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Case Report

Thyroid Storm Post-Radioactive Iodine Therapy

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Abstract

Background : Thyroid storm is an endocrine disorder emergency which has a high morbidity and mortality rates. The incidence of thyroid storm is seen in less than 10% of all hospitalized thyrotoxicosis patients. However, it has a high mortality rate, which accounts to 20–30% of the cases. It is important to diagnose early to facilitate appropriate immediate management, which can improve prognosis and clinical outcome in patients. Thyroid storm usually begins with precipitating factor. Thyroid storm precipitated by radioactive iodine therapy is rare.

Case Report : We report a rare case in a 28 year old female patient. Patient came with complaints of palpitations, nausea without vomiting, fever, >3x diarrhea, and shortness of breath after radioactive iodine therapy. The clinical presentation of thyroid storm is polymorphic that becomes a diagnostic problem as it can delay treatment and increase the risk of mortality. It is important to suspect a thyroid storm based on the patient's clinical presentation, because the diagnosis of thyroid storm is based more on the patient's clinical presentation. The existence of the Burch-Wartofsky scoring system facilitates the diagnosis of a thyroid storm. The total Burch-Wartofsky score in this patient based on the clinical presentation is 45, which is highly suggestive of thyroid storm.

Conclusion : Thyroid storm precipitated by radioactive iodine therapy is rare. The incidence of thyroid storm after administration of radioactive iodine therapy is 0.34 percent. Precipitating factors other than the administration of radioactive iodine therapy such as infection and discontinuation of antithyroid drug therapy can trigger a thyroid storm.

Keywords : thyroid storm, emergency, post radioactive iodine therapy

INTRODUCTION

Thyroid storm is one of the fatal manifestation that occur in patients with thyrotoxicosis. The incidence of thyroid storm in all hospitalized patients with thyrotoxicosis is approximately 10%, but the mortality rate from thyroid storm is 20–30%. Thyroid storm often begins with precipitating factor related to a previous thyroid disease. Radioactive iodine has been used to treat hyperthyroidism since 1946 and the treatment of choice for the majority of thyrotoxic patients, which has been shown to be highly effective and safe.[1] Thyroid storm precipitated by radioactive iodine therapy are rarely reported, but when they do occur, they are serious and often fatal.

Prompt and appropriate intervention starting with a proper diagnosis can provide good outcomes in patients with thyroid storm. High vigilance and the ability to recognize thyroid storm is very helpful in preventing the onset of a thyroid storm. This case concerns a patient diagnosed with a diffuse toxic goiter with thyroid storm after radioactive iodine therapy.

CASE REPORTS

Female patient, 28 years old, came to the emergency room on October 27, 2021 at 17.00 WIB with complaints of increasing chest palpitations after radioactive iodine therapy. The patient have been diagnosed with hyperthyroidism since 5 months before. Patient complained nausea without vomiting, fever accompanied by toothache since the previous 2 days. Complaints were accompanied by diarrhea as much as >3x/day and shortness of breath. There were no loss of consciousness, cough with phlegm, or pain when urinating. Physical examination of the patient was as follow: moderate illness with compos mentis consciousness, blood pressure of 134/74 mmHg with regular pulse rate 154x/minute, respiratory rate 26x/minute, and temperature: 38.3°C. Exophthalmos in the eye and palpable diffuse enlargement of the thyroid gland in the neck was found. There was no increase in jugular venous pressure and no leg edema was seen in the patient. The results of the EKG examination showed sinus tachycardia and anteroseptal ischemia. The Burch-Wartofsky scoring system for the diagnosis of thyroid storm shows a total score of 45 points (Table 1), which supports highly suggestive thyroid storm diagnosis.

Laboratory investigations showed Hb levels of 11.6 g/dl (N=12.3–15.3), hematocrit 34.5% (N=36.0–45.0), erythrocytes 4.52 million/µL (N =4.5–5.1), leukocytes 16,540/uL (N=4400–11300) and platelets 220,000/uL (N=150,000-450,000), random blood sugar level 155 mg/dL (N = <140). Urinalysis results showed glucose +1 (N=negative). No bacteria were found on microscopic examination of urine and no amoebae or worm eggs were found on routine stool examination.

