Thyroid & parathyroid glands

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* The thyroid gland is butterfly gland located anterior part of the neck, enclosed in paratracheal fascia, & moves with the swallowing. It is composed from 2 lateral lobes joined in the midline by the isthmus. It is divided by fibrous septa into pseudo lobules containing follicles, with proteinaceous colloid vesicles.it contains thyroglobulin in which T3 & T4 is synthesized & stored. The gland is the only source of T4, while it produces 20% of T3, the other 80% of T3 is generated by the peripheral deiodinations of T4 largely in the liver & kidneys.
* The free form of T4 & T3 are active forms, & match with their metabolic activities. T3 is more rapid acting & weakly bound to thyroid binding proteins.
* The parathyroid glands are located behind the thyroid gland, the structure & function of its hormone differs from that of the thyroid gland, & it does not contain abundant iodine as the thyroid hormones.

# CLASSIFICATION OF THYROID DISEASES

* 1- Hormone excess: Graves’ disease, multinodular goiter, adenoma.
* 2-Hormone deficiency: Hashimoto’s thyroiditis & atrophic hypothyroidism.
* 3- Hormone hypersensitivity.
* 4- Hormone resistance: in cases of enzymatic deficiency.
* 5- nonfunctioning thyroid tumors: Medullary carcinoma, Differentiated carcinoma, Lymphoma.
* It’s worth to mention that secondary causes of hyper & hypothyroidism occur, though less common due to excess of deficient TSH levels.

# THYROTOXICOSIS

* A disease in which there is overproduction of thyroid hormones.
* This will cause a constellation of clinical symptoms & signs in the patient, mainly to body metabolic hyperactivity, but also due to immune manifestations of the disease.
* The main 2 causes are Grave’s disease & multinodular goiter, with autonomously functioning nodule being less common. Sometime acute thyroiditis due to viral infection can cause transient hyperthyroidism, as well as some drug side effects. • In secondary TSH induced hyperthyroidism, TSH secreting pituitary adenoma, choriocarcinoma, & follicular carcinoma with metastasis are main causes.

# CLINICAL FEATURES OF HYPERTHYROIDISM

* 1- Weight loss. 7- Palmar erythema. 13- Fatigue.
* 2- Palpitation. 8- Lid lag & lid retraction. 14-Tremor.
* 3- Irritability. 9- Exophthalmos & ophthalmoplegia. 15- Palpitation & atrial fibrillation.
* 4- Excessive sweating. 10- Diplopia & conjunctival chemosis. 16- Frequent bowel motions.
* 5-Heat intolerance. 11- Pretibial myxedema.
* 6-Dyspnea. 12- Amenorrhea in female.

CLINICAL FEATURES OF HYPOTHYROIDISM

* 1- Weight gain. 6- Slow coarse speech & voice. 11-Menorrhagia.
* 2- Fatigue, somnolence. 7- Periorbital oedema.\ myxedema. 12- Delayed tendon relaxation.
* 3- Dry hair. 8- Bradycardia.
* 4- Dry skin. 9- Constipation.
* 5-Cold intolerance. 10- Anemia.

INVESTIGATIONS OF THYROID DISEASES

* T3, T4 & TSH are the main tests used for assessment of thyroid gland function.
* They could be affected, especially total T3 & T4 by alternation of thyroid binding proteins, such is cases of pregnancy.
* Free T3 & T4 are used in cases of altered protein level to have more precise idea about the gland activity.
* In primary hyperthyroidism the level of TSH will be very low or undetected while the T3 & T4 levels will be high, while in primary hypothyroid state, the T 3 & T4 are low with high TSH level due to pituitary overproduction to enhance the gland for more production of its hormones.
* In secondary hyperthyroidism all T3, T4 & TSH will be high, while in secondary hypothyroidism the TSH level will be low or normal despite low T3 & T4.
* Thyroid autoantibodies (thioperoxides, TRAB, thyroglobulin Abs) are also used in diagnosis.
* Imaging studies including ultrasound & radio-isotope studies are supplementary to the thyroid function tests.

# TREATMENT

* In thyrotoxicosis, drugs, radio- iodine & surgery are the main modalities of treatment, according to patient sex, age, clinical status.
* Sometimes combination of treatment is used, such as drugs to decrease the size & vascularity of the goiter before surgery.
* Every modality has its advantage, limitation & complications.
* For hypo – thyroid patients, hormone replacement is used in form of T4 mainly, & the dose is controlled by the clinical state, hormone level & TSH testing, to avoid iatrogenic thyrotoxicosis. The use of thyroid hormone treatment for weight control in overweight & obese patient is obsolete now.

