



Gel Beads Ingestion: A Case Report with Management and Review of Literature

Farah Faytrouni^{1*}, Quais Mujawar², Kamran Sadiq³ and Vishal Avinashi¹

¹Division of Gastroenterology, Hepatology and Nutrition, British Columbia Children's Hospital, Vancouver, Canada

²Pediatric Gastroenterology, University of Manitoba, Winnipeg, Canada

³Pediatric Gastroenterology, Aga Khan University Hospital, Pakistan

***Corresponding Author:** Farah Faytrouni, Clinical Pediatrics Gastroenterology Fellow, Department of Pediatric Gastroenterology, Hepatology and Nutrition, British Columbia Children's Hospital, Vancouver, Canada.

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Abstract

We hereby present a case of gel ball ingestion in a toddler. In this particular case the gel ball passed through the digestive tract without complication; however, the literature supports caution in the ingestion of super absorbent gel beads in the pediatric population which have the potential to grow in size in the digestive tract and can result in significant problems such as bowel obstruction, perforation and even death. Ingestion of gel balls should not conform to standard principals of foreign body management and requires a high index of suspicion.

Keywords: Gel Beads Ingestion; Bowel Obstruction; Perforation

Introduction

Foreign body ingestion is a common problem in the pediatric populations with up to 80% of cases occurring in children under the age of three [1]. Management of these ingested foreign bodies differs depending on multiple variables such as the presence of symptoms, the age/size of the child, location of the foreign body and the nature of the item ingested. Foreign bodies that require more attention/intervention include batteries, magnets, sharp and/or large objects. An estimated 10 to 20% of foreign bodies' ingestion will require endoscopic removal and less than 1% will necessitate surgical intervention [1]. Typically, round, small and soft objects tend to pass smoothly through the esophagus and pylorus and are expected to safely and spontaneously make their way out of the gastrointestinal (GI) tract.

Superabsorbent gel balls (also called water beads, water jelly pearls or gel beads) are manufactured as small rounded pellets

composed of super absorbent polymers which have the property to expand over little time when in contact with fluid. They can increase by variable amounts, but have been reported to increase by as much as 30 - 60 times their original size when immersed in water [2] (Figure 1). Their water absorbance capacity and relative volume expansion depend on both the properties of the fluid that comes in contact with the beads and the nature of the gel ball polymer [3]. They have been promoted for various uses including toys, learning or sensory tools, even marketed for autistic children, gardening equipment and other household products. The gel beads are commonly found in craft stores, gardening markets, and readily available online coming in packets of 100s to 10000s and are very inexpensive. Their various attractive colors and small sizes make them easily mistaken by young infants as edible products. Because of this property of expansion, when swallowed, they can cause harmful effects.

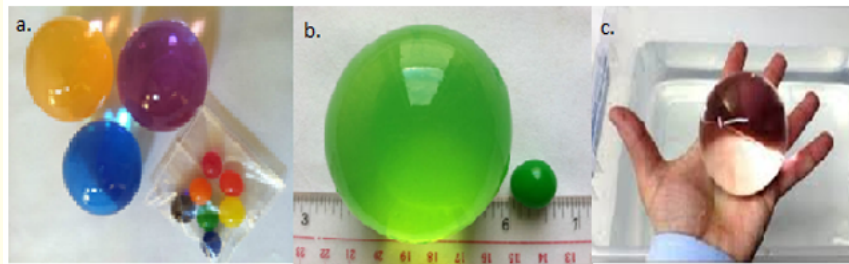


Figure 1: Increase in size of Gel balls over time. a. Multiple small round gel balls of different colors in bag, b. Size expansion demonstrated after immersion in water after 48 hours, c. Demonstration of gel ball after immersion relative to an adult hand.

