Water-Absorbing Balls: A “Growing” Problem

Foreign body ingestion is a potentially serious clinical problem in children. We report a case of an 8-month-old infant who developed complete bowel obstruction requiring laparotomy due to ingestion of a superabsorbent polymer ball with advertised growth up to 400 times its original size. Most ingested foreign bodies that pass through the pylorus will make it safely through the gastrointestinal tract. This is not true for water-absorbing balls that progressively increase in size and cause intestinal obstruction. Other household products and toys on the market use a similar polymer-based water-absorbing technology, thus increasing the risk for accidental ingestion by young children. These rapidly expanding objects can cause significant morbidity, and timely diagnosis and treatment are prudent to improve patient outcomes. Pediatrics 2012;130:e1011–e1014

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Foreign body ingestion is a potentially serious clinical problem in children. An estimated 40% of foreign body ingestions in children are unwitnessed.\(^1\) Most cases are uneventful as 80% to 90% of foreign bodies pass spontaneously, 10% to 20% require endoscopic removal, and <1% require surgical removal.\(^2\) The majority of foreign bodies small enough to pass through the pylorus will make it safely through the gastrointestinal tract.\(^3,4\) However, this is not true for superabsorbent polymer beads, such as those used as water-retaining agents in horticulture, which may absorb large quantities of fluid and if ingested have a high potential for causing intestinal obstruction.\(^5,6\) We report a case of an 8-month-old infant who ingested a superabsorbent polymer ball (Water Balz, DuneCraft, Inc, Chagrin Falls, OH) advertised to exhibit growth up to 400 times its original size. The object was initially small enough to traverse the pylorus; however, it grew in size in transit through the small intestine and caused a complete intestinal obstruction requiring laparotomy.

**PATIENT PRESENTATION**

An 8-month-old female infant presented to the hospital with bilious emesis, abdominal distention, and obstipation after ingesting a foreign body ~15 hours before arrival. The patient’s mother stated that she swallowed what was first thought to be a “piece of candy” but later discovered it was a part of her older sister’s toy made from an expanding polymer ball, which reportedly grows to “the size of a racquetball” after submersion in water. Her abdominal examination revealed hypactive bowel sounds, diffuse discomfort with palpation, no focal tenderness, no masses, and minimal distention. A plain radiograph of the abdomen showed multiple dilated loops of the small bowel and no radiopaque foreign body (Fig 1). The patient was subsequently admitted to the hospital for observation and serial abdominal examinations. Over the course of 48 hours, she had progressive abdominal distention and unrelenting symptoms of bowel obstruction. Due to the lack of clinical improvement, the decision was made to take her to the operating room for exploration.

A diagnostic laparoscopy was performed, which revealed moderate ascites and markedly dilated small bowel loops with decompressed colon. The transition point was identified, and the object was found to be obstructing the distal ileum (Fig 2). The affected bowel segment was exteriorized through a small lower midline incision, where an enterotomy was made and an intact 3.5-cm spherical gel ball was extracted (Fig 3). The ball appeared to be made of a gel-like polymer, and it was not degraded at the time of extraction (Fig 4). Bowel integrity was deemed to be intact after careful inspection; thus, no resection was required, and the enterotomy was closed primarily. The infant did well after the operation, progressed to a normal diet, and was discharged from the hospital on the fourth postoperative day.

