

## Thyroid storm: Report of four cases in two health institutions, Barranquilla

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### Abstract

Thyroid storm or thyrotoxic crisis is a life-threatening condition, characterized by signs and symptoms of thyrotoxicosis associated with multiorgan dysfunction, occurs as a complication of hyperthyroidism and due to its high risk of mortality, merits timely diagnosis and early treatment. Among the main causes of thyroid storm is Graves' Basedow's disease, which is associated with triggering factors such as non-adherence to medical therapy. The diagnosis is based on clinical manifestations and increased thyroid hormones, but thyroid hormone levels are not related to the severity of the condition, so sensitive scoring systems have been developed to support the diagnostic approach. In this review, we analyze a series of patients with thyroid storm in which half of the patients have a fatal outcome, demonstrating the association with high mortality.

**Keywords:** Thyroid Storm; Thyrotoxic Crisis; Hyperthyroidism; Graves' Disease.

### 1. Introduction

Thyrotoxicosis refers to the clinical manifestations of excess thyroid hormones in peripheral tissues, regardless of the source. When excess thyroid hormones occur due to increased synthesis and secretion of thyroid hormones by the thyroid gland, it is called hyperthyroidism (1). The prevalence of this condition is approximately 0.2 – 1.4% (2). Failure to receive treatment can lead to a variety of manifestations and complications, the most feared being thyroid storm, also called thyrotoxic crisis, a potentially lethal condition, characterized by overstated manifestations of thyrotoxicosis accompanied by multiorgan dysfunction (1).

The initial diagnosis is clinical and can be confirmed with a variety of criteria; one of the most widely used score to establish the diagnosis of thyroid storm is the Burch and Wartofsky Point Scale (Table 1), which consists of a scoring system that is composed of different variables: temperature, central nervous system disturbance, tachycardia or atrial fibrillation, gastrointestinal manifestations, among others. It scores from 0 to 140 points. A score of 45 or more is highly suggestive of thyroid storm, between 25 and 44 points indicates imminent thyroid storm, and less than 25 suggests that the diagnosis is unlikely (3).

The incidence of thyroid storm varies between 0.20 and 0.76 per 100,000 people per year in the United States (1), and despite its low frequency, it affects 0.22% of patients with thyrotoxicosis (4) and, without an early diagnosis and appropriate treatment, it can lead to a fatal outcome. We present four cases of patients with thyroid storm, alongside manifestations in varying degrees of severity, where some patients responded favorably to early management with an adequate evolution while others had an adverse outcome.

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**Table 1** Diagnostic criteria, Burch and Wartofsky point scale

Criteria	Values	Score
Temperature (°C)	36.8–37.3	5
	37.4–37.8	10
	37.9–38.4	15
	38.5–38.9	20
	39–39.5	25
	> 39.6	30
Central nervous system disturbance	Agitation	10
	Delirium. lethargy	20
	Coma	30
Heart rate (beat/min)	99-109	5
	110-119	10
	120-129	15
	130-139	20
	> 140	25
Heart failure	Edemas	5
	Kerley Lines	10
	Acute pulmonary edema	15
	Atrial fibrillation	20
Digestive impairment	Diarrhea. nausea. vomiting. abdominal pain	10
	Jaundice	20
Precipitating factors		10
Diagnosis of thyrotoxic crisis: 45 points: highly suggestive; 25-44 points: possible; < 25 points: unlikely.		

## 2. Case Presentation

### 2.1. Case 1

A 42-year-old male patient, with a history of hyperthyroidism, probably due to Graves' Basedow's disease, who has been prescribed treatment with methimazole 5 mg orally daily and propranolol 40 mg orally daily, without treatment for a month, he is referred from endocrinology outpatient clinic due to a 3 days clinical picture with regular palpitations of insidious onset, occurring during rest, associated with oppressive chest pain of intensity 4/10 on the verbal numerical pain scale, intermittent, associated with nausea with emesis of food content on 3 occasions and fever at 38°C. Physical examination revealed tachypnea, an 168 beats/minute heart rate, 38°C temperature, goiter and distal fine tremor in the upper limbs.

Paraclinical exams showed a blood count with leukopenia, transaminases elevated to 2 times the age reference limit, and an electrocardiogram with sinus tachycardia. Diagnosis of thyroid storm was considered, on account of a high Burch-Wartofsky score of 55 points, later, suppressed TSH levels were confirmed, total T4 at 24.8 mcg/dL. He required monitoring and management in an intermediate care unit due to the risk of imminent arrhythmia, management with thionamides, glucocorticoids, beta blocker and cholestyramine. Subsequently, it showed clinical improvement and a 22% decrease in free T4 and free T3 levels, normalizing levels of leukocytes and transaminases, which is considered thyroid storm resolution. Discharge was decided with strict outpatient control with results of antithyroid antibodies and controlled thyroid function.

