Clinical experience in the treatment of children who swallowed multiple magnetic foreign bodies: A report of five cases

Yue-Bin Zhang, Zhi-Gang Gao, Qi-Xing Xiong, Li-Feng Zhang, Dou-Te Cai, Jia-Bin Cai
Hangzhou, China

Breif report

Background: **Several clinical reports have been published on complications resulting from swallowing multiple magnetic foreign bodies. This study aimed to summarize the clinical experience of managing children who swallowed multiple magnetic foreign bodies.**

Methods: **We reviewed the clinical records of five children who swallowed multiple magnetic foreign bodies and were admitted to our hospital during June 2012 to June 2014. Details of the patients' presentation, imaging studies, complications and treatment were recorded.**

Results: **All five children suffered from gastrointestinal perforation and intestinal obstruction. The magnetic foreign bodies caused local bowel wall tissue ischemia necrosis and perforation as well as other complications associated with fistula formation. The magnets were finally removed by laparotomy surgery.**

Conclusion: **If magnetic foreign bodies cannot be removed by endoscopy, an operation is suggested as soon as possible to avoid serious complications.**

World J Pediatr 2017;13(3):274-277

Key words: **children;**
gastrointestinal perforation;
intestinal obstruction;
magnetic foreign bodies

Author Affiliations: Department of General Surgery, Children's Hospital Zhejiang University School of Medicine, Hangzhou, China (Zhang YB, Gao ZG, Xiong QX, Zhang LF, Cai DT, Cai JB)

Corresponding Author: Zhi-Gang Gao, MD, Department of General Surgery, Children's Hospital, Zhejiang University School of Medicine, No. 57 Zhugan Xiang, Hangzhou 310003, China (Tel: 86-13516727389; Email: 6734893@qq.com)

doi: 10.1007/s12519-016-0083-1
Online First, January 2017

Introduction

The ingestion of foreign bodies is common in children, especially among those younger than 3 years of age.[1] Commonly, a single magnet is typically innocuous and is much like other foreign bodies that can be normally excreted. However, when multiple magnetic foreign bodies are ingested, they can be attracted to each other and lead to serious complications such as gastrointestinal perforation, internal fistula and intestinal obstruction.[2-10] Therefore, it is important to recognize the risk of intestinal perforation caused by multiple magnetic objects. The application of an aggressive approach will reduce mortality.[9] However, to date, there are no definite guidelines for managing children who have ingested magnetic objects.[9]

We summarized the complications caused by the ingestion of multiple foreign bodies in five children and presented our clinical treatment experience.

Methods

During June 2012 and June 2014, five children were admitted to the Children's Hospital Zhejiang University School of Medicine (Hangzhou, Zhejiang, China) for ingestion of magnetic foreign bodies. We reviewed their clinical records. Details of their presentation, imaging studies, complications and treatment were recorded. The study was approved by the Ethics Committee of our hospital, and informed consent was obtained from the parents of the included children.

Results

Case 1

A 1-year-old boy was admitted to our department because of "crying after orally ingesting a magnetic foreign object and vomiting for nine days" (Table). Physical examination revealed an area of tenderness without induration in the epigastrium. A plain abdominal X-ray examination revealed five gastrointestinal foreign bodies;

Table. Clinical information of the five cases

Variables	Case 1	Case 2	Case 3	Case 4	Case 5
Gender	Boy	Girl	Boy	Boy	Boy
Age	1 y	2 y and 8 mon	7 y and 2 mon	7 y and 1 mon	2 y and 6 mon
Symptoms	Often crying and vomiting for 9 d	Abdominal pain and vomiting for 5 d	Swallowing magnetic foreign body 4 d previously	Abdominal pain and vomiting 1 d	Abdominal pain and vomiting
Time between ingestion and presentation, d	9	5	4	1	2
Number of foreign bodies and their position	Two of the three magnets located in the jejunum and one in a fistula of the gastric wall	Four cylindrical foreign bodies in jejunal perforation	Two olive-like foreign bodies in the stomach and one in the duodenum	Magnetic beads, button batteries and staples in the distal perforation of the ileum	Ten magnetic foreign bodies in the jejunum and 8 magnetic foreign bodies in the ascending colon
Complications	Gastric ulcer; perforation in combination with fistula	Intestinal obstruction; jejunal perforation	Perforated ulcer in the adjacent stomach and duodenal wall	Terminal ileum perforation	Ulcer perforation in the jejunum
Investigation	Radiograph examination	Radiograph examination	Radiograph examination	Radiograph examination	Radiograph examination
Management	Emergency gastroscopy and emergency exploratory laparotomy surgery; repair of gastrointestinal perforation	Emergency laparotomy surgery; intestinal perforation repair and peritoneal irrigation drainage	Emergency gastroscopy and laparotomy surgery; repair of gastro-duodenal perforation	Laparotomy surgery; repair of intestinal perforation	Emergency laparotomy surgery
Hospitalization duration, d	13	9	10	9	10