Case Report

An 18 month old girl, previously healthy, presented to a local ED with a witnessed ingestion of a gel ball. She was transferred to British Columbia Children's Hospital for further management, where she was found to be asymptomatic. An abdominal X-ray was unremarkable, with no apparent signs of a foreign body. Six hours post ingestion; she underwent an upper GI endoscopy to the extent of the 4th stage of duodenum. No foreign body was found, nor retrieved. She was admitted after the procedure to the inpatient ward and monitored overnight for symptoms of intestinal obstruction.

The following morning, an ultrasound abdomen was not able to detect the gel bead. We opted to give her a rectal enema, after which she passed a stool with a bluish collapsed sac-like foreign body that represented the gel ball (Figure 2). The patient was then discharged from hospital.



Figure 2: Gel ball recovered after passage through GI tract.

Review of Literature

43 gel ball cases involving ingestion in the GI tract with reported outcomes were found in the literature (Table 1) represented by 16 case studies and 2 case series (involving 6 and 21 cases each).

The first reported case was in 2011. Additionally, 129 incidents involving water-absorbing beads were reported to the New South Wales Poisons Information Centre [15], but no outcomes were reported so we have opted not to include those cases in table 1. Of the forty three patients reported, 14 patients (33%) were less than two years old. Forty four percent (19/43 cases) of the reported patients presented with signs of GI obstruction (vomiting and abdominal distention).

All patients who presented with obstruction ended up requiring laparotomy for retrieval of the foreign body due to signs of bowel obstruction. The youngest reported patient (6 months old) passed away subsequently due to sepsis secondary to bowel necrosis [5]. 22/43 cases (51%) patients were observed (either as an inpatient or as an outpatient) and did not develop complications. One asymptomatic patient was managed with whole bowel irrigation using initially oral PEG3350 and then switched to nasogastric PEG with electrolytes and successfully evacuated the gel beads with no complication [10]. One reported case did not require laparotomy after successful mechanical breakage (ultrasound guided) of the gel balls in the intestine [14].

In terms of imaging of these patients, 42% of the symptomatic patients- were reported in the literature to have undergone an abdominal x-ray part of initial investigation showing intestinal obstruction. 37/43 (86%) of the patients underwent an ultrasound. The ultrasound findings of the ingested beads can demonstrate an intraluminal cystic structure. 3 cases describe the use of a CT scan which can also demonstrate a cystic structure or a filling defect, but all of these cases were in obstructed patients.

Case	Age & Sex	*Time since Ingestion	Signs and Symptoms	Investigation	Management	Outcome
1 [4]	8 month Female	15 hours	Asymptomatic	AXR: obstruction	Exploratory Laparotomy	Gel ball in distal ileum/ discharged by day 5
2 [1]	18 month Female	4 days	Anorexia and Emesis	AXR: obstruction Ultrasound: FB in small bowel	Exploratory Laparotomy	Gel ball in jejunum/ discharged by day 4
3 [5]	6 month Male	25 days	Bilious vomiting, no stools >1 week, feed refusal	Contrast study: filling defect CT: round intraluminal mass	Exploratory Laparotomy	2 gel balls in jejunum/ died due to septicemia
4 [6]	29 month Female	8 hours	Asymptomatic	AXR: Normal	Observation for 24 hrs.	No complications
5 [7]	10 month Female	Unwitnessed	Irritability	AXR: Obstruction	Exploratory Laparotomy	Gel ball proximal to ICV/ no complications
6 [8]	9 month Female	Unwitnessed	Vomiting	AXR: dilated stomach Upper GI Contrast study: filling defect Ultrasound: cystic structure CT: hypodense structure	Exploratory Laparotomy	Gel ball in duodenum/ no complications
7 [9]	15 month Male	2 days?	Vomiting	Ultrasound: Cystic structure	Exploratory Laparotomy	3 Gel balls in duodenum and jejunum / discharged by day 5
8 [9]	18 month Male	3 days	Vomiting	Ultrasound: Cystic structure	Exploratory Laparotomy	3 Gel balls in jejunum/ discharged by day 4
9 [10]	2 y Female	same day	Vomiting	AXR: Normal	Whole Bowel Irrigation	Multiple Gel balls evacuated/No complications
10 [2]	9 month Female	7 days?	Vomiting	AXR: obstruction Ultrasound: cystic structure CT and MRI: cystic structure	Exploratory Laparotomy	Gel ball in duodenum/ discharged by day 3
11 [2]	12 month Female	30 days?	Vomiting, abdominal distention, constipation	AXR: Obstruction Ultrasound: Cystic structure	Exploratory Laparotomy	Gel ball in ileum / discharged by day 4
12 [2]	7 month Male	7 days?	Vomiting, abdominal distention, constipation	AXR: Obstruction	Exploratory Laparotomy	Gel ball in ileum/ discharged by day 4
13-33 [11]	21 pts with age range 2 to 15 years (14 Female, 7 Male)	30 minutes to 5 days	3 pts: discomfort and nausea, rest asymptomatic	AXR: Normal Ultrasound: Normal	Observation inpatient vs outpatient	No complications
34 [3]	18 month Male	2 days?	Fever, vomiting, abdominal distention and pain	AXR: Perforation Ultrasound: Fluid between intestinal loop and pelvis	Laparotomy	3 Gel ball in ileum/perforated bowel needing resection

