

Chapter 50

Approach to Hyperthyroidism in the ICU



50.1 Introduction

Hyperthyroidism in the ICU is a complex and potentially life-threatening condition, particularly in patients experiencing severe thyroid hormone excess, such as in thyroid storm. Early diagnosis and appropriate management are crucial to stabilizing the patient and mitigating risks associated with thyrotoxicosis, including cardiovascular, neurological, and metabolic complications. This chapter provides a detailed approach to managing hyperthyroidism in critically ill patients, emphasizing the assessment of severity, rapid symptom control, and addressing underlying etiologies [1, 2]. [Ref: Algorithm 50.1].

50.2 Order Laboratory Tests (TSH, Free T4, Free T3)

- **Rationale:** Confirming hyperthyroidism with thyroid function tests is the initial step in evaluation. Suppressed TSH with elevated free T4 and T3 levels typically indicates hyperthyroidism.
- **Subclinical Hyperthyroidism:** For ICU patients, particularly the elderly, subclinical hyperthyroidism (low TSH with normal T4 and T3) may be relevant. This condition can progress to overt hyperthyroidism or lead to complications like atrial fibrillation and osteoporosis. Treatment may be warranted in patients with TSH <0.1 mIU/L, especially if symptomatic or at risk.

Tests and Interpretation:

- **TSH:** Low or undetectable in hyperthyroidism.
- **Free T4 and T3:** Elevated in overt hyperthyroidism; normal in subclinical cases.

50.3 Assess for Life-Threatening Symptoms

- **Rationale:** Identifying life-threatening symptoms is critical in the ICU because patients with severe hyperthyroidism or a full-blown thyroid storm can rapidly deteriorate. Thyroid storm is an acute, life-threatening exacerbation of hyperthyroidism marked by a high metabolic state, which places enormous stress on the cardiovascular, neurological, and thermoregulatory systems. Early recognition allows for timely, aggressive intervention to stabilize the patient and prevent multi-organ failure.

Key Symptoms: Classic signs of thyroid storm include:

- **Tachycardia:** Often severe, with heart rates that may exceed 140 bpm. This reflects high adrenergic activity and increased cardiac output demands, which can lead to arrhythmias, including atrial fibrillation, and high-output heart failure.
- **Hyperthermia:** Fever is often above 38.5 °C (101.3 °F) and can reach up to 40 °C (104 °F) or higher in severe cases, due to increased metabolic rate and heat production.
- **Altered Mental Status:** Symptoms range from agitation and delirium to severe confusion, seizures, and even coma. These neurological signs are due to both hyperthermia and the direct effects of excessive thyroid hormone on the brain.
- **Arrhythmias:** Common in thyroid storm and can include atrial fibrillation, which significantly increases the risk of thromboembolic events, especially stroke.

Other Signs: Diaphoresis, vomiting, diarrhea, and jaundice may also occur, often exacerbating dehydration and electrolyte imbalance, which can further destabilize the patient.

Management Decision:

- **Aggressive Intervention:** If life-threatening symptoms are present, immediate intensive therapy is needed to control symptoms and prevent progression to multi-organ failure. Treatment should not be delayed for confirmatory testing if clinical signs strongly indicate a thyroid storm.
- **Symptomatic Management:** For patients with hyperthyroidism but without life-threatening signs, management can focus on controlling symptoms (e.g., with beta-blockers) while confirming the diagnosis and assessing for underlying causes [3].

50.3.1 *If Life-Threatening Symptoms Are Present*

- **Administer Beta-Blockers (e.g., IV Propranolol or Esmolol)**
 - **Purpose:** Beta-blockers provide rapid control of tachycardia and reduce cardiac output, essential in managing the adrenergic symptoms of thyroid storm. They block the effects of excess thyroid hormone on the cardiovascular system, improving tachycardia, anxiety, and tremor.

