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## Successful removal of two magnets in the small intestine by laparoscopy and colonoscopy: A case report

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### Abstract

#### BACKGROUND

Ingestion of multiple magnets can cause serious gastrointestinal complications, such as obstruction, fistulae, and perforation. When multiple magnets traverse the stomach, coordination between pediatric gastroenterologists and pediatric surgeons is recommended, and ultimate management is required dependent on clinical concerns.

#### CASE SUMMARY

A 5-year-old girl swallowed 2 small magnets that then remained in the right lower quadrant (RLQ) of the abdomen for 3 d; this required endoscopic and laparoscopic intervention. Abdominal X-ray and computed tomography revealed high-density objects in the RLQ area. Colonoscopy after proper bowel preparations on the third day of ingestion revealed no foreign body in the colonic area or the end of the ileum. The two magnets were removed *via* colonoscopy with laparoscopic intervention.

#### CONCLUSION

It is important to establish effective coordination between pediatric gastroenterologists and pediatric surgeons when using a non-invasive procedure to remove magnets.

**Key Words:** Child; Colonoscopy; Foreign bodies; Laparoscopy; Magnets; Case report

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**Core Tip:** The intake of foreign bodies in children is relatively common. Ingestion of multiple magnets can cause serious gastrointestinal complications, such as obstruction, fistulae, and perforation. This report presents the case of a 5-year-old female who ingested 2 magnets, both of which were successfully and safely removed without any complications *via* laparoscopy and colonoscopy. Surgical intervention is not always necessary, even in cases where the magnets have passed through the pylorus and have been attached together for 2 to 3 d. Endoscopic removal under diagnostic laparoscopy should be considered before further complications arise.

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## INTRODUCTION

The intake of foreign bodies (FBs) in children is relatively common. Up to 80% of ingested FBs cause no internal damage and are passed without any complications. If a single small magnet is ingested, it can be expected to pass. However, ingestion of multiple magnets can cause serious gastrointestinal complications, including obstruction, fistulae, and perforation due to pressure necrosis. If multiple magnets pass through the pylorus, especially if more than 12 h have passed since ingestion, and there is no sign of obstruction or perforation, endoscopic removal or surgical removal is recommended[1]. Even if more than 12 h have passed, surgical intervention is not always necessary in all cases of FBs distal to the pylorus. To date, there have been few reports on the management of a multiple magnets in the terminal ileum that use endoscopy under laparoscopic intervention without laparotomy.

We report the case of a 5-year-old female who ingested 2 magnets, both of which were successfully and safely removed without any bowel wall damage by laparoscopy and colonoscopy.

## CASE PRESENTATION

### Chief complaints

A 5-year-old girl visited the emergency department of our hospital, one day after she swallowed 2 small magnets. She did not show any signs of abdominal pain or vomiting.

### History of present illness

The patient ingested a 5 mm spherical magnet first. After 30 min later, she ingested another, 6 mm flat magnet.

### History of past illness

The patient had no relevant previous medical history.

### Personal and family history

The patient had no relevant personal and family history.

### Physical examination

Her abdomen was soft and flat. Normoactive bowel sounds were audible. No tenderness or rebound tenderness was observed in the abdomen. Her initial vital signs were stable – blood pressure: 100/70 mmHg, pulse rate: 85 beats/min, respiratory rate: 20 breaths/min, and body temperature: 36.7 °C.

### Laboratory examinations

Laboratory tests revealed a white blood cell count of 10990 cells/ $\mu$ L with predominant

neutrophils (67.4%), hemoglobin of 13.3 g/dL, hematocrit of 38.1% and platelet count of  $323 \times 10^3/\mu\text{L}$ . Erythrocyte sedimentation rate was 4 mm/h and C-reactive protein level was 0.07 mg/dL (normal range < 0.5 mg/dL). Prothrombin time and activated partial thromboplastin time were normal.

### **Imaging examinations**

Abdominal radiographs showed 2 small (one spherical and one flat) radiopacities in the right lower quadrant (RLQ) (Figure 1). No free air or other signs of perforation were visible.

Anticipating spontaneous passage of the two magnets, we monitored her using repeated radiographs that were taken twice a day. Serial abdominal X-rays revealed no migration for 2 d; the two magnets remained in the right lower abdomen. Abdominal computed tomography did not provide further information and only confirmed the location of the FB in the RLQ of the abdomen.

### **Further diagnostic work-up**

On the second day post-ingestion, polyethylene glycol 3350 was used to aid passage. However, this was ineffective. Colonoscopy after proper bowel preparation on the third day post-ingestion revealed no FBs in the colonic area or terminal ileum.

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## **FINAL DIAGNOSIS**

The two magnets that the patient ingested were diagnosed to be located in the small intestine, presumably the ileum.

