Thyroid Storm with Multiorgan Failure

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**Background:** Thyroid storm is a rare and potentially fatal condition. Various unusual presentations in patients with thyroid storm have been described but multiorgan dysfunction is uncommonly seen.

**Summary:** We describe a 35-year-old patient with a history of Graves' disease who was diagnosed with thyroid storm at 2 weeks postpartum. This was complicated by acute liver failure, acute kidney injury, severe lactic acidosis, disseminated intravascular coagulation, and heart failure with acute pulmonary edema. The multiorgan dysfunction was reversed by prompt institution of antithyroid drugs and supportive management in the intensive care unit.

**Conclusion:** Thyroid storm is a medical emergency. One of the challenges lies in recognizing its varied presentations. Early diagnosis and appropriate treatment is important to prevent the catastrophic outcomes associated with this condition.

**Introduction**

Thyroid storm is a rare, life-threatening condition, usually occurring in patients with preexisting thyrotoxicosis. We describe a young patient with Graves' disease who developed thyroid storm with multiorgan failure. She recovered well with early institution of antithyroid treatment.

**Patient**

A 35-year-old woman with a history of Graves' disease was admitted for acute delirium, fever, and vomiting. She had a cesarean section at 2 weeks before admission. The patient had not been compliant to thyroid medication for the previous year and had not informed her obstetrician about her medical history. Postdelivery, she had rapid atrial fibrillation and heart failure. This was attributed to thyrotoxicosis. She was not in thyroid storm at the time. A transthoracic echocardiogram revealed a left ventricular ejection fraction of 50%. Computed tomography pulmonary angiogram did not show pulmonary embolism. She was started on carbimazole 10 mg three times a day (TID) and propranolol 10 mg TID, which she stopped taking after a few days because of concerns about their safety during breast feeding.

On arrival to the emergency department, she was drowsy, confused, and diaphoretic. Vital signs were as follows: temperature was 38.0°C, blood pressure was 150/90 mmHg, and pulse rate was 220 and irregular. She had a diffuse goiter and exophthalmos. Bilateral basal crepitations were heard on auscultation of the lungs. Jugular venous pressure was elevated. Heart sounds were dull; there were no cardiac murmurs. Abdominal examination was unremarkable.

Electrocardiograph confirmed atrial fibrillation with a ventricular rate of 221. Chest radiography demonstrated cardiomegaly and pulmonary congestion. Laboratory investigations were as follows: white cell count 8.24x10^9/L (normal range, 3.26–9.28x10^9/L), hemoglobin 13.3 g/dL (normal range, 12.6–16.9 g/dL), platelet count 178x10^9/L (normal range, 160–398x10^9/L), sodium 134 mmol/L (normal range, 135–150 mmol/L), potassium 5.0 mmol/L (normal range, 3.5–5.0 mmol/L), creatinine 69 μmol/L (normal range, 65–125 μmol/L), urea 8.1 mmol/L (normal range, 2.5–7.5 mmol/L), lactate 6.6 mmol/L (normal range, 0.7–2.1 mmol/L), free thyroxine 34.1 pmol/L (normal range, 10.0–23.0 pmol/L), free triiodothyronine 12.4 pmol/L (normal range, 4.3–8.3 pmol/L), and thyroid-stimulating hormone <0.02 mIU/L (0.45–4.5 mIU/L). Thyroid-stimulating hormone receptor antibody was positive at 6.8 IU/L. Antithyroglobulin and antithyroid peroxidase antibodies were absent. Creatine kinase and its myocardial fraction were not elevated. Procalcitonin, a propeptide of calcitonin produced in the C cells of the thyroid gland and released in the presence of bacterial infection, was elevated at 3.23 μg/L (normal range, <0.50 μg/L).
She also had hypoglycemia with a blood sugar level of 1.2 mmol/L (normal range, 4.0–7.8 mmol/L). Intravenous dextrose was given, with improvement of mental status. Burch-Wartofsky score was 90 (highly suggestive of thyroid storm). Oral propylthiouracil 300 mg and intravenous hydrocortisone 500 mg were administered in the emergency department and intravenous digoxin 500 mcg was given for rate control of fast atrial fibrillation. The patient was intubated for severe metabolic acidosis (arterial blood gas on 100% oxygen showed pH 7.18, pCO2 18.9 mmHg, pO2 183 mmHg, and bicarbonate 7.1 mmol/L).

In the intensive care unit, she progressed to multiorgan failure, which included acute liver failure and acute kidney injury requiring hemodialysis. Ultrasound scan of the abdomen did not reveal any hepatic or renal lesion apart from mild dilatation of the intrahepatic veins and the intrahepatic inferior vena cava. The biliary tree was not dilated. The gall bladder was normal. The size of the kidneys was normal. There was no hydromephrosis. Viral hepatitis markers (anti-hepatitis A IgM, hepatitis B S antigen, antihepatitis C IgG, and antihepatitis E IgM) were negative.

