CASE REPORT

Simultaneous presentation of thyroid storm and diabetic ketoacidosis in a previously healthy 21-year-old man

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SUMMARY

A 21-year-old young man with no history of diabetes or thyroid disease presented to the emergency department with simultaneous thyroid storm and diabetic ketoacidosis. Notable findings on admission were a ventricular rate of 235 beats/min, tachypnoea, tremors, polydipsia and a lack of fever. Due to the unusual constellation of symptoms, diagnosis was only possible after initial laboratory results came back. While the lack of fever is unusual in thyroid storm, diabetic ketoacidosis has previously been reported to suppress fever, and this case supports the occurrence of this phenomenon. This case was highly unusual because the patient had not previously been diagnosed with either type 1 diabetes or Graves' disease.

BACKGROUND

Diabetic ketoacidosis (DKA) and thyroid storm are both serious and potentially fatal consequences of diabetes and hyperthyroidism, respectively. While the conditions are known to be associated, copresentation almost always occurs in someone with pre-existing diabetes, thyroid disease or both. We present a rare co-occurrence of thyroid storm and DKA in an individual with no history of either thyroid disease or diabetes. Increased awareness of the potential for copresentation and modification

of symptoms that can result from this is important for physicians to ensure a quick and accurate diagnosis preventing unnecessary delays in management or subsequent morbidity and mortality. This case also highlights that these conditions need to be considered even in individuals without documented history of hyperthyroidism or diabetes.

CASE PRESENTATION

A 21-year-old previously healthy man presented to the emergency department (ED) with tachycardia and tachypnoea. Other symptoms from the previous 2 days were fatigue, diaphoresis, palpitations, tremors, weakness, 'not feeling like himself' and polydipsia. He also noted weight loss over the past 2 months. Family history revealed potential diabetes on his father's side. On physical examination, he was cachectic, in moderate distress, and without thyromegaly. Blood pressure was 156/92, respiratory rate was 35, temperature was 36.7°C and ECG showed atrial fibrillation with a heart rate of 235 beats/min (figure 1).

INVESTIGATIONS

Initial laboratory test results of significance that were obtained on admission (table 1) show evidence

Figure 1 An ECG taken at the time of admission showing the initial ventricular rate of 235 beats/min.

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Table 1 Laboratory tests obtained on admission

Laboratory tests	Value	Normal range
Arterial pH	7.05	7.35–7.45
P _{CO2}	12 mm Hg	35–45
HCO ₃ ⁻	4 mmol/L	38
Glucose	317 mg/dL	70–99
β-Hydroxybutyrate	8.49 mmol/L	0.02–0.27
Thyroid Stimulating Hormone	<0.01 µIU/mL	0.27–0.42
Free T3	12.96 pg/mL	2.57–4.43
Free T4	3.8 ng/dL	0.9–1.7

Table 2 Further laboratory test values from an outside laboratory

Laboratory tests	Value	Normal range
Glutamic acid decarboxylase antibody	1437 nmol/L	<0.02
Islet antigen 2 antibody (reflecting autoimmunity against pancreatic islet cells)	0.12 nmol/L	<0.02
Thyroid peroxidase antibody	>1300 IU/mL	<60
Thyroglobulin antibody	>500 IU/mL	<4
TSH receptor antibody	1.25 IU/L	0–1.75
TSH receptor antibody repeat at follow-up visit	2.4 IU/L	0–1.75

of both DKA and thyroid storm. Further laboratory testing at an outside facility confirmed these diagnoses (table 2).

DIFFERENTIAL DIAGNOSIS

Many symptoms identified in the patient's history such as unexplained weight loss, gastrointestinal dysfunction and mild mental state changes could indicate either thyroid storm or DKA; however, these findings are also possible with milder conditions such as hyperthyroidism or type 1 diabetes (T1D). Additional physical examination findings such as diaphoresis, tachycardia and tachypnoea commonly occur in both disorders. The suspicion of thyroid storm was raised early in his presentation due to the extremely high ventricular rate on ECG monitoring. Pheochromocytoma was also initially considered, though the patient's condition had improved before further testing was completed.

