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Case Report

Thyroid storm in a refractory hyperthyroid patient: A case report

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ABSTRACT

Thyroid storm is a rare and life-threatening endocrinological emergency characterized by severe manifestations of thyrotoxicosis and multi-organ involvement. Prompt recognition and early intervention are paramount to reduce the high morbidity and mortality rates associated with this condition. A 45-year-old woman with a history of Graves' disease presented with high-grade fever, marked tachycardia, confusion, and persistent vomiting. This case report explores a unique presentation of thyroid storm in a hyperthyroid patient refractory to conventional treatment. The report integrates insights from key reviews and guidelines to present a cohesive approach to optimal care.

Keywords: Graves' disease, hyperthyroidism, multidisciplinary care, plasmapheresis, thyroid storm.

Thyroid storm is a rare but critical medical emergency arising from severe thyrotoxicosis. Characterized by exaggerated metabolic activity and multi-organ dysfunction, it requires immediate recognition and intervention to prevent fatal outcomes. While hyperthyroidism is relatively common, thyroid storm represents its most severe form, with a prevalence of 1-2% among hospitalized thyrotoxic patients.[1,2] This condition often arises due to a precipitating event such as infection, surgery, or trauma in patients with poorly managed hyperthyroidism.

Diagnosis remains challenging due to the absence of a specific laboratory marker; it relies heavily on clinical scoring systems such as the Burch-Wartofsky Point Scale (BWPS) and the diagnostic criteria established by the Japan Thyroid Association.[2,3] Current management strategies focus on addressing the precipitating factor, inhibiting thyroid hormone synthesis and release, and mitigating peripheral effects.[1,2] In severe cases, alternative therapies like plasmapheresis or thyroidectomy may be considered.[3,4]

This report presents the case of a refractory thyroid storm, integrating insights from recent clinical guidelines and systematic reviews. It aims to provide a comprehensive perspective on the pathophysiology, diagnosis, and evidence-based management of this critical condition. The discussion emphasizes the importance of a multidisciplinary approach, particularly in cases complicated by systemic triggers or patient non-compliance, and highlights emerging trends in therapeutic strategies.[1-8]

CASE REPORT

A 45-year-old female with a known history of Graves' disease presented to the emergency department with fever (40.1°C), severe tachycardia (heart rate: 145 bpm), confusion, and recurrent vomiting. Her symptoms had developed over three days following an upper respiratory tract infection, supported by elevated inflammatory markers including leukocytosis (WBC: 15,200/µL; reference: 4,000-11,000/µL) and an increased

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C-reactive protein (CRP: 12.4 mg/dL; reference: <0.5 mg/dL). The patient reported non-compliance with her prescribed antithyroid medication due to side effects, a common issue among hyperthyroid patients.[1] Her past medical history included multiple hospitalizations for thyrotoxicosis, further complicating her clinical course. Written informed consent was obtained from the patient.

Initial laboratory evaluation revealed suppressed thyroid-stimulating hormone (TSH) levels (<0.01 mIU/L; reference: 0.4-4.0 mIU/L), markedly elevated free T4 (>6.0 ng/dL; reference: 0.8-1.8 ng/dL), and mild hyperbilirubinemia (total bilirubin: 2.1 mg/dL; reference: 0.2-1.2 mg/dL), consistent with hepatic dysfunction. Liver enzymes were mildly elevated, including AST at 78 U/L (reference: <40 U/L), ALT at 85 U/L (reference: <41 U/L), and ALP at 160 U/L (reference: 44-147 U/L). Electrocardiography demonstrated atrial fibrillation with rapid ventricular response. These findings, in conjunction with clinical criteria, confirmed the diagnosis of thyroid storm as defined by the Burch-Wartofsky Point Scale (BWPS) and Japan Thyroid Association guidelines.[2,3]

Management commenced with aggressive resuscitation, including intravenous fluids, cooling measures, and oxygen therapy. Beta-blockers were cautiously administered to control her HR while avoiding precipitating cardiac failure. She received thionamides (propylthiouracil), iodine to block hormone release, and hydrocortisone to inhibit peripheral conversion of T4 to T3.[1,2,4] Broad-spectrum antibiotics were initiated to address the underlying infection, a common trigger of thyroid storm.

Despite initial improvement, the patient's condition deteriorated due to persistent thyrotoxicosis and worsening hepatic dysfunction. Multidisciplinary consultation led to the initiation of plasmapheresis, which provided rapid symptomatic relief by removing circulating thyroid hormones.[3] This case underscores the complexity of managing refractory thyroid storm, requiring tailored interventions and vigilant monitoring to prevent fatal complications.[2,4]