- Choice of Beta-Blocker:
- Propranolol: Preferred for its added benefit of partially inhibits peripheral conversion of T4 to T3, which can help lower the overall hormone activity.
- Esmolol: Often used in patients with contraindications to propranolol or where tighter control is needed due to its ultra-short half-life, allowing for rapid titration.
- Caution: Careful monitoring is necessary, as beta-blockers can lead to hypotension or bradycardia, particularly in elderly or volume-depleted patients. It's crucial to titrate the dose based on heart rate and blood pressure response.
- **Start Antithyroid Drugs (ATDs)**
 - Preferred Drug: Propylthiouracil (PTU) is often the first choice in thyroid storm due to its dual action—blocking both central thyroid hormone synthesis and peripheral T4 to T3 conversion. This additional inhibition of T3 production is particularly valuable in severe cases.
 - Alternative: Methimazole is used if PTU is unavailable. Methimazole is potent and effective in lowering hormone synthesis but lacks PTU's action on peripheral conversion.
 - Considerations: Liver function monitoring is essential because PTU, and to a lesser extent methimazole, can cause hepatotoxicity. Baseline liver function tests are recommended prior to initiation, with careful observation for any signs of hepatic impairment during treatment [4].
- **Administer Iodine Post-ATDs**
 - Example: Potassium iodide is administered after ATDs to inhibit the release of stored thyroid hormones from the thyroid gland, a phenomenon known as the Wolff-Chaikoff effect.
 - Timing: Iodine should only be given after ATDs are initiated to prevent paradoxical stimulation of hormone release. This step helps quickly reduce circulating thyroid hormone levels, providing further stabilization.
- **Add Glucocorticoids (e.g., IV Hydrocortisone or Dexamethasone)**
 - Purpose: Glucocorticoids block peripheral conversion of T4 to T3, reducing the active form of thyroid hormone. They also provide essential support in patients with adrenal insufficiency, which may coexist due to prolonged hyperthyroidism.
 - Dosing and Route: Use intravenous glucocorticoids for immediate effect. Hydrocortisone is commonly chosen due to its dual glucocorticoid and mineralocorticoid effects. Doses are adjusted based on the patient's clinical response, and ongoing assessment is needed to avoid potential adrenal suppression.

50.3.2 Administer Beta-Blockers for Symptomatic Relief (If No Life-Threatening Symptoms)

- Purpose: For patients who do not meet the criteria for thyroid storm but still have symptomatic hyperthyroidism, beta-blockers offer relief from cardiovascular symptoms like tachycardia and reduce the overall adrenergic tone, helping manage tremors and anxiety.
- Choice of Drug and Route:
- IV Propranolol or Esmolol is often used initially to ensure rapid symptom control. Once stabilized, patients can be transitioned to oral beta-blockers, maintaining adequate heart rate control over time.

50.4 Assess for Significant Symptoms or High Burch-Wartofsky Score

The Burch-Wartofsky Point Scale (BWPS) is a clinical scoring system used to assess the likelihood and severity of a thyroid storm. A thyroid storm is an extreme, life-threatening manifestation of thyrotoxicosis, and the BWPS helps clinicians to differentiate between severe hyperthyroidism and true thyroid storm, guiding treatment decisions. Developed by Dr. Henry B. Burch and Dr. Leonard E. Wartofsky, the scale assigns point values based on specific clinical parameters, each reflecting the severity of thyroid hormone excess across various physiological systems.

Components of the BWPS

The BWPS considers six major categories, each with varying points assigned depending on severity:

1. Thermoregulatory Dysfunction (Temperature)

- Fever is a hallmark of thyroid storm due to increased metabolic activity.
- Points are assigned based on the degree of hyperthermia, as follows:
- 37.2–37.7 °C (99–99.9 °F): 5 points
- 37.8–38.2 °C (100–100.7 °F): 10 points
- 38.3–38.8 °C (100.8–101.8 °F): 15 points
- 38.9–39.4 °C (102–102.9 °F): 20 points
- 39.4–39.9 °C (103–103.9 °F): 25 points
- ≥40 °C (104 °F or higher): 30 points.

2. Central Nervous System Effects (CNS)

- Thyroid storm can lead to significant neuropsychiatric symptoms due to heightened adrenergic response and metabolic activity.
- Points for CNS symptoms:
- Mild agitation: 10 points.

- Moderate delirium, psychosis, or extreme lethargy: 20 points.
- Seizures or coma: 30 points.

3. Gastrointestinal and Hepatic Dysfunction

- Gastrointestinal and hepatic symptoms occur due to increased metabolic demands, dehydration, and hepatocellular stress.
- Points for symptoms:
- Mild symptoms (nausea, vomiting, diarrhea, or abdominal pain): 10 points.
- Moderate to severe symptoms (jaundice, severe nausea, vomiting, or diarrhea): 20 points.

