

**Hong Kong College of Physicians**  
**Case Report for Interim Assessment**  
**Specialty Board of Advanced Internal Medicine (AIM)**

For AIM Training, case reports should be submitted in the prescribed format together with the application form for Interim Assessment at least EIGHT Weeks before the date of Interim Assessment

Name of candidate (print and sign):
Hospital and Unit:
Specialty:
Name of supervisor (print and sign):
Date(s) and place (hospital) of patient encounter: 5 <sup>th</sup> – 14 <sup>th</sup> May 2021
Date of report submission: 12 <sup>th</sup> September 2021

**Case report**

**Note: Failure to follow the prescribed format (including the number of words) results in a FAILURE mark (score between 0 and 4) for the Case Report.**

**Title: A case of thyroid storm**

**Case history:**

A 38-year-old lady presented to the emergency department with a week history of breathlessness, palpitations and bilateral lower limbs oedema. She also had a month history of irritability, insomnia, hand tremors, increasing bowel opening frequency and weight loss of approximately 5kg despite appetite was increased. She had no chronic medical illness and was not on any medications. On admission, she was afebrile and had a blood pressure of 110/56 mmHg. Her pulse rate was 126 beats per minute and her respiratory rate was 25 breaths per minute. She was dyspneic, sweating, tremulous with pressure of speech. Her thyroid gland was diffusely enlarged, bruit was heard over the goiter. There was no palpable retrosternal extension. She had bilateral fine hand tremors and sweaty palms, but she had no exophthalmos and no ophthalmoplegia. Her jugular venous pressure was not raised. Fine crepitation over bilateral lung bases was heard on auscultation. There was bilateral lower limb oedema up to her mid-shin.

Her initial blood tests showed normal complete blood count, electrolyte,

liver, and renal function tests. Free thyroxine (fT4) was 51.4pmol/L (reference range: 9-19 pmol/L), Thyroid Stimulating Hormone was less than 0.01mIU/L (reference range: 0.35-4.94 mIU/L). Anti-thyroid peroxidase antibodies was 102.99 IU/mL (reference range: < 4.11 IU/mL) and anti-thyroglobulin antibodies was more than 1000 IU/mL (reference range: < 5.61 IU/mL). Chest X-ray showed bilateral blunted costophrenic angle and upper lobe diversion. Electrocardiogram showed sinus tachycardia. Ultrasound of thyroid gland revealed diffuse thyroid heterogeneity consistent with thyroiditis. Echocardiogram showed good left ventricular ejection fraction. Her Burch Wartofsky Score on admission was 45 (agitation 10 + tachycardia 15 + heart failure 10 + precipitating event 10), which was diagnostic of thyroid storm.

She was admitted to the Intensive Care Unit (ICU) for thyroid storm management. She was initially treated with oral propylthiouracil (PTU) 200mg every 4 hours, oral propranolol 20mg every 4 hours, intravenous hydrocortisone 100mg every 6 hours and oral 5% Iodine and 10% Potassium iodide solution (Lugol's solution) 8 drops every 6 hours to control thyrotoxicosis and to prevent worsening of heart failure which was believed to be related to thyrotoxicosis. Her symptoms improved and was discharged to general ward after 3 days of ICU care. Hydrocortisone and Lugol's solution were weaned off. PTU was switched to Carbimazole. She was discharged home one week later and has since been followed up at the thyroid clinic for further titration of medications.

Upon thyroid clinic follow up 4 weeks after discharge, she was clinically euthyroid and her free T4 level was 15.8 pmol/L. The dosage of carbimazole was being tailed down gradually. She opted for radioactive iodine therapy for definitive management to prevent a future recurrence of thyrotoxicosis.

