



# The Complications of Multiple Magnets

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## Abstract

**Purpose:** To determine the incidence, characteristics and management of magnet ingestions over time.

**Methods:** In this retrospective chart review, we searched our institution's patient record for patients aged <18 years who had been diagnosed with ingested FB between 2013 and 2017. Cases were analyzed for age, gender, and management characteristics.

**Results:** We identified 664 patients who ingested FB. Among them there were 28 who ingested magnets. Multiple magnets were found in 14 cases (50%). Patients ingested between 1 and 32 magnets, most often 1 to 3 magnets. The median age was 3 (range 10 months to 12 years); mean 3.64 years and 64.3% were male.

Six cases required surgical removal of the magnets because of intra-abdominal sepsis or concern for the bowel perforation which made 42.9% of multiple magnets ingestions. There were no deaths in this group.

**Conclusion:** If more than one magnetic body is ingested, it is necessary to admit the patient to hospital and to remove them using an endoscope. The position of the magnets which is not changing in a location inaccessible for an endoscope during 24 h is an indication for surgery. Magnet safety standards are needed to decrease risk to children.

**Keywords:** Multiple magnet; Foreign bodies; Children

## Background

Reports of magnet ingestion are increasing rapidly globally [1-3]. Ingestion of a Foreign Body (FB) occurs commonly in children aged 3 to 4 years old [3-5]. Ingested magnets are a serious health hazard for children, with an extremely high risk of intestinal obstruction and perforation as loops of bowel may be trapped between multiple magnets, the morbidity is increasing [6]. Although conservative treatment is sufficient in most cases of FB ingestion, ingested FBs can cause serious morbidity or mortality depending on their size, their shape, and the patient's medical status; therefore, endoscopic or surgical intervention is occasionally required [7,8]. The increasing number of complications worldwide being reported secondary to magnet ingestion point not only to an acute lack of awareness about this condition among the medical profession but also among parents. In cases involving magnet ingestion physicians often face challenges in diagnosis if doubt exists regarding how many magnets were ingested and whether an ingested FB is magnetic or metallic, given that clear differentiation between these two types of FBs is not always possible [7,9]. Our purpose was to determine the incidence, characteristics and management of magnet ingestions in 5 years.

## Patients and Methods

We retrospectively reviewed the records of patients aged <18 years with a diagnosis of foreign bodies or bezoars in the upper gastrointestinal tract at our Regional Children's Hospital from January 2013 to December 2018. After excluding pediatric patients with insufficient data for analysis, in total, 664 cases were enrolled in this study. All patients underwent X-rays, an esophago-duodenoscopy if the FB was suspected in stomach or upper. All examinations were undertaken by certified endoscopists using flexible endoscopes. All patients gave informed consent for the procedure. Endoscopic devices used for the removal of foreign bodies included alligator forceps, biopsy forceps, rat-tooth forceps, and a net. In cases of suspected multiple magnets or acute abdomen signs the patient was referred to the surgical department. Patient demographic data that were analyzed included age, gender, intention to ingestion, symptoms at admission, diagnostic and surgical procedures. Clinical features of foreign bodies were analyzed, including type, size,

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Received Date: 04 Feb 2020

Accepted Date: 07 Mar 2020

Published Date: 11 Mar 2020

### Citation:

Shapkina A, Rodionova E. The Complications of Multiple Magnets. Clin Surg. 2020; 5: 2760.

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**Table 1:** Comparison of the operated patients.

Patient	#1	#2	#3	#4	#5	#6
<b>Age/ Gender</b>	3 year/ male	11 years/ female	7 year/ male	3 year/ male	1 years/ female	2 year/ male
<b>Chief complaint at admission</b>	FB ingestion Pain Vomiting	FB ingestion Pain Vomiting	FB ingestion Pain	Pain Vomiting	Irritability Vomiting	Pain Vomiting
<b>Physical exam at admission</b>	Tenderness	No signs of surgical abdomen	No signs of surgical abdomen	Tenderness	Tenderness	Tenderness
<b>Cause to perform an operation</b>	Surgical abdomen	Surgical abdomen	FB did not pass through digestive tract	Surgical abdomen	Surgical abdomen	Surgical abdomen
<b>Operation findings</b>	2 magnetic FBs Ileo-ileal fistula Peritonitis	2 magnetic FBs Ileo-cecal fistula	3 magnetic FBs in appendix Appendicitis	20 magnetic FBs Ileo-ileal fistula, caecum perforation Peritonitis	6 magnetic FBs Multiple jejunal fistulas	5 magnetic FBs multiple bowel perforations Meckel's diverticulitis
<b>Operation</b>	Primary closure	Primary closure	Primary closure	Primary closure	Primary closure	Primary closure Ileum resection

sharpness, number and location.