When arriving at the Nuclear Medicine Department, the patient came with complaints of palpitations, often feeling hot, losing weight dramatically in 1 year, defecating 4x/day, hair loss, hand tremors, emotional lability, difficulty sleeping, no regular menstruation, weak limbs, complaints of protruding eyes. There was no history of hypertension, diabetes, asthma or allergies. The patient routinely took Thyrozol 2x10 mg and propranolol 3x10 mg since 6 months ago, but stopped taking the medicine since 4 days ago. The patient brought laboratory results on July 23, 2021 showing thyroid hormone levels FT4 = 88.18 (N=9-20) and TSH = <0.05 (N=0.35–4.94). Then a re-check investigation of thyroid hormone levels was carried out at the Nuclear Medicine Department on October 25, 2021, showing TSH levels <0.0083 (N=0.55–4.94) and FT4 levels >5.00 (N=0.70–1.48). The patient received radioactive iodine therapy at the Department of Nuclear Medicine with a dose of 10 mCi of NaI–131.

The result of the thyroid scan in the Department of Nuclear Medicine showed a diffuse toxic goiter (Figure 1).

TABLE 1
Calculation Burch-Wartofsky scoring system for the diagnosis of thyroid storm in patients

Checklist		
Temperature	38.3°C	10
Tachycardia	154x/minute	25
Fibrillation	No	0
Congestive Heart Failure	No	0
Gastrointestinal Dysfunction	Diarrhoea, Nausea	10
CNS disorders	No	0
Triggers	Yes	10
Total Score		45

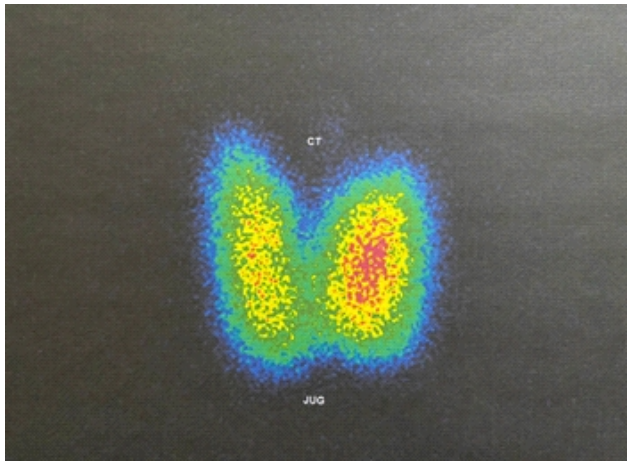

Figure 1.
Thyroid Scintigraphy Shows Diffuse Toxic Goiter

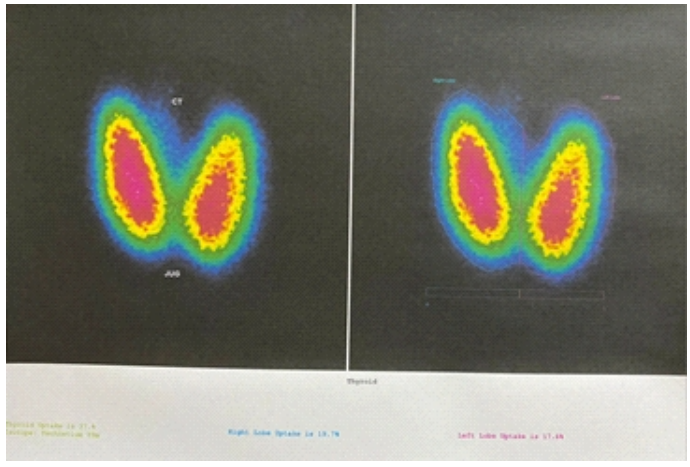

Figure 2.
Thyroid Uptake Test with a High Uptake Result

	Points		Points
Temperature °F (°C)		**Cardiovascular Dysfunction**	
99-99.9 (37.2–37.7)	5	Tachycardia bpm	
100-100.9 (37.8-38.2)	10	90-109	5
101-101.9 (38.3-38.8)	15	110-119	10
102-102.9 (38.9-39.4)	20	120-129	15
103-103.9 (39.4-39.9	25	130-139	20
≥104 (≥40)	30	>140	25
CNS Effects			
Absent	0	CHF	
Mild (agitation)	5	Absent	0
Moderate (delirium, psychosis)	10	Mild (pedal edema)	5
Severe (seizure, coma)	15	Moderate (bibasilar rales)	10
Gastrointestinal-hepatic dysfunction		Severe (pulmonary edema)	15
Absent	0		
Moderate (diarrhea, n/v, abd pain)	10	Atrial Fibrillation	
Severe (Jaundice)	20	Absent	0
Precipitating History		Present	10
Absent	0		
Present	10		

A score > 45 is highly suggestive of thyroid storm. Scores between 25-44 are suggestive of impending thyroid storm. A score <25 is unlikely thyroid storm.