### **Discussion and literature review**

Thyroid storm is an uncommon but potentially life-threatening presentation of thyrotoxicosis. A recent study in Taiwan showed the incidence of thyroid storm among patients with thyrotoxicosis was 0.55 per 100,000 persons per year, and the prevalence of thyroid storm was 1.48%.<sup>1</sup> The mortality rate of thyroid storm patients was up to 30%.<sup>2</sup>

Thyroid storm mostly affects middle-aged females with a female to male ratio of 3:1. The most common underlying predisposing factors of thyroid storm in individuals with thyrotoxicosis are sepsis, non-compliance to anti-thyroid medications, recent surgical procedure, including thyroid and parathyroid surgery.<sup>2</sup> Patient presented as severe classical symptoms of hyperthyroidism, as well as more life-threatening conditions such as arrhythmia, congestive heart failure, and neuropsychiatric manifestations, namely agitation, restlessness, delirium, mental aberration, psychosis, somnolence, convulsion, or coma. Like our patient, she presented to us because of tachycardia and congestive heart failure. In a national survey for thyroid storm patients in Japan, 76% of thyroid storm patients developed tachycardia over 130 beats per minute, and 39.4% of patients presented with congestive heart failure. Neuropsychiatric symptoms affected 84.4% of patients.<sup>3</sup>

The diagnosis of thyroid storm is mainly based on the presence of severe symptoms in a patient with thyrotoxicosis. There is no validated diagnostic criteria. The mostly used scoring tool is Burch and Wartofsky score (BWS), which has been applied for nearly 3 decades. It consists of 6 categories, including body temperature, central nervous system involvement, congestive heart failure, tachy-arrhythmia, gastrointestinal-hepatic dysfunction, and precipitating factors. The total score is 115 and a score of 45 or above is diagnostic of thyroid storm, while score between 25 to 45 is impending thyroid storm. Japanese Thyroid Association (JTA) system is another commonly used clinical criteria for thyroid storm diagnosis with similar inclusion criteria.<sup>3</sup> In a retrospective cohort study comparing two diagnostic score involving 25 patients with thyroid storm, 5 of them was in impending thyroid storm if BWS were applied, while they were not suspicious for thyroid storm if JTA system were applied. Thus, BWS criteria might be more sensitive to diagnose thyroid storm compared to JTA system.<sup>4</sup> Our patient's BWS on admission was 45, which was diagnostic of

thyroid storm according to the BWS system.

Patient with thyroid storm should be fully supported in intensive care unit since the mortality rate is considerable. The treatment of thyroid storm typically consisting of multiple medications, including beta blockers, thionamides, non-ionized iodine, glucocorticoid and bile acid sequestrants.

Beta-blocker is used to dampen the adrenergic tone and relieve hyper sympathetic symptoms. Propranolol is commonly used as it contains D-propranolol isomer which inhibits peripheral T3 formation by inhibiting 5'-deiodination, and this effect is not seen in other beta-blockers.<sup>5</sup> Common starting dose is oral propranolol 60mg every four to six hours. Esmolol is another commonly used beta-blockers for thyroid storm. The elimination half-life of esmolol and propranolol are 9 minutes and 2.3 hours respectively, the short half-life of esmolol enables the clinician to react quickly according to the rapid change in clinical condition. Also, esmolol maybe preferred in patients with risk of bronchospasm because it is beta-1 selective, which is not causing bronchospasm.<sup>6</sup>

Thionamides, such as PTU and imidazole, is also the main stem of treatment. Thionamides blocks the formation and release of thyroxine (T4) from thyroglobulin. Usual starting dose of oral PTU is 200mg every 4 hours. PTU is usually preferred as it inhibits the peripheral conversion of T4 to T3 while this effect is not seen in imidazole. Serum T3 level drop by 45% after 24 hours of PTU treatment but only drop 10% after 24 hours of imidazole treatment.<sup>7</sup>

Non-radioactive iodine is used to inhibit the synthesis and release of new thyroid hormone by the Wolff-Chaikoff effect. Common dose is 5% Iodine and 10% Potassium iodide solution (Lugol's solution) 8 drops every 6 hours. However, Iodine must be administered at least 1 hour after thionamide administration in order to prevent from being used as substrate for new thyroid hormone synthesis. Thionamides should also be continued during iodine administration to avoid organification of iodine and thyroid hormone production.<sup>8</sup>

Corticosteroid is used as it inhibits the peripheral conversion of T4 to T3. In addition, it gives added benefits of possibly treating underlying autoimmune

disease like Graves' disease. Moreover, patients suffering from thyroid storm frequently complicated by hypothalamus-pituitary-adrenal axis failure. The use of systemic corticosteroid helps to prevent adrenal crisis.<sup>8</sup> The starting dose is usually intravenous hydrocortisone 100mg every 8 hours.

