

Massive levothyroxine ingestion in a pediatric patient: case report and discussion

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ABSTRACT

We describe the course of a toddler who ingested a massive amount of levothyroxine and review treatment options for such overdoses. A 2½-year-old boy presented shortly after an ingestion of up to 7.6 mg of levothyroxine (potentially as much as 700 µg/kg). He was initially asymptomatic, treated with oral charcoal 1 g/kg, and discharged home from the emergency department after a few hours. He returned approximately 24 hours later with a temperature of 38.5°C, heart rate of 163 beats per minute, respiratory rate of 30 breaths per minute, and blood pressure of 136/70 mm Hg. He had a slightly decreased appetite and no signs or symptoms of infection. He was admitted to hospital and treated with oral acetaminophen. The initial free thyroxine (T₄) was > 100 pmol/L and free triiodothyronine (T₃) was 35.3 pmol/L. The patient had desquamation of the palms and soles, hair loss, and irritability during the month following the ingestion. Resolution of the elevated free T₄ occurred by 12 days post-ingestion and normalization of the thyroid-stimulating hormone by 7 weeks post-ingestion. There were no long-term sequelae. Levothyroxine overdose can result in significant complications, including seizures and arrhythmias, both of which should be monitored for. However, as our case illustrates, massive ingestion of levothyroxine in children typically follows a benign course.

RÉSUMÉ

Nous décrivons le cas d'un jeune enfant ayant ingéré une quantité massive de lévothyroxine et examinons les options de traitement de surdoses de ce genre. Un garçon de 2 ½ ans s'est présenté à l'urgence peu de temps après avoir ingéré jusqu'à 7,6 mg de lévothyroxine (potentiellement jusqu'à 700 µg/kg). Au départ, il était asymptomatique. On lui a administré du charbon activé par voie orale (1 g/kg), puis on l'a renvoyé chez lui après quelques heures. Il s'est présenté de nouveau environ 24 heures plus tard. Il avait alors une température de 38,5 °C, une fréquence cardiaque de 163 battements par

minute, une fréquence respiratoire de 30 cycles par minute, et une pression artérielle de 136/70 mmHg. Son appétit avait légèrement diminué et il ne présentait aucun signe ou symptôme d'infection. Il a été hospitalisé et a reçu de l'acétaminophène (oral). La thyroxine (T₄) libre initiale était de > 100 pmol/L et la triiodothyronine (T₃) libre était de 35,3 pmol/L. Une desquamation de la peau de la paume des mains et de la plante des pieds, une perte de cheveux et une irritabilité sont apparues dans le mois suivant l'ingestion. La résolution de la T₄ libre élevée s'est produite 12 jours après l'ingestion et la normalisation de l'hormone de stimulation de la thyroïde 7 semaines après l'ingestion. Aucune séquelle à long terme n'a été observée. Une surdose de lévothyroxine peut entraîner des complications graves, y compris des convulsions et des arythmies, qui doivent toutes deux faire l'objet d'une surveillance. Toutefois, comme l'illustre notre cas, l'ingestion massive de lévothyroxine chez les enfants donne habituellement lieu à une évolution bénigne.

Keywords: children, emergency department, levothyroxine, overdose, pediatric, thyroid hormone, treatment

Hypothyroidism is a common condition and is managed with thyroid hormone replacement. In a cross-sectional study involving 25,862 participants, 5.9% were taking thyroid hormone replacement.¹ Levothyroxine is available in various coloured tablets and has no noxious taste, making it particularly attractive to young children. Typical doses of levothyroxine range from 2 to 15 µg/kg per day depending on age.²

In the 2008 annual report of the American Association of Poison Control Centers' National Poison Data System, 9,006 unique exposures to thyroid preparations were reported, with only 3 cases of a major adverse outcome and no deaths.³ Significant levothyroxine ingestions in children have been reported

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previously.⁴⁻¹² We report a case of a toddler with a particularly large levothyroxine ingestion and very few clinical findings. Written consent was obtained from the patient's family for publication of this case.

