Seed GLOBAL HEALTH

Project ECHO

Thyroid Related Emergencies

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Presentation outline

- Introduction to thyroid emergencies
- Assessment, ED clinical presentation, and investigation of a patient with thyroid-related emergences.
  - Decompensated Hypothyroidism/myxedema coma
  - Thyroid storm
- Pre-hospital management
- ED management
- Disposition

The thyroid hormone

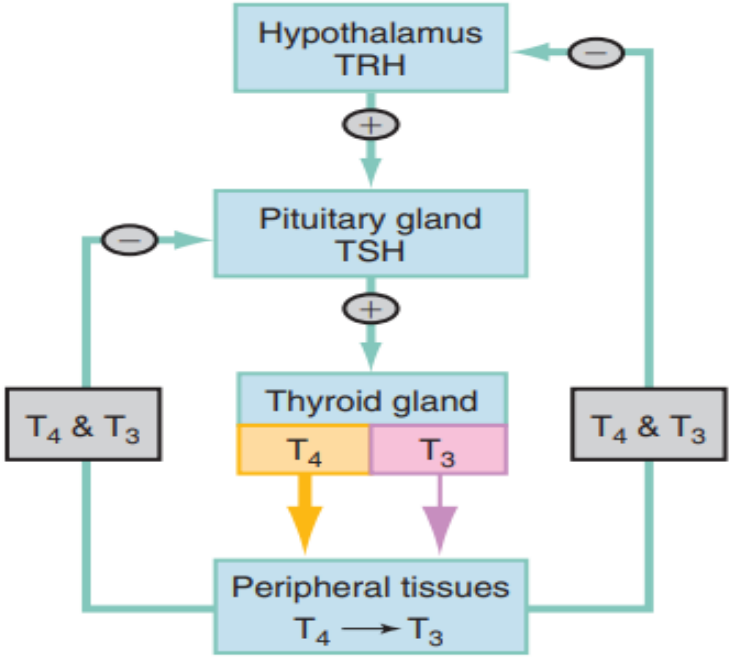
- Increases one's basal metabolic rate.
- Increases protein synthesis and functions together with other hormones necessary for normal growth and development.
- Increases the expression and sensitivity of β-adrenergic receptors, dramatically increasing response to endogenous catecholamines.

Introduction

- Thyroid gland secrete two iodinated hormones, T3 and T4
- Only about 20% of circulating T3 is directly secreted by the thyroid.
- Remainder is produced by peripheral conversion of T4 to the more biologically active T3
- Thyroid is the only endocrine gland that stores large quantities of hormone, with enough for a 100-day supply

Thyroid hormone regulation- hypothalamic-pituitary-thyroid axis

- Regulated by a negative feedback loop.
- Low serum T4 and T3 stimulated the hypothalamus to release TRH.
- TRH stimulates the anterior pituitary gland's release of TSH from its thyrotroph cells.
- TSH then binds to epithelial cells on the thyroid gland, stimulating follicular cells to synthesize and secrete T4 and T3



Thyroid Function test interpretation

TSH	Free T4	Free T3	Disease
Normal	Normal	Normal	None
Low	High	High	Hyperthyroidism
Low	Normal	Normal	Subclinical Hyperthyroidism
Low	Normal	High	T3 toxicosis
Low	High	Normal	Thyroiditis, T4 Ingestion,
Low	Low	Low	Central hypothyroidism
High	Normal	Normal	Subclinical hypothyroidism

Myxedema Coma

- Very rare condition
- Severe hypothyroidism leading to decreased mental status, hypothermia, and other symptoms related to slowing of function in multiple organs.
- It’s a medical emergency with a high mortality rate.
- Early recognition and therapy of myxedema coma are essential.

compensated hypothyroidism (organs working)

- Fatigue
- Depression
- Cold tolerance
- Hoarseness

decompensated hypothyroidism (organs failing)

- Delirium
- Hypothermia
- Bradycardia, shock
- Hypoglycemia

Physiologic stress, e.g.:

- Sepsis
- Cold exposure
- Surgery, Burns, Trauma
- Med nonadherence

Rather than thinking about "myxedema coma," we need to think about compensated vs. decompensated hypothyroidism.

