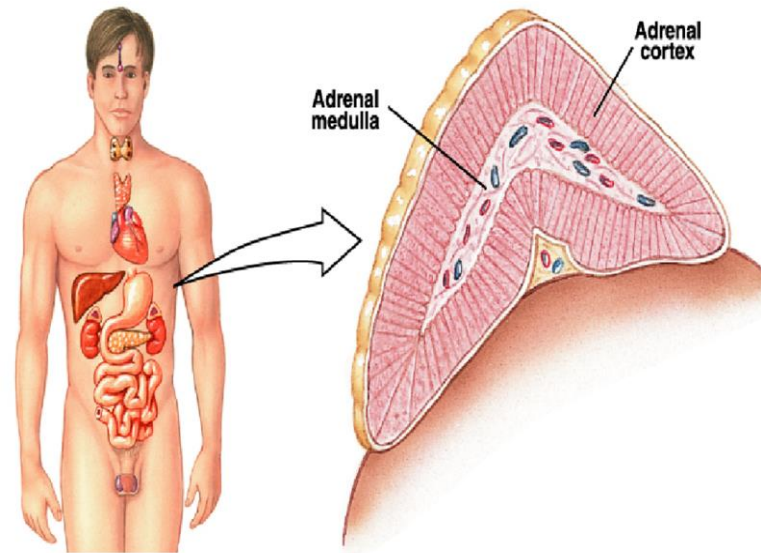
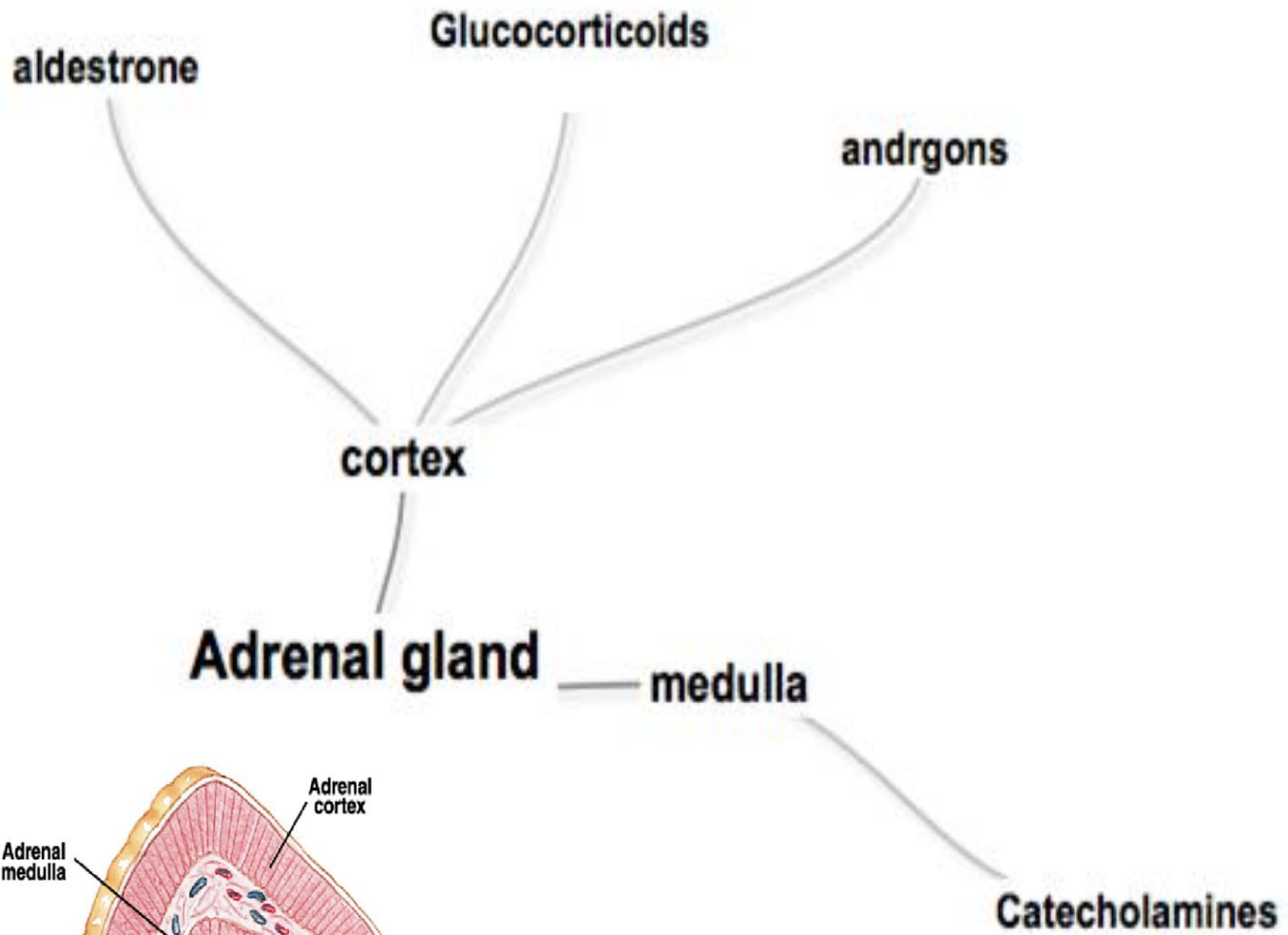
Glucocorticoids

