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Case Report

Thyroid storm in patient with uncontrolled hyperthyroid: a case-report

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ABSTRACT

Hyperthyroidism is a clinical condition which arise due to an increase of synthesis and secretion of thyroid hormone (TH) by the thyroid gland, and may lead to hyperthyroid crisis or thyroid storm which is a life-threatening emergency condition. Sudden discontinuation of anti-thyroid drugs influences the occurrences of thyroid storm. A 29-years-old female patient come to the emergency department with complaint of shortness of breath, cough, body weight loss, and palpitation. During hospitalization period, patient experienced symptoms of palpitation and seizure. The Burch-Wartofsky criteria score was ≥45 which consistent with thyroid storm. A multidisciplinary team approach is important in treating patient with thyroid storm.

Keywords: Thyroid storm, Hyperthyroid, Case report

INTRODUCTION

The thyroid gland produces THs which are hormones in the endocrinology system that play a role in increasing the basic metabolic rate (BMR), heart rate, muscle contractility, and muscle excitability and the central nervous system (CNS). The two main forms of THs are thyroxine (T4) and triiodothyronine (T3) which are excreted in a ratio of 20:1.[1] Hyperthyroidism is a clinical condition that results from an increase of TH production and secretion of by the thyroid gland.[2]

Hyperthyroid crisis or thyroid storm is a life-threatening emergency that can occur when a person with hyperthyroidism shows clinical manifestation of hyperthyroidism that are excessive from the usual complaints. Many factors can influence the occurrence of thyroid storm such as infection, trauma, radioiodine therapy, sudden discontinuation of anti-thyroid drugs, irregular medication, cerebrovascular disease, diabetic ketoacidosis, pregnancy toxemia, severe stress and emotional. Thyroid storm often occurs in patients with pre-existing Graves' disease or in patients who are not compliant with hyperthyroidism treatment. It primarily affects women, with an average age of 50 years.[3-5]

Establishing a diagnosis of thyroid storm is challenging because its clinical symptoms are similar to infectious diseases such as tachycardia, high fever, and also accompanied by shortness of breath. Thyroid storm needed early diagnosis and emergent treatment.[3,4] In thyroid storm, the cause of death is multi organ failure, respiratory failure, congestive heart failure, dysrhythmia, gastrointestinal (GI) perforation, disseminated intravascular coagulation (DIC), hypoxic brain injury and sepsis.[5] In this case report, we will discuss a 29-year-old female patient with thyroid storm due to uncontrolled hyperthyroid.

CASE REPORT

A 29-years-old female patient was presented to the emergency department with chief complaint of shortness of breath since the afternoon prior to admission. The complaint was said appeared suddenly when the patient was doing daily activity. The patient also complaint of

coughing in the last 1 week prior to admission accompanied with sputum. The patient also complaint of fever since 1 week prior to admission, accompanied with body weight loss around 6 kg in one month. Other than that, patient also experience palpitation which she felt since the afternoon prior to admission. Other complaints such as cold sweat, protrusion of the eye, trembling in the hand, lump on neck, nausea, vomiting, and headache were denied.

Previously on 2022, patient was hospitalized due to complaint of palpitations with EKG examination shown a SVT rhythm. She was then diagnosed with SVT et cause CAD and NSTEMI. The patient was treated with drip of amiodarone, bisoprolol, clopidogrel, aspilet and atorvastatin. The patient was then examined for TSH and FT 4 with the result of TSH 0,005 and FT4 4,47, therefore the patient was assessed with hyperthyroid. Patient was discharged with bisoprolol 1×2.5 mg, atorvastatin 1×20 mg, aspilet 1×80 mg, clopidogrel 1×75 mg, PTU 3×1 tab. Patient then didn't control for 6 months and did not took any medication for her thyroid. Patient come to the hospital on 2023 to control with complaint of palpitation and hand tremor and from examination it was found diffuse enlargement of thyroid. From USG colli examination was found a bilateral thyroiditis. Patient was given metimazol 1×10 mg, propranolol 2×10 mg, atorvastatin 1×20 mg, aspilet 1×80 mg, clopidogrel 1×75 mg. Patient was then loss of follow up since June 2023.

