

CASE REPORT

## Thyroid storm presenting as psychosis: masked by diabetic ketoacidosis

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**Introduction:** While extremely uncommon, diabetic ketoacidosis (DKA) and thyroid storm (TS) are endocrine emergencies that can coexist. We describe a case with a confounding clinical presentation that identifies these two emergencies within the setting of sepsis and influenza.

**Case:** A 69-year-old diabetic female was found by the paramedic staff to be disoriented. She demonstrated tachycardia and had a foul-smelling abdominal wound. Laboratory evaluation revealed DKA, leukocytosis, influenza B, and urinary tract infection. After appropriate management in the intensive care unit, the DKA resolved the following morning. However, the patient developed a fever, and her psychosis became more pronounced. Extensive analysis was performed but did not explain her mental status. The patient was found to have thyroid stimulating hormone of 0.06 mIU/mL, free T4 (thyroxine) of 2.38 ng/dL, and total T3 (triiodothyronine) of 72 ng/dL. Based on the Burch and Wartofsky criteria (score of 65), TS was diagnosed. Based on more recent diagnostic criteria suggested by Akamizu et al., the patient met criteria for TS grade 1. Within several hours of initiating treatment, the patient's mental state and tachycardia improved, and her psychosis resolved by the third day.

**Conclusion:** This case highlights the importance of recognizing the clinical diagnosis of TS, as the magnitude of thyroid hormone derangements may not correlate with clinical severity. While rare, DKA and TS can simultaneously occur and are associated with increased morbidity and mortality if not promptly recognized and treated.

**Keywords:** *thyroid storm; diabetic ketoacidosis; hyperthyroidism; thyrotoxicosis; diabetes mellitus*

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Thyroid storm (TS) is a life-threatening metabolic emergency that can cause significant dysfunction of multiple organ systems. The frequency of TS in the United States is not well defined but has been reported to be 0.2 cases per 100,000 individuals annually, occurring in less than 10% of patients hospitalized for thyrotoxicosis (1). If unrecognized and untreated, however, it can be associated with a mortality rate in the range of 10–25% (1, 2). It can develop in patients with chronic, untreated hyperthyroidism or may be precipitated by infection, surgery, trauma, iodine load, parturition, and/or non-adherence to antithyroid medications (1, 3). Diabetic ketoacidosis (DKA) and TS have been identified as coprecipitants, which can coexist (4, 5). We report the complex case of a female with known type 2 diabetes mellitus who presented with DKA, influenza B, and sepsis symptoms simultaneously, which made the diagnosis of TS a challenge.

Additionally, this was her first clinical manifestation of thyroid disease.

### Case description

A 69-year-old female, with a history of type 2 diabetes mellitus on insulin therapy, was brought to the hospital by emergency medical services due to encephalopathy. The patient also had a history of hypertension, hyperlipidemia, asthma, and panniculitis of the abdominal wall. She was post-surgery, which was complicated by a chronic non-healing abdominal wound. The patient, who at baseline was ambulatory and independent in activities of daily living, was found by her neighbors to be confused, agitated, and yelling incoherently. Upon arrival, paramedic staff found the patient to be disheveled and lying on the floor in a pool of her urine and feces. Upon physical examination, she was tachycardic, only oriented to self,

with a foul-smelling discharge emanating from her abdominal wound. Laboratory evaluation revealed the following readings: white cell count of  $12.6 \times 10^9$  cells/L, blood glucose level at 444 mg/dL, bicarbonate reading of 17 mmol/L, anion gap level of 17, positive ketones, pH of 7.26, and base excess of  $-8.3$ . She tested positive for influenza B, and urinalysis indicated urinary tract infection (UTI). The patient was admitted to the medical intensive care unit and initially managed with intravenous insulin infusion for DKA, broad-spectrum intravenous antibiotics (vancomycin and piperacillin/tazobactam) for UTI and the abdominal wound infection, and oseltamivir for influenza B. DKA resolved by the next morning, and the patient was transitioned to a subcutaneous insulin regimen.

On the second day of her hospitalization, the psychosis of the patient became more evident and was characterized by hallucinations, paranoia, incoherence, screaming, inappropriate laughter, and combativeness with the staff. That afternoon she had a fever (101.2°F) with worsening sinus tachycardia (and her heart rate was greater than 130 bpm). The symptoms the patient showed were attributed to delirium associated with sepsis and DKA. However, there was concern for a possible underlying central nervous system infection, and after a diagnostic lumbar puncture, the patient was empirically started on acyclovir. Cerebrospinal fluid studies, however, were not suggestive of infection. The patient was evaluated by multiple consultants for psychiatry, neurology, and infectious diseases. For symptomatic management, quetiapine and haloperidol were initiated, but she continued to manifest severe psychosis. Magnetic resonance imaging of the brain revealed an old right pontine infarct, which did not correlate with her symptoms. Additionally, vitamin B12 and ammonia levels were within normal limits. On the third day, the initial diagnostic workup was revisited and showed low thyroid stimulating hormone (TSH) (0.06 mIU/mL). Further thyroid analysis was performed, which showed high free T4 at 2.38 ng/dL and low total T3 at 72 ng/dL; suggestive of hyperthyroidism. Based on the Burch and Wartofsky scoring (BWS) system for TS (6), our patient's score was 65, which a result of 45 or greater is considered highly suggestive of TS (Table 1).

