Ruptured appendicitis with undiagnosed Graves' disease: contrast-induced impending thyroid storm

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Abstract

Thyrotoxicosis is a relatively common endocrine disorder. The diagnosis of thyrotoxicosis is upon clinical examination, laboratory, and further investigation. To prevent the thyroid storm is the goal of treatment of patients with thyrotoxicosis especially patients undergoing surgery.

Introduction

Thyrotoxicosis is a relatively common endocrine disorder. The prevalence of hyperthyroidism in the US is 1.3% [1]. Hyperthyroidism and thyrotoxicosis are different. Hyperthyroidism is characterised by increased thyroid hormone synthesis and secretion from the thyroid gland, but thyrotoxicosis refers to the clinical symptoms of excess circulating thyroid hormones such as thyroiditis, and iodine-induced or drug-induced thyroid dysfunction. The most common cause of hyperthyroidism is Graves' disease [2]. Diagnosis of thyrotoxicosis is upon clinical examination, laboratory tests, and further investigation to assist with diagnosing the specific cause and to arrange necessary treatment. The important issue among patients with thyrotoxicosis needing an operation is perioperative management and multidisciplinary care to prevent the thyroid storm that increases morbidity and mortality [1].

Case report

A 19-year-old female presented with abdominal pain for three days. She had colicky pain around the umbilicus with low grade fever and then migratory pain for one day. She denied history of past illness or drug allergy. Her physical examination showed normal appearance, and her lungs and heart were normal. Her abdomen revealed no distension, hypoactive bowel sound, soft, moderate tenderness at right lower quadrant area with localized guarding without mass. Completed blood clot showed leukocytosis with shift to the left (white blood cell 18350, PMN 81%), no anemia and normal platelet count. The urinalysis was normal and urine pregnancy test showed negative. Her computed tomography of the abdomen revealed retrocecal type acute appendicitis with focal nonenhanced wall at the appendiceal tip. She received a diagnosis of gangrenous appendicitis and was sent to operating theater for emergency laparoscopic appendectomy. The baseline vital signs included a blood pressure of 125/75 mmHg, a regular sinus rhythm heart rate of 120 beats/min, and peripheral oxygen saturation of 99%. Propofol (120 mg), succinylcholine (100 mg) and fentanyl (100mcg) were administered intravenously, and the trachea was intubated using a 7.0 mm cuffed endotracheal tube. Anesthesia was maintained using 1 L/min O_2, 1 L/min Air, and 2.5-3.0 vol% sevoflurane. During procedure, she presented persistent sinus tachycardia (heart rate 130-140 beats/min) and fever (body temperature 39°C). Fever was treated using intravenous paracetamol 1000 mg and cool pack. However, the E_TCO_2, maintained between 30-35 mmHg, had no signs of inadequate anesthesia and malignant hyperthermia. The anesthetist and surgeon discussed her tachycardia after treatment of dehydration and pyrexia. We suspected thyrotoxicosis and remained cautious regarding complications from this issue, e.g., the thyroid

storm. The operation took approximately 1 hour and proceeded unremarkably. The neuromuscular blocker was then reversed using 2.5 mg neostigmine and 0.4 mg glycopyrrolate. Extubation was performed without complication. When the patient completely recovered from anesthesia, she was transferred to the PACU. At the ward, the patient presented BP of 140/100 mmHg, 100% SpO_2, and the ECG showed sinus tachycardia with a HR of 140 beats/min. Complete physical exam found mild thyroid gland enlargement with thyroid built positive. She did not have palpitation or syncope. She had history of unintentional weight loss for 17 kg over 4 months. Her thyroid function test revealed FT4 >7.77 ng/dL (0.93-1.7), FT3 13.1 pg/mL (2-4.4) and TSH <0.005 mIU/L (0.27-4.2). The endocrinologist was consulted to co-evaluate and found the cause of severe thyrotoxicosis suspected from post iodine-contrast injection. The Burch Warsofsky point was 45 (impending storm) and thyroglobulin antibody (TgAb) was 16.1 IU/L (0-1.75). Her medications were PTU loading then switched to methimazole, intravenous hydrocortisone total 1 day and propranolol. Her clinical conditions had been observed for two days then she was discharge without complications. Her appendectomy wounds were completely healed, and the pathological report was ruptured appendix. The written informed consent of publication for the case details in this report has been obtained. At 6 months, her clinical conditions improved. Her weight was regained, and her thyroid function test showed FT4 5.02 ng/dL, FT3 13.3 pg/mL and TSH <0.005 mIU/L. Her current medications were methimazole (5) 3 tabs per oral bid and propranolol (40) 1-tab po bid. She was followed up at endocrine clinic regularly every 3 months.

