

Thyroid Storm Associated with COVID-19 and Complicated with Diabetic Ketoacidosis: A Case Report

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ABSTRACT

Thyroid storm (TS) is a rare, life-threatening health condition associated with undertreated hyperthyroidism. During a TS, individual vitals can soar to dangerously high levels, and without prompt, aggressive management, a TS can be fatal. Diabetic ketoacidosis (DKA) is a trigger for thyroid crisis. However, TS and DKA rarely occur simultaneously. Here, we are presenting a case of TS having coronavirus disease 2019 (COVID-19) at admission, complicated with DKA. However, it has been seen that TSs can precipitate DKA in a few instances.

Case description: A 72-year-old female with a history of diabetes mellitus (DM) was brought to the emergency room with symptoms of recurrent DKA. She was COVID-19-positive at the time of admission but with minimal upper respiratory symptoms. DKA protocol was started according to our hospital policy, but she developed tachycardia, a high fever, and a disturbing level of consciousness. After laboratory investigations revealed disturbing thyroid functions. So, DKA with TS was diagnosed. Antithyroid medication, inorganic iodine, and corticosteroids were then started as a treatment for TS, and β -blockers were administered to manage tachycardia. With these treatments, the patient's health improved, and she recovered.

Conclusion: In severe cases of DKA, sometimes the presence of TS can be considered, and early treatment should be initiated before the patient's condition worsens.

Keywords: Case report, Coronavirus disease 2019, Diabetic ketoacidosis, Thyroid medications, Thyroid storm.

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INTRODUCTION

Thyroid storm (TS) is a life-threatening condition that leads to multiple organ dysfunction¹ caused by either complete insulin deficiency or completer insulin sensitivity or sometimes by type 2 diabetes mellitus (DM). If TS is not diagnosed early, it can lead to high mortality^{2,3} in later stages. Females are more prone to develop TS, which can present at any age. Precipitating factors of TS are surgery, sepsis, diabetic ketoacidosis (DKA), burn injury, cerebrovascular accidents (CVA), and iodinated contrast dyes. Infection with coronavirus disease 2019 (COVID-19) can lead to multiorgan failure. Its association with thyroid disease is also encountered. The patient presented with conditions like hyperthyroidism and hypothyroidism, which are complications of COVID-19 infection, but there is not much data on how much severe the COVID-19 patient can present in hyperthyroidism.⁴ Disorder of this metabolic state is seen as a complication of DKA, which is characterized by hyperglycemia, ketosis, and metabolic acidosis.⁵ Females present with higher DKA cases compared to males, and the severity of disease is also high in them. The age-group which is presenting more is usually between 18 and 44 years⁶. In this study, we are presenting a rare case of TS of a 72-year-old lady with repeated attacks of DKA.

CASE DESCRIPTION

Here, we are presenting a 72-year-old female with a known case of type 2 DM, hypertension, and dyslipidemia. She was admitted to the casualty with a complaint of epigastric and suprapubic pain. She was on treatment of lispro insulin, but she was not compliant with her management of diabetes. The patient was admitted with a positive result of COVID-19 for 4 days with minimal upper respiratory symptoms. She had a confirmed case of thyrotoxicosis since her last

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admission, and she was taking carbimazole 40 mg tablet daily, but due to noncompliance with her treatment, she progressed to this situation.

Clinical Findings

On admission, she had a decreased level of consciousness but was arousable. When vital signs were checked, it was stable. She was shifted to the high-dependency unit for further management. Her random blood sugar level was 18 mmol/L, and her blood ketones were 4.4 mmol/L. When blood gas analysis [arterial blood gas (ABG)] was done, it reflected severe metabolic acidosis pH—7.08, base excess—negative 20 mmol/L, and bicarbonate 6.8 mmol/L. DKA protocol was started immediately. However, after 3 hours, her pulse rate became 160–170/minute with arterial blood pressure 101/59 mm Hg. The patient had a fever of up to 38.2°C. As she was hemodynamically unstable, synchronized direct cardioversion (DC) shock was given of 100 J, but no effect

was seen. This rise in heart rate was mistaken as supraventricular tachycardia (SVT), so due to hemodynamic instability, shock was delivered. Now, her Glasgow Coma Scale (GCS) has decreased to 6. So, the patient was intubated to secure the airway in view to protect it from aspiration. The patient was seen by a cardiologist and an endocrinologist. Thyroid function tests (TFT) were repeated. Laboratory test result was done using electrochemiluminescent immunoassay, which unveiled thyrotoxicosis symptoms. The clinical findings were as follows: thyroid-stimulating hormone—0.005 mIU/mL (normal range: 0.50–5.0 mIU/mL); free T4 level >100 pmol/dL (normal range: 12–22 pmol/L). The patient was treated with an increased dose of carbimazole, and Lugol's iodine was given through a nasogastric tube. Propranolol was given as an intravenous dose along with hydrocortisone. Polymerase chain reaction (PCR) test for COVID-19 was also repeated. Her chest X-ray shows moderate lung infiltrations. Ultrasound of the neck displayed an enlarged coarse texture thyroid with multinodular goiter. Four days after mechanical ventilation, her condition improved, and she was extubated on the fifth day.