Based on more recent diagnostic criteria suggested by Akamizu et al. (1), our patient also met the criteria for TS grade 1. Immediate treatment with methimazole, Lugol's iodine solution, hydrocortisone, and propranolol was started. Within several hours, the patient's mental state and tachycardia improved. She appeared more lucid, calm, and her speech became coherent. By the third day of treatment, the mental state of the patient had returned to her baseline. She behaved appropriately, and her psychosis resolved. Her overall condition improved, and the patient was discharged to a skilled nursing facility, in a stable condition, after three days.

**Table 1.** Burch and Wartofsky scoring system for thyroid storm

Diagnostic criteria	Scoring points	
Temperature °C (°F)	37.2–37.7 (99–99.9)	5
	37.8–38.2 (100–100.9)	10
	38.3–38.8 (101–101.9)	<b>15</b>
	38.9–39.4 (102–102.9)	20
	39.5–39.9 (103–103.9)	25
	> 40 ( $\geq 104$ )	30
CNS effects	Mild (agitation)	10
	Moderate (delirium/psychosis)	<b>20</b>
	Severe (seizure/coma)	30
Gastrointestinal–hepatic dysfunction	Moderate (diarrhea)	10
	Severe (jaundice)	20
Tachycardia	99–109	5
	110–119	10
	120–129	15
	130–139	<b>20</b>
	> 140	25
Congestive heart failure	Mild (pedal edema)	5
	Moderate (bibasilar rales)	10
	Severe (pulmonary edema)	15
Atrial fibrillation	Absent	0
	Present	10
Precipitant history	Negative	0
	Positive	<b>10</b>

CNS, central nervous system. Bolded values represent the patient's score.

## Discussion

The pathogenesis of the coexistence of DKA and TS is multifaceted. Normal thyroid function is essential for maintaining equilibrium in glucose metabolism. However, hyperthyroidism can worsen glycemic control in patients with diabetes mellitus (7). Thyroid hormone excess has been implicated in increasing intestinal glucose absorption, increased hepatic production of glucose from glycogen, decreased insulin secretion from the pancreas, increased insulin resistance, and increased renal clearance of insulin. Untreated thyrotoxicosis can also predispose a patient with type 2 diabetes mellitus to DKA by affecting adipokines and altering carbohydrate metabolism (8, 9).

The simultaneous presentation of these two endocrine emergencies, DKA and TS, can pose a diagnostic challenge as this combination is exceedingly rare. Several factors could mask or delay the diagnosis of either, including their co-existence, and sepsis. When considering the diagnosis of TS, it is important to bear in mind that a fever may be suppressed (as was the case in our patient) at the initial presentation due to DKA and may develop only after the resolution of the DKA (9–11). Another important element which can delay diagnosis is that severely uncontrolled

diabetes may falsely decrease blood levels of thyroxine and triiodothyronine (12).

In our patient, the initial clinical features of tachycardia and fever were confounding factors for systemic inflammatory response syndrome and TS, given that there were sources of infection (abdominal wound and UTI) and influenza B. The patient fulfilled diagnostic criteria for sepsis, and it is likely that this masked the presence of coexisting TS. However, the lack of improvement in her mental state, despite antibiotic therapy for more than 48 hours, prompted consideration of an alternative diagnosis with a thorough diagnostic analysis revealing the thyroid disorder.

The initial analysis revealed low TSH level, but it was not suppressed to the degree which one would expect to see in overt clinical hyperthyroidism. Therefore, this case highlights the importance of recognizing the clinical diagnosis of TS as the magnitude of thyroid hormone excess may not correlate with clinical severity. To date, there are no universally accepted diagnostic criteria for TS; however, the BWS system suggested by Burch and Wartofsky in 1993 is one of the most widely used diagnostic tools to differentiate uncomplicated hyperthyroidism from TS (6). Based on this scoring system, diagnoses are related to clinical assessment, rather than laboratory abnormalities (Table 1). More recently, the Japanese Thyroid Association (JTA) criteria were proposed by Akamizu et al. (1). According to one study, BWS selects a higher percentage of patients for aggressive treatment, in comparison to JTA (13). While differences do exist between BWS and JTA, both remain essential tools in the clinical evaluation for TS.

The present case also illustrates the neuropsychiatric manifestations of TS, which have been associated with high mortality risk (3). In a recently published retrospective study by Angell et al., the altered mental state was the only significant clinical feature distinguishing TS from compensated hyperthyroidism (14). TS is an under-recognized cause of the altered mental state and should be considered earlier in patients with a history of thyroid disease, diabetes mellitus, or other autoimmune pathologies. It is crucial to be aware of the coexistence of DKA and TS in order to prevent life-threatening complications, such as cardiac arrest (15, 16).

## Conclusions

Contributing factors must be taken into consideration when encountering a patient who may have both DKA and TS. They can simultaneously occur and are associated with significant morbidity and mortality if not promptly recognized and treated. This case emphasizes the importance of actively considering the presence of other endocrine disorders when encountering a patient with an endocrine disease. This is particularly important when the

patient fails to improve with initial management or there is a worsening of the underlying clinical condition.

Thorough clinical assessment remains the cornerstone of diagnosing TS as the derangements in thyroid hormones may not correlate with clinical severity.

## Conflict of interest and funding

The authors have no conflicts of interest or disclosures to declare.

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