



## CHRONOS AND CRISIS: THE DANGERS OF DELAYED TREATMENT IN THYROID STORM : A CASE SERIES

### Endocrinology

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### ABSTRACT

Thyroid storm, a critical and life-threatening exacerbation of hyperthyroidism, has a high mortality rate ranging from 8-25%, despite advancements in treatment. Incidence of 0.57 to 0.76 cases per 100,000 annually in the general population and 4.8 to 5.6 cases per 100,000 per year in hospitalized patients. This retrospective case series investigates patients diagnosed with thyroid storm at a tertiary care hospital over five years, focusing on cases with treatment delays exceeding 12 hours. Common triggers included infection, trauma, and abrupt discontinuation of antithyroid medications. The analysis revealed an average diagnostic delay of 18 hours, leading to severe complications such as acute respiratory distress syndrome (ARDS), cardiac arrhythmias, and prolonged ICU stays. One patient succumbed to multi-organ failure. These findings highlight the critical need for rapid diagnosis and prompt treatment initiation to mitigate severe outcomes and reduce the high morbidity and mortality associated with thyroid storm. Enhanced clinical awareness and timely intervention are imperative for improving patient prognosis.

### KEYWORDS

Thyrotoxicosis, Hyperthyroidism, Heart Failure, Dye Induced.

### INTRODUCTION

Thyroid storm, or thyrotoxic crisis, is a severe and life-threatening complication of hyperthyroidism, presenting with sudden involvement of multiple body systems. Despite modern treatments, its mortality rate is estimated at 8 to 25%<sup>1</sup>. In the US, it occurs at rates of 0.57 to 0.76 cases per 100,000 annually in the general population, and 4.8 to 5.6 cases per 100,000 per year in hospitalized patients.<sup>2</sup>

Thyroid storm, often linked to Graves disease and other hyperthyroid conditions, can be prompted by factors like sudden discontinuation of antithyroid drugs, thyroid or non-thyroid surgeries, trauma, acute illnesses including Covid-19 and diabetic ketoacidosis, and medication side effects such as those from amiodarone, anesthetics, and salicylates. Other triggers encompass parturition, recent use of iodinated contrast medium, radioiodine therapy, burns, stroke or traumatic brain injury, and hyperemesis gravidarum during pregnancy.<sup>3,4,5,6,7</sup>

Pathophysiologically, the exact trigger for thyroid storm in hyperthyroid patients is unclear. However, precipitating factors such as rapid hormonal surges post-surgery or drug cessation are implicated. Increased sympathetic nervous system activity and heightened cellular response to thyroid hormone during stress or infections may contribute.<sup>3,8</sup> Clinical manifestations involve exaggerated metabolic activity, leading to tachycardia, heart failure, arrhythmias, and CNS symptoms such as irritability, seizures, and coma.

### Burch-Wartofsky Point Scale (BWPS)<sup>3</sup>

In 1993, BWPS scoring system for the diagnosis of thyroid storm was introduced, different variables in the scale are as following

- Temperature: 5 points per 1 F above 99 F (maximum 30 points)
- CNS dysfunction: 10 points for mild (agitation), 20 for severe (delirium, psychosis, or extreme lethargy), and 30 for severe (seizure or coma)
- Tachycardia: 5 (99-109), 10 (110 -119), 15 (120 -129), 20 (130 -139) and 25 (greater than 140)
- Presence of atrial fibrillation: 10
- Heart failure: 5 for mild (pedal edema), 10 for moderate (bi-basilar rales), 15 for severe (pulmonary edema)
- GI dysfunction: 10 for moderate (diarrhea, nausea/vomiting, or abdominal pain) and 20 for severe (unexplained jaundice)
- Presence of Precipitating factor: 10 points

Diagnosis: A total score of more than 45 is highly suggestive of thyroid storm, 25 to 44 supports the diagnosis, and less than 25 makes the

diagnosis unlikely.

Scoring systems serve as general guidelines, but clinical judgment remains paramount in diagnosing thyroid storm. Chest X-ray aids in evaluating heart failure, while head CT can rule out neurological causes in some cases. ECG is commonly used to monitor arrhythmias.