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Please check out this link before viewing the file to know if there are any additions/changes or corrections. The same link will be used for all of our work [Physiology Edit](#)



Adrenal Gland

Small, triangular glands loosely attached to the kidneys.

introduction

Divided into two morphologically and distinct regions:

- Adrenal Cortex.
- Adrenal Medulla.

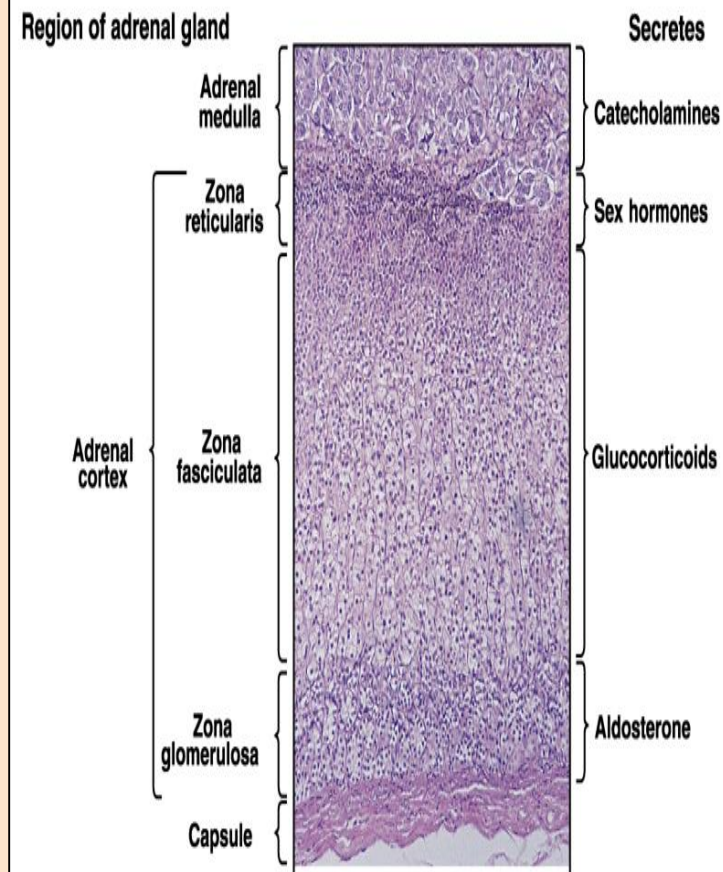
Hormone Of adrenal gland :

Cortex: (Secretes steroid hormones)

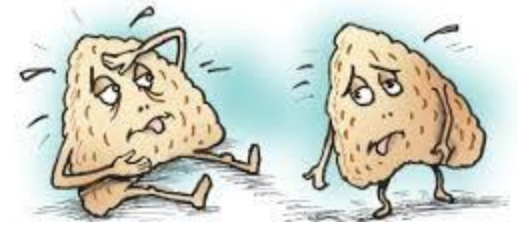
- Mineralocorticoids (aldosterone) → from zona glomerulosa
- **Glucocorticoids** → from zona fasciculata
- Androgens → from zona reticularis

Medulla (Amino acid secretions)

- Catecholamines



Glucocorticoids



Main glucocorticoids in humans:

- Cortisol.
- Corticosterone.
- Cortisol : Corticosterone produced in humans in a ratio of 10:1
- 90-95% bound to plasma protein.(since its steroid)
- Under control primarily by **ACTH**.

