



Perioperative considerations of hyperthyroidism in a patient with liver failure: case report

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Hyperthyroidism is one of the most common endocrinologic disorders. When patients with hyperthyroidism undergo general anesthesia, potential perioperative complications such as atrial fibrillation, congestive heart failure, ischemic heart disease, thrombocytopenia may occur. Hyperthyroidism treatment is mainly divided into three parts: Medical treatment, radioactive iodine therapy, and surgical removal of the thyroid. However, the previous two treatments may not have a significant effect on patients with liver failure. In this report, we present a case where a patient with an underlying disease of uncontrolled hyperthyroidism and liver failure undergoing liver transplantation, where preoperative thyroid levels couldn't be managed aggressively due to liver failure. We managed hyperthyroidism using conservative management before and during surgery; perioperative use of steroids, beta-blockers, calcium channel-blockers, IV (Intravenous) fluids, body temperature regulation, opioid use such as remifentanyl and fentanyl, sufficient sedation are all key in ensuring the hemodynamic stability of such a patient.

Keywords: Hyperthyroidism; Liver failure; Management

INTRODUCTION

Hyperthyroidism is one of the most common endocrinologic disorders [1-3]. It is present when thyroid hormone production is increased through various etiologies and can cause thyrotoxicosis, which is presented as high thyroid hormone levels. If uncontrolled, it can even lead to a state of multi-organ failure which we call 'thyroid storm' [4-6].

When patients with hyperthyroidism undergo general anesthesia, potential perioperative complications such as atrial fibrillation, congestive heart failure, ischemic heart disease, thrombocytopenia may occur [1,7]. Also, because thyroid hormones are glucuronidated and sulfated within the liver and subsequently excreted into bile, liver dysfunction is commonly observed in patients with thyroid disease

[8,9]. This is why all patients with an underlying thyroid condition are recommended to take a preoperative thyroid function test. If found abnormal, it is then advised to correct any abnormal levels before the scheduled operation [1,7].

Hyperthyroidism treatment is mainly divided into three parts: Medical treatment, radioactive iodine therapy, and surgical removal of the thyroid [1-3,5]. In medically treated patients, the drugs that are used (PTU, methimazole) have a potential to cause liver injury and greater consideration is taken with patients with low hepatic reserves [2,5,6,10]. Also, the onset of these drugs is 6 to 8 weeks [1,5-7], making it ineffective in controlling the disease before an emergency operation. Although delaying surgery until thyroid levels normalize may be optimal, this is not always the case in emergency situations. Anesthesiologists and surgeons will

ultimately have to weigh the risk and benefits, and there will be cases where a patient with high thyroid levels requires general anesthesia.

In this report, we present a case where a patient with an underlying disease of uncontrolled hyperthyroidism and liver failure undergoing liver transplantation, where preoperative thyroid levels couldn't be managed aggressively due to liver failure.

CASE REPORT

The patient was a 46 year old male with an underlying disease of Hepatitis B and Graves' disease, and was treated with antiviral and anti-thyroid medication. However, the patient withheld all medication 7 months prior to admittance to the hospital. He was first admitted for a sudden onset of jaundice and was diagnosed with acute liver failure, but was discharged on his own volition. After 3 days of being discharged, he was readmitted through the emergency room due to his sudden drowsy mentality.

In the initial laboratory tests, liver function tests (AST/ALT) were 3,266/2,738 IU/L, total bilirubin was 38.50 mg/dL, prothrombin time was 7%, prothrombin time international normalized ratio was 9.23, activated partial thromboplastin time was 78.7 sec, Albumin was 3.6 g/dL, HBV-DNA titer was >170,000,000 IU/mL, BUN/Cr were 4.8/0.91 mg/dL, electrolytes were normal (Sodium was 136 mmol/L, potassium was 4.8 mmol/L, and chloride was 98 mmol/L), and no abnormalities were seen in the urinalysis. Preoperative evaluation revealed a normal brain CT, while an echocardiogram showed no regional wall motion abnormalities, a normal ejection fraction of 55-60% and pulmonary artery pressure of 31 mmHg. The patient was diagnosed with acute exacerbation of chronic viral liver disease, hepatic encephalopathy, and with a MELD score of 45, was eligible for liver transplantation.

Initial thyroid function tests were extremely high (fT₄>7.77 ng/dL, TSH 0.060 uIU/mL, T₃ 139.1 ng/dL). The vital signs of the patient during intensive care unit (ICU) care showed blood pressure of 200-120/100-60 mmHg, heart rate of 110-150 bpm, daily fever of 38 degrees celsius. This was managed by beta-blockers, antibiotics and antipyretics, whilst the patient was sedated through continuous midazolam and fentanyl infusion. Vital signs were kept at blood

pressure 140-110/80-60 mmHg, heart rate 120-140 bpm while the patient waited for liver transplantation.

The patient presented to the operation room with blood pressure at 136/72 mmHg, heart rate 136 bpm, SpO₂ (saturation of percutaneous oxygen) 98% without premedication. Electrocardiogram showed a normal sinus rhythm, body temperature 36.4 degrees celsius, and he was sedated. Intraoperative monitoring included electrocardiography, heart rate, blood pressure, SpO₂, EtCO₂ (end tidal CO₂), invasive monitoring such as arterial cannulation of the femoral and radial arteries, and central cannulation of the femoral and internal jugular vein was done for rapid fluid therapy. A large-bore catheter was placed in the left internal jugular vein. Induction of anesthesia was achieved using desflurane inhalation and 50 mg of IV rocuronium, maintenance of anesthesia was done using O₂ 1.1 L/min, fresh air 1.9 L/min, and desflurane at 3-8 vol%.

