

Just How Good Are Handheld Metal Detectors for Ingested Foreign Bodies?



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0196-0644/\$-see front matter

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<http://dx.doi.org/10.1016/j.annemergmed.2017.02.001>



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[Ann Emerg Med. 2017;69:516-518.]

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ANNALS CASE

An otherwise healthy 9-year-old boy presented with a 5-day history of abdominal pain, low-grade fever, and bilious emesis. He was admitted and initially treated for gastroenteritis. After he clinically deteriorated the next day, his mother reported a history of ingesting 2 magnets from a board game, and subsequently, an abdominal radiograph showed obstructive ileus requiring surgery. Diagnosis? Jejunioleal fistula and jejunum perforation from swallowed magnets.

Honestly, there's a lot to process here. First, we feel for the patient and the family (what a horrible sequence of events, all because of a board game). Second, we feel for the provider (who honestly asks a vomiting 9-year-old with abdominal pain if he intentionally ingested a foreign body?). On that note, we were expecting this to happen in a child much younger than a 9-year-old (although you're probably pointing out that he was a boy). Finally, when you think about how many children's games involve magnets (travel-sized magnetic checkers or chess, magnetic darts, magnetic fishing, magnetic tiles—the list goes on), it's really amazing this doesn't happen more frequently.

MAGNETS: IT TAKES 2 TO CLICK

Think back to the last time you played with a pair of magnets. You probably pulled them apart and then brought

them just close enough so that those magnets pulled themselves together, resulting in that satisfying *click*. Obviously, you need at least 2 simple magnets to play that game. So it shouldn't come as a surprise that swallowing 2 or more magnets puts the patient at risk for attracting 2 segments of bowel, which can lead to obstruction, pressure necrosis, fistulas, and bowel perforation,¹⁻³ as we saw in this case. On the flip side, ingesting a single magnet is pretty harmless and can be treated just like any other foreign body. Just make sure to ask whether that magnet was coingested with other metallic foreign bodies, which should make you worry.

So let's say that 2 or more magnets were ingested. If the magnets are in the stomach or duodenum, an attempt can be made to retrieve them with emergency endoscopy.¹ Once the magnets pass the stomach and duodenum, though, there is no consensus on management. Some case reports recommend surgical consultation and removal of the magnets before they become symptomatic.^{1,4} Yikes. It looks like when it comes to ingested magnets, all pathways lead to manual removal.

FIRST THINGS FIRST: WHERE IS IT?

Fortunately, magnets aren't the most commonly ingested foreign body by children. The coin easily wins that title.⁵ And when it comes to coins, have you ever wondered about the patient who swallowed a coin and is asymptomatic? Do we need to do anything? Believe it or not, 30% to 40% of ingested foreign bodies in the esophagus may be asymptomatic^{6,7} and can lead to complications including esophageal erosion, perforation, tracheoesophageal fistulas, and mediastinitis.⁸⁻¹⁰ It turns out that the object's location is important. So what's your screening tool of choice? Good ol' radiograph has been the mainstay,^{6,10,11} but you may have heard about handheld metal detectors (HHMDs).

HHMD: THE COIN DIVINER

Using an HHMD for identifying and locating ingested metallic foreign bodies was first introduced by Lewis¹² in 1980 and has been well established in the literature.¹³⁻¹⁵ In a systematic review that included 11 studies, the sensitivity

for detecting a coin by HHMD was 99.4% and the accuracy of identifying location was 99.8% compared with chest radiograph as the criterion standard.¹⁶ To be clear, HHMDs have been best studied in coin ingestions, although Muensterer and Joppich¹⁷ reported a sensitivity of 100% in detecting button batteries in a very small sample size of 8. The sensitivity for detecting other metallic foreign bodies (eg, jewelry, screws, washers, bottle caps, hair clips) is reported as low as 70% for the HHMD, and radiograph is still recommended if the item is not detected with the HHMD. Why all the fuss about using HHMDs? Let's remind ourselves of the realities of our work: some patients (ahem; excuse us, *parents*) refuse radiographs, sometimes it takes a long time to even get a radiograph, and using HHMD has actually been shown to be more cost-effective.¹⁷⁻¹⁹