She developed disseminated intravascular coagulation with bleeding manifestations: hematuria, vaginal bleeding, and gastrointestinal bleeding with bloody nasogastric aspirates. Hemoglobin count remained stable. Platelet count reached a nadir of 61 x 10^9/L. Gynecological consult was sought. Gynecological examination did not find any retained products of conception that could cause disseminated intravascular coagulation. The syndrome of hemolysis, elevated liver enzymes, and low platelets was deemed to be unlikely as it mostly occurs prior to delivery (70%). In the remaining 30%, it usually occurs within 48 hours of delivery (1,2). The patient’s biochemical picture was not suggestive of hemolysis, elevated liver enzymes, and low platelets syndrome. There were no features of hemolysis such as helmet cells or fragmented red cells on peripheral blood smear. Indirect bilirubin levels were not elevated. Haptoglobin levels were normal (39 mg/dL; normal range, 35–170 mg/dL). Dengue virus and chikungunya virus serology and polymerase chain reaction were negative as well. She did not have any hemodynamic compromise throughout her stay.

Transthoracic echocardiogram performed on the second day of admission showed a depressed left ventricular ejection fraction of 45%, dilated left and right heart chambers, moderate mitral and tricuspid valve regurgitation, and moderate pulmonary hypertension.

She was treated with IV dexamethasone 2 mg TID, per oral (PO) propylthiouracil 200 mg 4 hourly, PO sodium iodide 1 g twice a day (BID), PO digoxin 125 mcg once a day, and IV esmolol infusion titrated to blood pressure and pulse rate, to which she responded well. She was also treated with IV ceftriaxone and IV azithromycin for suspected sepsis in view of elevated serum procalcitonin levels. However, there was no obvious source of sepsis. Coagulase-negative Staphylococcus was initially cultured from the blood. This was likely to be a skin contaminant, as the patient did not have any indwelling lines or prostheses. Subsequently, repeated sets of blood cultures were negative. Urine and sputum cultures, including cultures for acid-fast bacilli, were negative. Her liver and kidney function improved over the next few days with treatment and she did not require further hemodialysis (see Table 1). Her coagulation profile also normalized. She was subsequently extubated and discharged with propylthiouracil 100 mg TID and propranolol 40 mg TID. However, she remained in persistent atrial fibrillation and required maintenance therapy with digoxin 125 mcg once a day.

**Table 1. Trend of Selected Biochemical Markers**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Normal range</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
<th>Day 12</th>
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<tbody>
<tr>
<td>Urea (mmol/L)</td>
<td>2.5–7.5</td>
<td>8.1</td>
<td>12.6</td>
<td>21.3</td>
<td>11.7</td>
<td>15.8</td>
<td>12.7</td>
<td>8.9</td>
<td>5.1</td>
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<td>Creatinine (μmol/L)</td>
<td>65–125</td>
<td>69</td>
<td>138</td>
<td>205</td>
<td>115</td>
<td>110</td>
<td>83</td>
<td>70</td>
<td>64</td>
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<td>Albumin (g/L)</td>
<td>38–48</td>
<td>21</td>
<td>22</td>
<td>20</td>
<td>21</td>
<td>20</td>
<td>22</td>
<td>22</td>
<td>25</td>
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<tr>
<td>Bilirubin (μmol/L)</td>
<td>5–30</td>
<td>24</td>
<td>21</td>
<td>19</td>
<td>28</td>
<td>30</td>
<td>28</td>
<td>22</td>
<td>16</td>
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<td>Aspartate aminotransferase (U/L)</td>
<td>10–50</td>
<td>774</td>
<td>1349</td>
<td>1658</td>
<td>1359</td>
<td>519</td>
<td>196</td>
<td>139</td>
<td>34</td>
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<td>Alanine aminotransferase (U/L)</td>
<td>10–70</td>
<td>209</td>
<td>386</td>
<td>556</td>
<td>739</td>
<td>493</td>
<td>290</td>
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<td>Alkaline phosphatase (U/L)</td>
<td>40–130</td>
<td>127</td>
<td>111</td>
<td>120</td>
<td>186</td>
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<td>114</td>
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<td>Lactate dehydrogenase (U/L)</td>
<td>250–580</td>
<td>2963</td>
<td>3632</td>
<td>3917</td>
<td>2498</td>
<td>1292</td>
<td>1121</td>
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<td>858</td>
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<td>Prothrombin time (s)</td>
<td>12.0–14.5</td>
<td>25.3</td>
<td>30.3</td>
<td>34.1</td>
<td>29.5</td>
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<td>Activated partial thromboplastin time (s)</td>
<td>27.0–35.6</td>
<td>31.9</td>
<td>37</td>
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<td>139.7</td>
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<td>International normalized ratio</td>
<td>2.32–2.89</td>
<td>3.28</td>
<td>3.35</td>
<td>2.8</td>
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<td>pH</td>
<td>7.35–7.45</td>
<td>7.18</td>
<td>7.35</td>
<td>7.39</td>
<td>7.47</td>
<td>7.5</td>
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<td>Bicarbonate (mmol/L)</td>
<td>23.0–33.0</td>
<td>7.1</td>
<td>14.3</td>
<td>17.4</td>
<td>24</td>
<td>23.5</td>
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<td>pCO2 (mmHg)</td>
<td>35.0–45.0</td>
<td>18.9</td>
<td>26.2</td>
<td>29.1</td>
<td>33.6</td>
<td>31</td>
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<tr>
<td>Free thyroxine (pmol/L)</td>
<td>10.0–23.0</td>
<td>34.1</td>
<td>31.2</td>
<td>19.7</td>
<td>19.7</td>
<td>6.8</td>
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<tr>
<td>Lactate (mmol/L)</td>
<td>0.7–2.1</td>
<td>6.6</td>
<td>5.2</td>
<td>1.9</td>
<td>1.9</td>
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<td></td>
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<tr>
<td>Platelet count (×10^9/L)</td>
<td>160–398</td>
<td>178</td>
<td>84</td>
<td>83</td>
<td>72</td>
<td>78</td>
<td>61</td>
<td>112</td>
<td>212</td>
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</table>

