Chronic Ingestion of a Zinc-Based Penny

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uct poses a significant risk for choking, particularly in infants, children, and the elderly.[17] In response to this warning, several large retailers have removed the snack from their shelves. However, it is still readily available from many smaller stores and on the Internet, is widely available in Asia, and can be hand-carried into the United States. Although the package has a warning that this candy is not suitable for children <3 years of age, several aspiration-related deaths have occurred in children older than 3 years, including 1 of the cases we reported, and many parents believe it is safe for older children.

Pediatricians should be aware of the aspiration risks posed by these candies. They should educate parents and children of all ages of the dangers of eating these snacks until such time that they are no longer available.

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In the early 1970s the cost of using a copper alloy in the minting of US pennies was becoming greater than the value of the penny itself. Initially, a very inexpensive aluminum penny was proposed as a replacement to the copper alloy. However, it was never distributed because of its poor radiographic appearance after ingestion as well as the vending machine industry's concern that the lightweight penny would cause mechanical difficulty.[1,2] Because of the high prevalence of coin ingestion particularly among the pediatric population, a radiodense zinc penny was the next alternative to the original copper alloy (Fig 1). Since 1982, the US Mint has produced a penny composed mostly of zinc with a thin copper coating (0.0003 inches thick).[1] Although the post-1982 penny is easily seen on radiographs, zinc is highly reactive with gastric acid, and causes local corrosion and potentially systemic toxicity. This case report presents a child with a chronically ingested post-1982 penny that was lodged in the esophagus for at least 4 months before a radiograph identified its presence.

CASE REPORT

Our 14-month-old patient presented to the emergency department with a 1-day history of a high fever. His mother reported a 48-hour history of coryza and general malaise but denied any significant change in the child's appetite or diet. His mother also reported a chronic "raspy" cough for approximately 4 months. This cough had been the source of numerous visits to the child's primary care clinic where he had been treated for multiple presumed upper respiratory infections. His mother was unable to give details about the onset of this cough as the child was living with his father before this point. Initial physical examination revealed a tired but nontoxic appearing child with a temperature of 40°C. His respiratory rate was 24 breaths/minute and his pulse was 168 beats/minute. Physical examination revealed mild erythema to his oropharynx and copious nasal secretions. No middle ear effusions or pharyngeal exudates were noted. His chest examination revealed no abnormal cardiac sounds and clear lung fields bilaterally. Plain film chest radiographs were obtained and revealed a circular metallic foreign body in the cervical esophagus (Fig 2). The cardiopulmonary boarders were all within normal limits. After informed consent was obtained, the child was brought to the operating room and examined using rigid endoscopy. A coin was identified in the cervical esophagus positioned within a pseudodiverticulum in the anterior esophageal wall. The surrounding esophageal wall appeared edematous and granulation tissue surrounded the edges of the coin. Because removal of the coin posed significant risk of esophageal perforation, the exploration was terminated and a nasogastric tube was placed under direct vision. The patient was admitted to a monitored unit and treated with intravenous antibiotics, intravenous steroids, histamine receptor-2 blockade, and nasogastric tube feedings for 72

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Fig 1. Cross-sectional view of pre-1982 (above) and post-1982 penny (below). The post-1982 penny demonstrates the thin copper coating overlying the zinc core.

hours. On the fourth day of admission, the patient was returned to the operating room and rigid endoscopy revealed a significant decrease in granulation tissue and edema around the impacted coin. The coin was gently mobilized from the pseudodiverticulum and removed. The coin was identified as a penny, and noted to be eroded in numerous areas with exposed zinc (Fig 3). The esophagus was noted to be without perforation, and the child was returned to a monitored setting for 48 hours. A water-soluble contrast esophagram was completed and no extravasation of contrast was noted. The patient was transferred to a ward setting for an additional 4 days for monitoring and slow advancement of a clear liquid oral diet. The nasogastric tube was removed at 1 week, and the patient's diet was slowly advanced over the next 2 weeks. Serial esophagrams have been used to follow the stable pseudodiverticulum for 4 months.

DISCUSSION

Pediatric coin ingestion is all too common in the young child with an incidence of up to 5% and the mean age just under 3 years old.[3] This child poses a unique situation in that most studies and case reports have discussed the ingestion of zinc-salt or pennies in direct contact with gastric contents.[4–9] These reports discuss a myriad of symptoms as a result of local and systemic toxicity, ranging from malaise to severe gastritis to renal failure. The veterinary literature is also replete with reports of zinc toxicosis from multiple swallowed pennies in captive animals and household pets.[10,11] This patient, however, had a single post-1982 penny lodged in the upper cervical esophagus for an estimated 4 months with exposure to esophageal secretions and only the gastric acid that periodically refluxed. He did not demonstrate systemic toxicity, but rather had a local reaction resulting in a persistent esophageal pseudodiverticulum. Although the child was without esophageal obstruction, the pseudodiverticulum created a partial obstruction of the trachea and manifested as a "raspy" cough.