Treatment for thyroid storm comprises supportive measures such as IV fluids, oxygen, cooling blankets, and acetaminophen, alongside addressing any precipitating factors like infection. Patients require intensive care unit admission with close cardiac monitoring and potential ventilatory support. Specific treatment steps involve controlling increased adrenergic tone with beta-blockers, reducing thyroid hormone synthesis using thionamide, decreasing thyroid hormone release with iodine solution, blocking peripheral conversion of T4 to T3 with iodinated radiocontrast agent, glucocorticoid, PTU, or propranolol, and reducing enterohepatic recycling of thyroid hormone with bile acid sequestrants.<sup>1,9,10</sup>

### MATERIAL AND METHODS

This is a case series of 6 patients diagnosed of Thyroid storm. Demographic details, comorbidities, clinical features, treatment were noted down after obtaining consent from the patients.

### RESULTS

Case 1: A 68-year-old female presented to the emergency department with a complaint of loose motions persisting for four months, associated with weight loss. According to the patient's relatives, she had been experiencing breathlessness for the past two days, accompanied by lethargy and incomprehensible speech.



**Figure 1 Show Mid Line Neck Swelling Suggestive Of Thyroid Swelling**



**Figure 2 Xray Of Same Patient Show Mid Line Large Thyroid Swelling, Cardiomegaly And Left Lower Zone Haziness Suggestive Of Heart Failure**

On examination, her pulse was 114/min, blood pressure was 80/50 mmHg, and patient was afebrile, Jugular venous pressure was elevated. Icterus and neck swelling were present. The CNS examination revealed drowsiness and irrelevant speech, with a Glasgow Coma Scale score of E2V3M5. Cardiovascular examination showed tachycardia and the presence of a third heart sound (S3). Bilateral basal crepitations were noted on respiratory examination. Abdominal examination revealed a soft, nontender abdomen with no organomegaly.

Laboratory investigations showed a hemoglobin level of 7.6 g/dl, total leukocyte count of 5600/cumm, platelet count of 93000/cumm, and total bilirubin level of 3.8 mg/dl. Thyroid function tests revealed T3 levels of 12.2 pg/ml, T4 levels of >24.86 ng/dl, and a suppressed TSH level of <0.05 mU/L. Ultrasonography of the neck demonstrated a multinodular goiter.

An EKG showed sinus tachycardia, and a chest X-ray was obtained suggestive of midline thyroid enlargement, cardiomegaly and left lower zone haziness.

Based on these findings and a Burch-Wartofsky point scale score of 70, a diagnosis of multinodular goiter with thyroid storm was made. Symptomatic and supportive treatment was initiated, including beta-blockers, steroids, diuretics, and antithyroid drugs. The patient showed signs of improvement and was discharged after 12 days of hospitalization.

Case 2: A 37-year-old male presented to the outpatient department with a complaint of chronic loose motions persisting for one year, accompanied by weight loss. He had self-medicated with multiple over-the-counter medications. Additionally, he reported experiencing involuntary movements of the upper limbs for the past five months. The patient's attendant described restlessness and confusion. The patient had a past history of hyperthyroidism but had discontinued medication three months prior.

On examination, his pulse was 120/min, blood pressure 120/70 mmHg, and patient was febrile (101.5). Icterus was absent, but neck swelling was present. Neurological examination revealed confusion and restlessness. Cardiovascular examination showed tachycardia, while bilateral vesicular breath sounds were present on respiratory examination. Abdominal examination revealed a soft, nontender abdomen with no organomegaly.

Laboratory investigations showed a hemoglobin level of 12.9 g/dl, total leukocyte count of 4800/cumm, platelet count of 2.20 lac/cumm, and total bilirubin level of 0.3 mg/dl. Thyroid function tests revealed T3 levels of 7.4 pg/ml, T4 levels of >24.86 ng/dl, and a suppressed TSH level of <0.05 mU/L, along with elevated anti-thyroid peroxidase (anti-TPO) antibodies. Ultrasonography of the neck revealed thyroiditis with a colloidal nodule.

An ECG showed sinus tachycardia, while a chest X-ray showed no

abnormalities.

Based on these findings and a Burch-Wartofsky point scale score of 60, a diagnosis of autoimmune thyroiditis with thyroid storm (due to sudden discontinuation of medication) was made. Symptomatic and supportive treatment with beta-blockers and antithyroid drugs was initiated. The patient showed signs of improvement and was discharged after eight days of hospitalization.