35 [12]	18 month Female	2 days?	Vomiting	AXR: Obstruction Ultrasound: Cystic structure	Exploratory Laparotomy	Gel ball in ileum
36 [13]	18 month Female	2 days?	Vomiting and poor intake	Ultrasound: Cystic structure Lower GI Contrast study: Opacification with sudden tapering	Exploratory Laparotomy	Gel ball in jejunum/discharged by day 3
37 [13]	17 month Female	1 day?	Vomiting and poor intake	AXR: Obstruction Ultrasound: Hypochoic intraluminal lesion	Exploratory Laparotomy	Gel ball in ileum/discharged by day 5
38-43 [14]	2-6y	not mentioned	GI obstruction symptoms	Ultrasound: Echoless spheresx6	Exploratory Laparotomyx5 Endoscopic crumbling failed in 1 and worked in 1	Not mentioned

Table 1: Summary of case reports reviewed related to gel ball ingestion.

*: Time since ingestion means time from ingestion to presentation.

Discussion

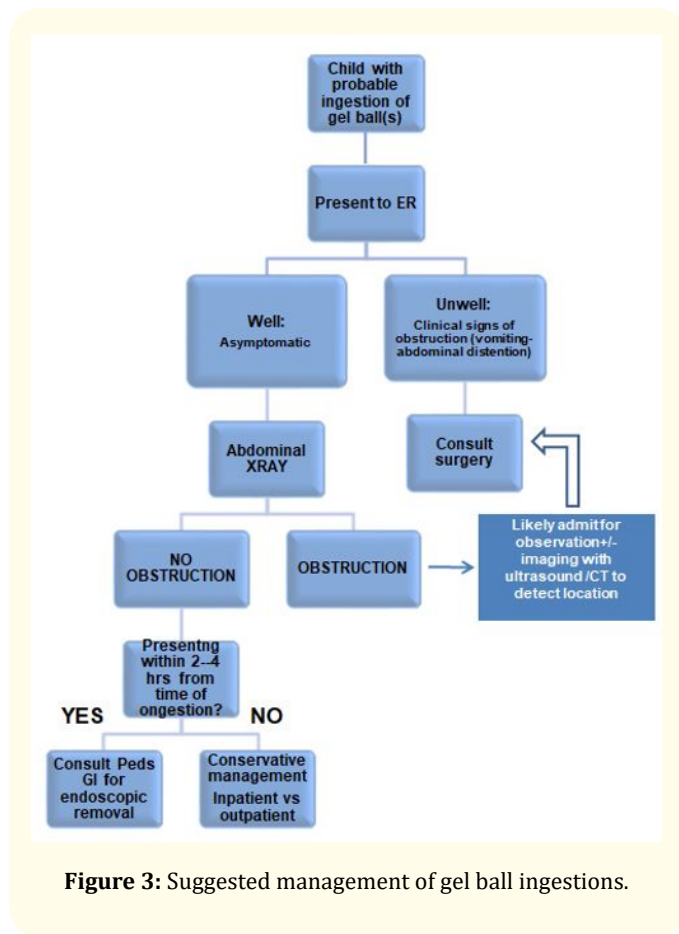
The above described cases of gel ball ingestion highlight a significant risk to children with less than 50% of reported cases presenting with obstruction and requiring a laparotomy. Foreign body ingestion rarely predisposes to intestinal perforation and the mechanism is usually direct penetration by sharp objects, but with these beads it's most plausible to think that perforation is caused by pressure necrosis [3].

