

**A case of thyroid storm where the CT findings were the first clue****Hiromichi Ohsaka<sup>1</sup>, Yasuji Namiki<sup>1</sup>, Ryota Matsuoka<sup>2</sup>, Kentarou Tsuboi<sup>2</sup>, Kei Jitsuiki<sup>1</sup>, Toshihiko Yoshizawa<sup>3</sup>, Kouhei Ishikawa<sup>3</sup>, Youichi Yanagawa<sup>3</sup>**<sup>1</sup>Department of Acute Critical Care Medicine, Shizuoka Hospital, Juntendo University, Japan<sup>2</sup>Department of Emergency Medicine, Shimada Municipal Hospital, Japan<sup>3</sup>Department of Diabetes, Endocrinology and Metabolism, Shimada Municipal Hospital, Japan**\*Corresponding author**

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**Abstract:** A 15-year-old girl fell down a flight stairs. Upon arrival at our hospital, she was dazed with emotional incontinence. She had tachycardia (150 beats per minute), tachypnea and hypertension. She had swelling of the thyroid gland, upper abdominal discomfort without peritoneal stimulating signs, and no particular traumatic findings except for in the legs. Traumatic pan scan using CT was negative for trauma. However, CT demonstrated diffuse swelling of the thyroid gland with iso-low density compared to the surrounding tissues. We suspected that she had thyroid storm. Given that our hospital did not measure thyroid function, she was transferred to another hospital after correction of sinus tachycardia using beta blocker. After thyroid function analysis, she was diagnosed with thyroid storm due to Basedow disease. After medical treatment, she was discharged on Day 10 of hospitalization. Given that the CT density of the thyroid tends to correlate with the thyroid stimulating hormone level, checking the CT density and size of the thyroid may help diagnose thyroid disease when the levels of thyroid hormone cannot be measured immediately.**Keywords:** thyroid storm; CT; density.

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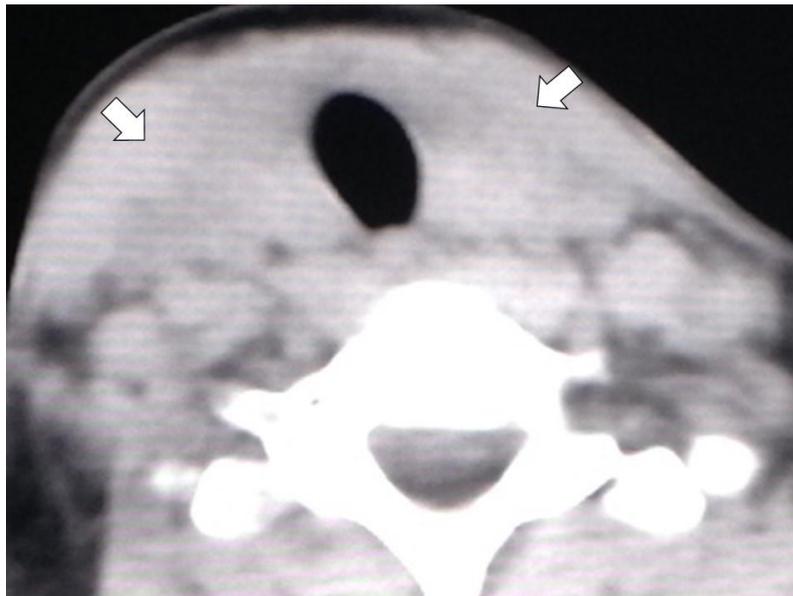
**INTRODUCTION**

Thyroid storm is a rare disorder with a sudden onset, rapid progression, and high mortality (over 10% even with proper treatment) [1-3]. To prevent a fatal outcome, early recognition of the disease and early treatment are essential [3, 4]. We herein report a case of thyroid storm where the computed tomography (CT) findings after trauma were the first clue to this disease.

**CASE REPORT**

A 15-year-old girl fell down a flight stairs while on vacation during a national holiday period. When emergency medical technicians checked her, she had consciousness disturbance, abdominal pain, and scabbling wounds on both legs. Her medical and family history was unremarkable, but she had experienced palpitations and dizziness when she experienced these symptoms every instance in the past year. Upon arrival at our hospital (not her local hospital, but near her vacation spot), her Glasgow Coma Scale score was 13, with emotional incontinence, and she had isochoric reactive pupils. She had a blood pressure of 150/84 mmHg, a heart rate of 150 beats per minute (BPM), a respiratory rate of 38 BPM, an SpO<sub>2</sub> of 100% in room air, and a body temperature of 36.9 °C. As the physiological findings, she had swelling of the thyroid gland, upper abdominal discomfort without peritoneal stimulating signs, and no particular traumatic findings except for in the legs. Focus assessment sonography for