The Internet Book of Critical Care, by @PulmCrit

Diagnostic clues for Myxedema coma

- Presence of a thyroidectomy scar
- History of radioiodine therapy or hypothyroidism.
- History of antecedent symptoms of thyroid dysfunction followed by progressive lethargy, stupor, and coma

Clinical features of myxedema

- Hypothermia
- Hypotension – refractory
- Hypoventilation
- Bradycardia
- AMS
- Edematous face
- Hyponatremia
- Hypoglyemia

Aggravating or precipitating factors in myxedema coma

- Myocardial infarction
- Infection
- Sepsis
- Stroke
- Pulmonary embolism
- Prolonged exposure to cold
- Exposure to drugs that suppress the central nervous system

Laboratory findings

- **TSH** – Low or high (central versus Primary respectively)
- **Free thyroxine (T4)** – Very Low
- **Cortisol** – Low in coexisting adrenal insufficiency

Management of Myxedema

- **AB:** Protect airway, ventilatory support; monitor for alkalosis

- **Fluid resuscitation:** 0.9 NS or D5/0.9 NS if hypoglycemia and Vasopressor support for hypotention

- **Thyroid hormone replacement:**
  - Administer levothyroxine 200 to 400 mcg intravenously, followed by daily doses of 50 to 100 mcg, and triiodothyronine 5 to 20 mcg intravenously, followed by 2.5 to 10 mcg every eight hours.*
  - Change to an appropriate oral dose of levothyroxine when the patient can tolerate oral medications. (Oral dose is approximately the intravenous dose divided by 0.75).

Management of Myxedema

- **Hyponatremia:**
  - Consider fluid restriction.
  - Avoid hypotonic fluids; use only 0.9 NS or D5/0.9 NS.
  - If <120 mEq/L, consider 3% saline, 50- to 100-mL boluses

- **Treatment of any precipitating illness:** Empiric antibiotics until negative cultures

- **Steroid:** IV 100mg Hydrocortisone every 8 hrs until exclusion of possible adrenal insufficiency

Management of Myxedema

- **Passive rewarming with regular blankets**
  - Active rewarming carries a risk of vasodilatation and worsening hypotension.

- Watch for unmasking of CHF;
  - Monitor for arrhythmias and treat when indicated

Thyroid Storm

- Rare form of thyrotoxicosis
- 100% mortality without treatment
- Caused by overproduction and increased circulation of thyroid hormone
- Hypermetabolic condition that results from elevated levels of thyroid hormones
- Very septic patient not improving on antibiotics

Causes of Thyrotoxicosis

- **Graves' disease:** Most common cause!
- **Toxic multinodular goiter**: second most common cause
- **Toxic adenoma:** A single hyperfunctioning nodule within the thyroid
- **Thyroiditis:** Trauma, Drug-induced (commonly amiodarone/lithium), Infectious thyroiditis (bacterial or fungal or viral), Autoimmune (including silent thyroiditis), Postpartum thyroiditis, Subclinical thyroiditis, Factitious thyroiditis (ingestion of excess thyroxine)

Thyroid storm

- More often it is an **acute reaction to thyroid or nonthyroid surgery, trauma, infection, iodine load (contrast media or amiodarone), or parturition in patients with preexisting hyperthyroidism**.

- Other precipitants include **acute myocardial infarction**, **pulmonary embolism, hyperemesis, toxemia of pregnancy, and diabetic ketoacidosis**.

Typical clinical manifestations of thyroid storm

- Marked pyrexia (104°−106°F [40°−41°C]),
- Extreme tachycardia (often out of proportion to the level of fever),
- Altered mental status (agitation, delirium, or coma).

Diagnosis of thyroid storm - Burch criteria

- **FAT PIG**
  - Fever
  - Altered LOC (mental status)
  - Tachycardia
  - Precipitating event
  - Increased CO (high output CHF)
  - GI / hepatic symptoms

CRITERIA	SCORE[a]
FEVER (°F)	
99–99.9	5
100–100.9	10
101–101.9	15
102–102.9	20
103–103.9	25
≥104	30
TACHYCARDIA (beats/min)	
90–109	5
110–119	10
120.129	15
130–139	20
≥140	25
MENTAL STATUS	
Normal	0
Mild agitation Delirium, psychosis	10
Extreme lethargy	20
Coma, seizures	30
CONGESTIVE HEART FAILURE	
Absent	0
Mild (edema)	5
Moderate (rales)	10
Pulmonary edema	15
Atrial fibrillation	10
GASTROINTESTINAL AND HEPATIC SYMPTOMS	
None	0
Nausea, vomiting Diarrhea, abdominal pain	10
Unexplained jaundice	20
PRECIPITATING EVENT	
None	0
Present	10

Interpretation of Burch criteria

45 or more: Highly suggestive of thyroid storm.