Initial thyroid function tests showed nearly undetectable TSH with elevated T3 and T4 levels, raising a high degree of suspicion for thyroid storm. In the absence of a high temperature, it was the presence of the tachycardia that prompted checking of the patient's thyroid status. Delayed diagnosis of thyroid storm due to suppression of fever by DKA has been reported several times previously resulting in fatal outcomes.^{1,2} DKA was also high on the differential based on history and physical examination findings, being confirmed with initial labs showing elevated ketones, decreased P_{CO2}, bicarbonate and low pH combined with high glucose (table 1).

TREATMENT

The patient was initially managed in the ED where he received intravenous fluids and was started on an insulin drip as per our local DKA protocol. He was then transferred to the intensive care unit where management continued for DKA and treatment for thyroid storm was initiated consisting of oral propranolol, propylthiouracil and hydrocortisone. His heart rate improved and ketoacidosis resolved within the first day of treatment. He was discharged in a stable condition 2 days after admission.

OUTCOME AND FOLLOW-UP

Three years after initial presentation, the patient was well, and was maintained on insulin glargine 12 units two times a day, insulin aspart 15 units premeal and methimazole 10 mg daily. His weight increased from 59 kg to 89 kg, with a body mass index of 27.5. Most recent laboratory tests showed non-fasting glucose of 205, haemoglobin A1c of 5.7%, TSH of 1.91, free T4 of 1.0 and free T3 of 3.55. A taper of methimazole was initiated.

DISCUSSION

The annual incidence of DKA is 12.9 per 100 000 individuals with a mortality rate of 1%–5%.³ Thyroid storm has an incidence of 0.8–1.4 per 100 000 individuals with a mortality rate of 10%.⁴ There are limited data on co-occurrence of these conditions outside of case reports; however, there are multiple reasons why they co-occur more frequently than predicted by their incidences.

First, the underlying conditions that most frequently lead to thyroid storm and DKA, Graves' disease and T1D, occur together at an increased rate. This is because patients with established autoimmunity in the endocrine system, including the thyroid or pancreas, are at an increased risk of developing autoimmunity in the other location.^{5,6} Graves' disease and T1D occur together at such a high rate that their co-occurrence has recently been classified as: autoimmune polyglandular syndrome 3A. Additionally, prevalence of each disease individually is also on the rise.^{7,8}

Second, both DKA and thyroid storm can induce the other condition in susceptible patients. Thyroid hormone is known to increase glucose concentration through hepatic and peripheral mechanisms and has also been shown to decrease insulin activity, further predisposing hyperthyroid individuals to the consequences of diabetes or DKA.⁹ Conversely, though the exact mechanism is not known, the metabolic derangements associated with DKA can cause thyroid storm, in fact DKA is frequently listed as one of the major causes of thyroid storm.^{10,11}

While this case report aims to increase the awareness of copresentation of these two diseases, the more unique aspect of this presentation is the fact that the patient lacked prior history of Graves' disease or T1D. We could only find one case report in the literature of DKA and thyroid storm co-occurring in a previously healthy individual; however, that report was significantly different because the DKA was found to be secondary to type 2 diabetes rather than type 1.¹²

One potential confounding variable in our literature search is that differentiation of thyroid storm from thyrotoxicosis is determined based on clinical scoring algorithms that can vary between institutions. The major classification systems for thyroid storm are the Burch-Wartofsky scoring system and the Akamizu criteria. While both incorporate similar features, there is significant disparity in the systems. Our patient was classified by both criteria to be in thyroid storm. Thus, co-occurrence of DKA and thyroid storm may be underestimated as patients may be diagnosed with thyrotoxicosis rather than thyroid storm.

In summary, while both thyroid storm and DKA are rare conditions, co-occurrence is more common than the incidence of both would suggest due to the potential for either condition to induce the other and overlap of risk factors for susceptible individuals.

Learning points

- ▶ Although initial copresentation of thyroid storm and diabetic ketoacidosis (DKA) is rare, the potentially catastrophic consequences of missing either diagnosis make this an important clinical entity to consider.
- ▶ Even in the absence of prior thyroid disease or history of diabetes, the copresentation of thyroid storm and DKA must be considered.
- ▶ The overlap in symptoms for thyroid storm and DKA, as well as potential suppression of fever by DKA, can make an early clinical diagnosis challenging.
- ▶ There is well-established interaction between thyroid storm and DKA, and either condition can induce the other.

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