Case no. 3: A 24-year-old male presented to the casualty with a complaint of chronic loose motions persisting for two months, accompanied by weight loss, despite visiting multiple hospitals. Investigations for suspected Koch abdomen, including stool examination, colonoscopy, and contrast-enhanced computed tomography (CECT) abdomen, yielded normal results. He also reported fever for the past two days.



**Figure 3 Grave's Exophthalmos**

On examination, his pulse was 126/min, blood pressure 102/70 mmHg, and temperature was 102.6°F. Icterus and exophthalmos were present, but no neck swelling was noted. Neurological examination revealed consciousness with orientation to time, place, and person, albeit slight agitation. Cardiovascular examination showed tachycardia, while bilateral vesicular breath sounds were present on respiratory examination. Abdominal examination doesn't revealed any abnormality.

Laboratory investigations showed a hemoglobin level of 13.5 g/dl, total leukocyte count of 6700/cumm, platelet count of 1.01 lac/cumm, and total bilirubin level of 5.1 mg/dl. Thyroid function tests revealed T3 levels of 11.63 pg/ml, T4 levels of >24.86 ng/dl, and a suppressed TSH level of <0.05 mU/L. Ultrasonography of the bilateral cervical region revealed lymphadenopathy.

An ECG showed sinus tachycardia, while a chest X-ray showed no abnormalities.

Based on these findings and a Burch-Wartofsky point scale score of 65, a diagnosis of Graves' thyroiditis with thyroid storm was made. Symptomatic and supportive treatment with beta-blockers, steroids, and antithyroid drugs was initiated. The patient showed signs of improvement and was discharged after seven days of hospitalization.

Case no. 4: A 67-year-old male presented to the outpatient department with complaints of loose motion and fever persisting for two months, accompanied by weight loss. Despite taking multiple over-the-counter medications, his condition did not improve. Additionally, he reported palpitations over the past few days.

On examination, he had a pulse rate of 117/min, low blood pressure 90/50 mmHg, and a temperature of 101.2°F. A neck swelling was noted. His central nervous system was intact, albeit he appeared agitated and restless. Cardiovascular examination revealed tachycardia, while bilateral vesicular breath sounds were appreciated on respiratory examination. Abdominal examination was unremarkable.

Laboratory investigations revealed normal hemoglobin levels,

leukocyte count, and platelet count. However, his thyroid function tests indicated thyrotoxicosis with suppressed TSH levels and elevated T3 and T4 levels, along with positive anti-thyroid peroxidase antibodies suggestive of thyroiditis. Ultrasound of the neck suggestive of thyroiditis.

ECG showed sinus tachycardia, and chest X-ray was normal.

Based on the Burch-Wartofsky point scale Score of 55, a diagnosis of thyroiditis with thyroid storm was made. Symptomatic and supportive treatment was initiated, including beta-blockers and antithyroid drugs, leading to improvement in his condition. He was discharged after five days of hospitalization.

Case no5: A 62-year-old female, who underwent coronary angiography a week ago for acute coronary syndrome, was hospitalized with multiple complaints. She presented with loose stools (8 to 10 episodes/day), frequent vomiting, and nausea persisting for 4 days. Additionally, she reported fever, difficulty in breathing for 2 days, palpitations, and tachycardia.



Figure 4 Mid Line Neck Swelling Suggestive Of Thyroid Swelling

On examination, her blood pressure was elevated at 160/90 mmHg, pulse rate was 120/min, temperature was 100°F, respiratory rate was 30 per min and jugular venous pressure was elevated. A midline diffuse neck swelling was noted, which was soft in consistency, moved with deglutition, and had a nodular surface with defined margins and increased local temperature. No thyroid bruit was detected. CNS examination revealed restlessness but no focal neurological deficits. Cardiovascular examination showed S3 present without murmurs, while bilateral basal crepitations were appreciated on respiratory examination. Abdominal examination was unremarkable.

Laboratory investigations revealed elevated levels of total T3 (3.14 ng/ml), total T4 (24.86 mcg/dl), and suppressed TSH (<0.05 microIU/mL), indicative of thyrotoxicosis. Ultrasound of the neck showed multinodular goiter and bilateral cervical lymphadenopathy. Additionally, total bilirubin levels were elevated.

