CASE REPORT

Thyrotoxic crisis as an acute clinical presentation in a child

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SUMMARY

A previously well, 4-year-old girl presented with a 4–6 weeks' history of increased appetite, weight loss, tiredness, sleep difficulty, excessive sweating, swelling in the neck and new-onset 'prominent, protruding eyes.' Family history revealed paternal grandmother receiving treatment for hyperthyroidism. Clinical assessment demonstrated features of thyrotoxicosis (tachycardia, warm peripheries, small smooth goitre with no nodules, exophthalmos). TFT (Free T4=101 pmol/L, thyroid-stimulating hormone <0.05 mIU/L) with raised thyroid peroxidase antibody levels (TPO=541 IU/mL) confirmed autoimmune hyperthyroidism. Observation on the ward showed features of thyrotoxic crisis with persistent severe tachycardia on ECG (sinus tachycardia with left ventricular hypertrophy (LVH)) and hypertension. Ultrasound thyroid showed diffuse thyroiditis with no focal lesion. Echocardiogram confirmed the above findings. A diagnosis of Graves' disease with thyrotoxic crisis was made. Antithyroid treatment (carbimazole) and beta-blocker (propranolol) was commenced. Thyrotoxic crisis resolved over 2 weeks and the child has continued to respond to carbimazole treatment at 1-year follow-up.

Thyroid-stimulating hormone: <0.05 mIU/L (0.5–5.0)

Thyroid peroxidase (TPO) antibody: 541 IU/mL (0–60)

ECG: sinus tachycardia with left ventricular hypertrophy (LVH)

Echocardiogram: mild LVH

Thyroid ultrasound: diffuse thyroiditis with no focal lesion

DIFFERENTIAL DIAGNOSIS

There were many differentials for the initial presentation of lethargy. However, given the clinical features and other symptoms, the diagnosis of hyperthyroidism was high on the list and this was confirmed with results of the initial blood tests. The important issue was differentiating uncomplicated hyperthyroidism from thyrotoxic storm. Even though the overall appearance of this child was a well child, the high blood pressure, left ventricular hypertrophy and isolated raised bilirubin raised the suspicion of thyroid storm. This is further supported by the Burch-Wartofsky Point Scale¹ for thyrotoxicosis which, even though developed to be used in adults, was highly suggestive of thyroid storm in this patient.

BACKGROUND

Thyrotoxic crisis (also referred to as thyroid storm) is an acute, life-threatening, hypermetabolic state in children with thyrotoxicosis. This is fortunately extremely rare but can be an initial presentation in previously undiagnosed children, particularly neonates. Rapid diagnosis and prompt treatment are crucial as this condition can be fatal if left untreated.

CASE PRESENTATION

A previously well, 4-year-old girl presented with a 4–6 weeks' history of increased appetite, weight loss, tiredness, sleep difficulty, excessive sweating, swelling in the neck and new-onset 'prominent, protruding eyes.'

On examination, the child had features of thyrotoxicosis including resting tremor, tachycardia, hypertension, warm peripheries, small smooth goitre with no nodules and features of bilateral exophthalmos with no lid lag.

There was a family history of paternal grandmother receiving treatment for hyperthyroidism.

INVESTIGATIONS

Free T4: 101 pmol/L (normal 9–25)

TREATMENT

The child was commenced on the antithyroid drug carbimazole (20 mg once daily) and beta-blocker propranolol (10 mg three times a day). Further dose adjustments based on thyroid function tests can be seen in [table 1](#).

Currently, 10 months after initial diagnosis, she has remained well and euthyroid on a maintenance dose of carbimazole (5 mg OD). Propranolol was weaned from 3 months and stopped by 5 months where her cardiology status, including BP, was normal. The plan is to continue her on carbimazole for at least 2–3 years in the first instance before discontinuation.

OUTCOME AND FOLLOW-UP

Initial improvement in the cardiovascular parameters was noted within 5 days of treatment, with gradual improvement in other clinical signs and symptoms. [Table 1](#) summarises the results.

DISCUSSION

Thyrotoxicosis is a rare disorder of childhood with the UK annual incidence 0.9 per 100 000 children.² The incidence between the age of

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Table 1 Summary of the thyroid function tests and dose changes to medication

Timeline	Weight (kg)	Free T4 (9–25 pmol/L)	Thyroid-stimulating hormone (0.5–5.0 mIU/L)	Carbimazole dose	Propranolol dose
Presentation	17.8 kg	101.9	<0.05	20 mg OD	10 mg three times a day
Day 5	17.7 kg	30	<0.05	10 mg OM, 5 mg ON	10 mg three times a day
4 weeks	18.9 kg	14	<0.05	10 mg OM, 5 mg ON	10 mg three times a day
3 months	18.9 kg	8.7	<0.05	5 mg BD	5 mg three times a day
5 months	19 kg	12	5.4	5 mg OD	Weaned and stopped
10 months	19.9 kg	15	1.2	5 mg OD	None

0 and 4 years is estimated to be just 0.1 per 100 000, making this an important clinical case for the medical community. While this means many clinicians will not see a presentation like this in their careers, it is important for those that do to manage the patient correctly to prevent patient harm.

Thyrotoxicosis is a hypermetabolic state in which there is an increased level of circulating thyroid hormone.³ This leads to a higher energy demand and tissue oxygen consumption, resulting in symptoms such as lethargy, hyperphagia, weight loss and heat intolerance.⁴ This can lead to an increased cardiac output, characterised by tachycardia and hypertension³ in order to meet the raised metabolic demand.