## 2.2. Case 2

A 26-year-old male patient with a history of hyperthyroidism secondary to Graves' Basedow's disease without treatment for a year; The patient was admitted to the emergency room (ER) due to a clinical picture of 6 days of evolution characterized by episodes of unquantified fever, accompanied by hemoptysis and general malaise. He referred unintentional weight loss in the last month, insomnia of conciliation and permanent regular palpitations during the last week. On physical examination, the patient had a heart rate of 105 beats/minute, presence of diffuse goiter, not painful on palpation, exophthalmos, fine tremor in the hands, tachypsychia, and agitation.

Admission paraclinical exams reported a blood count with mild leukocytosis, hypochromic normocytic anemia grade I according to WHO, a chest x-ray showing cavitation, and an electrocardiogram with sinus tachycardia. It's considered patient is undergoing imminent thyroid storm, with Burch Wartofsky of 30 points, therefore he is transferred to the intensive care unit; Propranolol 40 mg orally every 8 hours, methimazole 20 mg orally every 8 hours and potassium iodide saturated solution 5 drops every 8 hours were started with an indication to start potassium iodide 1 hour after methimazole.

Free T4 report showed a value of 7.77 mcg/dL, thyroglobulin 858.90 mg/ml, suppressed TSH, and simple chest tomography evidenced the presence of a consolidation in the right lung field with air bronchogram and tarnished glass pattern, so management with broad-spectrum intravenous antibiotic therapy was added. However, the patient presented an unfavorable clinical evolution that led to his death.

## 2.3. Case 3

A 47-year-old woman, with a history of vitiligo and hyperthyroidism due to Graves' Basedow's disease, who had discontinued treatment 4 months ago. She was admitted to the ER due to a clinical picture of 8 days of evolution of diffuse abdominal pain associated with distention, dyspnea of medium exertion and multiple episodes of diarrheal stools.

Physical examination revealed vital signs within the age range, exophthalmos, goiter, painful hepatomegaly, and lower limb stiff edema. The paraclinical report showed mild thrombocytopenia, WHO grade II anemia with preserved erythrocyte indices, severely suppressed TSH, electrocardiogram in sinus rhythm and total abdomen ultrasound that evidenced congestive liver disease with slight enlargement of the caudate lobe, ascites of 400 mm<sup>3</sup> and right pleural effusion of 700 mm<sup>3</sup>. The patient is considered to have thyroid storm with Burch Wartofsky of 45 points, associated with acute heart failure as complication.

He received management in the intensive care unit, beta-blockers to control symptoms secondary to increased adrenergic tone, and heart rate control, also methimazole for blockade of hormone synthesis and glucocorticoids were indicated. Subsequently, a transthoracic echocardiogram reported left ventricle of normal systolic dimensions, left ventricular ejection fraction (LVEF) preserved with 60%. Acute heart failure secondary to thyroid storm was considered, management was established presenting an adequate clinical response whereby medical discharge was indicated. Once stabilized, permanent management with iodine or ambulatory thyroidectomy would be evaluated.

## 2.4. Case 4

A 25-year-old male with a history of Down syndrome and chronic heart failure with preserved LVEF due to severe mitral and aortic regurgitation. He was admitted due to generalized tonic-clonic movements. Physical examination revealed diffuse, soft, non-painful goiter, blood pressure 150/100 mmHg, heart rate at 120 beats/minute. Paraclinical exams showed normocytic anemia WHO grade II, preserved renal function, thyroid function tests with suppressed TSH, free T4 above the reference threshold, and electrocardiogram with sinus tachycardia.

An imminent thyroid storm was considered with Burch Wartofsky 40 points, so management with corticosteroids, thionamides and cholestyramine was instituted, avoiding the use of beta blockers due to known cardiac alteration, transfer to the intensive care unit was indicated. Subsequently, the patient presented torpid evolution, severe hypotension with vasopressor requirement and complications that led to his death.

