Case Report

The aluminum beverage tab and a soldier with chronic abdominal pain

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\textbf{ABSTRACT}

Since its introduction in the 1960s, the aluminum pull-tab has been an uncommon cause of aspiration and intestinal obstruction. In many cases, the inability to visualize aluminum on imaging studies delayed diagnosis and therapy or missed the foreign body altogether. Early reports of injury secondary to pull-tab ingestion or aspiration spurred the beverage industry to re-engineer the pop-tab in the 1980s. The new design meant to reduce injury by keeping the tab attached permanently to the can. Despite this innovation, the aluminum pop-tab continues to be a cause of injury. Here, we describe the inadvertent ingestion of an aluminum pop-tab by a 22-year-old patient that resulted in chronic intermittent abdominal distress due to recurrent bowel obstruction for 4 years. This case is unique in the length of delayed diagnosis and demonstrates the elusive nature of an aluminum foreign body.

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\textbf{Introduction}

In 1958, the Coors Company introduced the modern aluminum beverage can. It provided a pressurized can as thin as a piece of paper but able to endure up to 90 pounds of pressure per square inch. Due to the design’s revolutionary utility and widespread acceptance, beverage can production now consumes one-fifth of all aluminum production in the United States [1]. With the original pull-tab designed for detachment from the beverage can, the common practice soon became dropping it through the drinking slot to reduce litter and waste [2]. This habit led to inadvertent ingestion and aspiration over the subsequent 2 decades.

Pediatricians were first to sound the alarm. In 1970, 4 independent case series reported over a dozen pull-tab related injuries. Patients ranged from 4 months to 22 years old. The most common patient was an infant. Symptoms were almost always acute and involved dysphagia, respiratory distress, and chest pain. Plain films were invariably nonrevealing unless the patient or their parent could disclose to their provider that they had the recently swallowed pull-tab. However, even cases with a correlating history still presented with difficulty visualizing the tab. Contrast esophagography or direct bronchoscopy occasionally revealed tell-tale esophageal distortion or obstruction. Esophagoscopy or thoracotomy was often required to remove a pull-tab often encased in food, pus, or granulation tissue. Most cases would resolve without

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complication, but 3 patients required follow-on serial esophageal dilations. One case resulted in death due to a pull-tab that eroded into the aortic arch of an 11-month-old infant. In terms of delayed diagnosis, another case involved a 22-year-old male who presented with symptoms 2 years after pull-tab ingestion that occurred during his deployment to Vietnam [2–5].

These reports prompted a redesign of the pull-tab in the early 1980s to the modern pop-tab, which remains attached to the beverage can during consumption [6]. However, it is unclear if rates have improved since the introduction of the pop-tab. Nevertheless, it is apparent that pop-tab related injuries still do occur based on the report of a 7-year-old male who ingested a pop-tab in 2010. This case prompted an investigation into modern injury rates caused by pop-tab ingestion and aspiration. Researchers found that between 1990 and 2010 at a single pediatric medical center, 19 cases of witnessed or self-reported ingestion of pop-tabs resulted in radiographic identification in only 4 cases [7]. Now one decade later, we report the case of a 22-year-old male who presented with an intermittent small bowel obstruction of at least four years duration after inadvertent ingestion of a pop-tab.

**Case report**

A 22-year-old male active-duty soldier with no significant past medical history presented to his unit’s medical station at about midnight with an acute bout of colicky abdominal pain localized to his lower abdomen, the left more than the right lower quadrant. His symptoms began as mild postprandial discomfort after dinner that progressed in intensity and duration. He disclosed a 4-year history of random but recurrent