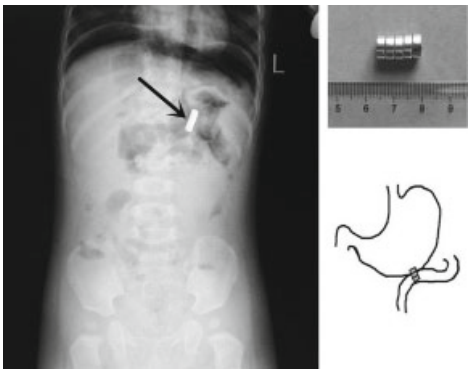

Fig. 1. The perforation caused by magnetic foreign bodies' inter-attraction in the stomach in case 1. The arrow indicates a total of 3 gastrointestinal foreign bodies arranged in a row; two of the three magnets were located in the jejunum and the other was located in the fistula of the gastric wall.

two of them were arranged in a row in his stomach. We performed an emergency upper gastrointestinal gastroscopy examination and removed the two magnets. However, the other three magnets could not be removed via gastroscopy; an emergency exploratory laparotomy surgery was performed. A perforation in combination with a fistula was found at the beginning of the jejunum and mesocolon. Two of the three magnets were located in the jejunum, and one was located in a fistula of the gastric wall (Fig. 1). After the removal of all the foreign bodies, the gastrointestinal perforation was repaired. This patient was discharged 13 days after successful surgery.

Case 2

A 2-year-and-8-month-old girl had suffered from abdominal pain and vomiting for five days (Table). Physical examination showed that her abdomen was tender, with quadrant tenderness in the periumbilical and right lower regions, but no muscle tension or rebound tenderness was detected. We diagnosed this case as intestinal obstruction that was most likely caused by foreign body ingestion through an erect abdominal X-ray examination. An emergency laparotomy surgery showed two ileal perforations of 2 mm in diameter separated by a distance of 20 mm. The foreign bodies can be seen at the perforation site in the distal jejunum. By expanding the jejunal perforation, a total of four magnetic cylindrical foreign bodies were removed. After intestinal perforation repair and peritoneal irrigation drainage, the patient had an uneventful postoperative recovery and was discharged from our hospital 9 days later.

Case 3

A 7-year-and-2-month-old boy came to the emergency room at our hospital for "swallowing magnetic foreign bodies four days previously" (Table). Plain chest radiography in combination with a KUB (kidney-ureter-bladder) examination showed that there were two olive-like foreign bodies in the stomach and one in the duodenum. We performed an emergency upper gastrointestinal endoscopy and found that all of the foreign bodies were magnetic. However, the first

attempt to remove the foreign bodies was unsuccessful. Then, laparotomy surgery was employed. There was a 2 mm perforated ulcer at the adjacent stomach and duodenal wall (Fig. 2). During surgery, the foreign body in the duodenum was squeezed back into the stomach; finally, the three magnets were successfully extracted. Subsequently, the gastro-duodenal perforation was patched, and the incision in the stomach was sutured. This child had a good recovery and was discharged 10 days after surgery.

Case 4

A 7-year-and-1-month-old boy presented with a history of abdominal pain with vomiting one day before admission (Table). He reported that "he had swallowed several metal foreign bodies". The radiograph examination revealed the foreign bodies in the digestive tract of his right lower quadrant. Laparotomy surgery was performed; approximately 200 ml of turbid exudate was found, and the terminal ileum was closely adhered to the ileocecus. After the separation of the adhesions, two terminal ileum perforations were visible. Finally, the foreign bodies, including magnetic beads, button batteries and staples, were removed from the distal perforation. After repair of the intestinal perforation, the patient had an uneventful recovery and was discharged 9 days after surgery.