**Table 2** Paraclinics of Reported Cases

Paraclinics	Reference values	Cases			
		1	2	3	4
Leukocytes (mm <sup>3</sup> )	5 000–10 000	3 890	11 010	7 740	11 400
Hemoglobin (g/dL)	12.6–16	14	11.1	10.5	10.4
Hematocrit (%)	39.1–50	43	34.1	32.5	31.7
TSH (ng/dL)	0.27– 4.2	0.01	0.01	< 0.0083	< 0.0083
T4 libre (ng/dL)	0.93–1.7	7	7.77	> 5	4.2
Free T3 (pg/dL)	2– 4.4	32.55	29.04	> 20	-
AST (U/L)	0–41	38.5	-	28	-
ALT (U/L)	0–40	40.6	-	11	-

### 3. Discussion

The prevalence of hyperthyroidism, and especially Graves' disease, is higher in women (5). However, there is no evidence in the literature of a gender-specific prevalence of thyroid storm. In a multicenter, retrospective study conducted in France of 92 patients admitted to the intensive care unit with a diagnosis of thyroid storm, 58% were men (6), while in a retrospective study conducted in Pakistan that included 8 patients, 62% were women (7) and in an also retrospective study in Taiwan, 67% of thyroid storm cases were women (8). In the present series, 75% of the patients were men. Among the triggering conditions for the development of thyroid storm are interruption of pharmacological treatment of hyperthyroidism or non-adherence to medication, but also other conditions such as infectious diseases, surgical procedures, trauma, labor, exposure to exogenous iodine or the use of amiodarone can trigger it. However, between 24-43% of cases have no identifiable trigger (1). It should be noted that in 3 of the 4 cases described, the patients are not compliant with pharmacological treatment, while in the last case, the patient has no previous history of hyperthyroidism, but presents the first seizure episode without a specific cause, with the finding of a goiter and later evidence of an alteration in the thyroid profile.

Most patients admitted to the emergency department present typical manifestations of hyperthyroidism such as weight loss, distal tremor, tachycardia, goiter, diarrhea, and hyperreflexia (9), but they also may present exaggerated characteristics of thyrotoxicosis, fever, marked tachycardia, arrhythmias, heart failure, jaundice, and frequently altered state of consciousness (10). In this series, it was observed that 3 of the 4 patients had tachycardia, one of the patients had neurological impairment and another one had acute heart failure as a serious cardiovascular manifestation.

There are no specific laboratory tests that indicate the definitive diagnosis (9), and hormone levels do not reliably distinguish patients with thyroid storm from those with uncomplicated thyrotoxicosis (5, 6). Therefore, as mentioned above, the diagnosis is mainly clinical. For this reason, two scoring systems have been developed to identify patients who are likely to have thyroid storm (9). The most used is the Burch-Wartofsky Point Scale (Table 1), which is based on clinical manifestations (4). The other scoring system is that of the Japanese Thyroid Association, which, unlike the first, includes both clinical manifestations and thyroid biochemistry tests (2).

Of the four cases presented, two had a Burch-Wartofsky score greater or equal to 45, they received therapy early, and responded favorably, the other two had lower scores. Therefore, it is considered that, although these tools contribute to the identification of patients with thyroid storm and increase the diagnostic probability, they should not be used in isolation and clinical judgment should prevail. As mentioned above, this disease can show a wide range of manifestations and should be recognized early by the clinician to reduce the risk of fatal outcome.

Treating thyroid storm is based on reducing the synthesis and secretion of thyroid hormones, taking measures to reduce their peripheral action, treating systemic effects, and finally identifying and treating the triggering condition (11). This is why the treatment for thyroid storm includes drugs with different targets. Among the medications that are indicated there's antithyroid drugs, beta-blocker therapy, systemic glucocorticoids, iodine, and cholestyramine (12). Regarding antithyroid drugs, the evidence indicates that there is no statistical difference in mortality and adverse event outcomes between the use of methimazole versus propylthiouracil (13).

Of the beta-blockers, propranolol is the drug of choice because it is non-selective, reducing peripheral conversion of T4 to T3. However, its use in patients with ventricular dysfunction should be avoided, as it can trigger cardiogenic shock, especially in patients with reduced left ventricular ejection fraction. Therefore, reviews recommend assessment of cardiac function prior to beta-blocker administration when possible, considering that an estimated 6% to 19% of patients with thyroid storm have underlying cardiac dysfunction, with a mortality rate approaching 30% (4). In the case of the patient with history of chronic heart failure with valvular origin, the use of beta-blocker was avoided, and despite this, the patient has a fatal outcome. In some cases, alternative measures are used, with controversial evidence, such as the use of immunosuppressive therapy in patients with Graves' disease (14) or the use of plasmapheresis as a bridging therapy to thyroidectomy. However, these interventions are not available in all care facilities.

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#### 4. Conclusion

Thyroid storm is a rare but serious complication with a high mortality rate of a common pathology, hyperthyroidism. It can develop as a result of infectious diseases, trauma and, in particular, as assessed in these cases, the discontinuation of antithyroid medication. Diagnostic tools should be used correctly to avoid deleterious effects in patients with thyroid storm. Early diagnosis and timely, appropriate and aggressive treatment will have the greatest impact on mortality.

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#### Compliance with ethical standards

##### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

##### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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