Thyroid Storm

Thyroid storm is a life-threatening, hypermetabolic physiologic state that results as a complication of hyperthyroidism. While the exact pathophysiology is unknown, it is thought to be caused by a combination of decrease in thyroid-binding proteins, rapid increase in free hormone, and decrease in ability to physiologically compensate. It presents with altered mental status, fevers above 103 degrees, diarrhea, and tachycardia that may lead to fatal tachyarrhythmias. Treatment involves propranolol to control heart rate, and cooling blankets and acetaminophen for hyperpyrexia. Thionamides such as PTU are given to block new hormone synthesis, and iodine is given at least one hour after PTU administration to block the release of preformed hormone.

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Symptoms

Diarrhea
Toilet
Patients are in a hypermetabolic state, causing gastrointestinal symptoms such as abdominal pain, cramping, and diarrhea.

Liver Failure
Dead Liver
Thyroid storm can lead to liver failure, although the mechanism is multifactorial. The pathophysiology is thought to involve ischemic damage to hepatocytes as their metabolic activity increases beyond their blood supply. Clinically, this may manifest as jaundice and increased liver function tests late in the course of disease.

Insulin Resistance
Insect-syringe swatted by Resistance
The increased catecholamines present during thyroid storm leads to a hypermetabolic state consisting of increased glycogenolysis, insulin resistance, and increased insulin breakdown. Insulin resistance prevents the utilization of glucose and can therefore lead to ketoacidosis

Tachycardia
Tac-heart-card
Thyroid hormone has sympathomimetic and adrenergic effects due to structural similarity to catecholamines, as well as direct cardiotoxic effects. Thyroid hormone has multiple effects on cardiac tissue, including decrease in diastolic blood pressure and systemic vascular resistance with concurrent increase in cardiac output and heart rate. These effects cause tachycardia with a widened pulse pressure, which may lead to life-threatening dysrhythmias such as atrial fibrillation. Persistently increased cardiac output in this setting may also lead to high-output heart failure.

Lid lag
Eye-lid Lagging
Also known as von Graefe sign, lid lag is described as persistent elevation of the upper eyelid in a downward gaze. On clinical exam, patients will show an abnormal amount of upper eye sclera when instructed to look downwards.

Change in LOC (Altered Mental Status)
Delta Halo
Patients in thyroid storm may develop a range of mental status alterations, including anxiety, agitation, and confusion that can progress to stupor and coma in severe cases. Patients often present in a delirious, confused, or psychotic state. Altered mental status is a key element in differentiating compensated thyrotoxicosis from thyroid storm.

High fever
High Fever-beaver
Hyperpyrexia is often present, with fevers ranging from 103 to 106 degrees.

Treatment

Propranolol (Or Esmolol)

Propane-lolly

Immediate treatment with beta-blockers is crucial to control heart rate by blocking beta-adrenergic effects. Propranolol is most commonly used as it can be given intravenously, along with esmolol, which is another quick-acting IV beta-blocker. Other beta-blockers are occasionally used as they are safer, although less effective. In patients who cannot receive beta-blockers due to reactive airway disease, calcium channel blockers may be substituted.

PTU (Thionamides) Initially

Propeller-Thigh plane

Rapid treatment with a thionamide, such as PTU or methimazole, is necessary to block de novo thyroid hormone synthesis, which occurs within several hours of administration. PTU is the recommended agent as it additionally blocks the peripheral conversion of T4 to T3, and may lower serum T3 concentrations more rapidly than methimazole. Rarely, thionamides can have severe side effects such as agranulocytosis and hepatotoxicity.

Iodine Solution (Lugol Iodine)

Iodine-bottle

Iodine in the form of potassium iodine (Lugol's iodine) or saturated solution of potassium iodide (SSKI) is given to block the release of T3 and T4 from the thyroid gland. Importantly, iodine must not be given until at least one hour after administration of a thionamide. If given before the thionamide has taken effect, iodine can be used as a substrate for new hormone synthesis, and may worsen symptoms.

Glucocorticoids

Glue-quarter-on-steroids

Glucocorticoids are used to further decrease the conversion of T4 to T3. Additionally, they may help suppress the underlying autoimmune process if present, and alleviate situations in which there is relative adrenal insufficiency.

Cooling Blanket

Cool Blanket

Cooling blankets should be used to treat hyperpyrexia in initial stabilization.