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## **TREATMENT**

After in-depth discussions with pediatric surgeons, explorative laparoscopy was performed. General anesthesia using inhaled sevoflurane, intravenous thiopental sodium, and rocuronium bromide was administered by an anesthesiologist. During diagnostic laparoscopy, the attractive forces that kept the magnets together weakened, and the magnets entered the large intestine. We decided to perform colonoscopy in the operating room. The magnets were found in the hepatic flexure of the colon and were removed *via* the colonoscopy (Figure 2).

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## **OUTCOME AND FOLLOW-UP**

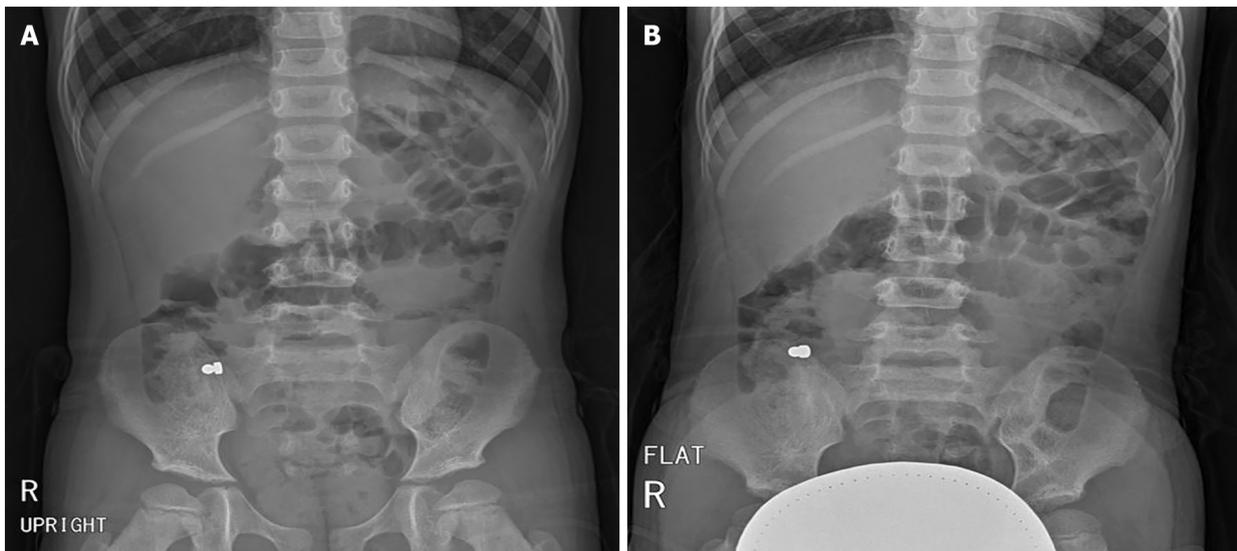
On the 8<sup>th</sup> day post-ingestion day, or 5<sup>th</sup> day post-operation, the patient began a soft-food. Ten days after ingestion, she was discharged with no complications.

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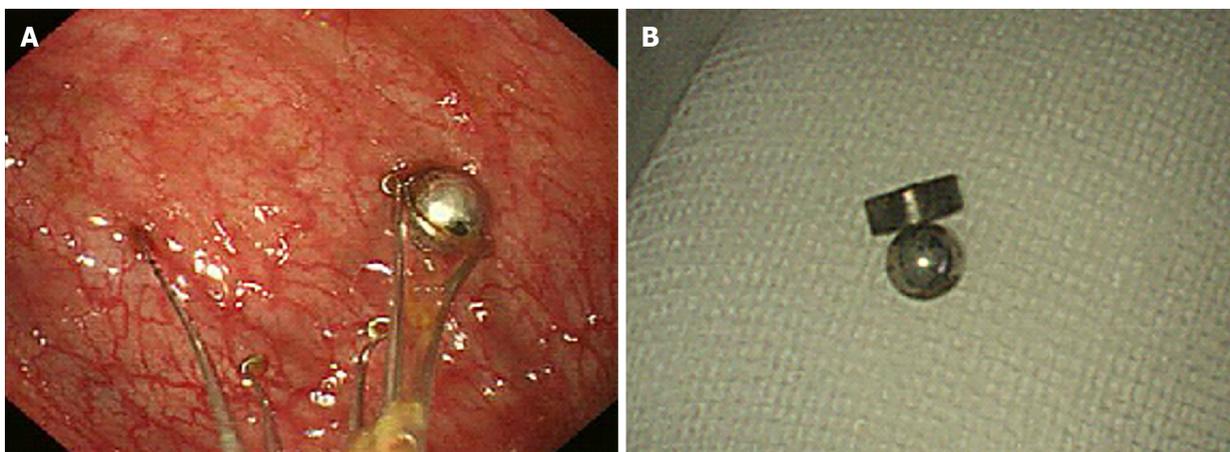
## **DISCUSSION**