Natural episodic secretion rhythms

- After ACTH has been produced,cortisol will be evident 15 to 30 minutes later.
- There are usually 7-15 episodes per day.
- There is a major burst in the early morning before awakening.

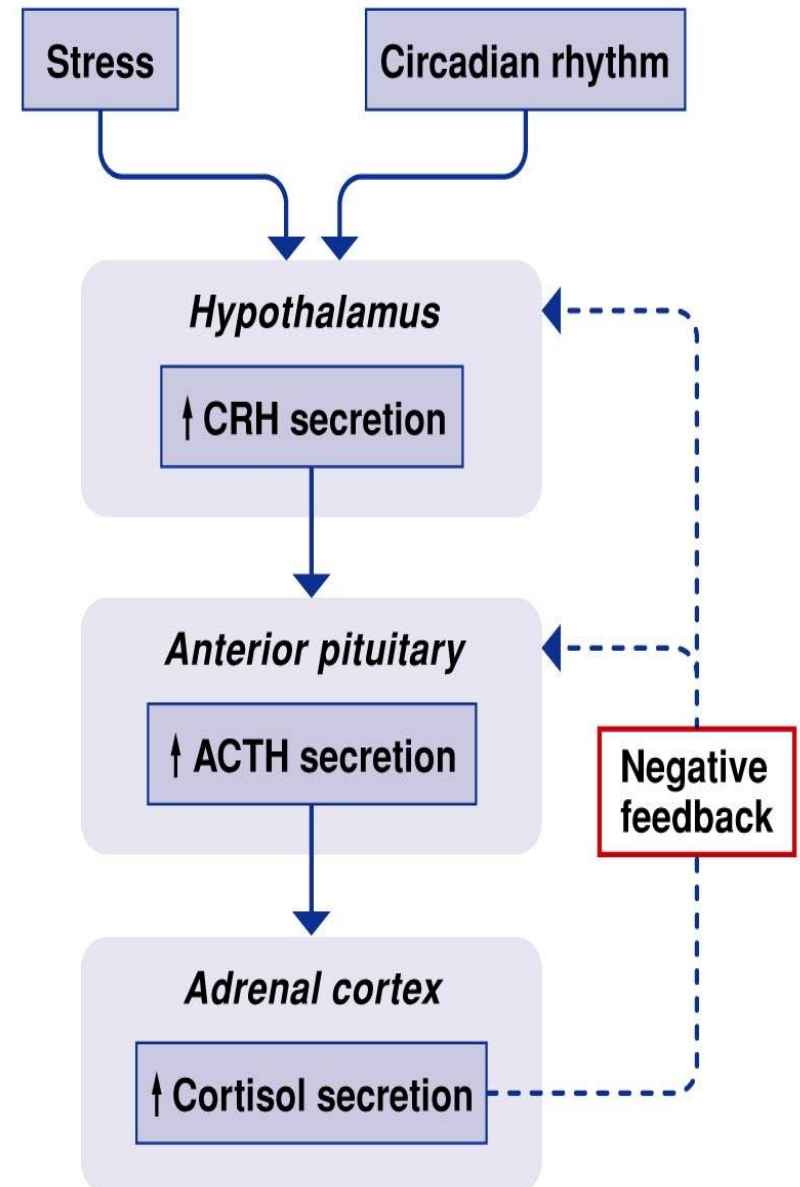
Steroid Hormones Transport



Steroid hormones when released from adrenal cortex into blood stream bind to plasma protein carries:

- **Cortisol binding globulin (CBG)** (transcortin).
- **Albumin.**
- Only unbound steroid hormones are biologically active
- (~2%)
- To cross the target tissue membrane, the hormone must dissociate from its carrier protein.
- Importance: Binding to plasma proteins act as reservoirs and ensure a uniform distribution to all tissues.
- Aldosterone has a lower half-life than cortisol.