## Results

We identified 664 patients who ingested FB. Among them coins-money 211, batteries-140, sharp objects (including needles) -43, toys-23, stones-8, jewelry 30 and others. Among them there were 28 who ingested magnets. Mean age of the patients was 4.2 years (range, 9 months to 14 years). 66% were male. Multiple magnets were found in 14 cases (50%). Patients ingested between 1 and 32 magnets, most often 1 to 3 magnets.

Among 14 patients in 2 cases multiple magnets (2 and 32) were located in the stomach and were removed endoscopically. In six cases magnets were ingested in one time and spontaneous passage occurred.

Six cases required surgical removal of the magnets because of peritonitis or the bowel perforation which was 42.9% of multiple magnets ingestions.

The commonly presented symptoms were vomiting in 5 to 6 patients and abdominal pain in all 6 patients; 3 of 6 patients or families provided a positive FB swallowing history. The most common sign on exam was abdominal tenderness. Moreover, all patients showed FB positive findings on plain radiographs and all underwent laparotomy. The summary of the patient's data is provided in Table 1. The mean hospital stay was 17 days. There were no deaths in this group. A comparison of the operated cases is presented in Table 1.

## Discussion

In pediatric patients, ingested FBs are usually coins, fish and chicken bones, stones, toys, and other small objects; a esophageal FBs, especially such potentially hazardous as batteries and sharp objects should be removed immediately but other ingested FBs can pass spontaneously. But the ingestion of magnetic FBs in pediatric patients has become common due to the increasing use of toys with magnetic elements [3,5]. A single magnetic FB does not cause serious morbidity because behaves as an isolated FB and pass through the GI tract; in contrast, multiple magnetic FBs always attract each other across the bowels loops leading to intestinal obstruction, fistulas, or perforation. Literature reviews have revealed that prompt surgical intervention is required in cases involving the ingestion of multiple magnetic FBs and any symptoms indicative of surgical abdomen but conservative treatment is not recommended in cases involving the ingestion of multiple magnets [7]. As presented in our case reports, it appears that children usually come when the complications have already occurred. Usually children cannot describe the number, size,

or nature of ingested FBs. Comparing to history given by parents the radiologic examinations might play a key role in establishing an initial diagnosis and treatment strategy for pediatric patients. But it is impossible to detect whether the magnets are in physical contact on plain radiographs.

Some authors think that stable clinical condition does not guarantee stable intra-abdominal condition because intestinal contents or inflammatory exudate might be contained in a localized peritoneal space due to massive intestinal adhesion; accordingly, signs of peritoneal irritation signs might be absent [7].

We agree with the following recommendations for the treatment of pediatric patients with FB ingestion [7] if an ingested FB is metallic on radiologic examination or if the number and nature of ingested FBs cannot be determined, a surgical specialist should be consulted to reach a decision regarding endoscopic or surgical intervention; if a patient exhibits signs of surgical abdomen, including abdominal distension, pain, and vomiting, prompt removal of ingested FBs regardless of their number or nature should be considered; and patients who are confirmed to have ingested multiple magnets should be regarded as conditional surgical patients and should be observed closely for any clinical deterioration even if they appear to be clinically stable. Usually we do radiography every 24 h and if FBs stay in one place plan surgery (as we had in the case of FBs in appendix, patient #3). Proper education and improved awareness among parents and medical staff is key in addressing this rapidly emerging problem [3,6]. The goal of managing such cases of suspected magnet ingestion should be aimed at reducing delays between ingestion time, diagnosis time and intervention time.

## Conclusion

Premature discharge from the hospital due to a misdiagnosis or the misconception that a solitary magnet has been ingested may lead to a fatal outcome. Early surgical or endoscopic intervention performed before symptoms develop or at the first sign of surgical abdomen could prevent more severe complications. If more than one magnetic body is ingested, it is necessary to admit the patient to hospital and to remove them by any way. The position of the magnets which is not changing in a location inaccessible for an endoscope during 24 h is an indication for surgery. There is an increased need for magnet regulations.

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