4. Cardiovascular Dysfunction

- Cardiovascular instability, marked by tachycardia and arrhythmias, is common in thyroid storm.
- Points for heart rate:
- Tachycardia (99–109 bpm): 5 points.
- Moderate tachycardia (110–119 bpm): 10 points.
- Significant tachycardia (120–129 bpm): 15 points.
- Severe tachycardia (≥ 130 bpm): 20 points.
- Additionally:
- Presence of atrial fibrillation: 10 points.
- Congestive heart failure (CHF): 10 points.

5. Congestive Heart Failure (CHF)

- Often a direct result of high cardiac output, which can exceed cardiac reserves and lead to left ventricular dysfunction.
- Points for CHF:
- Mild CHF (rales only): 10 points.
- Moderate CHF (rales and peripheral edema): 15 points.
- Severe CHF (pulmonary edema): 20 points.

6. Precipitating Event

- Recognizing any underlying or precipitating factor is important, as these can exacerbate hyperthyroidism or trigger thyroid storm.
- Precipitating event (e.g., infection, surgery, trauma, withdrawal of antithyroid drugs): 10 points.

Interpreting the BWPS Score

- Scores >45 : Indicative of a high likelihood of thyroid storm. Aggressive intervention is recommended with supportive care, antithyroid drugs, and glucocorticoids.
- Scores 25–44: Suggest impending thyroid storm or severe hyperthyroidism. Close monitoring is advised, with preparations for escalation if symptoms worsen.

- Scores <25: Unlikely to be a thyroid storm. These cases might be managed as severe hyperthyroidism without the full intensive interventions required for thyroid storm.

Utility of BWPS

The BWPS provides a standardized approach to assess thyroid storm, helping guide the urgency and intensity of treatment. By focusing on the most common symptoms of thyroid storm across multiple systems (CNS, cardiovascular, thermoregulatory), the BWPS allows clinicians to identify critical instability early. However, clinical judgment remains crucial, as BWPS is an adjunctive tool rather than a definitive diagnostic criterion.

50.4.1 If Significant Symptoms or High Score Are Absent

- Identify and Confirm Hyperthyroidism Etiology.

Purpose: Differentiating between Graves' disease, toxic multinodular goiter, and thyroiditis aids in selecting appropriate treatment.

- Tests and Markers: Consider TSH receptor antibodies (TRAb) to confirm Graves' disease, especially when etiology is unclear. TRAb testing is also valuable during pregnancy and in assessing relapse risk after ATD therapy.
- Thyroid Imaging Recommendations.

Use Ultrasound: Ultrasound can help evaluate thyroid morphology, identify nodules, and distinguish Graves' disease from nodular goiters. A thyroid scan may also help assess nodules' functional status.

Indications: Nodules or goiters suspected on physical exam, or when malignancy cannot be excluded.

50.5 Track TSH, Free T4, Free T3, and Adjust Therapy as Needed

- Purpose: Regular monitoring is essential to evaluate treatment efficacy and adjust ATDs and beta-blockers as required.
- Considerations: Avoid overtreatment to prevent hypothyroidism. Monitor both lab results and clinical symptoms to fine-tune therapy.

Additional Management Considerations

1. Management of Graves' Orbitopathy

- Guidelines: For patients with Graves' orbitopathy, avoid radioactive iodine (RAI) in active orbitopathy due to the risk of exacerbation. If RAI is necessary, prophylactic glucocorticoids are recommended for patients with mild-to-moderate orbitopathy to minimize inflammation.

2. Monitoring and Side Effects of Antithyroid Drugs (ATDs)

- **ATD Monitoring:** Obtain baseline liver function and complete blood count before starting PTU or methimazole. Monitor for adverse reactions, such as agranulocytosis and hepatotoxicity. Advise patients to report symptoms like fever or sore throat immediately, as these may indicate agranulocytosis.

3. Radioactive Iodine Therapy (RAI)

- **Indications and Preparation:** RAI is effective for toxic adenomas and multinodular goiter. Stop ATDs before RAI to enhance uptake, conduct pregnancy testing in women of reproductive age, and carefully select RAI doses based on the patient's clinical status and thyroid uptake studies.

4. Considerations for Thyroidectomy

- **Preoperative Preparation:** Beta-blockade, euthyroid status (using ATDs), and iodine (Lugol's solution or potassium iodide) administration reduce thyroid vascularity, aiding surgical outcomes. Thyroidectomy may be preferred in cases of large goiters, obstructive symptoms, or in patients unresponsive to RAI.