Regulation of cortisol release



Cortisol

Pattern of secretion:

- Increased release with coffee consumption.
- Increases proportionately with exercise time & intensity.

Cortisol metabolism

- Free cortisol is excreted into urine.
- Metabolized in liver by reductases & conjugated to glucuronides and excreted via kidney.

Regulation of cortisol release

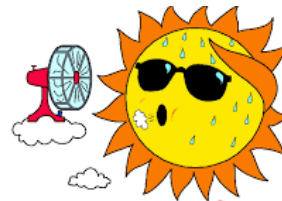
Stimuli releasing cortisol:



Extreme mental anxiety.



Infection



HOT WEATHER

Extreme heat



Cold



Exercise to the point of exhaustion.



Physical trauma.



Stress

Physiological effects of Cortisol:

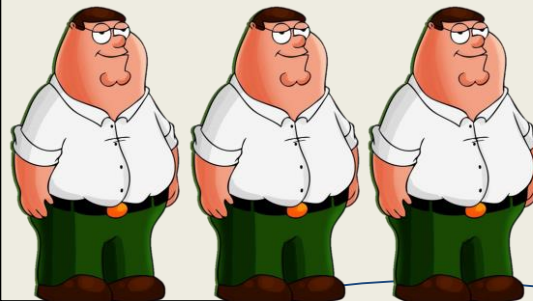
1-Protein metabolism

- Reduces protein formation in all tissues Except liver.
- Extrahepatic protein stores reduced (catabolic).
- Amino acids not transported into muscle cells ↓ protein synthesis & ↑ amino acid blood levels.
- These high blood amino acid levels are transported more rapidly to hepatic cells for gluconeogenesis and protein synthesis in liver.

2- Carbohydrate metabolism

Increases blood glucose levels by:

- (+) gluconeogenesis in the liver.
- Decreasing utilization of glucose by cells via direct inhibition of glucose transport into cells.



3- Fat metabolism

- Lipolytic.
- Mobilizes fatty acids & glycerol from adipose tissue lead to ↑ their blood concentrations, so more glycerol available for gluconeogenesis.
- Fat broken down & less formed due to less glucose transported into fat cells.
- Redistribution of body fat:
 - ↑ formation of fat in trunk areas & face
 - ↓ fat (& muscle) from extremities.
- Increases appetite.

4- Developmental Functions

- Permissive regulation of fetal organ maturation.
- Surfactant synthesis (phospholipid that maintains alveolar surface tension).
- **Inhibition of linear growth** in children due to direct effects on bone & connective tissue.



Anti-inflammatory

- ★ Reduces degree of vasodilatation.(vasoconstriction)
- ★ Stabilizes lysosomal membrane.
- ★ Decreases permeability of capillaries.
- ★ Decreases migration of white blood cells.
- ★ Suppresses immune system.



Continue..

Blood Cells and Immunity

- ★ Decrease production of **eosinophils and lymphocytes.**
- ★ Suppresses lymphoid tissue systemically therefore decrease T cell and antibody production→ decreasing immunity.

This effect is useful in **transplantation** surgery in reducing organ rejection.

Circulation

Cortisol has mineralocorticoid effect,**not as potent as aldosterone.**

- ★ Maintains body fluid volumes & vascular integrity.
- ★ BP regulation & cardiovascular function: Sensitizes arterioles to action of noradrenaline→ Permissive effect. (تفرع معاها، تخليها تستجيب بشكل افضل)
- ★ Decreases capillary permeability.
- ★ Maintains normal renal function.



CNS responses

- ★ Negative feedback control on release of ACTH.
- ★ Modulates perception & emotion.



Mineral metabolism

- ★ Anti-vitamin D effect.



GIT

- ★ Increases HCl secretion.(Might cause ulcers)

Cortisol excess

Exogenous:

Most cortisol excess is induced by steroid therapy (prednisone)

Example in:

- Asthma
- Rheumatoid arthritis
- Lupus.
- Immunosuppression after transplantation.



Endogenous

Due to excessive production of cortisol:

→ ACTH- independent:

-Primary adrenal defect (adenoma).

→ ACTH-dependent:

-Overproduction of ACTH by pituitary.

-Overproduction of ACTH by ectopic ACTH-producing tumor. (Tumor secreting ACTH not in pituitary).