Figure 3.
The Burch-Wartofsky scoring system for the diagnosis of thyroid storm

Figure 2 is the result of a thyroid uptake test in the Department of Nuclear Medicine, Hasan Sadikin Hospital, Bandung. The results of the uptake test value were 37% (the normal value of the thyroid uptake test at RSHS Bandung was 0.5–5%). The uptake value in the right lobe was 19.7%, while the uptake value in the left lobe was 17.6%.

DISCUSSION

Radioactive iodine has been used to treat hyperthyroidism since 1946. Since then, it was the treatment of choice for the majority of thyrotoxic patients, which has been shown to be highly effective and safe.[1] Thyroid storm precipitated by radioactive iodine therapy are rarely reported, but when they do occur, they are serious events and often fatal.

The clinical presentation of thyroid storm is sometimes polymorphic and becomes a diagnostic problem that can delay treatment and increase the risk of mortality. It is important to suspect a thyroid storm based on the patient's clinical presentation, as the diagnosis of thyroid storm is based more on the clinical presentation rather than laboratory test results. The existence of the Burch-Wartofsky scoring system could facilitate the diagnosis of a thyroid storm.[2-5] In this patient, a total score of 45 points (Table 1) supports a highly suggestive thyroid storm diagnosis.

TABLE 2
Studies with Large Number of Hyperthyroid Patients Treated with Radioactive Iodine

Study	Patients Treated with Radioiodine	Cases of Thyroid Storm	Severe Exacerbations
Nicholson *et al.* [22]	136	1	0
Christensen *et al.* [23]	50	1	0
Feitelberg *et al.* [24]	184	1	0
Rubenfeld *et al.* [25]	294	1	0
Nadler *et al.* [26]	86	1	0
Beierwaltes and Johnson [27]	330	4	10
Werner *et al.* [28]	525	1	6
Williams *et al.* [30]	111	0	3
Larsson [31]	370	0	2
Davis and Davis [32]	81	0	5
Cassidy and Astwood [34]	465	0	0
Chapman *et al.* [35]	343	0	0
Total	2.975	10 (0.34%)	26 (0.88%)

TABLE 3
Factors Precipitating Thyroid Storm

Several conditions have been reported to cause thyroid storm	
Thyroid gland surgery	Radioactive iodine therapy
Non thyroid surgery	Iodine contrast exposure
Traumatized	Discontinuation of antithyroid therapy
Excessive manipulation of the thyroid gland	Untreated Graves' disease
Thyroiditis	Infection
Labor	Hypoglycemia
Burns	Thyroid cancer metastases
Myocardial infarction	Molar pregnancy
Pulmonary embolism	Psychological stress
CVA	Strenuous physical activity
Drugs: anesthetics, salicylates, pseudoephedrine, and amiodarone	

Based on the literature, the pathophysiology of thyroid storm after administration of radioactive iodine (I–131) causes injury to thyroid follicular cells, which acutely releasing stored thyroid hormone into the circulation. Histopathological examination of the thyroid gland in the first two weeks after administration of radioactive iodine has shown epithelial swelling and necrosis, disruption of follicular structure, edema, and infiltration of polymorphonuclear leukocytes. Another study demonstrated a statistically significant increase in triiodothyronine and thyroxine levels 24 to 48 hours after administration of therapeutic doses of I–131 to a group of

hyperthyroid patients. This corresponds to the marked elevation in thyroid function test results found by Mazzaferri and Skillman. Free thyroid hormone levels are markedly increased in patients with thyroid storm compared to the uncomplicated group, possibly as a result of an acute decrease in thyroid-binding protein. How this mechanism relates to radioactive iodine-induced thyroid storm and other complications remains unclear. It should also be noted that other events, such as discontinuation of antithyroid drugs and violent palpation of the thyroid gland, both common at the time of administration of I–131, were also reported in previous studies to be precipitating factors in cases of thyroid storm. It is possible that this event may have been important, or at least contributed, to the development of subsequent complications radioactive iodine treatment that can not be ignored.[6,7]

Thyroid storm is a quite rare medical emergency, still unfamiliar and often overlooked by clinicians. Several other studies reported that out of 2,975 patients who were given radioactive iodine therapy, thyroid storm was reported in 10 patients (0.34 percent), while 26 patients (0.88 percent) were said to have experienced moderate exacerbations of thyrotoxic symptoms.

