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ACUTE L-THYROXINE OVERDOSE; THERAPY WITH SODIUM IPODATE: EVALUATION OF CLINICAL AND PHYSIOLOGIC PARAMETERS

Paul D. Berkner, DO, Harold Starkman, MD, Nils Person, PhD

The Pediatric Endocrinology Center, Morristown Memorial Hospital, Morristown, New Jersey
Reprint address: Harold Starkman, MD, Morristown Memorial Hospital, 100 Madison Avenue, P.O. Box 1956, Morristown, NJ 07960-1956

☐ **Abstract — Two children with acute L-thyroxine overdose were treated with sodium ipodate, an oral cholecystographic agent. Initial thyroxine (T4) levels were elevated to 98.5 mcg/dL and 134.1 mcg/dL, with associated triiodothyroxine (T3) levels of 354 ng/dL and 402 ng/dL. T3 levels increased to a maximum of 662 ng/dL and 468 ng/dL. With administration of sodium ipodate, the T3 decreased with a simultaneous increase of rT3 level. Sodium ipodate effect lasted 72 hours. No toxic effect was noted. Interestingly, thyroid hormone levels correlated with systolic blood pressure but with no other physiologic parameter. Sodium ipodate appears to be a viable treatment modality for acute thyroid overdose in children.**

☐ **Keywords — sodium ipodate; thyroid overdosage; thyroid toxicity**

INTRODUCTION

Historically, the treatment of massive thyroid hormone ingestion has been an initial treatment of gastric emptying followed by activated charcoal. Many patients have then been admitted to the hospital for observation and administration of propylthiouricil to decrease conversion of thyroxine (T4) to triiodothyroxine (T3) and propranolol for relief of adrenergic symptomatology (1). In view of recent reported cases of minimal morbidity associated with massive ingestion of L-thyroxine (2–6), the role of potentially toxic therapy has been questioned (2–6).

We present two children with massive ingestions of L-thyroxine, successfully treated with sodium ipodate. During treatment, thyroid hormone levels were measured to further delineate the pharmacodynamics of L-thyroxine ingestion and the effects of therapy on physiologic parameters.

CASE PRESENTATION

J.O. and D.R. were 2.5- and 3-year-old white male and female cousins who were in good health until the morning of admission. At 9:00 AM the children were found after having ingested approximately 60 to 70, 0.2 mg L-thyroxine (Synthroid) tablets.

The children were brought to the emergency department 1½ hours post ingestion and underwent gastric lavage and administration of activated charcoal. Pill fragments were noted in the stomach contents of D.R. Initial vital signs are shown in Table 1. Physical examination of both children was normal, except for moderate irritability. Initial thyroid function tests 1½ hours after ingestion are shown in Table 2.

The children were admitted to the pediatric unit and vital signs were monitored every 4 h as were thyroid function tests.

Activated charcoal was again administered to both patients via nasal gastric tube 4 hours after ingestion. They were also given sodium ipodate (Oragrafin) 3 g/1.7 m^2 10 hours after ingestion in response to tachy-

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Table 1. Initial Vital Signs 1.5 h after Ingestion

	Temp. (C)	Pulse	B/P	Resp.	Weight (kg)
D.R.	36.6	156	105/84	26	10.23
J.O.	37.4	120	110/70	24	10.04

cardia, hypertension, and fever. They again required treatment for similar symptomatology 82 h after ingestion. At this time, they were given both sodium ipodate (Oragrafin) and 5 mg of propanolol.

The children did well in the hospital without further intervention. They were discharged 11 days after ingestion with follow-up by phone. An additional episode of diarrhea occurred 2 days after discharge.

METHODS

On admission and every 4 h subsequently, all vital signs were recorded and thyroid function tests (T4, T3U, TSH, T3RIA, and Reverse T3) were drawn. Thyroxine (T4), T3RIA, and TSH were measured by coated tube competitive binding RIA. The reagents used were Autopak T4 RIA kits (ICN Micromedic Systems, Inc., Horsham, PA) and were performed on a Concept 4 Analyzer (ICN Micromedic Systems). For samples exceeding the linear range of the assay, samples were assayed again following dilution with the 0 standard supplied with the reagents.

Reverse triiodothyronine levels were performed at Endocrine Sciences Laboratories, Tarzana, California, by competitive binding RIA.

Statistical analysis was performed on an IBM main frame 370 VM/CNS computer, using the SAS (Statistical Analysis System) programming package (7).