CASE PRESENTATION

A 2½-year-old boy presented to the emergency department (ED) with a history of levothyroxine ingestion. Approximately 45 minutes prior to ED presentation, the boy's mother found him on the floor with an empty prescription container for levothyroxine and 53 tablets missing (200 µg/tablet = 10,600 µg total). The medication container, which had a childproof top, had been left on a high breakfast bar and the boy had pushed a chair to the counter to reach it. Both parents were cooking in the kitchen and thought he was playing with a rattling toy. It is unclear how the boy managed to open the lid. The child's mother had recently filled the prescription and knew that approximately 83 tablets were in the bottle. Initially, 30 pills were found on the floor, leaving 53 tablets unaccounted for. Later in the day, a further search revealed approximately 15 more tablets in the living room. The exact amount of levothyroxine ingested is uncertain but was calculated to be a maximum of 38 tablets (7,600 µg), resulting in a potential dose of as much as 700 µg/kg.

On examination, the boy was alert, interactive, and happy. His vital signs were temperature 37.1°C, heart rate 106 beats per minute, respiratory rate 28 breaths per minute, blood pressure 87/60 mm Hg, and oxygen saturation 99% on room air. He weighed 11.6 kg, and his physical examination was normal. He was on no regular medications and had no allergies, and his immunizations were up to date. His past medical history was unremarkable aside from one episode of pyelonephritis at 1 year of age. His family history included maternal hypothyroidism.

The poison control centre was contacted and recommended charcoal treatment but no further intervention or investigations. The patient was treated with oral charcoal 1 g/kg approximately 1 hour post-ingestion. He remained asymptomatic and was discharged home from the ED after 3 hours with instructions to return if any new symptoms arose.

Approximately 24 hours after the levothyroxine ingestion, the patient was brought back to the ED after his mother noted that he had tachycardia, fever, irritability, agitation, and increased thirst. His vital signs were: temperature 38.5°C, heart rate 163 beats per minute, respiratory rate 30 breaths per minute, blood pressure 136/70 mm Hg, and oxygen saturation on room air 95%. He had a slightly decreased appetite and no signs or symptoms of infection. An electrocardiogram showed sinus tachycardia. The patient's free thyroxine (FT₄) level was > 100 pmol/L, and his free triiodothyronine (FT₃) level was 35.3 pmol/L (Table 1). He was admitted to hospital and treated with oral acetaminophen, dosed at 15 mg/kg, for his elevated temperature. No other medications were administered. The patient was discharged from hospital after 1 day. Normalization of the patient's FT₄ level occurred by 12 days post-ingestion and normalization of the thyroid-stimulating hormone by 7 weeks post-ingestion.

The patient developed desquamation of his palms and soles approximately 10 days after being in the hospital, which persisted for 2 weeks. He also had some hair loss and irritability during the month following the ingestion. No other significant sequelae from the ingestion were seen.

DISCUSSION

Our case is similar to other reports of massive levothyroxine ingestion (a *PubMed* literature search conducted using the key terms levothyroxine, ingestion,

Table 1. Laboratory results post-ingestion of levothyroxine

Test (reference range)	Day 1	Day 3	Day 12	Day 54
	Second presentation to ED (24 hr post-ingestion)	Prior to discharge from hospital	Outpatient	Outpatient
Free T ₄ (10.0–25.0 pmol/L)	> 100.0	> 100.0	23.1	18.2
Free T ₃ (3.8–6.7 pmol/L)	35.3	26.3	7.2	6.8
TSH (0.2–6.0 mU/L)			0.02	3.98

ED = emergency department; T₃ = triiodothyronine; T₄ = thyroxine; TSH = thyroid-stimulating hormone.

and overdose), in that the patient had only mild fever and tachycardia. He did not require any supportive therapy beyond acetaminophen for symptom relief. He did, however, have sequelae that persisted for approximately 1 month post-ingestion. This is in keeping with the half-life of levothyroxine of approximately 7 days.¹³ Although the onset of symptoms can be delayed up to 11 days, our patient developed symptoms 24 hours after his ingestion.¹³

Levothyroxine overdose in children typically follows a benign course. Patients may be asymptomatic or have symptoms including mild fever, tachycardia, hypertension, and irritability.^{4-6,8,13,14} Some cases involving seizures have been reported.^{12,15} In contrast, adults with massive levothyroxine ingestion typically have more severe symptoms, including cardiac arrhythmias, coma, and malignant hyperthermia.^{16,17} Some case reports suggest that adults with underlying comorbidity, including chronic renal failure and cardiac pathology, are more predisposed to develop severe arrhythmias

and decreased level of consciousness following levothyroxine ingestion.¹⁶ However, it is uncertain whether prediction of who is at risk of severe complications among patients who were previously well is possible.