Both exogenous & endogenous hyperfunction show manifestations of **Cushing's disease**.

Symptoms

Continue

Buffalo torso

- Redistribution of fat from lower parts of the body to the thoracic and upper abdominal areas



Moon Face

- Edematous appearance of face.



Acne & hirsutism (has sex hormone effect)

- (excess growth of facial hair)



Continue

Metabolism (Same but exaggerated effect)



Protein metabolism

↑ protein loss

- Muscle atrophy, weakness
- Thin skin
- bone matrix & mass losses
- bone formation ↓ less Ca^{2+} absorbed & more excreted in urine.
- **osteoporosis**
- In lymphoid tissue results in suppression of immune system.
- Stria in skin → due to lack of collagen formation.

Carbohydrate metabolism “Adrenal diabetes”

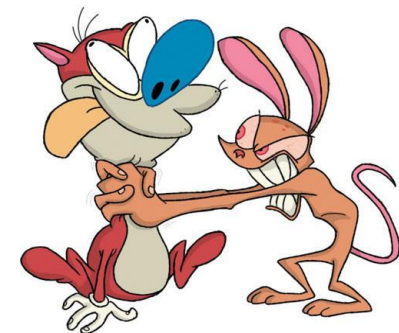
- ↑ **blood glucose levels**, up to 2x normal (200 mg/dl).
- ↓ sensitivity to insulin.

-over secretion of insulin
→ “burn out” the beta cells of the pancreas resulting in lifelong DM.

Fat metabolism

Redistribution of body fat:

- ↑ Trunk & face fat deposition.
- ↓ Extremities fat deposition.



Continue

Effect On..



Inflammation & Immunity

- Increased** infection susceptibility.
- Ab synthesis **suppressed** & normal immune responses to infecting pathogens **suppressed**.
- Decrease** in fibrous tissue formation.

CNS

- Initially euphoria but then replaced with **depression**.

Circulation

- Hypertension** due to Na retention & K excretion.
- Hypervolemia**.
- Hypernatremia** due to increased Na absorption.
- Hypokalemia due to increased K excretion.

Cushing syndrome

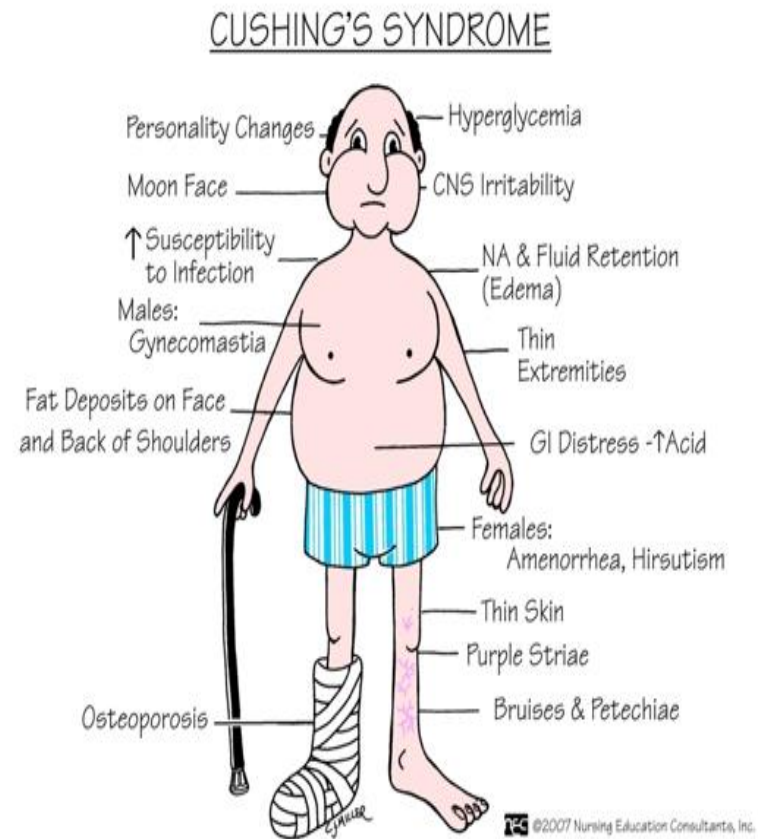
Hypersecretion of glucocorticoids by the adrenal cortex characterized by weight gain in the trunk of the body but not arms and legs

