Clinical History

Patient

40-year-old male.

Chief Complaint

Pain and numbness in his legs along with persistent nausea.

Past Medical History

The patient has been using denture adhesive for years. The patient stated that he speaks for a living and cannot have loose teeth. Other wise, he was previously healthy.

Findings

The patient had difficulties flexing his feet. The patient was also suffering from gait problems.

Principal Laboratory Findings

Table 1

Table 1. Comprehensive Metabolic Panel

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		Ref
Glucose	95	65–100 mg/dL
BUN	15	8–25 mg/dL
Creatinine	1.1	0.8–1.4 mg/dL
Calculated BUN/creat	14	6–28
Sodium	140	133–146 mEq/L
Potassium	4.4	3.5–5.3 mEq/L
Chloride	104	97–110 mEq/L
Carbon dioxide	22	18–30 mEq/L
Calcium	10	8.5–10.5 mg/dL
Protein, total	7.6	6.0–8.4 g/dL
Albumin	4.7	2.9–5.0 g/dL
Calculated globulin	2.9	2.0–3.8 g/dL
Calculated A/G ratio	1.6	0.9–2.5
Bilirubin, total	0.4	0.1–1.3 mg/dL
Alkaline phosphatase	103	30–132 U/L
AST	10	5–35 U/L
ALT	24	17–56 U/L

BUN, blood urea nitrigen; AST, aspartate aminotransferase; ALT, alanine aminotransferase

Questions

1. What are this patient's most striking clinical and laboratory findings?
2. How do you explain these findings?
3. What are the principal causes of the most striking laboratory finding in this patient?
4. What is this patient's most likely diagnosis?
5. What laboratory test will be helpful in confirming the diagnosis?
6. What causes this patient's disorder, and how common is it?
7. What is the treatment and management of this disorder?

Possible Answers

1. The laboratory values from the comprehensive metabolic panel, lipid panels, and complete blood count (CBC) are reported in Table 1 , Table 2 , and Table 3 , respectively. Most of the values are within the normal limits and did not correlate with the patient's history and symptoms. According to the 24-hour urine heavy metal screen (Table 4), however, the patient showed a marked level of zinc with values of 207 µg/dL (ref. 15 to 120 µg/dL) and 2,691 µg/d (ref. 15 to 1,200 µg/d).

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Table 2. Lipid Panel

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		Ref
Cholesterol	255	<200 mg/dL
Triglycerides	248	<150 mg/dL
HDL	9	>39 mg/dL
Calculated LDL	176	<100 mg/dL
Risk ratio LDL/HDL	6.08	<3.55

Table 3. Complete Blood Count

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		Ref
WBC	13.8	4.0–11.0 K/Cumm
RBC	5.07	4.10–5.70 M/Cumm
Hemoglobin	16.2	13.0–17.0 g/dL
Hematocrit	46.6	37.0–49.0%
MCV	92	80–100 fL
MCH	31.9	27.0–34.0 UUG
MCHC	34.7	32.0–34.0 g/dL
RDW	14.2	11.0–15.0%
Neutrophils	73	40–74%
Lymphocytes	17	19–48%
Monocytes	7	3–11%
Eosinophils	2	0–7%
Basophils	1	0–2%
Platelets	333	130–400 K/Cumm

WBC, white blood cell; RBC, red blood cell; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; RDW, red cell distribution width

Table 4. 24-Hour Urine Heavy Metal Screen

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Total volume	1,300 mL	Ref
Cadmium	1.4	0.0–3.3 µg/d
	1.1	0.0–2.6 µg/L
	0.7	0.0–3.0 µg/gCr
Lead	0	0–31 µg/d
	0	0–23 µg/L
	0 µg/gCr	
Copper	25	3–50 µg/d
	1.9	0.2–8.0 µg/dL
	11.8 µg/gCr	
Mercury	0	0–15 µg/d
	0	0–10 µg/L
	0	<35 µg/gCr
Arsenic	21.8	0.0–50.0 µg/d
	16.8	0.0–35.0 µg/L
	10.4 µg/gCr	
Zinc	2,691	150–1,200 µg/d
	207	15–120 µg/dL
	1,285.7 µg/gCr	