From the current admission, physical examination on the emergency room shown the patient was compos mentis with GCS E4V5M6, blood pressure 114/63 mmHg, pulse 93×/min, respiration 22×/min, temperature 36.3ºC and oxygen saturation was 98% on room air. Based on the general status, exophthalmos was not found in eyes. From the thyroid gland examination, it was found an enlarged of thyroid gland and bruit (+). No abnormalities found in cardiac, pulmonary and abdominal examinations. The extremities were warm, tremor on both hand +/+, CRT < 2 seconds and no edema was found.

Figure 1: Patient's neck from front view.

Additional examinations were performed on the patient including laboratory tests, electrocardiography (EKG), thorax x-ray, and colli ultrasound. From the laboratory examination, it was found WBC 4.84×10^3/Ul, Hb 13.3 g/dl, HCT 38.6%, PLT 241×10^3/Ul, SGPT 30 U/l, SGOT 27 U/L, urea 16 mg/dl and creatinine 0.3 mg/dl, blood glucose 127 mg/dl, Na 139 mEq/L, K 3.8 mEq/l and Cl 101 mEq/l. Thyroid function examination shown TSHs: <0.09 mIU/l and FT4 4.16 ng/dl. EKG examination shows a normal sinus rhythm. Thorax x-ray shows normal cardio thoracic ratio and pulmonary within normal limits. Form TCM examination, MTB was not detected. The patient was then assessed with lower respiratory tract infection, hyperthyroid and thyroid heart disease. Patient was given treatment metimazole 1×10 mg, cefoperazone 2×1 gr via intravenous, nebulization of combivent every 8 hours, and n-acetylcysteine 3×200 mg.

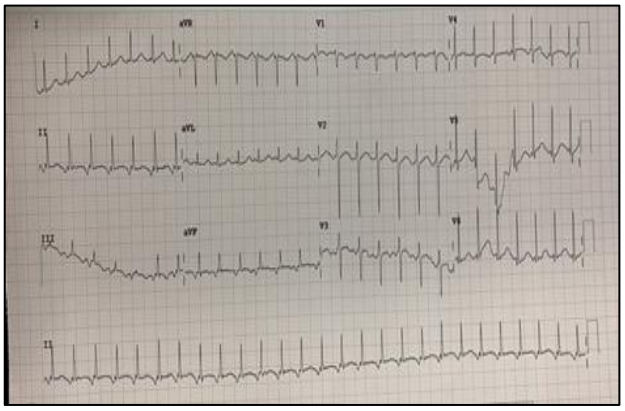

Figure 2: EKG of the patient on second day of hospitalization.

On the second day of hospitalization, patient start to feel palpitation, and from examination was found the heart rate was 167×/m, with blood pressure of 121/66 mmHg, and body temperature 36.7ºC. EKG examination shown result of atrial fibrillation with rapid ventricular rhythm. Patient was treated with drip of digoxin ½ ampule in 20 cc aquabidest drip in 30 minutes and continue with digoxin 1×1 tablet. On the afternoon of the second day, patient start to feel restless, and then start having convulsion, around less than 1 minute, after convulsion patient was conscious, but didn't remember about having convulsion. It was found the heart rate was 240×/m, blood pressure of 150/78 mmHg. Patient was given diazepam intravenous slow bolus. Patient was then stable with heart rate of 96×/m and blood pressure 147/72 mmHg, treatment of digoxin was stopped and replace with propranolol 1×20 mg, patient was also given citicoline 2×500 mg, phenytoin 3×1, omeprazole 1×1 vial, the metamizole was stopped and replace with PTU 5×200 mg, hydrocortisone 2×100 mg intravenous, patient was also planned to be given Lugol but it was unavailable in the hospital, and the patient was moved into ICU room. From this data, the total score of Burch-Wartofsky criteria in this patient was 70. A score of ≥45 indicates the presence of a thyroid storm; therefore, the patient was assessed with thyroid storm.

On the third day of hospitalization, patient have convulsion again, with stiffness of whole body, for less than one minute. After convulsion patient was conscious but restless and confused. From examination, heart rate was 180×/m, with blood pressure 118/72 mmHg, body temperature 37.6 C and blood sugar of 76 g/dl. Patient was given D40% 2 flash, drip of digoxin ½ ampule in 20 cc aquabidest drip in 30 minutes, phenytoin 3×100 mg, PTU 6×200 mg, propanolol 3×20 m. After given digoxin twice, patient heart rate return to normal.