The most common cause of thyrotoxicosis in children is Graves' disease (GD)⁵, which is thought to be six times more common in girls.⁴ This is an autoimmune disorder where the thyroid gland is stimulated by autoantibodies. Another feature of thyrotoxicosis, especially with GD, is the thyroid eye disease.⁶ This is less common in children than in adults and usually presents with a mild form of proptosis and soft tissue swelling.⁶ It should be noted that one important differential would be hashitoxicosis. This is a transient hyperthyroid state caused by destruction of thyroid follicles, subsequently releasing thyroid hormone. However, this tends to run a shorter course and only 5% of cases feature ophthalmopathy.⁷ While it is important to consider, our case study is more consistent with a diagnosis of GD given the positive TPO antibody and symptoms as described above, particularly with relation to the thyroid-associated ophthalmopathy. Based on the positive TPO and clear clinical features, no further antithyroid antibodies were measured in this patient. However, had there been diagnostic uncertainty, the highly specific thyrotropin receptor antibody would have been considered. This assay has become more specific in recent years and has been shown to predict the risk of relapse, helping to guide future management of patients.⁸

One of the most severe complications of thyrotoxicosis is thyrotoxic crisis, also known as thyroid storm. There is usually a precipitating event such as an infection, thyroid surgery or abrupt cessation of antithyroid medication.⁹ Interestingly, in our case, there was no known precipitant and this was the first presentation of thyrotoxicosis in this patient. Characteristic features of this life-threatening complication can include end-organ damage, seizures, hyperthermia, agitation, severe tachycardia and raised blood pressure, leading to cardiac failure.¹⁰ This is a rare but potentially fatal complication with an estimated mortality rate ranging from 10% to 30%.^{9 11} While there are no specific diagnostic criteria for children, the Burch-Wartofsky Point Scale¹ was highly suggestive of thyrotoxic crisis in our patient. This led to the rapid instigation of antithyroid medication, as well as propranolol for cardiovascular support.

The patient we have described is doing well on the antithyroid medication. However, many children require more

definitive treatment such as surgery or radioactive iodine.¹² This emphasises the point that these children require long-term multidisciplinary follow-up to detect complications or relapse early.

Learning points

- Thyrotoxic crisis (also referred to as thyroid storm) is an acute, life-threatening, hypermetabolic state in children with thyrotoxicosis. This is fortunately extremely rare but can be an initial presentation in previously undiagnosed children.
- A high index of suspicion, rapid diagnosis and prompt treatment is crucial as this condition can be fatal if left untreated.
- A multidisciplinary follow-up is important to ensure that the patient experiences a holistic approach to their care. An ECG is essential along with the blood pressure and should be discussed with cardiology. Furthermore, exophthalmos should be assessed by an ophthalmologist.

Contributors AB was the doctor who clerked and assessed this child on admission. He has searched the literature to ensure an accurate summary within the discussion and has written up the whole case study. SS is the consultant who cares for the patient. She has reviewed the case study and made amendments to the sections prior to submission for publication.

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REFERENCES

- 1 Burch H, Wartofsky L. Life-threatening thyrotoxicosis. Thyroid storm. *Endocrinol Metab Clin*. 1993 <http://europepmc.org/abstract/med/8325286> (cited 15 Sep 2017).
- 2 Williamson S, Greene SA. Incidence of thyrotoxicosis in childhood: a national population based study in the UK and Ireland. *Clin Endocrinol* 2010;72:358–63.
- 3 Chantra M, Limsuwan A, Mahachoklertwattana P. Low cardiac output thyroid storm in a girl with Graves' disease. *Pediatr Int* 2016;58:1080–3.
- 4 Raine J, Donaldson M, Gregory J, et al. Practical endocrinology and diabetes in children. 2011 <https://books.google.co.uk/books?hl=en&lr=&id=tS10bNAJk1UC&oi=fnd&pg=PP12&dq=Practical+Endocrinology+and+Diabetes+in+Children.+Malden,+MA,+USA:+Blackwell+Publishing+Ltd%3B+2006&ots=evcwQw7Qi&sig=QpZVbjSRCiklrbMlbf7KZj9aGg> (cited 15 Sep 2017).
- 5 Rivkees SA. Controversies in the management of Graves' disease in children. *J Endocrinol Invest* 2016;39:1247–57.
- 6 Szczapa-Jagustyn J, Gotz-Więckowska A, Kocięcki J. An update on thyroid-associated ophthalmopathy in children and adolescents. *J Pediatr Endocrinol Metab* 2016;29:1115–22.
- 7 LaFranchi S. In: Geffner M, Hoppin A, eds. *Clinical manifestations and diagnosis of hyperthyroidism in children and adolescents*: UpToDate, 2016. <https://www.uptodate.com>.

- com/contents/clinical-manifestations-and-diagnosis-of-hyperthyroidism-in-children-and-adolescents#H18
- 8 Hesarghatta Shyamasunder A, Abraham P. Measuring TSH receptor antibody to influence treatment choices in Graves' disease. *Clin Endocrinol* 2017;86:652–7.
 - 9 Chiha M, Samarasinghe S, Kabaker AS. Thyroid storm: an updated review. *J Intensive Care Med* 2015;30:131–40.
 - 10 Lee HS, Hwang JS. Seizure and encephalopathy associated with thyroid storm in children. *J Child Neurol* 2011;26:526–8.
 - 11 Nayak B, Burman K. Thyrotoxicosis and thyroid storm. *Endocrinol Metab Clin North Am* 2006;35:663–86.
 - 12 Srinivasan S, Misra M. Hyperthyroidism in children. *Pediatr Rev* 2015;36:239–48.

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