15 minutes after the initiation of surgery, blood pressure was 120/60 mmHg, heart rate 130 bpm and esmolol infusion and fentanyl 50 mcg bolus was given twice. Afterwards blood pressure was controlled between 120-90/60-50 mmHg, heart rate at 110 bpm. To keep the patient at normothermic levels, various ways, such as cool/warm blanket, hot line, and air warmer, were used throughout the surgery and the patient's body temperature ranged from 35.7 to 36.8 degrees celsius.

After reperfusion, blood pressure rose to 150/60 mmHg, and heart rate rose to 130 bpm. Esmolol infusion dose was increased to control this change. After the surgery, dexmedetomidine (Precedex) was infused while the patient was transported to the ICU.

In order to control the heart rate, esmolol infusion was maintained postoperatively. At POD (postoperative day) #4 the patient was extubated and at POD #5 bisoprolol (oral β -blocker) was given instead and esmolol infusion was discontinued. At POD #9 the patient was moved to the general ward. Postoperative fT₄ levels at POD #7 was 2.3 ng/dL but quickly rose again to 3-4 ng/dL, and TSH was 0.05 uIU/L at POD #7 and rose to 0.01 uIU/L afterwards. Although methimazole was primarily considered in treating the underlying hyperthyroidism, liver function was not fully normal after liver transplantation. Steroid (continued until POD #12), and bisoprolol was maintained until liver function returned to normal levels at POD #26. The patient was discharged 30

days after having liver transplantation surgery.

DISCUSSION

The patient in this case was diagnosed with Graves' disease but discontinued his antithyroid medication and was at a uncontrolled hyperthyroidism state at the time of his liver transplantation surgery. The reason for this patient's liver failure wasn't deemed to be caused by a thyroid storm or the adverse effects from antithyroid medication. This was because of several facts; he discontinued his antithyroid medication 7 months before the diagnosis, liver function was normal 3 days before the onset of jaundice, and his HBV-DNA titer was very high at >170,000,000 IU/mL because he had also discontinued his HBV medication. It was thought that the patient's chronic HBV infection caused the sudden liver failure.

Managing hyperthyroidism is very important because it causes many cardiac conditions but also can cause liver injury. Because thyroid hormones are glucuronidated and sulfated within the liver and subsequently excreted into bile, liver dysfunction is commonly observed in patients with thyroid disease. The reported prevalence of liver dysfunction in patients with hyperthyroidism varies widely, ranging from 15% to 79% [8,9]. For this patient, he had hepatic encephalopathy as a result of severe liver failure and a MELD score of 45.

Prior to the liver transplantation, many considerations were made in managing the patient's thyroid function. Antithyroid medication was first considered but quickly dismissed due to the probability of liver toxicity [1,2,5,7,11]. Generally, antithyroid medication (PTU, methimazole) induced liver toxicity are reported to be under 0.5% [2,11]. Especially, PTU is reported to even cause liver failure [2]. Methimazole causes liver injury in a cholestatic pattern and PTU in a hepatic pattern [11]. Also, it generally takes 6 to 8 weeks for the maximal effect of the drug and therefore was another reason for oral medication not being an optimal method of hyperthyroidism management for this case [1,5-7]. Lugol's solution had to be used after antithyroid medication [6,7,12], so it wasn't applicable to this patient. Radioactive iodine is widely used in patients with hepatic dysfunction, but there are cases which report hepatotoxicity and exacerbation of liver function so it must be used with

care [3,13-15]. Also, the effects of radioactive iodine takes weeks to assess so it is not fit for use in emergency situations [3,5,6]. Glucocorticoid was also considered due to its effects of reducing the conversion of thyroxine to triiodothyronine within 24 hours of usage, however it is only effective when used concomitantly with other therapies [7,12,16].

Therefore, The preoperative management of hyperthyroidism was made difficult due to the patient's liver condition, and we had to resort to conservative and symptomatic treatment, such as beta-blockers, hydration and body temperature control, in order to proceed with the surgery [5,7]. After the surgery, glucocorticoid was continuously used, and methimazole was given after liver function normalized.

It is recommended that all patients with hyperthyroidism have their thyroid function levels corrected before general anesthesia, due to the numerous perioperative complications such as atrial fibrillation, congestive heart failure, ischemic heart disease, thrombocytopenia, and liver dysfunction might arise during surgery. This may be done using antithyroid medication, radioactive iodine, and surgical resection of the thyroid tissue. However, antithyroid medication potentially causes liver injury and Lugol's solution is only effective after the use of antithyroid medication so it can't be considered in cases of liver failure. In this case, the patient had severe liver injury and thus couldn't have delayed his liver transplantation in order to control his thyroid function. Therefore, an approach using conservative treatment must be taken in order to manage hyperthyroidism before and during surgery; perioperative use of steroids, beta-blockers, calcium channel-blockers, IV fluids, body temperature regulation, opioid use such as remifentanyl and fentanyl, sufficient sedation are all key in ensuring the hemodynamic stability of such a patient. Whenever possible, postoperative use of antithyroid medication must ensue to treat hyperthyroidism after the liver function normalizes again.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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