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CASE REPORT

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Multiple foreign body ingestion and ileal perforation

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Abstract Foreign body ingestion is a common problem encountered in the pediatric age group. The swallowed object is often passed with little or no morbidity. Problems ensue if the ingested foreign body is hazardous, is multiple, or becomes impacted. We describe an ileal perforation following the ingestion of an alkaline disc battery, a magnet, and a steel ball impacted in the ileum for about 48 h. The magnet and the steel ball were attracted to each other, forming a composite unit. The disc battery and the magnet were attracted to each other across a loop of ileum, causing necrosis and perforation of the ileum.

Keywords Foreign body · Battery · Magnet · Ingestion

Case report

A 10-year-old boy presented with abdominal pain, vomiting, and fever of 2 days' duration. His pain was mainly in the right lower quadrant. The child had been well until this episode of pain, and there was no other contributing history. Clinical examination revealed rigidity, guarding, and tenderness in the right lower quadrant. An abdominal radiograph in the course of evaluation for suspected appendicitis revealed multiple foreign bodies in the right iliac fossa, including a radiopaque bar magnet, a ball, and a disc battery (Fig. 1). On questioning the child, he disclosed that he had swallowed, in succession, a steel ball, a bar magnet, and a disc battery, all parts of a toy. A computed tomography scan confirmed the same findings along with proximal bowel obstruction and free fluid.

At laparotomy, there was a loop of ileum 6 inches proximal to the ileocecal valve, which doubled on itself with a disc battery and a magnet stuck across the bowel wall, causing a perforation. On-table fluoroscopy to search for the third ingested foreign body revealed it to be in the right colon; the foreign body was then removed by a colotomy and proved to be the steel ball. Segmental ileal resection and end-to-end anastomosis were done. The child had an uneventful postoperative recovery. On examination of the resected ileum, there was local necrosis at the point of contact with the disc battery. There was also evidence of degeneration of the battery with leakage of fluid. Histopathological examination of the perforation site revealed a full-thickness burn and necrosis at the site of impaction by the battery and the magnet.

Discussion

Accidental ingestion of foreign bodies is a problem peculiar to infancy and childhood. Every manner of object in every shape and size has been described in the literature. The oral-digital phase of exploring new objects with the mouth wanes by the 2nd or 3rd year, and in large series worldwide, the incidence of 10-year-old children presenting with foreign body ingestion drops to 2% [1]. Most foreign bodies that are ingested are passed in 2–3 days with very little morbidity unless they are sharp or impacted. Children at increased risk of morbidity are those with mental retardation, psychiatric or social problems, or congenital or preexisting esophageal disorders. Coins lead the list of ingested foreign bodies, followed by alkaline disc batteries [1, 2].

With the advent of microelectronics, which has revolutionized the modern world, the incidence of disc battery ingestion has increased. Fancy toys, cards, cameras, watches, calculators, video games, and books, to name a few items, have been brought to life by these

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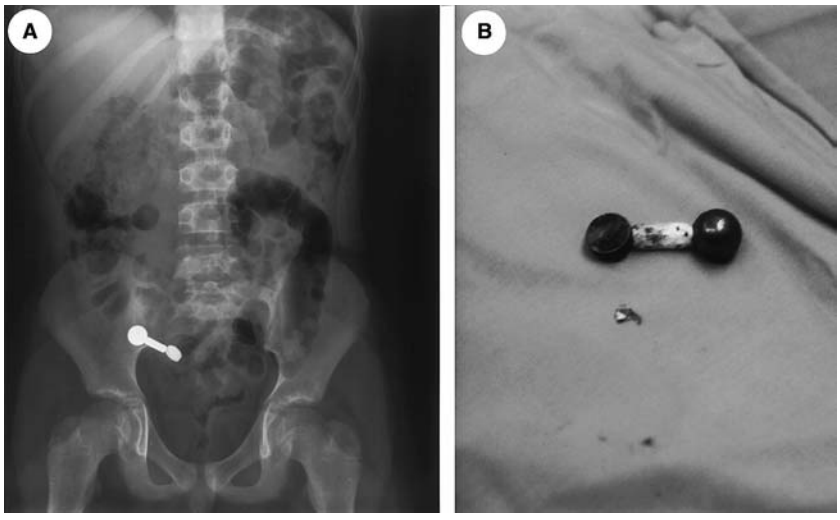

Fig. 1 **a** Radiograph of the abdomen showing a radiopaque ball, a bar magnet, and a disc battery. **b** Photograph of the retrieved objects: the steel ball, magnet, and disc battery

small but power-packed discs. Measuring between 8 and 28 mm, they are made of heavy metal oxides such as mercuric oxide, silver oxide, manganese dioxide, and lithium and zinc-air cells. All of these contain a concentrated alkali, 26–40% sodium or potassium hydroxide, lodged between the anode and the cathode. It is important to note that the batteries are not biologically sealed, and when they come into contact with saline in human tissues, sodium hydroxide and chlorine gas are liberated, causing denaturation and necrosis. A disc battery causes tissue damage by four mechanisms:

1. Cellular damage resulting from diffusion of heavy metals
2. Bidirectional diffusion of liquids across the battery seal in a liquid medium
3. Low-voltage burns caused by the generation of an electric current external to the battery due to the electrical potential between the cathode and the anode
4. Effects of local pressure necrosis alone [3]

Impaction usually occurs in the esophagus, and most reports in the literature describe sequelae of esophageal injury [3] and of the adjacent structures such as the trachea [4]. A ruptured Meckel's diverticulum [5] is the only other reported bowel perforation associated with alkaline battery ingestion after passage of the battery beyond the esophagus into the gastrointestinal tract.

When ingested alone, magnets pass out as any other cylindrical or round object, but when multiple magnets are swallowed, they tend to interact through the bowel wall, and the magnetic force generated across the bowel wall causes pressure necrosis and perforation. Intestinal perforations resulting from multiple magnets have been reported from Southeast Asian countries, where magnets are widely used to relieve musculoskeletal pain [6, 7]. In our patient, the magnet was attracted to the steel ball, and the alkaline disc battery was attracted to this across a loop of ileum, causing adherence and impaction. Necrosis of the bowel wall must have ensued not only from the pressure but also by the coagulative effects of the impacted alkaline disc battery on the intestinal mucosa. During laparotomy, manipulation of the bowel caused the steel ball to dislodge, and we found it in the colon using fluoroscopy. A colotomy was done to retrieve the steel ball as well as a segmental resection of the ileum to include the perforation.

As the hazards of ingested disc battery have become well documented, it is imperative for the clinician to facilitate removal of the offending battery. Several methods have been successfully used, including fluoroscopy, endoscopy, and extraction by a magnet [8, 9]. Even whole-bowel irrigation using saline to move the battery has been described [10]. All of these methods aid faster extraction or expulsion so that the period of contact between the bowel wall and the battery is minimized, thereby decreasing the potential hazard. This is the first reported instance in which a magnet, a steel ball, and a battery have been impacted together and caused a perforation by virtue of magnetic attraction across the bowel wall.

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