Thyrotoxicosis: brace yourselves, thyroid storm is coming

Twitter/Instagram: @emboardbombs

Check out other guides and our podcasts at www.emboardbombs.com

Author: Blake Briggs

Introduction

Thyroid storm is rare but has a high mortality ranging from 10-30%. It is more commonly precipitated by an acute stress event such as surgery, trauma, infection, etc. Less commonly it is from untreated hyperthyroidism. This guide reviews the common causes, presentation, and diagnosis of thyroid storm, as well as the life-saving treatment needed in the ED.

Quick pathophysiology

Remember the simplified approach to hyperthyroidism and the 2 B's:
Increased Beta-adrenergic activity: tachycardia, palpitations, tremor, diaphoresis, heat intolerance, oligomenorrhea.
Increased Basal metabolic activity: weight loss with high appetite, diarrhea, polyuria, hyperglycemia, hypocholesterolemia, increased lipolysis.

Major causes of hyperthyroidism include:
1) Grave's Disease: most common cause worldwide. Autoimmune disease in which thyroid-stimulating immunoglobulin binds to the TSH receptor and stimulates it, leading to excess thyroid hormone production.
2) Toxic Multinodular Goiter: hyperactive nodules within the gland that release thyroid hormone.
3) Iodine-induced hyperthyroidism: rare. Iodine load from iodine-rich drugs like amiodarone or iodinated contrast.

Presentation

Hyperpyrexia: temperature is often >102 F.
Skin: erythematous, warm skin to touch, thinning of hair.
Eyes: only Grave's has ophthalmopathy causing exophthalmos. Inflammation of extraocular muscles and connective tissue results in proptosis and impaired eye function due to edema. Lid lag on exam.
Neck: goiter only in Grave's.
Cardio: tachycardia with wide pulse pressure. Heart rate often exceeds 140 in >60% of patients. Atrial fibrillation can be found in ~20% of patients.
Pulm: tachypnea.
Neuro/Psych: agitation, restlessness, emotional lability, sometimes if severe enough, psychosis. High association with mortality (very similar to excited delirium).

Diagnosis

Note: these sick patients required a large differential and generous workup. See our handout on delirium for mnemonic and diagnostic approach!

All patients with overt hyperthyroidism will have some clinical constellation of symptoms and low TSH.
Serum TSH cannot determine the cause or degree of hyperthyroidism.
High free T4 and/or T3, however they are no higher than in patients with just simple hyperthyroidism.

There are no validated, clinical tools available to assist in diagnosis. A high index of suspicion in patients is needed in those with fever, tachycardia, and psychological symptoms, especially in those with a history of other endocrine/autoimmune disorders.

Determining cause will likely not occur in the ED, although most commonly the cause is Grave's. Radioiodine uptake and/or thyrotropin receptor antibody measurement should be performed but this will occur in the ICU. This should never delay treatment.

Treatment

Should be without delay and in a distinct order as outlined below.

1)	Control unstable beta-adrenergic symptoms	Beta-blockers
2)	Stop hormone release	Thionamides
3)	Stop new hormone production	Iodine
4)	Reduce inflammatory burden	Glucocorticoids

Step 1 Beta-blockade

Propranolol 60-80 mg orally every 6 hours or IV 1 mg every 1-2 hours as needed
Propranolol has added benefit of reducing T3 levels by inhibiting Type 1 deiodinase.
Why propranolol? It is for sure the correct answer on boards, but it doesn't have to be in real life. In cardiac patients or those with asthma/COPD, B1-selectivity and titratability would be more preferred. Esmolol, metoprolol, diltiazem can be used. In fact, esmolol is best suited for IV form due to rapid titration and minimizing adverse effects and quick on/off.

Step 2 Thionamides

-Propylthiouracil 200 mg every 4 hours
-Methimazole 20 mg every 6 hours

PTU is favored as it has peripheral blockage of conversion from T4 to T3. However, there is no difference in mortality or morbidity in patients receiving either drug.
Thionamides start working in ~1-2 hours.
Methimazole is preferred for less severe hyperthyroidism due to less frequent dosing and overall it is less hepatotoxic. Methimazole should be used once discharge approaches because it is less dosing.

Unfortunately, both thionamides are only in PO form. So, either the patient is able to tolerate oral intake (debatable if it's true Thyroid Storm), or intubated with an NG/OG tube.

Side effects: agranulocytosis, hepatotoxicity, but these are complications that occur much later in the patient's care and are not typically observed in the ED.

Step 3 Iodine
KI 5 drops PO every six hours or Lugol's solution, 10 drops every eight hours
It should be given 1 HOUR after thionamide dose to prevent it from being used as substrate.
A large bolus of iodine inhibits further T4 and T3 production in the thyroid (Wolff-Chaikoff effect), preventing the production of new hormone for ~5-7 days. Works within a few hours.

Step 4 Glucocorticoids
IV Hydrocortisone 100 mg every 8 hours.
Glucocorticoids reduce T4-to-T3 conversion and possibly reduce the autoimmune process in Graves' disease.
They should not be given in hyperthyroidism absent of storm.

Other critical supportive care measures
-Acetaminophen for fever
-Aggressively look for infection, empiric antibiotic coverage is not a bad call.
-Early intubation for control of airway and proper administration of medications.
-In those with Grave's disease, radioactive iodine or thyroidectomy should be performed when clinically stable, within 5-7 days.
-Rate control for A fib (via B-blockers). A fib automatically converts in 60% patients if hyperthyroid is treated. These patients still need anticoagulation.

References: for a complete list of references, check out our website under this topic heading.