5. Management of Hyperthyroid Emergencies (Thyroid Storm)

- **Protocol:** In thyroid storm, rapidly administer high-dose beta-blockers, ATDs, and glucocorticoids. Supportive care includes aggressive cooling, electrolyte management, and monitoring for organ dysfunction. Quick, coordinated action is critical to mitigate this life-threatening condition.

6. Follow-Up and Long-Term Management

- **Guidance:** For patients post-treatment with RAI or thyroidectomy, regular TSH and free T4 monitoring is crucial to detect hypothyroidism or recurrent hyperthyroidism early. Long-term follow-up ensures timely adjustment of therapy and addresses complications.

7. Special Considerations in Pregnancy

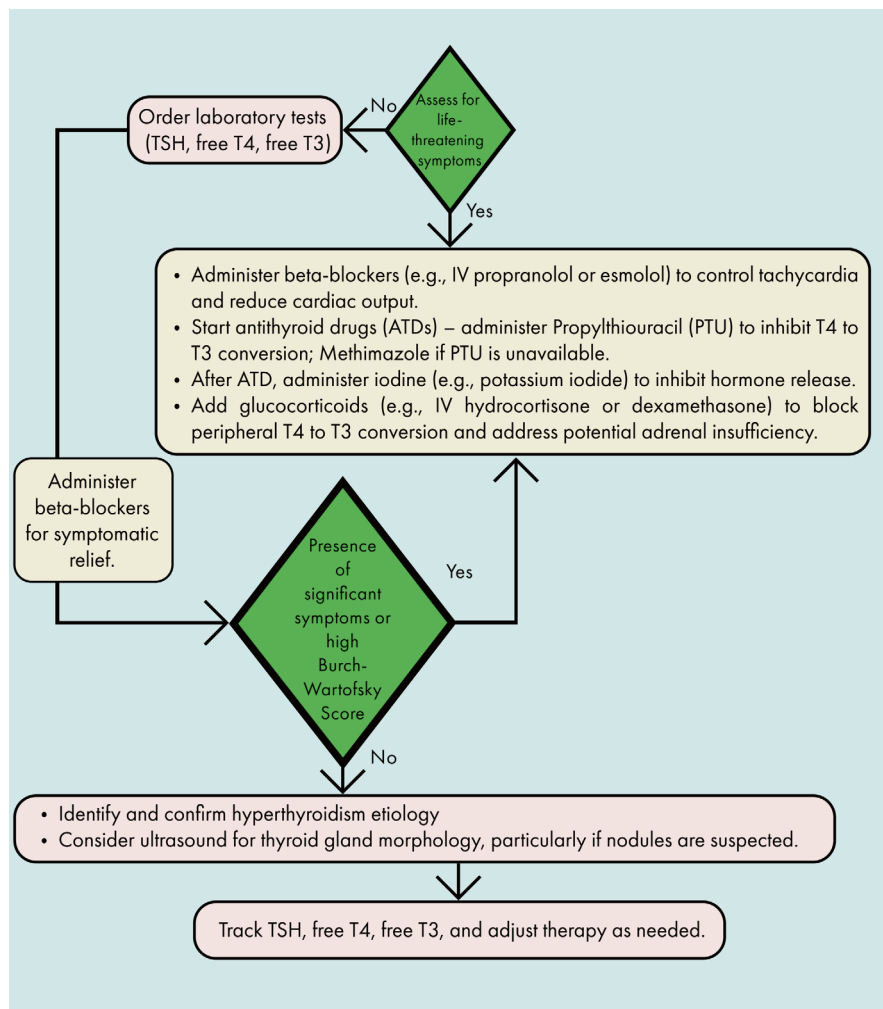
- **Management:** PTU is the preferred ATD during the first trimester due to lower teratogenic risk. Switch to methimazole after the first trimester if continued ATD therapy is required. Monitor thyroid function and TRAb levels closely to manage maternal and fetal risks effectively.

50.6 Conclusion

Effective management of hyperthyroidism in the ICU requires a structured approach that prioritizes rapid assessment, appropriate therapy initiation, and continuous monitoring. Identifying the etiology and considering specific patient factors, such as

pregnancy or orbitopathy, enables tailored treatment. Regular follow-up with TSH, free T4, and free T3 measurements ensures optimal control, preventing complications and improving outcomes for ICU patients.

Algorithm 50.1: Approach to hyperthyroidism in the ICU



Bibliography

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