ECG show ST depression in II, III, aVF and chest X-ray revealed bilateral lower zone haziness.



Figure 5 Chest X-ray Revealed Bilateral Lower Zone Haziness.

Table 1

Case number	Thermoregulation dysfunction	Cardiovascular			Gastro-hepatic dysfunction	CNS disturbance manifestation	Precipitant history	Total
		Tachycardia	Atrial fibrillation	Congestive heart failure				
Case 1	0	10	0	20	20	20	0	70
Case 2	15	15	0	0	10	20	0	60
Case 3	20	15	0	0	20	10	0	65
Case 4	15	10	0	0	10	20	0	55
Case 5	10	15	0	10	20	10	10	75
Case 6	0	15	10	0	10	10	10	55

Table 2

Case number	Hemoglobin (gm/dl)	Total leucocyte count (/cumm)	Platelet count (lac/cumm)	Total bilirubin (gm/dl)	Total T3 (pg/ml)	Total T4 (ng/dl)	TSH (mU/L)	USG NECK
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Based on the Burch-Wartofsky point scale Score of 75, a diagnosis of Multinodular Goiter with Thyroid storm(Iodine Dye Induced) was made. Symptomatic and supportive treatment was initiated, including beta-blockers and antithyroid drugs, leading to improvement in her condition. She was discharged after nine days of hospitalization

Case 6: A 70-year-old male sought medical attention at the Medicine OPD due to loose motion,persistent hiccups and palpitations lasting for 2 weeks. Despite undergoing multiple consultations and trying various medications such as PPI, prokinetic, baclofen, and anti-anxiety drugs, his symptoms remained unresolved. Past history of fever 15 days back

On examination revealed an irregularly irregular pulse of 120 bpm (atrial fibrillation) and blood pressure of 110/70 mmHg, with no evidence of thyromegaly. Neurological examination showed fine tremors without any focal neurological deficits. Cardiovascular examination showed irregular heart sounds, while bilateral vesicular breath sounds were appreciated on respiratory examination. Abdominal examination was unremarkable.

Further investigations revealed abnormal thyroid profile with elevated Total T3 (3.54 ng/ml), Total T4 (24.33 ug/dl), suppressed TSH (<0.001 uIU/ml), and positive Thyroid-Stimulating Hormone Receptor Antibody (TSHR-Ab) (20.63 IU/L). Neck ultrasound with color Doppler indicated mildly enlarged thyroid lobes with increased parenchymal vascularity.

Cardiac investigations showed atrial fibrillation with a fast ventricular response on ECG, while 2D Echo was normal.

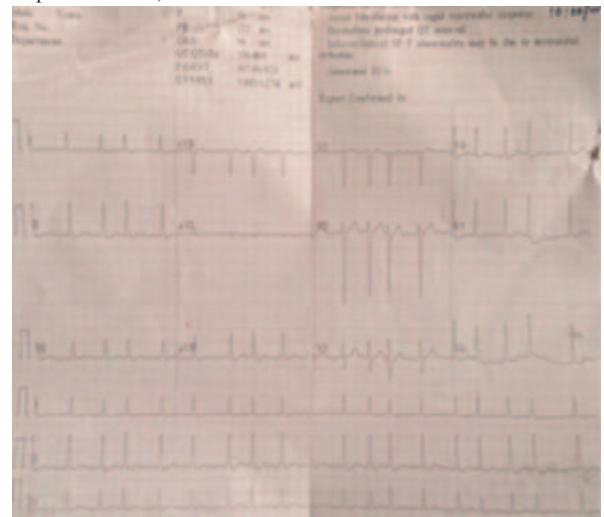


Figure 6 ECG Showing Atrial fibrillation

Based on the Burch-Wartofsky point scale Score of 55, a diagnosis of Multinodular Goiter with Thyroid storm(Iodine Dye Induced) was made. Symptomatic and supportive treatment was initiated, including beta-blockers and antithyroid drugs, leading to improvement in his condition. He was discharged after seven days of hospitalization