DISCUSSION

Thyroid storm represents an extreme and rare progression of poorly managed or untreated thyrotoxicosis, with an estimated mortality rate ranging from eight to 25% in severe cases. It is often precipitated by systemic stressors such as infections, trauma, or surgical interventions. The condition is characterized by multi-system decompensation involving cardiovascular, hepatic, and neurological dysfunction, largely due to the excessive release of thyroid hormones and an amplified tissue responsiveness to catecholamines. This exaggerated hypermetabolic state underscores the importance of early recognition and prompt treatment to mitigate its life-threatening consequences. The pathophysiology of thyroid storm involves several interconnected mechanisms. Excess thyroid hormone levels directly enhance basal metabolic rate and tissue oxygen consumption. Additionally, thyroid hormones amplify the sensitivity of beta-adrenergic receptors to catecholamines, precipitating severe tachycardia, hyperthermia, and hemodynamic instability. This pathophysiological cascade often leads to complications such as arrhythmias, congestive heart failure, and hepatic dysfunction, all hallmarks of advanced thyroid storm. Studies emphasize the critical role of catecholamine overdrive in exacerbating this crisis, particularly in patients with pre-existing cardiac conditions.[2,4]

Diagnosis remains a clinical challenge due to the lack of a definitive laboratory test. Clinicians rely heavily on scoring systems such as the BWPS, which incorporates clinical features like fever, tachycardia, gastrointestinal distress, and neurological impairment. This scoring system provides a structured framework for identifying thyroid storm in emergency settings. While biochemical markers such as suppressed TSH and elevated free T4/T3 levels support the diagnosis, these findings alone cannot differentiate thyroid storm from uncomplicated thyrotoxicosis.[2,3] Clinical judgment is therefore paramount, particularly in patients with coexisting conditions that may obscure classic symptoms.

The cornerstone of thyroid storm management involves three primary goals:

reducing thyroid hormone synthesis, mitigating peripheral effects, and addressing the underlying precipitating factor. Standard treatment protocols recommend the use of thionamides, such as propylthiouracil or methimazole, to inhibit thyroid hormone synthesis. Beta-blockers, such as propranolol, are administered to control the cardiovascular effects of excessive catecholamines. Corticosteroids, like hydrocortisone, play a dual role by reducing thyroid hormone conversion and managing systemic inflammation. Iodine is introduced as a delayed intervention to block thyroid hormone release after initial thionamide administration, ensuring maximum efficacy.[1,2] These therapies work synergistically to stabilize the patient and prevent further escalation of symptoms.

Refractory cases, where conventional therapy fails, pose significant management challenges. Advanced interventions, including plasmapheresis and thyroidectomy, are considered for these patients. Plasmapheresis is particularly effective in rapidly reducing circulating thyroid hormones, providing a critical bridge to definitive therapy in unstable patients. A recent review highlights the success of plasmapheresis in managing severe thyroid storm, particularly in patients with coexisting hepatic or renal dysfunction, where conventional therapies may exacerbate systemic instability.[3,4] Thyroidectomy, although rarely performed during an acute storm, remains an option for patients unresponsive to medical therapy or those with contraindications to radioactive iodine.[3]

Unique challenges arise when managing thyroid storm in specific populations. Pediatric patients, for example, often present with atypical symptoms such as irritability and growth disturbances, complicating timely diagnosis. A systematic review on pediatric thyroid storm underscores the importance of adapting adult treatment protocols to this demographic, particularly in ensuring appropriate dosing and monitoring.[5] Similarly, pregnant patients represent a high-risk group due to the dual need to protect maternal and fetal health. Treatment regimens must balance the risk of fetal hypothyroidism from antithyroid drugs with the potential maternal complications of inadequate therapy. Recent evidence highlights the importance of multidisciplinary care in achieving favorable outcomes in such cases.[6]

Emerging therapeutic strategies hold promise for addressing the limitations of current treatments. Novel agents targeting thyroid hormone receptors or autoimmune pathways, such as TSH receptor antibodies, offer potential avenues for reducing disease severity and recurrence. Long-term management is equally critical to prevent relapses, particularly in patients with a history of refractory thyrotoxicosis. Maintenance strategies often include low-dose antithyroid therapy or definitive treatment through radioactive iodine or surgery, tailored to individual risk profiles and patient preferences.[4,7]

This case also highlights the essential role of emergency clinicians in identifying and managing thyroid storm. A comprehensive understanding of its clinical presentation and evidence-based management is critical for improving outcomes. Emergency physicians must remain vigilant for atypical presentations and ensure rapid stabilization while coordinating care with endocrinology and critical care teams.[7,8] The integration of established guidelines with emerging therapies underscores the need for continued research and collaboration to address the complex challenges posed by this rare but critical condition.[1-8]

In conclusion, thyroid storm is a critical endocrine emergency that requires rapid recognition and immediate treatment to prevent life-threatening outcomes. The complex interplay of systemic stressors, excessive thyroid hormone activity, and heightened catecholamine sensitivity creates an unstable clinical scenario that necessitates a structured, multidisciplinary approach. This case highlights the diagnostic and therapeutic challenges of managing refractory hyperthyroidism and underscores the importance of early recognition using clinical scoring systems. While standard therapies such as thionamides, beta-blockers, corticosteroids, and iodine remain the foundation of treatment, advanced interventions like plasmapheresis can be lifesaving in severe

or complicated cases. Close collaboration among emergency medicine, endocrinology, and critical care teams is essential for optimal outcomes, and ongoing research into emerging targeted therapies offers promise for more individualized management in the future.

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