**Discussion**

Thyroid storm is an acute, severe condition caused by excessive thyroid hormone release and sympathetic activity (3). The diagnosis of thyroid storm is clinical, based on the presence of fever, acute change in mental status, suggestive history, and cardiovascular and gastrointestinal dysfunction. Burch and Wartofsky have derived a scoring system in 1993 based on the above symptoms to predict the likelihood of thyroid storm (4). As in our patient, hypoglycemia had been reported as a presenting feature in thyroid storm (5).
Thyroid storm is frequently precipitated by physical stress, such as surgery, infection, noncompliance to antithyroid medications, or trauma (6). Patients with thyroid storm precipitated by labor or cesarean section have also been described (7). In this patient, the acute precipitating factor appears to be sepsis on the background of irregular compliance to antithyroid medication. Although there was no obvious localizing source of sepsis, procalcitonin was elevated on admission. Procalcitonin is released in bacterial infections but not in inflammatory or viral diseases (8). It has shown value as a marker of bacterial infections especially in the medical intensive care unit (8–10). A procalcitonin level above 0.5 mg/L has a sensitivity of 0.35–0.78 and a specificity of 0.79–0.99 in the detection of systemic infections (11–13). The sudden withdrawal of antithyroid medications following a few days of use might also have contributed to the event.

Various unusual presentations of thyroid storm have been described, including heart failure (14,15), arrhythmias (14,16), complete heart block (17), acute liver failure (18), cholestatic jaundice (19), coma (20), status epilepticus (21,22), stroke or cerebral infarction (21,23,24), and rhabdomyolysis (25), but multiorgan failure (26,27) is rare. In our patient, thyroid storm was complicated by concurrent atrial fibrillation and heart failure, lactic acidosis, acute kidney injury, severe liver dysfunction, and disseminated intravascular coagulation. Most patients with thyroid storm have mild, nonspecific transaminitis. Severe transaminitis with serum aspartate amino transferase levels of more than a thousand, as seen in our patient, is uncommon.

Lactic acidosis is likely to be due to a combination of acute cardiomyopathy with reduction in cardiac output, increase in cellular demands of oxygen in a hypermetabolic state, and impairment of hepatic clearance (18,26). Poor cardiac output may also explain the acute kidney injury, as there are no other obvious renal insults, such as obstructive uropathy or nephrotoxic drug usage. Acute liver failure in this patient is most likely due to hepatocellular injury as a result of increased cellular oxygen demands on a background of reduced cardiac output. This is compounded by heart failure (the inferior vena cava was noted to be dilated).

The presentation of thyroid storm in our patient mimics that of severe sepsis, with lactic acidosis, intravascular coagulation, and other features of multiorgan failure. Fortunately, the history of thyrotoxicosis was apparent and this led us to the diagnosis of thyroid storm.

Mortality for thyroid storm has been quoted to be between 10% and 30% (28,29). As the diagnosis of thyroid storm was established quickly and treatment was instituted early, the patient had a favorable outcome despite severe multiorgan dysfunction.

Disclosure Statement

The authors report no conflicts of interest.

References