Burch-Wartofsky Point Scale (BWPS) of all patients shown in table 1

Investigation of all patients shown in table 2

Case 1	7.6	5600	0.93	3.8	12.2	>24.86	<0.05	Multinodular Goiter
Case 2	12.9	4800	2.2	0.3	7.4	>24.86	<0.05	Thyroiditis with colloid nodule
Case 3	13.5	6700	1.01	5.1	11.63	>24.86	<0.05	Bilateral cervical lymphadenopathy
Case 4	12.2	7800	1.51	0.4	8.31	>24.86	<0.05	Thyroiditis
Case 5	9.5	10300	2.54	3.0	5.18	19.40	<0.05	Multinodular goiter with bilateral cervical lymphadenopathy
Case 6	10.6	5900	1.96	0.8	3.54	24.33	0.001	mildly enlarged thyroid lobes with increased parenchymal vascularity.

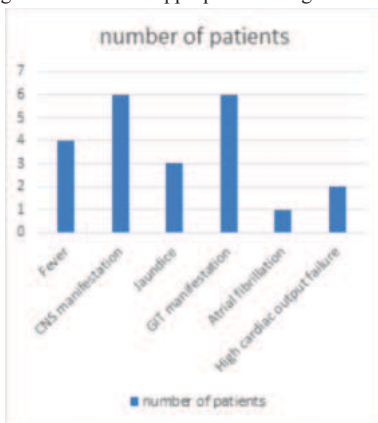
**DISCUSSION**

Thyroid storm is a rare but critical manifestation of hyperthyroidism, characterized by an acute exacerbation of symptoms and potentially life-threatening complications. The cases presented in this series offer valuable insights into the diverse clinical presentations and management challenges associated with thyroid storm.

In our series, Case 1 was admitted with heart failure and neck swelling, which were attributed to thyroid storm, a severe manifestation of hyperthyroidism characterized by an acute exacerbation of symptoms. Case 2 developed thyroid storm due to self-discontinuation of medication, highlighting the critical importance of adherence to treatment regimens in managing thyroid disorders. In Case 3, the patient visited multiple hospitals with symptoms mimicking Koch abdomen, leading to a delay in the diagnosis of hyperthyroidism until thyroid storm ensued. Case 4 presented to the emergency department after initially treating fever and loose stool at home, only to be diagnosed with thyroid storm later, underscoring the need for prompt medical evaluation in cases of suspected hyperthyroidism. Case 5 experienced thyroid storm following iodine dye injection during investigation for coronary angiography due to palpitations, emphasizing the potential risks associated with medical procedures in patients with underlying thyroid disorders. Lastly, Case 6 exhibited a rare presentation of thyroid storm with persistent hiccups, highlighting the diverse clinical manifestations of this condition and the challenges it poses in diagnosis and management.

One of the key takeaways from these cases is the importance of maintaining a high index of suspicion for thyroid storm, especially in patients with a history of hyperthyroidism or those presenting with symptoms suggestive of thyroid dysfunction. Prompt recognition and initiation of treatment are essential to prevent the progression to severe complications such as cardiovascular collapse or organ failure and can reduced mortality significantly.

Furthermore, the cases illustrate the diagnostic dilemmas often encountered in the evaluation of thyroid storm. While classic symptoms such as fever, tachycardia, and CNS manifestations may be present (various complication given in figure 9), atypical presentations or confounding factors can complicate the diagnostic process. Clinicians must carefully interpret clinical findings and laboratory results in the context of individual patient characteristics to make an accurate diagnosis and initiate appropriate management.



**Figure 7 Bar Diagram Show Complication Of Thyroid Storm In Our Patients**

Collaboration between multidisciplinary teams, including endocrinologists, emergency physicians, and specialists in critical care, is paramount in the effective management of thyroid storm. Each case may require a tailored approach based on the patient's clinical presentation, underlying comorbidities, and response to initial

interventions.

Finally, these cases underscore the importance of patient education and follow-up in the long-term management of hyperthyroidism. Patients should be educated about the warning signs of thyroid storm and instructed to seek immediate medical attention if they experience any concerning symptoms. Additionally, regular monitoring and optimization of thyroid function are essential to prevent recurrence and ensure optimal outcomes.

**CONCLUSION**

Thyroid storm represents a complex and potentially life-threatening medical emergency. Through the examination of diverse clinical cases, clinicians can gain valuable insights into the recognition, diagnosis, and management of this challenging condition, ultimately improving patient outcomes and reducing the risk of complications.

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