25-44: Supports diagnosis of thyroid storm or impending storm

<25: Thyroid storm unlikely

Diagnosis

Presence of **severe and life-threatening symptoms (hyperpyrexia, cardiovascular dysfunction, altered mentation)** in a patient with **biochemical evidence of hyperthyroidism** (elevation of free T4 and/or T3 and suppression of TSH).

Work up

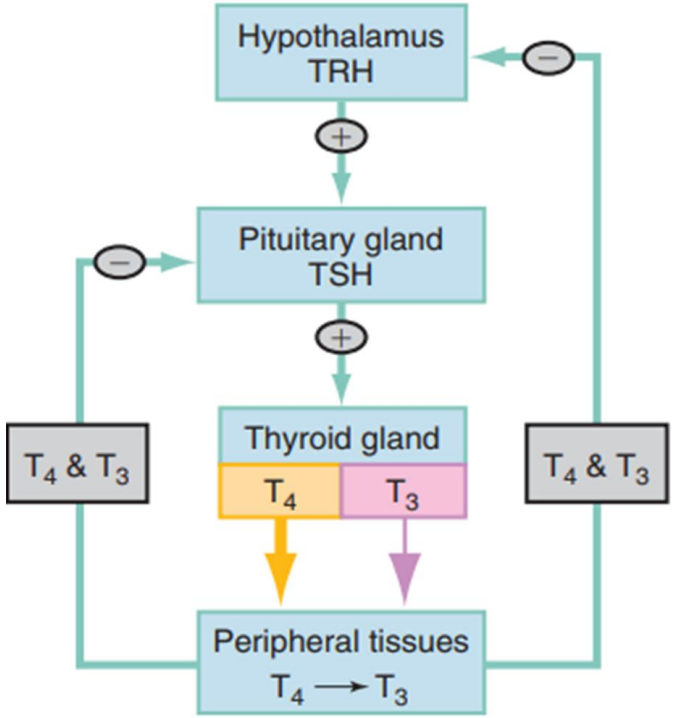
- Glucose, electrolytes including Ca/Mg/Phos.
- Liver function tests.
- CBC.
- Coagulation studies (thyroid storm can cause DIC).
- Creatinine kinase (thyroid storm can cause rhabdomyolysis).
- Blood cultures & infectious workup as indicated (e.g., chest X-ray, possibly CT scan).

Treatment of thyroid storm

- **Step 1: Supportive care**
  - ABCs
  - Antibiotics (given other entities on Ddx)*
  - Benzos (for agitation)
  - Cooling / warming (acetaminophen)
  - Dexamethasone / steroids
  - Fluids / electrolyte replacement
  - Glucose

Treatment of thyroid storm

- **Step 2: Beta-blockade**
  - Propranolol 60mg PO q6hrs
  - Propranolol 1mg IV q15min PRN
- **Step 3: Inhibition of T3 & T4 Production**
  - Propylthiouracil (PTU) 600mg PO/NG/PR q6hrs
  - Methimazole 30mg PO/NG/PR q6hrs



Treatment of thyroid storm

- **Step 4: Inhibition of T3 & T4 release**
  - Potassium iodide 1-2 drops PO/NG/PR q6hrs OR
  - Lugol's solution 5 gtt PO/NG/PR q6hrs OR
  - Lithium 300mg PO/NG q6hrs (only if allergy to iodine/amio/contrast)
  - NOTE: must delay 1 hr post step 2 so as not to allow solution to act as substrate for more T3/T4 production
- **Step 5: Inhibition of peripheral T4 to T3 conversion**
  - Hydrocortisone 300 mg IV x 1 then
  - Hydrocortisone 100mg IV q8hrs
  - Note: PTU and propranolol also do this

Disposition

Pitfalls

- Maintain a high index of suspicion for thyroid storm, as this will **commonly *mimic*** other conditions (e.g. psychosis, meningitis, hyperthermia, sepsis, cardiogenic shock).

- **Avoid salicylates or NSAIDs**, as these may bind to thyroid-binding globulin, causing increased levels of free thyroid hormone levels

Pitfalls

- **Be cautious with beta-blockers**, because some patients have thyrotoxicosis-induced cardiomyopathy and distributive shock. Aggressive beta-blockade may cause hemodynamic collapse in this situation, because the tachycardia is a *compensatory* response.

- Avoid administration of iodine (including iodinated contrast dye) until first giving methimazole.

Thank you