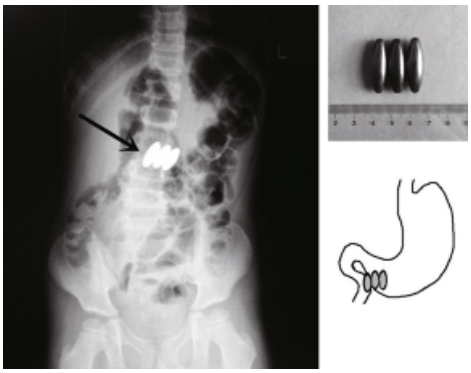

Fig. 2. The perforation in the stomach wall and the duodenal wall caused by inter-attraction of magnetic foreign bodies in a one-year-old boy (case 1). The arrow indicates that there were two olive-like foreign bodies in the stomach and one in the duodenum.

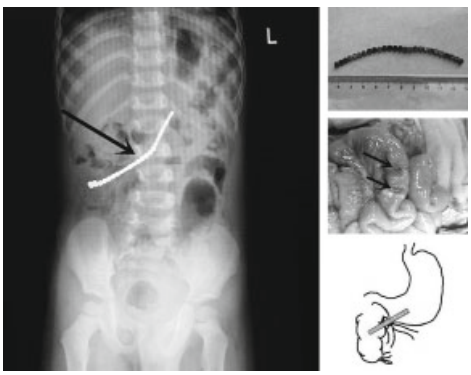

Fig. 3. Gastric-intestinal perforation caused by the inter-attraction of magnetic foreign bodies in the stomach, jejunum and ascending colon in case 5. The arrow indicates a total of 28 foreign bodies. Among them, 10 magnetic foreign bodies were found in the jejunum, 8 magnetic foreign bodies were at the front wall of the stomach and the other 8 magnetic foreign bodies were located in the ascending colon.

Case 5

A 2-year-and-6-month-old boy with a history of foreign body consumption 2 days prior to admission presented with abdominal pain and vomiting (Table). The radiograph examination revealed many pieces of metallic foreign bodies organized in a row (Fig. 3). Emergency laparotomy surgery was performed. Multiple adhesions were observed in the jejunum between the ascending colon and the stomach wall. After the separation of these adhesions, six early ulcer perforations and 10 magnetic foreign bodies were found in the jejunum. Stomach exploration found eight more magnetic foreign bodies at the front wall of the stomach, and they were successfully extracted. Further exploration of the colon showed another eight magnetic foreign bodies in the ascending colon, and they were removed by cutting open the ascending colon. The abdomen was closed once a C-arm machine confirmed that no more foreign bodies were present. This patient had an uneventful recovery and was discharged 10 days after surgery.

Within a follow-up of 3-6 months, all patients returned to a normal diet and normal growth and development. No postoperative complications were reported.

Discussion

Magnet ingestion is rare. In our study, we reported 5 cases of children with magnet ingestion to summarize our clinical experience in treating these cases. Almost all patients presented with abdominal pain and vomiting. Typically, parents are not aware of their children's history of foreign body ingestion. Therefore, once the ingestion of foreign bodies is suspected, it is important for physicians to obtain a detailed history.[3]

The ingestion of multiple magnets usually causes several problems. Though most magnets are small enough to pass through the gastrointestinal tract, the number of complications increases when magnets get separated as they pass into the duodenum. Because of the magnetism, multiple ingested foreign bodies attracted to each other and oppress the adjacent stomach wall, intestinal wall or other surrounding tissue, causing ischemia, resulting in ulceration and eventually fistula and perforation.[11,12] This usually leads to clinical symptoms including abdominal pain, vomiting,

intestinal obstruction and peritonitis.