Thyroid storm triggers such as infection, stress, myocardial infarction, or trauma will amplify the effects of thyroid hormone by freeing thyroid hormone from its binding sites or increasing receptor sensitivity in tissues through upregulation of adrenergic target cell receptors or postreceptor modifications in signaling pathways.

Thyroid storm and severe exacerbations of thyrotoxicosis associated with I–131 treatment are rare, but must be kept in mind because of the high mortality rate. It is important to identify patients at risk before implementing preventive measures. High-risk patients include elderly, severe thyrotoxicosis, significant weight loss, and those with cardiovascular or cerebrovascular disease. The risk is lower in patients with other chronic diseases, such as diabetes mellitus and peptic ulcer disease, as well as those with severe dehydration and infection. Patients with very large goiter, multi-nodular goiter, and prolonged thyrotoxicosis are also a high-risk group. Several other conditions that can trigger a thyroid storm are presented in Table 3.[8-10]

Infection is one of the causes of fever, which can also trigger a thyroid storm. Infection is proven to be the most common precipitating factor for thyroid storm with an incidence rate of 28%.

The precipitating factor in this patient is the presence of infection on the teeth, which is consistent with a very high level of leukocytes i.e. 16.540/uL, while the normal level of leukocytes is between 4400–11300/uL. Based on the ATA guidelines in the diagnosis and management of hyperthyroid and thyrotoxicosis patients, patients at high risk for thyroid storm (patients with free T4 levels 2–3 times normal) are recommended to be administered methimazole and carbimazole antithyroid drugs as premedication. Discontinuation of antithyroid drugs before giving radioactive iodine therapy can also be a precipitating factor for thyroid storm.

Thyroid storm is usually be triggered by precipitating factors previously stated. In this case, it was also triggered by non-adherence to the treatment program, in which radioactive iodine therapy is initiated without proper preparation. Preparation before radioactive iodine therapy include stopping drugs or foods containing high iodine level at least 1 week in advance, stopping antithyroid drugs at least 5 days before. On the day of radioactive iodine administration, the patient must fast and may only eat one hour after administration of radioactive iodine therapy.

Several side effects that need to be considered after radioactive iodine therapy include exacerbation of thyrotoxicosis to thyroid storm. However, these side effects are rare. After 1 week follow-up post radioactive iodine therapy, dry mouth and swelling sensation on thyroid area usually has gone away on its own. Hypothyroidism that occurs after treatment can be transient (usually 3–6 months after treatment) or persistent (monitored by checking TSHs levels periodically every 3–6 months). The risk of hypothyroidism after radioactive iodine therapy with moderate doses is approximately 10% within the first 2 years, and approximately 3% each year thereafter. The higher the dose given, the earlier the occurrence and the higher the incidence of hypothyroidism. Treatment of hyperthyroidism with radioactive iodine is preferred in patients who are resistant to antithyroid drugs or have recurrent hyperthyroidism after thyroidectomy. There is no age limit for those who are allowed to receive this method of treatment as it has been proven not to interfere with fertility, and has no teratogenic, carcinogenic or leucomogenic effects. Thyroid storm after radioactive iodine therapy will occur due to the sudden leakage of thyroid cells. This condition needs to be protected with corticosteroids 1 week before RAI.[8-10]

CONCLUSION

Thyroid storm precipitated by radioactive iodine therapy is rare. The incidence of thyroid storm after administration of radioactive iodine therapy is 0.34 percent. The presence of precipitating factors other than the administration of radioactive iodine therapy, such as infection and discontinuation of antithyroid drug therapy, can precipitate the thyroid storm.

CONFLICT OF INTEREST

There is no conflict of interest.

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