Further examination was done on the patient. The patient serial EKG shown atrial fibrillation and CAD ischemic anterior. Patient undergo echocardiography examination with result of normal ejection fraction, global normo, RAP 3 mmHg. CT-head non-contrast shown no sign of bleeding, infarction, nor intracerebral and intracerebellar SOL. From coli ultrasonography examination**,** it was found a thyroiditis. Patient was assessed with lower respiratory tract infection, atrial fibrillation rapid ventricular response S. CAD ischemic anterior, observation of convulsion, thyroid storm and thyroid heart disease. The patient is planned to undergo TrAb examination, to determine the possibility of Graves' disease.

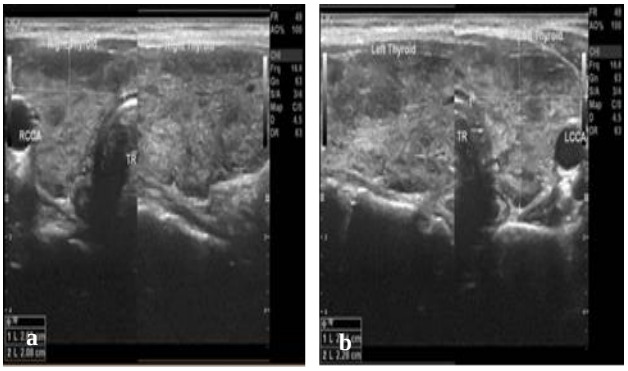

Figure 3 (a and b): Coli ultrasonography of the patient.

After 9 days of hospitalization, patient shown better sign of clinical and laboratory result and was allowed to discharged with PTU 3×200 mg, clopidogrel 1×75, propranolol 3×20 mg, digoxin 1×1/2-tab, n-acetylcysteine 3×1, cefixime 2×200 mg, phenytoin 3×100 mg, clobazam 2×5 mg, folic acid 1×1 mg.

DISCUSSION

Hyperthyroidism is a clinical condition which occurs due to an increase of TH synthesis and secretion by the thyroid gland. On the other hand, thyrotoxicosis is a clinical manifestation due to elevated TH levels. Hyperthyroidism commonly occurs due to toxic nodular goiter and Graves' disease (GD). Biochemical testing of TH and TSH is the essential in the initial diagnostic approach for individuals who based on their clinical presentation are suspected of hyperthyroidism or thyrotoxic crisis. Wayne' s index is a diagnostic index which may be useful in enhancing the accuracy of clinical assessments. This system has been developed since 1972 and have been aiding to the improvement of diagnostic accuracy of thyroid conditions. In overt hyperthyroidism, both serum free T4 and T3 are typically elevated, while serum TSH is either <0.01 mU/l or undetectable. Subclinical hyperthyroidism is characterized by normal serum free T4 and normal total T3 or free T3 levels, alongside a subnormal serum TSH concentration.[2,6] In this case, the patient was diagnosed with hyperthyroidism in 2022 based on laboratory examination which shown result of TSH 0,005 and FT4 4,47.

A thyroid ultrasound examination (US) will also be performed in addition to assessing thyroid function and measuring TSH-R-Ab levels. Some imaging examination can be done, such as radioactive iodine uptake (RAIU) and thyroid scanning, ultrasonography, and fine needle aspiration biopsy (FNAB). USG can assess the size of the thyroid by providing an approximate measure of tissue density, visualize vascular flow and velocity, also assist in guiding a needle for diagnostic purpose. Doppler studies may also be incorporated during the ultrasound procedure.[2] The thyroid ultrasound on this patient shown a thyroiditis.

Thyroid storm or crisis is a life-threatening complication that can occur in patients with hyperthyroidism. This condition can be triggered by acute events like a myocardial infarction, infection or other stress. It may also lead to complications such as atrial fibrillation, which increases the risk of stroke, as well as high-output heart failure. Individuals with inadequately treated hyperthyroidism or those who experience a disruption in their medication regimen are at higher risk for developing thyroid storm. Thyroid storm is a very dangerous, though rare, thyrotoxicosis. This is most common in young women, but can occur in men and all age groups.[7,8] While mortality rates in hospitalized patients have been reported as high as 75%, recent data indicate the mortality rates is closer to 10% to 30%, this indicate the importance of prompt diagnosis and urgent treatment.[1,6,9] In this case, the patient independently discontinued her hyperthyroid medication and has been loss of follow up since 2022. Additionally, factors like lung infection contributed to the occurrence of thyroid storm in this patient.