Source: Lab Med © 2007 American Society for Clinical Pathology

2. The patient's laboratory findings insofar as the elevated zinc levels are indicative of hyperzincuria.

3. The average daily intake of zinc for Americans is roughly 5.2 to 16.2 mg, mostly from food.[1] The recommended daily allowance for zinc is 11 mg/d for men and 8 mg/d for women. About 20% to 30% of the zinc ingested is absorbed from the GI tract.[2] Causes of elevated zinc levels include occupational exposure, ingestion of poorly treated water flowing through galvanized copper pipes, and overuse of supplements or products containing zinc.

4. ***Most likely diagnosis:*** *hyperzincuria.* Due to the elevated urinary zinc levels coupled with the patient's history of chronic denture adhesive use containing a zinc compound, oral exposure to the zinc is the likely cause of the patient's elevated zinc level. It can be inferred that the patient also suffers from hyperzincemia due to the high clearance of zinc from the body.

5. Although a 24-hour urine collection is the "gold standard" for detecting metals in the body, a serum analysis should also be performed. Because elevated zinc concentrations cause copper deficiency, a serum copper concentration should always be obtained simultaneously.[1] Whole blood zinc levels exceed serum levels by a ratio of approximately 6:1 to 7:1 because the metal accumulates in the erythrocytes.[3] But because zinc is found everywhere in the environment and laboratory, one must exercise extreme caution to avoid contamination of samples.[1]

6. There are a number of sources leading to elevated zinc levels in the body. Typically, high zinc levels are seen in those who have had environmental exposure to it. Chronic exposure to zinc can engender a reversible sideroplastic anemia and a reversible myelodysplasia-like syndrome.[1] Granulocytopenia and anemia can also be clinical signs with the bone marrow showing vacuolated precursors and ringed sideroblasts;[1] the mechanism is believed to be through a zinc-induced copper deficiency.[4] For example, Willis and colleagues examined 3 cases whereby chronic ingestion of zinc-containing products led to severe neuropathy and neutropenia.[5] The bone marrow findings in all of their cases suggested copper deficiency. Subsequent laboratory testing determined this deficieny to be due to zinc excess. Hepatic or renal toxicity has not been observed in individuals who have consumed excessive amounts of elemental zinc.[6] Furthermore, it has been suggested that exposure to elevated levels of zinc may be important in the pathogenesis of

demyelinating diseases,[7-9] possibly causing neurological defects. Overall, however, toxicity from zinc is rare.

7. The treatment for acute oral zinc poisoning is primarily supportive. Hydration and antiemetic therapy should be employed. Insofar as chelation therapy, where the data regarding the efficacy of chelation therapy is lacking, calcium sodium EDTA has been used successfully in a few cases.[10,11] The agent DMPS (sodium 2,3-dimercaptopropane-1-sulfonate) has been shown to be efficacious in increasing the urinary excretion of zinc.[12] Finally, there exists 2 potential zinc-selective chelators, DPESA (4-{ [2-{ bis-pyridin-2-ylmethylamino)ethylamino]-methyl} phenylmethanesulfonic acid sodium salt and TPESA (4-{ [2-{ bis-pyridin-2-ylmethylamino)ethyl]-pyridine-2-ymethylamino} -methyl)phenyl]methanesulfonic acid sodium salt,[13] that have shown promise in vitro but further in vivo studies are warranted to assess its clinical utility.[1] Finally, given the plausibility of zinc-induced copper deficiency, serum copper levels should also be determined and replenished if necessary.

Patient Follow Up

The patient was told to discontinue using the product and to seek an alternative dental adhesive that does not contain zinc. Insofar as treatment, chelation therapy was recommended while obtaining zinc levels during the course of chelation.

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Authors and Disclosures

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