

HYPERTHYROIDISM

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Authors:	Dhaval Rana, DO, Bryan Perez, MD, Children's Hospital of Philadelphia, Philadelphia, PA

Question:

A 16-year-old girl is in the recovery room following an MRI of the brain for exophthalmos. She develops severe agitation, anxiety, sweating, and tremors. Vital signs include BP 150/70, HR 140, and Temp 38.4 °C. An EKG shows sinus tachycardia with occasional PACs. A venous blood gas shows pH 7.36, PCO₂ 44, PO₂ 40, HCO₃ 22 with normal lactate. Which of the following medications should be administered FIRST?

- A. Midazolam
- B. Dantrolene
- C. Propranolol
- D. Phenoxybenzamine

Key Points

- Hyperthyroidism is a hypermetabolic condition that can impact multiple organ systems, including the cardiovascular, gastrointestinal, neurological, and ocular systems.
- Graves' disease is the most common cause of hyperthyroidism, especially in children, with thyroiditis and other factors also contributing.
- A thyroid storm is a severe complication requiring immediate medical attention.

Pathophysiology

- Hyperthyroidism is a result of an overactive thyroid gland, leading to excess thyroid hormone production and a hypermetabolic state. Symptoms include hyperthermia, diaphoresis, thinning hair, nail changes, tachycardia, increased cardiac output, widened pulse pressure, increased bowel movements, weight loss, muscle weakness, anxiety, restlessness, and neuropsychiatric symptoms.¹
- A thyroid storm is a life-threatening complication of hyperthyroidism, marked by a sudden rise in thyroid hormone levels. The resulting surge in free T3 and T4 levels may lead to severe hypermetabolic effects. It is often triggered by untreated hyperthyroidism and stressors like infection or surgery. This emergency requires immediate treatment.²

Diagnosis

- The diagnosis of hyperthyroidism requires a comprehensive clinical evaluation. Key laboratory tests show suppressed TSH and elevated free T4 and T3 levels. Elevated thyroid-stimulating immunoglobulin (TSI) and thyroid receptor antibodies (TRAb) confirm Graves' disease, while negative results warrant testing for thyroid peroxidase (TPO) and antithyroglobulin antibodies to rule out Hashimoto thyroiditis. Imaging studies, such as thyroid scintigraphy and ultrasound, can ensure an accurate diagnosis.¹
- Diagnosis of thyroid storm is typically through clinical assessment in the setting of a patient with known hyperthyroidism and an acute stressor.²

Table 1. Signs and Symptoms of Thyroid Storm²

Cardiovascular	Tachycardia, arrhythmias, high-output heart failure, widened pulse pressure, possible shock
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Neurological	Agitation, intense restlessness, anxiety, tremors, significant weakness, delirium, confusion, seizures, or coma
Gastrointestinal	Nausea, vomiting, diarrhea, abdominal pain, liver dysfunction
Thermoregulatory	Hyperpyrexia (>104°F or 40°C) and profuse sweating

Management

- The management of hyperthyroidism in children follows a structured approach to control hormone levels and manage symptoms. First-line treatment typically involves antithyroid medications like methimazole, preferred for its effectiveness and lower risk of hepatotoxicity. Beta-blockers, such as propranolol, are used to relieve symptoms like tachycardia and tremors.¹ If hyperthyroidism persists after a few months of treatment with antithyroid therapy, or there is a high risk of relapse, options like radioactive iodine therapy or thyroidectomy may be considered.
- Laboratory studies should confirm a euthyroid state before proceeding with elective surgery. In acute situations like thyroid storm, immediate treatment involves high dose antithyroid medications, beta-blockers, glucocorticoids, fluid resuscitation, and electrolyte correction, along with addressing underlying triggers and providing supportive care.²

Table 2. Treatment Strategies for Hyperthyroidism^{2,3}

Drug Type and Name	Mechanism of Action
Antithyroid	
Propylthiouracil (PTU)*	Prevents T ₃ /T ₄ production in the thyroid gland; Blocks T ₄ to T ₃ conversion
Methimazole	Prevents production of thyroid hormone
Iodides	
Lugol solution	Blocks release of stored thyroid hormone from gland
Glucocorticoids	
Dexamethasone Hydrocortisone, Prednisone	Blocks conversion of T ₄ to T ₃
Beta-blockers	
Propranolol, Atenolol, Esmolol	Reduces symptoms of catecholamine response, blocks T ₄ to T ₃ conversion

*Black Box Warning: serious liver damage and sudden liver failure can occur in pediatric patients. It may be utilized in exceptional cases where other treatment options are unsuitable with close monitoring (baseline complete blood cell counts and liver tests)⁴

References

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Answer: C The patient's thyroid storm is likely caused by Graves' illness, which was previously misdiagnosed. Beta-blockers are the first-line treatment for thyroid storm because they quickly reduce hyperadrenergic symptoms from high thyroid hormones. Midazolam is unsuitable since the patient's agitation is caused by a thyroid storm, while dantrolene is used to treat malignant hyperthermia and neuro malignant syndrome. Phenoxybenzamine, a nonselective irreversible alpha-blocker, is suggested for pheochromocytoma to treat catecholamine-induced hypertension but not thyroid storm.

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