A variety of potential treatments exist for acute levothyroxine ingestion (Table 2). Gastrointestinal decontamination for large ingestions of levothyroxine, in particular the administration of activated charcoal, can decrease systemic absorption if instituted within 1 hour post-ingestion.¹⁸ Given the typically benign clinical course in otherwise healthy children, asymptomatic children can be monitored at home following gastrointestinal decontamination. In cases with severe symptoms, such as decreased level of consciousness, seizures, arrhythmias, or symptomatic tachycardia, children should be monitored in hospital for cardiac or neurologic instability. Continuous electrocardiographic monitoring may be prudent in patients with cardiac symptoms or

Table 2. Treatment options for levothyroxine ingestion

Treatment	Proposed benefits/actions	Adverse effects
Conservative monitoring ^{10,11,18}	Benign clinical course in most cases Recommended for most cases when patient is asymptomatic or only mildly symptomatic	
Gastrointestinal decontamination ^{10,11,19,20} (eg, activated charcoal 1–2 g/kg PO ²)	Decreases systemic absorption Recommended if within 1 hr of ingestion ²⁰	Nausea/vomiting Aspiration pneumonia
Cholestyramine ^{7,13} (240 mg/kg/d in 3 divided doses ²)	Decreases systemic absorption by binding and enhancing elimination Consider if ingestion is recent	Nausea/vomiting Abdominal distention/pain
Beta-blocker ^{7,13} (eg, propranolol 1–2 mg/kg/d divided in 2–3 doses/day ²)	Decreases palpitations and tachycardia Consider if patient has symptomatic tachycardia	Bronchospasm Hypoglycemia Bradycardia
Propylthiouracil ⁷ (5–7 mg/kg/d in divided doses every 8 hr ²)	Decreases conversion of thyroxine (T ₄) to triiodothyronine (T ₃) Consider in addition to beta-blockers in severely symptomatic patients	Adverse drug reactions (eg, liver dysfunction, agranulocytosis, rash, joint pain)
Prednisone ^{7,13} (case reported of prednisone 2.8 mg/kg/d divided q 6 hr being given ⁷)	Decreases conversion of T ₄ to T ₃ Consider in addition to beta-blocker in severely symptomatic patients	Adrenal suppression and Cushing syndrome with long-term use
Sodium ipodate ^{9,13} (case reported of sodium ipodate [Oragrafin] 3 g/1.7 m ² being given as a single dose ⁹)	Decreases conversion of T ₄ to T ₃ Consider in addition to beta-blockers in severely symptomatic patients	Allergic reaction in people with iodine sensitivity
Charcoal hemoperfusion ²¹	Extracts excess T ₄ Consider only in cases of severe thyrotoxicosis with significant cardiac or neurologic symptoms	Invasive procedure
Plasmapheresis ¹⁶	Extracts excess T ₄ Consider only in extreme cases of severe thyrotoxicosis with significant cardiac or neurologic symptoms	Invasive procedure

underlying cardiac conditions such as pre-existing arrhythmias.

Supportive therapy, including acetaminophen for fever and beta-blockers for tachycardia, can be useful once symptoms appear. The potential benefits of administration of antithyroid medications (such as propylthiouracil or prednisone) or invasive procedures (such as charcoal hemoperfusion or plasmapheresis) must be balanced against the potential risks, and such modalities should therefore be considered only in cases of extreme thyrotoxicosis (see Table 2).

CONCLUSION

Levothyroxine is a common medication that can be attractive to young children as the pills are colourful and palatable. Levothyroxine overdose can result in significant complications, including seizures and arrhythmias, both of which should be monitored for. However, as our case illustrates, massive ingestion of levothyroxine in children typically follows a benign course.

Competing interests: None declared.

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