Thyroid storm can manifest as multiple organs decompensation with altered consciousness, heart failure, high fever, jaundice, and diarrhea. The severity of the symptoms is assessed using the Burch-Wartofsky point scale system, with a score total of ≥45 corresponding to thyroid storm, 25-44 points indicating imminent thyroid storm, and a score of <25 indicate unlikely thyroid storm. It is still not fully understood the exact mechanism that causes thyroid storm to develop in uncomplicated hyperthyroidism. However, an exaggerated response to TH is often thought to be involved, accompanied by increased of free hormones availability and binding to TH receptors.[6,7,9]

Table 1: Burch-Wartofsky criteria for thyroid storm.[5]

Criteria	Points
Temperature (ºC)	
37.2-37.7	5
37.8-38.3	10
38.4-38.8	15
38.9-39.4	20
39.4-39.9	25
≥40.0	30
Tachycardia (bpm)	
90-109	5
110-119	10
120-129	15
130-139	20
≥ 140	25
Atrial fibrillation	
Absent	0
Present	10
Congestive heart failure	
Absent	0
Mild	5
Moderate Severe	10 15
Gastrointestinal dysfunction	
Absent	0
Moderate (nausea/vomiting, diarrhoea, abdominal pain)	10
Severe (jaundice)	20
CNS disturbance	
Absent	0
Mild (agitation)	10
Moderate (delirium psychosis, extreme lethargy)	20
Severe (seizure, coma)	30
Precipitating event	
Absent	0
Present	10
Total score	
≥ 45	Thyroid storm
25-44	Impending storm
<25	Storm unlikely

The diagnosis of thyroid storm is primarily based on clinical signs and symptoms. Patient typically present with severe manifestations of hyperthyroidism, along with manifestations of multi-organ failure. Cardiac complications in hyperthyroidism can include tachycardia, palpitations, shortness of breath on exertion, exercise intolerance, widened pulse pressure, atrial fibrillation, or cardiac ischemia. Heart failure symptoms may develop due to the increased of cardiac output and associated tachyarrhythmia, and can lead to cardiovascular collapse and shock. Central nervous system involvement is almost always present and can range from delirium, agitation and confusion to stupor, lethargy, and coma. Additionally, patients may experience gastrointestinal symptoms such as profuse vomiting, nausea, and diarrhea.[4,7,9]

Table 2: Common presentation of thyroid storm.[5]

System	Sign and symptoms
Systemic	Fever
	Sweating
	Weight loss
Cardiovascular	Tachycardia (sinus tachycardia, atrial or ventricular fibrillation)
	Heart failure
	Wide pulse pressure, systolic hypertension
Gastrointestinal	Diarrhea, nausea, vomiting
	Abdominal pain
	Jaundice
Neurologic	Restlessness, tremor
	Agitation, delirium
	Confusion, stupor, coma
Other	Goiter
	Exopthalmus
	Evidence of partial thyroidectomy

High fever is a typical picture in most cases of thyroid crisis because in thyroid crisis there is an increase in BMR 2 times compared to the condition before the crisis. On physical examination found: signs and symptoms of hyperthyroidism either due to Graves or others, central nervous system disorders (such as delirium and coma), high fever up to 40C, tachycardia up to 130-200x/minute, often there is AF with a rapid ventricular response and can show congestive heart failure.[7] In this case, the patient has symptoms of thyroid storm such as weight loss, tachycardia along with atrial fibrillation, restlessness followed with convulsion on the second day of hospitalization. From this data, the total score of Burch-Wartofsky criteria in this patient was≥45 which consistent with thyroid storm.