trauma was negative, and her cardiac motion was hyperkinetic. The results of a biochemical analysis of the blood revealed only an increased creatinine phosphokinase level (217 IU/L). Traumatic pan scan using CT was negative for trauma. However, CT demonstrated diffuse swelling of the thyroid gland with iso-low density compared to the surrounding tissues (Figure 1). After excluding traumatic intracranial lesions, we suspected that she had thyroid storm because she had unexplainable marked sinus tachycardia disproportionate to trivial trauma and was dazed with emotional incontinence, in addition to the thyroid findings on CT. Given that our hospital did not measure thyroid function on national holidays and she was on vacation, away from her local hospital, she was transferred to another hospital nearer to her home where her thyroid function could be measured, after correction of sinus tachycardia using beta blocker. The thyroid function analysis revealed the following: free T<sub>3</sub> of 3.9 ng/dl (normal range: 0.9-1.9 ng/dl), free T<sub>4</sub> of 16.5 pg/dl (normal range: 2.5-4.5 pg/dl) of free T<sub>4</sub>, and thyroid stimulating hormone (TSH) of 0.01 ng/ml (normal range: 0.44-4.95 ng/ml) ng/ml. Given her TSH receptor antibody level of 21.7 IU/L (normal range: <2.0 IU/L) and anti-thyroid antibody level of 201.8 IU/mL (normal range: <28.0 IU/mL), she was diagnosed with thyroid storm due to Basedow disease<sup>1</sup>. After medical treatment, she was discharged on Day 10 of hospitalization.



**Fig 1: Cervical computed tomography (CT) on arrival**

The CT shows diffuse swelling of the thyroid gland with iso-low density in comparison with the surrounding tissues (arrow). The average CT number of the thyroid was 50 Hounsfield units.

#### DISCUSSION

We initially suspected that the present case had head trauma when she fell down the stairs, but she did not have any headache, and the head CT findings were unremarkable. However, she satisfied the diagnostic criteria of thyroid storm induced by deterioration of Basedow disease that had developed at least one year prior. Accordingly, the possibility of a cerebral concussion was excluded, and she was diagnosed with thyroid storm. Given that the reason for her travels had been to meet her boyfriend's mother for the first time, emotional stress and/or trauma due to the fall might have triggered the development of thyroid storm.

Kaneko *et al.*; reported on the clinical evaluation of thyroid CT values under various thyroid conditions [5]. They investigated the CT number (mean Hounsfield units [HU]  $\pm$  SD) concerning the region of interest (ROI) obtained from CT images of the thyroid. The values were  $112 \pm 10$  HU in 44 normal cases and  $58 \pm 4$  HU in 13 untreated cases and  $73 \pm 7$  HU in 13 treated cases of 26 cases of hyperthyroidism. Twelve cases of chronic thyroiditis and 5 cases of hypothyroidism showed CT values of  $57 \pm 11$  and  $36 \pm 13$  HU, respectively. The results of the above-mentioned clinical study indicate the utility of the estimated CT value of the thyroid for diagnosing various thyroid conditions. Pandey *et al.*; also recently investigated the correlation between CT density (number) and the functional status of the thyroid gland [6].

In their study, both the low- and high-TSH groups' demonstrated significantly decreased thyroid CT densities compared with the normal TSH group ( $P < 0.0001$ ). A significant positive correlation was observed between thyroid CT densities and TSH levels ( $r = 0.40$ ;  $P < 0.0001$ ) for subjects with a TSH level of  $<3.0$   $\mu$ IU/mL, and a significant negative correlation ( $r = -0.66$ ;  $P < 0.0001$ ) was observed for those with a TSH level of  $\geq 3.0$   $\mu$ IU/mL. In addition, Iida *et al.* reported that the mean density for normal controls ( $118.1 \pm 12.2$  HU) was significantly higher than the mean density in patients with diseased thyroids, except for 2 cases of simple goiter [7]. In addition, they observed a significant correlation between thyroid CT density and the iodine concentration of the tissue ( $r = 0.889$ ;  $p$  less than 0.001). The normal thyroid tends to absorb iodine to produce thyroid hormone. Iodine has an enhancing effect when a CT examination is performed, giving the normal thyroid higher density than the surrounding tissues; in contrast, hypothyroidism or subacute thyroiditis with cell destruction inducing temporary hyperthyroidism reduces the production of thyroid hormone. As a result, less iodine is absorbed, and the density of the thyroid decreases on CT. Hyperthyroidism induced by Basedow disease increases the uptake of the iodine, but the iodine in the thyroid tissue may become tapped out, due to overproduction of thyroid hormone. As a result, the CT density paradoxically decreases under conditions of hyperthyroidism induced by Basedow disease. Further exacerbating the situation is the tendency among recent Japanese generations to consume less traditional Japanese foods such as seaweed, which contain abundant amounts of iodine [8]. This tendency may promote the production of iodine-insufficient thyroid tissues in Japanese patients with Basedow disease.

Based on the diagnostic criteria of thyroid storm established by Burch, the present case scored 35 points, which was suggestive of thyroid storm [3]. However, a lack of data on the thyroid hormone levels prevented a definitive diagnosis, resulting in a delay of commencing optimal treatments. Given that the CT density of the thyroid tends to correlate with the TSH level, checking the CT density and size of the thyroid may help diagnose thyroid disease when the levels of thyroid hormone cannot be measured immediately.

### **CONCLUSION**

Checking the CT density and size of the thyroid may help diagnose thyroid disease when the levels of thyroid hormone cannot be measured immediately.

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