Ingestion of FBs is relatively common in children aged < 6 years[2]. In 80% of cases, the FBs are passed spontaneously without any complications; in 10% to 20% of cases, they are removed by endoscopy; in 1% of cases, they require surgical removal[3]. Common objects that children ingest are coins, toys, batteries, and pins, as well as fish bones. Ingestion of magnets is rare, but its incidence has increased with the popularity of magnetic toys, such as high-powered ball-bearing neodymium magnets, which have 5 to 10 times higher strength than traditional ferrite magnets[1].

A single ingested magnet may pass without any complications. However, in cases where multiple magnets are ingested, the attractive forces between them can lead to the objects finding each other despite being in different regions of the bowel. The magnets can cause bowel damage, such as ischemia and pressure injuries, since they attach to each other and do not separate[1]. In some cases, the force created through the bowel may result in complications such as bowel obstruction, perforation, fistula formation, volvulus, intraperitoneal hemorrhage, and even death[4,5]. The time the until onset of complications may vary depending on the magnet's strength, size, and shape. It is difficult to determine the appropriate timing for the endoscopic removal of FBs.



**Figure 1** Abdominal radiograph showing 2 magnets in the right lower abdominal quadrant.



**Figure 2** Removal of magnets. A: Removal of a spherical magnet using pentapod forceps during colonoscopy and laparoscopy; B: Successful removal of individual magnets separately.

As the incidence of magnet ingestion increases, several algorithms have been developed to help guide management[1,6,7]. If the patient is asymptomatic and has a post-pyloric magnet, the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition recommends non-operative management such as enteroscopy or colonoscopy[8,9]. If removal by endoscopy is unsuccessful, close monitoring by repeated X-rays is required, and polyethylene glycol 3350 or other laxative solutions may be considered to aid the passing of the magnets. However, if this remains unsuccessful, surgical management of post-pyloric magnets is required[1, 10].

Recent reports have described two cases of magnet ingestion in children who underwent open laparotomy. The first case involved a 7-year-old girl who swallowed a toy consisting of 10 small pieces of magnet; however, the ingestion time was uncertain. She consulted with a 5 d history of abdominal pain, vomiting, and diarrhea. Abdominal radiography revealed a FB in the RLQ abdomen and free air below the diaphragm. Laparotomy was performed to remove the FB and repair the bowel perforation. The second case was a 2-year-old girl who presented with abdominal pain and non-bilious vomiting. Abdominal radiography revealed a FB consisting of multiple spherical parts bound together, forming a circle in the lower abdomen. Three days after serial abdominal radiography, laparotomy was performed due to development of symptoms. Upon exploration, perforation of the intestinal wall was observed. To our knowledge, there is limited literature on the laparoscopic and endoscopic removal of multiple magnets that are distal to the pylorus and without any

complications[11,12].

In our case, a radioopaque single FB was observed in the RLQ area by a simple abdominal radiograph. Multiple magnets ingested at different times can attach to each other through the loops of the gastrointestinal tract. Since the magnets were thought to be in the terminal ileum or colon that colonoscopy could approach, colonoscopy was considered to remove the magnets. However, we failed to identify magnets during colonoscopy. Laparoscopic removal is also an effective method, but it inevitably damages the intestine. If more than 12 h have passed since ingestion, surgical intervention is not always necessary in all cases with post-pyloric FBs. If endoscopic or surgical removal of the FB is not an emergency or is not an absolute indication, the risk-benefit ratio should be considered in assessing the complications expected to occur because of the FB itself and those expected to occur secondary to FB removal procedures[13].

The ingestion of FBs is a common problem faced by pediatricians. To prevent damage caused by ingestion of FBs, parents should be careful in keeping their children from swallowing dangerous objects and provide warnings about the potential risks of their products. Nevertheless, if children ingest FBs, especially if it is more than one magnet, they should be immediately referred to the hospital for appropriate management to prevent complications.

## CONCLUSION

We report a case of ingestion of two magnets that attached to each other in the small intestine. The magnets were removed without complications by performing laparoscopy and colonoscopy simultaneously in the operating room.

If multiple ingested magnets pass through the pylorus and do not show any movement, we propose to consider simultaneous colonoscopy and laparoscopy, which can provide a physical force that weakens the strength of the attached magnets, to remove FBs at an appropriate time before the occurrence of complications or symptoms. It is important to establish effective coordination between pediatric gastroenterologists and pediatric surgeons regarding non-invasive procedures for safe and uncomplicated magnet removal.

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