The diagnosis of thyroid storm is primarily clinical. Although laboratory test may help to diagnose and choosing treatment, abnormalities found in these laboratory tests are not diagnostic. However, the degree of these abnormalities may reflect the severity of end-organ damage. There is no specific cutoff value of serum T4 or T3 that clearly distinguish uncomplicated thyrotoxicosis from thyroid storm. Examination of free T4, free T3 and TSH can be valuable in the intensive care unit (ICU) setting because various treatment and non-thyroid diseases can affect the results of these tests.[3,4,9]

A collaborative, multidisciplinary team approach is essential to ensure that patient with thyroid storm receive all possible therapeutic options. Treatment of hyperthyroidism include both PTU and methimazole, but PTU is preferred during thyroid storm due to its additional benefit of inhibiting the peripheral conversion of T4 to T3. These medications, however, need to be administered at significantly higher doses than those typically used for uncomplicated hyperthyroidism.[6,7,9] According to the latest American association of clinical endocrinologist

guideline for thyroid, a loading dose of 500 to 1000 mg of PTU is recommended, followed by 250 mg every 4 hours. Methimazole should be given in doses of 60 to 120 mg per day, divided doses.[9,10]

Table 3: Medical treatment to treat thyroid storm.[9]

Variables	Oral dose	Rectal dose	Intravenous dose
Propylthiouracil	Loading dose of 500-1000 mg followed by 250 mg every 4 hours	400-600 mg every 6 hours	10-30 every 6-8 hours
Methimazole	60-120 mg per day in 4-6 doses	20-40 mg every 6-8 hours	
SSKI	5 drops every 6 hours	250-500 mg every 6 hours	0.5 g every 12 hours
Lugol's solution	8 drops every 6 hours	80 drops per day/5-10 drops every 6-8 hours	
Sodium iodide	300 mg every 6-8 hours		
Lithium			
Propranolol	60-120 mg every 4-6 hours		50-100 mcg/kg/min
Esmolol			300 mg loading dose IV then 100 mg every 8 hours
Hydrocortisone			
Cholestyramine	1-4 g twice a day		

The administration of nonradioactive iodine in addition to thionamides. Once plasma iodide levels reach a critical threshold, nonradioactive iodine inhibit the binding of iodide to thyroglobulin in the thyroid gland, therefore reducing the synthesis of new TH. This mechanism, known as the Wolff-Chaikoff effect, is temporary, lasting between 26 to 50 hours, as the thyroid gland eventually adapts to or escapes the effects of prolonged iodide excess. Inorganic iodine can be given orally as Lugol's solution, administered every 6 hours of 8 drops or a saturated solution of potassium iodide every 6 hours in a dose of 5 drops (0.25 ml or 250 mg).[4,9]

Propranolol is the first-choice drug used as initial therapy in atrial fibrillation in thyroid patient, and can be given intravenously or orally. The dosage typically starts at 1 mg/minute, with additional doses given as needed until the desired effect is achieved.[1,7] Propranolol (20-40 mg every 6 h) or longer acting beta-blockers such as atenolol or bisoprolol, are effective in controlling adrenergic symptoms like tremor and palpitations, mainly in the early stages before anti-thyroid drug take effect. These beta-blockers also hinder the peripheral conversion of T4 to T3. Additionally, anticoagulation therapy with direct oral anticoagulants or warfarin for all patients with atrial fibrillation should be considered, depending on their CHA_2DS_2-VASc risk score.[6,8]

Administration of 100 mg hydrocortisone every 8 hours (or dexamethasone 2 mg every 6 hours) is essential in every treatment of thyroid crisis. The rationale for administration is due to steroid deficiency due to hyper metabolism and to inhibit peripheral conversion of T4. If the patient is refractory to the above therapy, plasmapheresis can be performed. After the triggering factors are overcome, the patient's response will generally improve within 24 hours, although some continue for up to a week. The prognosis is good if the diagnosis is made early with adequate treatment.[7]

In this case, the patient was given treatment of PTU 200 mg 5 times per day orally, hydrocortisone 100 mg twice a day via intravenous. Patient was also supposed to be given lugol but unfortunately it was unavailable. Following other symptoms such as atrial fibrillation, patient was treated along with cardiologist and was given digoxin ½ ampule in 20 cc of aquabidest drip in 30 minutes and propranolol 20 mg thrice a day. For the treatment of the convulsion, the patient was given citicoline 2×500 mg, phenytoin 3×100 mg, the patient was also treated and monitored in ICU room.

CONCLUSION

Patients with hyperthyroidism may develop a life-threatening complication known as thyroid storm or crisis. This condition most commonly occurs in patients who are not compliant with their treatment for hyperthyroidism. The Burch-Wartofsky point scale system can be used to diagnose thyroid storm in patient with hyperthyroidism. A multidisciplinary team approach is crucial in order to treat patient with thyroid storm and achieve good result in treatment.

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