**IN VITRO ANALYSIS**

To better understand the growth potential of this superabsorbent polymer ball, in vitro experiments were performed by using the same brand (Water Balz, DuneCraft, Inc) ingested by the patient in this case. A total of 5 polymer balls were used for the experiment. By using a standard metric ruler, the diameter of each ball was initially measured to obtain a baseline size before submersion in water. Each ball was then individually submerged in 200 mL of tap water in a standard 250-mL Pyrex glass beaker at room temperature, and the start time was recorded. The balls were then carefully removed from the beakers at 2, 4, 6, 12, 24, 48, 72, and 96 hours postsubmersion, and the diameters were again measured and recorded (Fig 5). Pictures of the balls were also taken at each time interval as a visual...
record of the growth obtained by each ball. The mean initial size of the balls was 0.95 ± 0.13 cm, and they reached a mean maximum diameter of 5.55 ± 0.06 cm after 96 hours of submersion (Fig 6). The fastest rate of growth occurred during the first 12 hours of submersion, after which the rate slowed considerably. Within 2 hours, the balls had more than doubled their original size to a mean of 2.05 ± 0.17 cm and by 12 hours after submersion, the size had doubled again to a mean of 4.0 ± 0.08 cm. Between 12 and 96 hours, the rate of growth was considerably slower, gaining on average only 1.5 cm more during that 84-hour time period. Throughout the experiment, the balls appeared intact with no signs of degradation even at 96 hours.

DISCUSSION

To the best of our knowledge, this is the first reported case in the literature of a complete bowel obstruction caused by ingestion of a superabsorbent polymer ball in humans. A similar case was reported in 2 birds that suffered fatal intestinal obstruction after ingestion of single particles of polyacrylamide gel, which is used in soils for gardening and agriculture. The majority of children who ingest foreign bodies are asymptomatic, and objects that progress beyond the esophagus generally pass spontaneously and do not cause significant complications. The water-absorbing ball reported in this case is fundamentally different from most toys and caused a significant complication. Because only ~60% of foreign body ingestions are witnessed, water-absorbing polymer balls present a unique clinical problem in that their ingestion may be difficult to diagnose due to inaccurate reporting of events and their radiolucentcy. Furthermore, due to the unique growth properties of these balls, there is a high likelihood that nonoperative management will fail. As a result, practitioners must maintain a high degree of suspicion for the diagnosis of an unexplained intestinal obstruction in a child. Although axial imaging or abdominal ultrasounds were not performed in our case, the obstructing lesion should be identifiable with these modalities.

Many of these balls are brightly colored and may appear candy-like to young children. They start at a size easy to swallow for even very young children but then increase in size over a short period of time. These toys, and their inherent ability to grow in the presence of liquid, may be prohibitive of a benign course through the gastrointestinal tract and warrant more proactive management to prevent bowel obstruction. For initial management in witnessed ingestions, we recommend prompt endoscopic removal of these polymer water-absorbing balls before they pass the pylorus. If the ball is not visualized on endoscopy, then the threshold for operative management should be lower than for other foreign body ingestions. Our in vitro studies demonstrated that within 2 to 4 hours of immersion in water, the balls are still small enough to pass through the pylorus. We expect that the in vivo growth rate of the balls will lag behind our in vitro studies because the balls grow faster in pure water. Thus, the point of obstruction would be expected to be in the mid- to distal small bowel as the size increases with transit time. In our case, the time from ingestion to operation was 68 hours, which as depicted in our ex vivo experiments would correspond to a diameter of ~4.8 cm (Fig 5). The polymer ball in this patient was 3.5 cm at the time of
operation. The size discrepancy is most likely related to the in vivo environment of the gastrointestinal tract as well as the external compression of the bowel on the growing polymer ball. However, this case demonstrates that these rapidly expanding polymer balls can exceed the normal diameter of the small bowel (2.5–3.0 cm) within 6 hours of ingestion; thus, timely diagnosis and treatment are prudent to improve patient outcomes. Furthermore, no degradation of the polymer was noted in our patient or in the in vitro studies by 3 to 4 days. It would therefore be unwise to delay intervention expecting that these polymers will degrade and pass spontaneously.

This report should serve to raise awareness of the hazards of accidental ingestion of these products, which pose a public health concern. We speculate that this problem may increase in incidence as a cursory look at department stores suggests that the use of superabsorbent polymer technology is becoming more prevalent in toys, gardening equipment, and other household products. This case represents a cautionary warning for both parents and practitioners of the potential dangers of ingesting polymer, water-absorbing balls. It also highlights the need for earlier intervention if these superabsorbent toys are accidentally ingested.

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