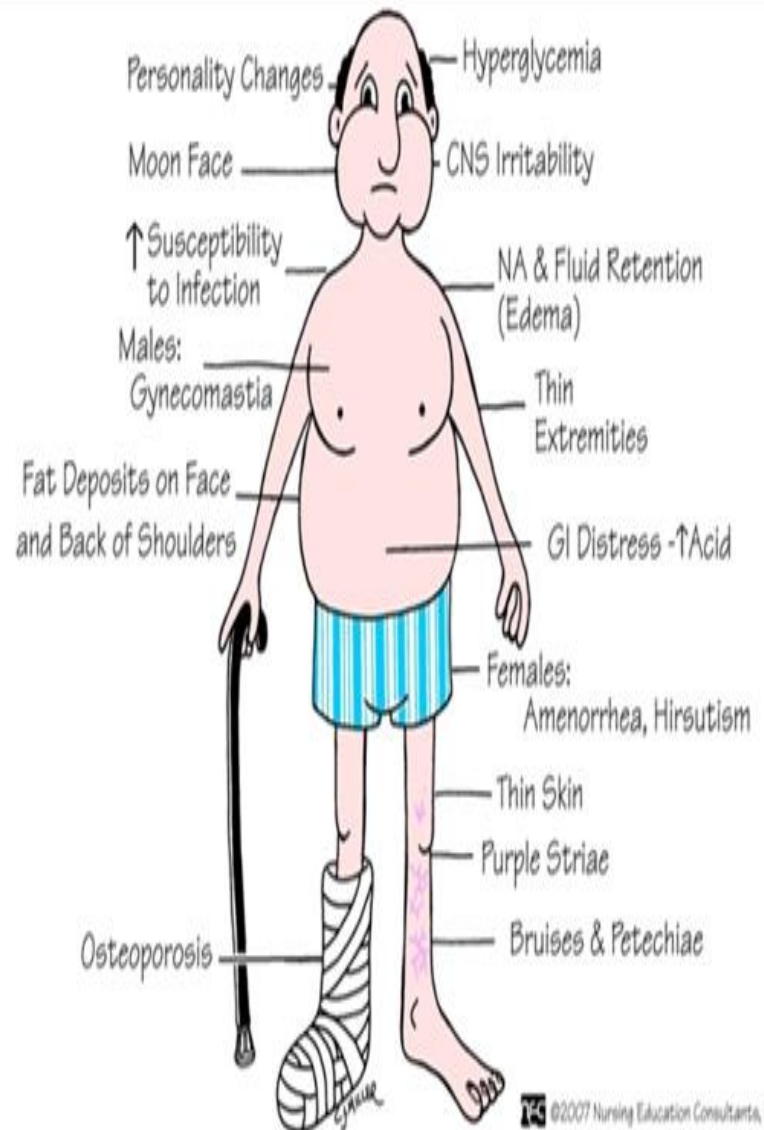
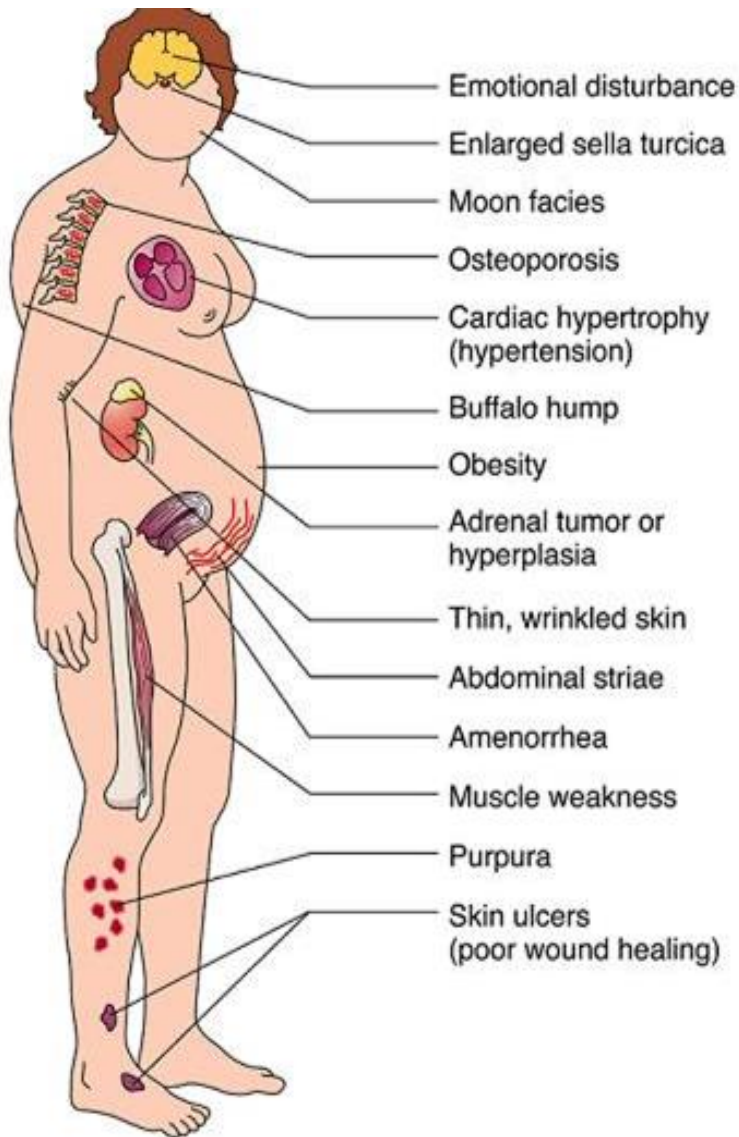
Symptoms