The symptoms of zinc toxicity range from lethargy[12] to severe gastroenteritis, nausea, vomiting, and hematemesis.[4–6,9] The latter symptoms are best accounted for by the caustic action of zinc salts, such as zinc chloride, on the tissue that are contacted. After absorption, primarily by the pancreas and liver, zinc is excreted in the pancreatic secretions and bile.[13] The major laboratory indicators of zinc toxicity are elevated white blood cell count, amylase, lipase, alkaline phosphatase, and hematuria.[5,8,9] However, the absence of systemic toxicity does not exclude the presence of local reactivity. Some patients, such as ours with accidental zinc ingestion, may have normal lab values, but sustain severe ulceration, corrosion, and scarring.[4,5]

One other case report of a child who had swallowed a post-1982 penny was found in the literature.[14] The only symptoms reported by the parents were heavy breathing and congestion 1 day before the patient's presentation. After radiographs demonstrated a foreign body in the esophagus just above the gastroesophageal junction, the partially-eroded coin was removed endoscopically. This patient had no residual anomalies postoperatively. Although the length of time that the penny was lodged in this patient's esophagus is uncertain (perhaps only days), it was ample time to generate respiratory symptoms. The amount and exposure-time necessary to cause a gross inflammatory reaction to zinc is uncertain, yet this case demonstrates that a penny will corrode within a few days and has the potential for causing zinc exposure and an inflammatory response. Post-1982 pennies are now commonly found in circulation, and the copper coating is more likely to become disrupted as they are damaged through prolonged wear and tear.

The pathologic response of tissue to zinc, both locally and systemically, has been evaluated in several studies. Perhaps the most complete pathology findings in a human were reported in a case involving the death of a schizophrenic patient after a massive ingestion of coins (336 out of 461 were post-1982 pennies).[8] The patient admitted to ingesting the coins a few days before the onset of symptoms, which included nausea, anorexia, epigastric pain, and hematemesis. The coins were not removed until 20 days after admission allowing for an estimated zinc dosage of at least 32.7 g or 0.4 g/kg. The patient died 20 days after the removal of the coins of multisystem organ failure. The patient's autopsy revealed acute hemorrhagic esophagitis, acute tubular necrosis, acute massive hepatic necrosis, mild fibrosis of the pancreas, and hypercellular bone marrow. The stomach, which had contained most of the coins, revealed mild chronic inflammation, dilated vessels with unorganized thrombi, transmural acute inflammation,

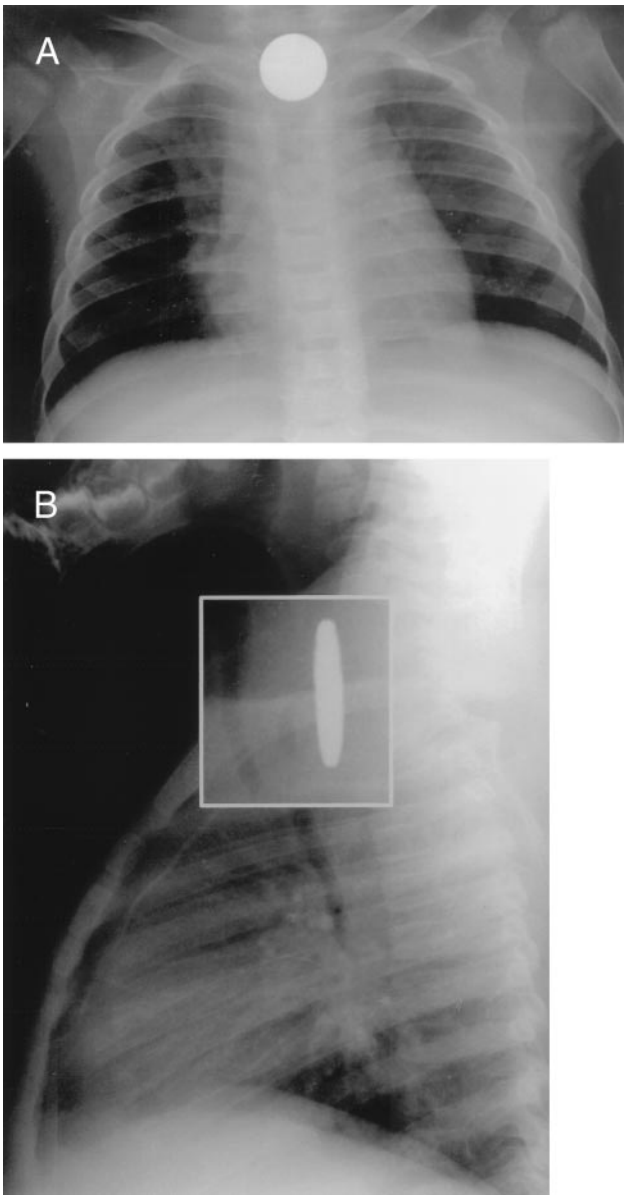

Fig 2. A, PA chest radiograph with radiodense coin in the cervical esophagus. B, Lateral chest radiograph with a magnified inset highlighting preesophageal air.

and necrosis. Although our patient was not exposed to this amount of zinc, and did not manifest any signs or symptoms of systemic toxicity, the acute, local reaction to the coin in the esophagus for a 4-month period is consistent with the findings in this patient's esophagus and stomach.

CONCLUSION

This child's experience serves to illustrate 2 important issues. First, chronic coughing without other evidence of symptoms or signs that point to a clear cause must trigger a detailed evaluation. Foreign body ingestion should always be included in the differential diagnosis. Had this child not been evaluated for an unrelated fever, his foreign body may have resulted in an esophageal perforation. Second, zinc-based coins are now common and when ingested, have the potential to create acute and chronic inflammatory responses. Early detection and intervention can prevent serious morbidity.

Fig 3. Penny obverse after endoscopic removal. Note corrosion of copper coating and exposure of gray zinc.

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