The American Journal of Surgery (2014) 207, 754-759

The American Journal of Surgery®

North Pacific Surgical Association

Pediatric magnet ingestions: the dark side of the force

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KEYWORDS:
Pediatric;
Magnet ingestion;
Emergency;
Foreign body;
Gastrointestinal;
Prevention

Abstract

BACKGROUND: Pediatric magnet ingestions are increasing. Commercial availability of rare-earth magnets poses a serious health risk. This study defines incidence, characteristics, and management of ingestions over time.

METHODS: Cases were identified by searching radiology reports from June 2002 to December 2012 at a children's hospital and verified by chart and imaging review. Relative risk (RR) regressions determined changes in incidence and interventions over time.

RESULTS: In all, 98% of ingestions occurred since 2006; 57% involved multiple magnets. Median age was 8 years (range 0 to 18); 0% of single and 56% of multiple ingestions required intervention. Compared with 2007 to 2009, ingestions increased from 2010 to 2012 (RR = 1.9, 95% confidence interval 1.2 to 3.0). Intervention proportion was unchanged (RR = .94, 95% confidence interval .4 to 2.2). Small spherical magnets comprised 26.8% of ingestions since 2010; 86% involved multiple magnets and 47% required intervention.

CONCLUSIONS: Pediatric magnet ingestions and interventions have increased. Multiple ingestions prompt more imaging and surgical interventions. Magnet safety standards are needed to decrease risk to children.

The commercial availability of small, high-powered, rare-earth magnets in toys and desktop novelties has paralleled a steady increase in reports of magnet-related ingestion injuries in children.[1–5] An analysis of National Electronic Injury Surveillance System data suggest that there have been more than 22,000 pediatric cases of ingested magnetic foreign bodies in the United States from 2002 to 2011.[1] The United States Consumer Products Safety Commission in December 2012 acknowledged this disturbing trend by issuing proposed safety standards for small, high-powered magnets, based on the "unreasonable risk of injury associated with children ingesting high-powered magnets that are part of magnet toy sets."[6] However, no mandatory standards exist for jewelry, refrigerator magnets, or novelties targeted to adults. The goal of this study was to characterize the epidemiology and temporal trends of magnet ingestion in children over a 10-year span from 2002 through 2012 in a metropolitan free-standing children's hospital.

The authors declare no conflicts of interest.

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Manuscript received October 28, 2013; revised manuscript December 20, 2013

0002-9610/$ - see front matter © 2014 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2013.12.028

Methods

Eligible patients younger than 21 years seen for magnet-related ingestion from June 2002 through December 2012 were identified by performing keyword searches using Clario zVision (version 1.4.65 build 5745; Clario Medical Imaging, Seattle, WA), a mirrored, real-time database of all patients who had radiographs obtained at a freestanding, tertiary care, university-affiliated teaching hospital. Search strategies included (a) any patient who had the exam type "Dx Foreign Body Search," a dedicated electronic order for plain radiography for suspected foreign body or (b) exam type "Dx" (all plain radiographs) with the addition of Boolean keywords: "swallowed," "ingested," "magnet," or "magnets." Keyword searches retrieved any patient where the search word(s) appeared either in the clinical history of the imaging order or in the radiologist's report of the images obtained.

For every potential magnet-related case in the radiology base narrative, electronic medical records and all relevant radiographic images and reports were reviewed to confirm eligibility. Cases with disagreement were resolved by consensus excluding cases where the foreign body was unlikely to be magnetic. Many construction toys contain magnetic rods along with nonmagnetic steel balls. Patients with ingestion of nonmagnetic steel balls were excluded if the foreign body was (a) described as a nonmagnetic steel ball or (b) a ball was confirmed from a specified brand of construction set where the balls are typically nonmagnetic (eg, Magnetix or K'nex).

Multiple magnet ingestions were defined as 2 or more freely moving objects, at least one of which must be magnetic. Magnet–metal combinations were designated as multiple magnet ingestions posing similar risk for injury as 2 or more magnets. Spherical balls from magnet sets are typically .5 mm in diameter. For this study, small spherical magnets were defined as .5 to .75 mm in diameter to account for possible distortion on plain radiography.

Electronic records were mined to retrieve patient characteristics such as age, race, gender, date of evaluation, number of magnets ingested, radiographs obtained, treatment type, interventions, and outcome. Statistical analyses were performed and graphs produced using Stata, version 12.1 (StataCorp, College Station, TX). Poisson regressions were used to determine relative risk (RR).

Results

During the study, 55 eligible children with 56 magnet ingestions involving the stomach or beyond were identified. One child was included twice for 2 independent ingestions. This child underwent a laparotomy where 4 magnets were retrieved and returned to the parents. Three months later, the child found the magnets and ingested 3 of them again. Single magnet ingestion was seen in 24 cases, including 3 cases where a single rod had a small encased magnet at each end. Multiple magnet ingestions occurred in 32 children. Six of these cases involved multiple magnets with other metallic objects. Ingestions occurred in children ranging from 0 to 18 years with no sexual or racial predilection (Table 1). At presentation, most patients were asymptomatic.

Both the incidence of magnet ingestions and the incidence of multiple magnet ingestions increased over time (Fig. 1). Only 1 case occurred before 2006. Compared with 2007 to 2009, total magnet ingestions increased from 2010 to 2012 (RR 1.9, 95% confidence interval [CI] 1.2 to 3.0), but the proportion of ingestions requiring intervention over both intervals was unchanged (RR .94, 95% CI .4 to 2.2). Total emergency department plus Urgent Care Census remained similar (113,481 in 2007 to 2009 vs 112,377 in 2010 to 2012).

Interventions for magnet ingestion increased over the time of the study (Fig. 2). However, the proportion of total cases requiring intervention was the same over 2007 to 2009 as in 2010 to 2012 (RR .9, 95% CI .4 to 2.2). All cases requiring intervention involved multiple magnet ingestion (Table 2). Children with single magnet ingestion were discharged from the emergency department 96% of the time, most with no follow-up at our institution. There were no reported complications. One child with a large, rhomboid hematite rock that had remained in the stomach

Table 1 Characteristics of magnet ingestion cases

Number of cases	56
Median age, y (IQR)	8 (4–10)
Age	
<5 y	33.9%
Patient sex	
Male	50%
Race/ethnicity	
White	69.6%
Black	5.4%
Asian	7.1%
Hispanic	3.6%
Other	8.9%
Not indicated	5.4%
Chronic diagnoses	
Autism	5.4%
Attention deficit disorder	5.4%
Developmental disability	7.1%
Behavioral issues	1.8%
History of pica	5.4%
None	75%
Multiple magnets ingested	57.1%
Single, spherical balls ingested	
2002 to 2009	0%
2010 to 2012	50%
Symptoms	
Abdominal (pain, vomiting)	32.1%
Choking event	10.7%
None	57.1%

IQR = interquartile range.