- Proximal muscle wasting & weakness.
- Moon face, striae
- Osteoporosis.
- Glucose intolerance.
- HTN, hypokalemia.
- Thromboembolism.
- Depression, Psych.
- Infection.v
- Glaucoma.

Treatment

- ❖ Removal of adrenal tumor if this is the cause.
- ❖ Microsurgical removal of hypertrophied pituitary elements to reduce ACTH secretion.
- ❖ Partial or total adrenalectomy followed by administration of adrenal steroids to compensate insufficiencies that develop.





Answer key: A,C,D,B,A,D,C

MCQs

1- What is the most abundant Glucocorticoid that found in the body

- A-Cortisol
- B-Corticosterone
- C-Aldosterone
- D-Prednisone

2- The release of Glucocorticoids is controlled by :

- A-TSH
- B-ADH
- C-ACTH
- D-GH

3- Which of the following affect the release of Glucocorticoids :

- A-circadian rhythm
- B-coffee consumption
- C-exercise
- D-all of above

4- Which of the following is an effect of cortisol :

- A-Increase utilization of glucose
- B-Increase gluconeogenesis
- C-decrease appetite
- D-decrease oxidation of fatty acids

5- Cortisol attenuates fever by :

- A-reduce release of Interleukin-1
- B-Increase release of TNF
- C-Increase release IL-6
- D-B&C

6- Cortisol effect in Mineral metabolism is :

- A-anti vit-K
- B-anti vit-B
- C-anti vit-C
- D-anti vit-D

7-Which of the following is an ACTH-independent :

- A-Cushing's disease
- B-Excess Cortisol due non pituitary tumors
- C-latrogenic Cushing's syndrome
- D-none of above

Q1:How can cortisol excess be caused by exogenous factors?

Ans:It might be induced by steroid therapy as in asthma or rheumatoid arthritis.

Q2:Mention the effect of cortisol on CNS?

Ans:Initially euphoria but replaced then with depression.

Q3:Briefly explain the role of hypothalamic-pituitary-adrenal axis in control of glucocorticoid secretion.

Ans:Hypothalamus secrete CRH in response to stimuli→ affect the release of ACTH from pituitary gland → cause the release of cortisol from adrenal gland. Cortisol causes **Negative feedback** on CRH and ACTH.

Q4:Briefly explain the anti-inflammatory action of Glucocorticoid.

Ans: 1-Reduces degree of vasodilatation 2-Stabilizes lysosomal membrane 3-Decreases permeability of capillaries.

Q5:What mineralocorticoid affect Cortisol have and is it more potent than aldosterone?

Ans: No it's not,Maintains body fluid volumes & vascular integrity.

Thanks for checking our work

Good Luck

Done by:

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