Bile acid sequestrants, such as cholestyramine, can be used as adjunctive therapy. Usual regimen is 4g oral cholestyramine for 4 times per day. This is because thyroid hormones are metabolized in the liver and excreted in the bile. Bile acid sequestrants can prevent recycling of thyroid hormones by interfering enterohepatic circulation.<sup>8</sup>

Lithium can also inhibit thyroid hormone synthesis. Because of its narrow therapeutic range and potential renal toxicity, lithium is used only when iodine is contraindicated.<sup>8</sup>

Plasmapheresis has been used to treat thyroid storms in patients who are not responsive to the above traditional treatment.<sup>8</sup>

The half-life of T4 is around 1 week, thus, initial therapy should be tailed down slowly after acute management for the maintenance of underlying disease. Glucocorticoids and iodine can be tapered and discontinued. Switching from PTU to imidazole is suggested. This is because the risk of agranulocytosis and liver toxicity is lower in imidazole. The agranulocytosis risk of patients using imidazole and PTU are 0.11% and 0.27% respectively, while the risk of liver failure are 0.03% and 0.05% respectively.<sup>9</sup> Moreover, imidazole has a longer serum and intra-thyroid half-life, such that single daily dose is possible for imidazole but not for PTU. However, for pregnant lady during the first trimester, PTU is preferred over imidazole because PTU is associated with less severe birth defects.<sup>9</sup>

Even disease is controlled, it is not uncommon to have disease relapse after a course of antithyroid drug therapy. Definitive treatment is suggested to prevent recurrence, including Radioactive Iodine (RAI) or surgical thyroidectomy.<sup>8</sup> A meta-analysis revealed a high relapse rate of 52.7% if patient on antithyroid drug therapy only, in comparison with RAI or surgery, the risk of relapse is 15% and 10% respectively.<sup>10</sup>

The main advantage of RAI is lack of surgical risk. However, it carries the

disadvantages of thyroid pain, sialadenitis, hypothyroidism requiring lifelong thyroxine replacement therapy, slower correction of hyperthyroidism, higher relapse rate and adverse effect of ophthalmopathy. It is contraindicated in pregnancy and those on breastfeeding, pregnancy should be postponed for 6 months after RAI. Also, close children contact should be avoided after RAI.

Surgical thyroidectomy is the alternative definitive treatment of thyroid storm. The advantages of total thyroidectomy include no recurrent hyperthyroidism, absence of radiation risk, rapid correction of hyperthyroidism and no adverse effect on Graves' ophthalmopathy. However, thyroidectomy bears a number of disadvantages including postoperative hypoparathyroidism, risk of recurrent laryngeal nerve palsy, permanent hypothyroidism requiring long term thyroxine replacement therapy, risk related to anesthesia and having a permanent surgical scar. The pros and cons of RAI and thyroidectomy had been discussed with our patient, she opted for RAI for definitive treatment eventually.

**Tables and figures** (where applicable) (no more than two figures)

Trend of serum thyroxine and medication titration

Days after first presentation	0	2	5	14	28	60	90
FT4 (pmol/L)	51	46	46	24	16	17	14
TSH (mIU/L)	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PTU (mg/day)	1200	800	/	/	/	/	/
Carbimazole (mg/day)	/	/	40	30	10	10	7.5
Lugol's solution (drops/day)	48	48	/	/	/	/	/
Hydrocortisone (mg/day)	300	300	150	/	/	/	/
Propranolol (mg/day)	120	30	30	30	15	15	10

**Reference** (not more than 10)

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**No of words in Case History and Discussion (excluding references):** 1609.

**(Should be between 1000-2000)**

**Declaration**

I hereby declare that the case report submitted represents my own work and adheres to the prescribed format. I have been in clinical contact with the case selected. The case report has not been submitted to any assessment board or publication and it is NOT related to my second specialty(ies), if any. My consent is hereby given to the College to keep a copy of my case report, in written and/or electronic, at the College Secretariat and allow the public to have free access to the work for reference.

\_\_\_\_\_  
(Signature of Trainee)

Endorsed by Supervisor \*

\_\_\_\_\_  
(Signature of Supervisor)

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