RESULTS

Thyroxine levels were initially very elevated and subsequently decreased to normal levels in a linear relation with respect to time (Figure 1). T3 by RIA was initially

Table 2. Initial Thyroid Function Tests 1½ h after Ingestion

	T4 (5–12 mcg/dL)	T3U (.88–1.33)	RT3 (80–120 ng/dL)	T3RIA (80–120 ng/dL)
D.R.	98.5	.96	—	354
J.O.	134.1	1.01	155	402

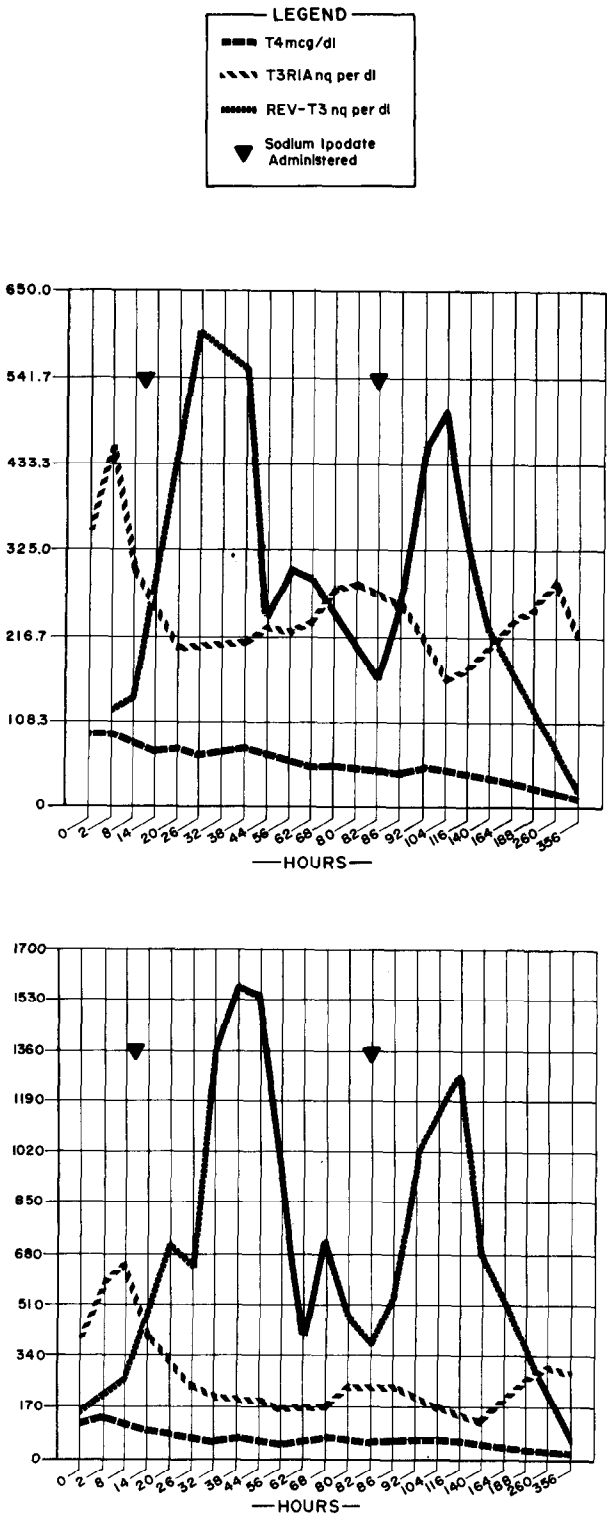

Figure 1. Thyroid function tests: A. Subject D.R.; B. Subject J.O. (T4 levels are expressed as mcg/dL; T3RIA and Reverse T3 are expressed as ng/dL.)

elevated. After administration of sodium ipodate, a sharp decline was noted within 6 h mirrored in an acute

increase of rT3. This effect was sustained until 72 h after sodium ipodate administration when a sharp increase in the T3 by RIA occurred with an associated decline in rT3 level. Pooled data calculated before the dose of propranolol showed levels of T3 by RIA and T4 to correlate with systolic blood pressure ($P < 0.05$). No other significant correlation with vital signs was noted.

TSH was persistently suppressed to unmeasurable levels during the time monitored.

DISCUSSION

Although thyroxine (T4) has little direct toxicity, peripheral conversion to triiodothyroxine (T3), a more biologically active hormone, is responsible for morbidity. Our patients presented after massive L-thyroxine overdosage with significantly elevated T4 and T3 levels. Interestingly, symptoms were consistent with only minimal toxicity. Analysis showed systolic blood pressure to correlate with elevated T3 levels ($P < 0.05$).

Sodium ipodate is an agent used for oral cholycystograms (8) that has recently been advocated as a safe and effective alternative for treatment of hyperthyroidism in adults (9–15) and infants (16). Sodium ipodate acts as an inhibitor of peripheral conversion of T4 to T3 by shunting T4 to reverse triiodothyroxine (rT3). Onset of action occurs within 6 h and lasts for 36 to 48 hours. Side effects are few and limited to patients who are hypersensitive to iodine compounds.

Our patients responded to sodium ipodate 1 g/kg with a decrease in the level of T3 and a concomitant increase in the rT3. As previously reported, the effect appeared to last for 72 h. Both children did well in the hospital requiring no further intervention. Interestingly, an additional episode of diarrhea occurred at the predicted nadir of sodium ipodate effect 2 days after discharge, but quickly resolved spontaneously.

Of late, controversy has developed regarding the most appropriate mode of therapy for acute ingestion of L-thyroxine, in view of reports of minimal morbidity and possible toxic effects of treatment. The use of sodium ipodate may represent a viable alternative to the use of propylthiouricil in patients with toxic ingestion of L-thyroxine. Additional clinical data will more clearly delineate those patients who will benefit from such therapy.

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