Determining how to treat patients after digestion of a magnetic foreign body is the key point. First, we should identify the presence of magnetism in the swallowed foreign bodies. For older children, we can learn a detailed history; for infants and young children who usually do not provide a reliable history, an abdominal X-ray is required. If it is a single magnet, the treatment should be the same as that for a non-magnetic foreign body; a single magnet can be smoothly self-excreted. If more than one magnetic foreign body is ingested, close dynamic observation of the abdominal *X*-ray is necessary. If the patient has presented with pneumoperitoneum or an aggravated intestinal obstruction, emergency surgery is needed. The mutual attraction of magnetic foreign bodies oppresses intestinal wall tissue and causes severe complications. Therefore, early interventional treatment should be taken into account to avoid perforation, fistula formation, peritonitis or bleeding and other serious complications.[13]

Methods for clinical gastrointestinal foreign body removal include upper gastrointestinal endoscopy, laparoscopy surgery, and laparotomy surgical removal. However, magnetic gastrointestinal foreign bodies cannot be removed endoscopically and most required surgery. Because the distal and proximal (stomach) magnetic foreign bodies were attracted to each other and fixed in the gastrointestinal wall. All of them required exploratory laparotomy. During surgery, one or more gastrointestinal perforations were observed. We mostly observed multiple perforations. Therefore, if a perforation was found, the proximal and distal bowel conditions should be checked to avoid missing other gastrointestinal perforations.

In conclusion, the ingestion of multiple magnetic foreign bodies is likely to cause gastrointestinal perforation and other serious complications; thus, clinicians should be highly vigilant. If the clinical examination reveals fixed magnetic foreign bodies in the abdomen, surgery should be performed as soon as possible to avoid further complications.

Funding: This study was supported by Chinese medical Bureau of Zhejiang Province (2011ZA068), Science Technology Department of Zhejiang Province (2012C13024-1) and Health and Family Planning Commission of Zhejiang Province (11-CX23).

Ethical approval: The study was approved by the Ethics Committee of our hospital, and informed consent was obtained from the parents of the included children.

Competing interest: None.

Contributors: Zhang YB conceived and designed the study. Xiong Q and Zhang L collected patients' data. Cai D and Cai J performed the statistical analysis. Gao Z wrote the manuscript. All authors read and approved the final manuscript.

References

1 Black RE, Johnson DG, Matlak ME. Bronchoscopic removal of aspirated foreign bodies in children. J Pediatr Surg 1994;29:682-684.
2 Cox S, Brown R, Millar A, Numanoglu A, Alexander A, Theron A. The risks of gastrointestinal injury due to ingested magnetic beads. S Afr Med J 2014;104:277-278.
3 Anselmi EH, San Román CG, Fontoba JEB, González LA, Dieguez EV, González JL, et al. Intestinal perforation caused by magnetic toys. J Pediatr Surg 2007;42:e13-e16.
4 Brown JC, Otjen JP, Drugas GT. Pediatric magnet ingestions: the dark side of the force. Am J Surg 2014;207:754-759; discussion 759.
5 Kim Y, Hong J, Moon SB. Ingestion of multiple magnets: the count does matter. J Pediatr Surg Case Rep 2014;2:130-132.
6 Mandhan P, Alsalihi M, Mammoo S, Ali MJ. Troubling toys: rare-Earth magnet ingestion in children causing bowel perforations. Case Rep Pediatr 2014;2014:908730.
7 Silverman JA, Brown JC, Willis MM, Ebel BE. Increase in pediatric magnet-related foreign bodies requiring emergency care. Ann Emerg Med 2013;62:604-608 .
8 Tsai J, Shaul DB, Sydorak RM, Lau ST, Akmal Y, Rodriguez K. Ingestion of magnetic toys: report of serious complications requiring surgical intervention and a proposed management algorithm. Permanente J 2013;17:11-14.
9 Naji H, Isacson D, Svensson JF, Wester T. Bowel injuries caused by ingestion of multiple magnets in children: a growing hazard. Pediatr Surg Int 2012;28:367-374.
10 Robinson AJ, Bingham J, Thompson RL. Magnet induced perforated appendicitis and ileo-caecal fistula formation. Ulster Med J 2009;78:4.
11 Nui A, Hirama T, Katsuramaki T, Maeda T, Meguro M, Nagayama M, et al. An intestinal volvulus caused by multiple magnet ingestion: an unexpected risk in children. J Pediatr Surg 2005;40:e9-e11.
12 Pryor HI, Lange PA, Bader A, Gilbert J, Newman K. Multiple magnetic foreign body ingestion: a surgical problem. J Am Coll Surg 2007;205:182-186.
13 İlçe Z, Samsum H, Mammadov E, Celayir S. Intestinal volvulus and perforation caused by multiple magnet ingestion: report of a case. Surg Today 2007;37:50-52.

Received July 7, 2015
Accepted after revision October 21, 2015