Their management requires a high index of suspicion. Radiologically it's hard to delineate them and discern them as the beads are radiolucent and findings are non-specific. Plain films will only show consequent complications such as obstruction. Ultrasounds may demonstrate the gel balls represented by cystic structures but has also been described to mimic other pathological findings such as enteric duplication cysts [7] - in our case, the ultrasound failed to detect the beads.

Contrast studies could be considered to demonstrate a filling defect but it is unclear when this is best used. CT scans can also demonstrate cystic structures and should be considered in symptomatic patients and may be of help in pre-surgical planning prior given all patients who underwent CT went on to have an exploratory laparotomy.

We propose the following algorithm for management of gel beads ingestion in the GI tract (Figure 3). The recommendation following witnessed ingestion of gel balls in a well young infant or child is for prompt endoscopic removal presuming they are in the upper GI tract (esophagus, stomach or duodenum). If the beads are not endoscopically accessible and the patient is asymptomatic then we recommend watchful management with monitoring for signs of bowel obstruction in the ensuing 96 hours [4]. If the patient is presenting with signs of bowel obstruction, particularly with bilious emesis, immediate surgical consultation should occur. Early discussion and consultation with the pediatric GI and surgical teams is appropriate. It is unclear when to consider bowel irrigation, but the case in which it was used, was an example of an asymptomatic child who had ingested more than 100 gel beads [10], highlighting the number of ingested beads may be part of the treatment decision.

While there is very likely a publication bias (with more serious cases being published), it is still very important to be aware of the expanding nature of these gel balls and to not treat them like other round and soft items even if they pass the esophagus and the pylorus.



While this report has focused on gel beads in the digestive tract, numerous cases have been reported by otolaryngologists where the gel balls have been placed easily in the ear or nose causing harmful complications [16].

There has been some advocacy in the area to highlight the danger of these gel balls. The *Australian Competition and Consumer Commission* issued a warning urging the market not to advertise for water beads as toys and alerting consumers of its risks [15]. Likewise, in 2012 and 2103, the *US consumer product safety commission* issued a voluntary recall of several types of the water absorbing beads and toys and the American Academy of Pediatrics has a 2016 newsletter highlighting the potential harm of water absorbing beads [17], yet similar products can still be easily purchased in Canada and around the world.

Conclusion

The ingestion of gel balls poses a public health concern given that the use of superabsorbent polymer technology is becoming

more prevalent and can result in significant morbidity and mortality. Both parents and practitioners need to be aware of the potential dangers of ingesting these polymers. Management should not conform to standard protocols of foreign body removal, and early removal whenever possible should be attempted in order to prevent complications.

Key Points

- Gel balls are made of super absorbent polymers which have the property to expand over little time when in contact with fluid; thus, when ingested, their expanding size can cause serious complications such as bowel obstruction.
- Ingestion of gel beads should not conform to standard principals of foreign body management and requires a high index of suspicion.
- Prompt endoscopic removal should be attempted for all patients with no signs of obstruction whenever the gel beads might be in the upper GI tract.
- The ingestion of gel balls poses a public health concern, and the public should be aware of the potential harmful effect if ingested. Gel balls should not be made available as toys to young children and they should not be marketed to kids.

Conflict of Interest

All authors declare no conflict of interest.

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