Discussion

Thyrotoxicosis is a common problem of endocrine disorder [2]. The common cause of hyperthyroidism is Graves' disease that commonly occurs among female, aged 20-40 years. Prevalence of hyperthyroidism is 0.8% in Europe, and 1.3% in the USA. Thyrotoxicosis has many different causes both endogenous and exogenous [1]. Exogenous thyrotoxicosis is factitious or iatrogenic, develops after ingestion of excessive amounts of thyroid hormone, and is associated with low serum thyroglobulin concentrations. In this case report, she had many clinical conditions of thyrotoxicosis [1]. She received a diagnosis of Graves' disease due to high TgAb level. It could explain that she had subclinical Graves' disease. When she underwent CT of the abdomen with contrast-injection that excessed contrast-induced thyrotoxicosis, she showed clinical conditions of hyperthyroidism. It revealed that this event was very dangerous because it might lead to the thyroid storm at any moment since the preoperative until the postoperative period. Clinical features are similar to hyperthyroid symptoms such as palpitations, dyspnea, and weight loss [3].

The mechanism of iodine- or contrast-induced thyrotoxicosis can be explained in massive iodine exposure to the thyroid gland. Patients suspected of iodine-induced thyrotoxicosis need to receive iodine-contrast injection not exceeding 24 hours [4]. Iodine is used to synthesize thyroid hormones using sodium-iodine symporters at the thyroid follicles [5]. Large amounts of iodine can affect thyroid dysfunction. Diet, medications, or radiographic iodine-contrast media (ICM) are iodine excess sources [6]. Iodine-induced hyperthyroidism has been reported with as little as 300–500 μg of iodide. A typical dose of iodinated contrast medium contains about 13500 μg of free iodide and 15–60 g of bound iodine that may be liberated as free iodide in the body [4]. Exogenous iodine decreases thyroidal radio-iodine uptake both by dilution of the total body iodine pool, and by inhibiting the thyroid hormone synthesis via the Wolff- Chaikoff effect. Among patients with euthyroidism, exogenous iodine in large doses inhibits organification of iodide and thyroid hormone synthesis and may lead to hypersecretion of thyroid hormones, a phenomenon known as the Jod–Basedow effect [7,8].

Risk factors include nontoxic diffuse or nodular goiter, latent Graves' disease, and long-standing iodine deficiency [9]. Generally, for patients suspected of ICM-induced thyrotoxicosis, their serum TSH concentrations will be suppressed, and T4, FT4 and/or total T3 concentrations may be elevated. Once contrast-induced hyperthyroidism is diagnosed, further excess iodine exposure should be avoided. In this case, we suspected iodine-induced thyrotoxicosis with undiagnosed Graves' disease that was confirmed by TgAb. When a patient develops amiodarone or iodine-induced thyrotoxicosis, distinguishing between the two forms of thyrotoxicosis would be extremely important. Type I usually occurs when patients with an underlying euthyroid nodular goitre or latent Graves' disease are exposed to the high iodine content of amiodarone. This exposure leads to excess thyroid hormone synthesis and release, similar to iodine-induced hyperthyroidism among patients

receiving excess iodine from other sources. It can be treated with antithyroid drugs but type II constitutes a destructive thyroiditis caused by a direct toxic effect of amiodarone on thyrocytes. This form is usually self-limiting and, when necessary, amiodarone can be continued [1]. However, the Contrast Media Safety Committee of the European Society of Urogenital Radiology has concluded that routine monitoring of thyroid function before contrast-injection among patients with a normal thyroid is not indicated. However, high risk patients, i.e., those with a history of Graves' disease or nodular goiter, especially the elderly or those residing in areas of dietary iodine deficiency, should be carefully monitored after iodinated contrast studies [10]. This includes patients, particularly unable to tolerate thyroid dysfunction, such as those with underlying unstable cardiovascular disease. CT scanning is being used much more frequently in the acute care setting. A study in one emergency department revealed that from 2000 to 2005, CT scanning of the chest increased by 226%, and of the abdomen by 72% [11]. Prompt diagnosis of thyrotoxicosis, along with awareness of the interference of intravenous contrast with use of radioactive iodine and the frequency with which this occurs, may prevent unnecessary CT scans among some patients. Therefore, it might lead to increased incidence of ICM-induced thyrotoxicosis and produce severe thyrotoxicosis or the thyroid storm. However, thyroid storm is a rare disorder. The incidence is 0.2 per 100,000 person-years in Japan and occurs in 1-5% of patients admitted to a hospital for thyrotoxicosis. It constitutes an emergency with a high mortality rate of 8–25% [12]. The pathogenesis of the thyroid storm is still poorly understood. Diagnosis is clinical and based on the presence of hyperthyroidism in a patient with severe and life-threatening manifestations [1]. To make the diagnosis, Burch and Wartofsky proposed a scoring system, modified by Akamizu and colleagues [12]. A multidisciplinary treatment approach should be used. Goals of treatment are lowering thyroid hormone synthesis and secretion, reducing circulating thyroid hormones, controlling peripheral effects of thyroid hormones, and treating any precipitating illness [1].

In conclusion, the clinical clues of thyrotoxicosis remain very crucial. To prevent the thyroid storm is the goal of treatment of patients with thyrotoxicosis especially patients undergoing surgery. Widespread use of radiologic investigations and interventional procedures is important and can increase the incidence of contrast-induced thyrotoxicosis especially among high-risk patients. Clinicians need to prompt manage thyrotoxicosis and prevention the thyroid storm using a multidisciplinary team.

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