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Fig. 1 – Abdominal imaging. (A) Abdominal plain film. A 2.4 × 1.2 cm oblong radiodensity with 2 central areas of lucency projects right of midline over the sacral apex. (B) CT abdomen/pelvis without contrast, coronal reformat. A 2.4 cm hyperdensity is visualized within the distal ileum. (C) CT abdomen/pelvis without contrast, axial slice. A 2.4 cm hyperdensity is visualized within the distal ileum. Stool filled distended thickened terminal ileum and contracted/thickened right colon with adjacent stranding. The hyperdensity is seen just proximal to this stool-filled dilated terminal ileum. Small amount of pelvic-free fluid (arrow). (D) CT abdomen/pelvis without contrast, sagittal reformat. A 2.4 cm hyperdensity is visualized within the distal ileum. Thickened ileocecal junction and contracted/thickened right colon with adjacent stranding. The ingested foreign body is seen just proximal to this stool-filled dilated terminal ileum.
bouts of similar abdominal symptoms. On examination, his bowel sounds were normoactive, and there was no abdominal distension. Plain films and computed tomography (CT) of his abdomen and pelvis (Fig. 1) revealed a foreign body localized to the ileum with an associated chronic stricture. We performed a mini-laparotomy and segmental ileal resection with the retrieval of what turned out to be an embedded pop-tab (Fig. 2). We reconstructed enteric continuity by staple anastomosis in the standard side-side fashion. Pathologic examination of the stricture (Fig. 3) identified benign ileal tissue with submucosal edema and chronic inflammation. We identified no dysplasia in the pathologic specimen. Inpatient recovery was uncomplicated, and the patient returned to his usual lifestyle after 2 weeks. We suspect the pop-tab was most likely ingested after being dropped in a beverage can from which he was drinking, though in follow-on questioning he denied any habit of pulling off pop-tabs and dropping them as such. At 20 weeks out from treatment, he continues to enjoy a regular diet and unrestricted activity without issue.

**Discussion**

We considered 3 treatment options for this patient: open resection, laparoscopic resection, and endoscopic retrieval. Open resection appeared to be the most advantageous for definitive treatment. Based on the patient history, the foreign body had been lodged in the intestine for at least 4 years. Chronicity and soft tissue findings on CT imaging were

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Fig. 2 – Recovered foreign body. (A) The recovered foreign body and (B) a pop-tab still attached to a beverage can for comparison.

Fig. 3 – Histopathology of stenotic ileum. (A) Area of defect in the enteric wall with fibrin deposition. (B) Benign small intestinal tissue with submucosa edema and chronic inflammation. No dysplasia was identified.
suspicious for embedment into the intestinal wall, a phenomenon described in previous case reports [3,5]. Altogether, this raised concern that endoscopic retrieval would not address the associated chronic enteric stricture, meaning that removal of the foreign body alone would not necessarily prevent future episodes of abdominal pain. Additionally, the possibility that the foreign body might be “floating” within the enteric lumen, requiring manual palpation to locate, raised questions regarding the utility of an endoscopic or laparoscopic approach. We ultimately chose a limited 4-cm mini-laparotomy to recover the foreign body and resect 4 cm of stenotic ileum.

Radiographic imaging plays a vital role in the diagnosis and localization of foreign bodies that are difficult to locate by clinical exam. However, foreign bodies must sufficiently contrast against their surrounding tissues in order to identify them on plain radiographs. Images of the chest or abdomen require high kilovoltage to diminish the contrast characteristics between bone, metal, water, soft tissues, fat, and air. Aluminum has a density of 2.7 g/cm³ making it difficult to distinguish from surrounding soft tissue [5-8]. The difficulty of imaging aluminum is not a new challenge. It was the reason pediatricians raised concern in 1974 when the US Mint proposed to switch the penny from copper to aluminum (approximately half of the coins children ingest are pennies) [9]. Interestingly, many cases report difficulty visualizing the aluminum tab on imaging, but our particular case had an easily identifiable aluminum foreign body on both plain films and CT. We suspect this is most likely due to its extended lodgment.

Specifically, this case shows that the aluminum pop-tab is an unusual cause of abdominal pain associated with delayed presentation and diagnostic imaging challenges. Aluminum is not as radiopaque as other metal objects, making it difficult to visualize on plain film. Adjunct imaging modalities or endoscopic investigation may be required to establish a timely diagnosis and avoid secondary injury. Even a skilled physician can overlook the aluminum foreign body.

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