# PARATHYROID GLANDS

* 4 glands responsible for the production of parathyroid hormone which have important role in maintaining the level of serum calcium. Calcitonin, a hormone produced by medullary thyroid C cells, & vitamin D also play important rule in homeostasis of serum calcium.
* The parathyroid hormone is 84 amino acid hormones, produced mainly when serum calcium falls below the normal level for maintaining normal neuromuscular function.
* Diseases of the parathyroid gland occur either alone or as a part of multiple endocrine disorders such as MEN with pituitary, pancreas & adrenal medulla adenomas.
* The overproduction of parathyroid hormone causes hypercalcemia, with its deleterious effect on body tissue especially the eyes, kidneys, brain & vascular structure.
* On the other hand, failure of proper parathyroid hormone production to maintain normal serum calcium level in hypocalcemia patients, lead to neuromuscular & cardiac dysfunction, with tetany & carpopedal & laryngeal spasm.
* Other disorders of parathyroid hormone could be due to end organ resistance to the effect of this hormone (pseudohypoparathyroidism), or due to chronic hypocalcemia effect in chronic renal failure patients due to failure of Vitamin D activation by chronic kidney disease, this will eventually cause autonomous hyperparathyroidism. Leading to complications in skeletal system structure.

# ADRENAL GLANDS & GONADS

* The adrenal glands are pair of glands located each above & posterior to the corresponding kidney. Each gland composed from the outer cortex which in turn, composed of 3 layers, & concerned with production of steroid hormones, while the inner medulla is responsible for production of catecholamines, & considered part of the autonomic nervous system.
* Zones of the adrenal cortex from outer to inner side are:
* 1-Zona glomerulosa: responsible for production of (Aldosterone), which regulates the blood pressure.
* 2- Zona fasciculata: is responsible for glucocorticoid production such as cortisol.
* 3- Zona reticularis: responsible for androgen hormones production.
* 4- Medulla: produces catecholamines (epinephrine 80% & norepinephrine 20%).

# CORTISOL FUNCTION

* Cortisol & its derivatives play crucial rule in metabolism & energy mobilization from its reserves. Most important functions are:
* 1-Maintaining blood glucose level by enhancing gluconeogenesis.
* 2- Increases glycogen synthesis as storage for energy.
* 3- Increase protein catabolism.
* 4-Enhances lipolysis.
* 5-Increase the appetite.
* 6- Increase insulin resistance.
* 7- anti-inflammatory effect by suppressing the body reaction to any inflammation, infection or allergic reactions. 9-Lympholytic effect.
* 8- Very important to prepare the human reaction in stressful situations. 10-Impairment of wound healing.

# EFFECTS OF CATECHOLAMINES

The primary effect of catecholamines is to supplement the sympathetic nervous system. they are released directly into the blood from the adrenal medulla, usually in fearful & stressful situations.

Their major effects on the body are:

* 1- increase blood pressure.
* 2- increase heart rate.
* 3- enhance circulation & blood supply to the muscles.
* 4- increase the respiratory rate & cause bronchodilatation.

# DISEASES OF THE ADRENAL GLAND

* Excess corticoid production either primarily by the gland or as secondary effect due to high pituitary gland production of ACTH. Is called Cushing’s syndrome or disease respectively. While under production of corticoid is called Addison’s disease.
* Excess aldosterone production causes a disease called Conn’s disease.
* Excess catecholamine production from the adrenal medulla or any part in sympathetic axis called Pheochromocytoma.

# GONADS & ADRENAL ANDROGENS

* The adrenal gland produces androgenic hormones (DHEA & Androstenedione) from the zona reticularis layer, these hormones are later converted to either testosterone or estrogen (postmenopausal women). Testosterone is important for maintaining secondary sex characters such as axillary, pubic male- pattern facial hair distribution.
* The gonads also produce sex steroids to maintain their function in reproduction.
* The gonads (testes in male & ovaries in female), are under control of pituitary FSH & LH effect.
* The testes is responsible for spermatogenesis during puberty period in male. They also have other cell types responsible for androgen production.
* The ovaries are responsible for ovulation in pubertal female, they also produce estrogen to main secondary sex characters in female ( breasts, pubic & axillary hair) & maintain regular menstrual cycle, & progesterone , to support & maintain the uterine mucosa integrity after conception.

# DISEASES OF GONADS

* Failure of gonads cause infertility in male & female patients.
* Infertility can be primary due to gonadal failure, in which we get usually high levels of FSH & LH from the pituitary overproduction. Or it may be secondary due to inadequate or absent pituitary production of FSH & LH.
* Primary infertility in both male & female patients can occur due to failure of normal development of the gonads due to different causes, such as hereditary & chromosomal abnormality, trauma, tumor, infection & radiation being among the most common causes. Failure of sex hormone production in male & female patient, can also cause infertility or affect their virility or femineity, despite normal ovarian & testicular structure.