Glucocorticoids (GCs) are good immunosuppressive and anti-inflammatory medications used widely in the recent COVID-19 pandemic encountered recently. They were used for their immunosuppressive and immunomodulatory properties to control the pandemic. So, GCs can have adverse effects of aggravating high blood glucose levels in persons with DM, undiagnosed DM, or precipitate GC-induced DM.

So, in this case, antithyroid medication, corticosteroids, and inorganic iodine were continued as a treatment for TS, and along with this management, β -blockers were also added to tackle the tachycardia. We were fortunate to manage the TS successfully, and tachycardia was also settled. We did not encounter any DKA complications like organ damage during the whole course of patient management. She was discharged after 10 days with carbimazole, and a β -blocker like propranolol was added until the next review at the outpatient clinic. Optimization of diabetic medication and education before discharge was done to prevent any further events. She was called to the diabetic outpatient department after 2 weeks for review.

DISCUSSION

In this case, we saw the clinical signs and symptoms of TS, which developed during repeated DKA. The incidence rate of DKA is 0–57 per 1000 per year annually. Both TS and DKA can present together, which is a not very common life-threatening emergency presentation.⁷ In another report, mortality rate of TS and DKA was 15%.⁸ Another study presented that hyperthyroidism has aggravated the glycemic index of diabetes patients. Changes in thyroid hormone levels have been noted in diabetes patients, especially those with uncontrolled glycemic index. Diminishing T3 levels have been pointed out in patients with poor diabetic control because we can easily explain the detrimental effect of T4–T3 that normally occurs with the peripheral conversion.⁶ Both endocrine disorders, when present together, have higher mortality. Even though the patient was COVID-19-positive at the time of admission, an association was seen between the COVID-19 infection and thyroid dysfunction, but it has not been fully explained. Many factors can mask or delay the presentation and diagnosis of disease. Therefore, when these endocrine disorders present together, they present a diagnostic challenge.

We should always search for the precipitating factor of DKA. Here is a list of common factors that precipitate various infections,

stress conditions due to other illnesses, new-onset diabetes, missed insulin doses, and steroids.

Euthyroid syndrome is often seen as an illness that is not directly related to the thyroid gland. It signifies the change in TFTs. Although it is not a true thyroid syndrome, it is a slight alteration in the axis of the hypothalamic–pituitary–thyroid. It is seen in almost 75% of the patients who are hospitalized. Medical situations where we can have similar problems are in patients with critical illness, which is of severe variety, lack of calories, and following major operations.

In a situation like untreated hyperthyroidism, it is associated with a reduced C peptide to proinsulin ratio, which suggests an underlying defect in the formation of proinsulin. It was associated with an increase in growth hormone, catecholamine levels, and glucagon, which further leads to impaired glucose tolerance.

If an altered level of consciousness is found in DKA patients with a normal serum osmolality, then we should search for alternative causes such as CVA, head injury, hyponatremia, and meningitis, and rhinocerebral mucormycosis should be kept in mind.⁹

It was really difficult to diagnose TS at the time of the initial presentation because she presented with a history of recurrent DKA. Symptoms related to the central nervous system did not improve even after initiating the DKA protocol. The presence of fever caused tachycardia, so TS features could not be identified. After blood tests, thyroid function was found to be severely deranged, which led to a diagnosis of TS.

Outcome

Thyroid and glucose metabolism are closely related to each other. Increased level of thyroid hormone has been associated with increased absorption of glucose from the intestine. It can also lead to increased hepatic production of glucose from glycogen, which also causes increased insulin resistance because of decreased insulin secretion.

CONCLUSION

Presentation of both TS and DKA is relatively rare, but sometimes it can be a life-threatening condition if diagnosis and management are not done early.¹⁰ We should evaluate complete physical and laboratory investigations to detect early this rare combination and its presentation. Current literature does not specify the frequency of this rare entity. We should make efforts so that patients can be compliant with antithyroid and antidiabetic medications to prevent the above complications.

Prospective studies on the simultaneous presentation of TS and DKA are not easily possible because of their uncommon nature. Even then, continuous reporting of such type of cases is necessary for a better understanding of these uncommon diseases.

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