So how does the HHMD fit into your clinical evaluation? A recent publication by Nation and Jiang²⁰ proposes an algorithm for emergency department patients with an esophageal coin that replaces serial radiographs with HHMD. In this algorithm, patients with a foreign body detected distal to the gastroesophageal junction via HHMD scan are discharged home. If the HHMD scan is negative, a confirmatory radiograph is obtained. Foreign bodies proximal to the gastroesophageal junction and in the esophagus are managed by either esophagogastroduodenoscopy or observation. If you're wondering where the gastroesophageal junction is on a patient's body, the costal margin can be used as the anatomic landmark. Objects above the costal margin are likely esophageal. Objects in the high epigastrium may be in the gastroesophageal junction and should be interpreted as esophageal. Here's a pro tip: when an HHMD is used to scan, the positive signal must show that the metal object is well within the abdominal cavity when the child is standing upright. Usually, the signal will sound when the wand is in the right upper quadrant. Any location above this point, particularly one in the high midepigastrium, should be considered suspect and the location confirmed with a chest radiograph.

What kind of HHMD should you use? A quick Google search shows endless choices. Common sense tells us that the \$10 one probably isn't as great as the \$100 one. None of us have any financial interests in metal detectors, but the ones used in studies include the Garrett Super Scanner,^{15,18,20} the Bochold Tracker IV,¹⁷ and the AH Electronics Backpacker-2.¹⁴

THE FOLEY BALLOON EXTRACTION TECHNIQUE

Earlier, we talked about how some patients with esophageal coins are asymptomatic. After you've identified

the esophageal coin in asymptomatic patients, guidelines recommend an observation period of 12 to 24 hours, with serial examination and nonurgent endoscopy.^{6,21-23} On the other hand, for patients with esophageal coins and symptoms such as neck or throat pain, choking, coughing, drooling, emesis, food refusal, stridor, wheezing, or dysphagia,^{24,25} urgent or emergency endoscopy is indicated.^{10,25} Think esophageal obstruction, especially in patients unable to manage their secretions. Emergency endoscopy is recommended in the American Society for Gastrointestinal Endoscopy guidelines.²⁵ As an alternative, the Foley balloon technique for extraction is safe and reasonable to try under the appropriate circumstances (Table).

Before you reach for that Foley and walk over to the wide-eyed kid clinging to his parents, know the indications and contraindications for attempting the Foley balloon extraction technique:

- There is a single, blunt, and flat object in the esophagus;
- there is no underlying esophageal pathology;
- the foreign body has been present less than 72 hours because the success rate decreases to less than 50% beyond this point; and
- the esophagus is not totally obstructed.²⁶

The Foley balloon extraction technique is effective and safe. It successfully removes the foreign body in more than 88% of cases.²⁶⁻²⁹ Complications are uncommon in the literature. Epistaxis appears to be the most commonly reported complication and is observed in approximately 1% of cases if the Foley is introduced nasally. Vomiting has also been rarely noted, as well as respiratory distress. There was only one case of esophageal injury, and this was in a patient

Table. Foley balloon extraction procedure.

Step Number	Description
1	Gather supplies: 8- to 12-French Foley catheter Saline solution flush Barium 10-mL syringe Tongue depressor Airway equipment
2	Inflate and then deflate the balloon with the barium to coat the balloon and catheter in the event that imaging is needed.
3	Approximate the insertion length by measuring from the Foley insertion site to the distal esophagus.
4	Feed the Foley catheter down either the nares or mouth into the distal esophagus.
5	Turn the patient onto his or her side and in slight Trendelenburg's position to avoid aspiration. ^{7,26,27}
6	Inflate the Foley balloon with saline solution and then slowly withdraw the catheter.
7	Sweep the mouth after each attempt (if the balloon is introduced nasally, deflate the balloon before removal from the nasopharynx).

with multiple attempts to remove a coin that was in the esophagus for 4 days,²⁸ which is outside the recommended window. In one study of 468 patients, zero patients aspirated.²⁹

Some pro tips: the balloon is inflated and then deflated with barium to coat it and the channel in the event that imaging is needed. Water-soluble iodinated radiopaque contrast, such as Gastrografin, should be avoided because it could cause toxicity to the lungs if the balloon breaks (barium is inert). This procedure has been described as safe either with or without fluoroscopy.^{27,29} It is reasonable to use fluoroscopy or portable radiography if blind attempts have failed. Finally, light sedation is optional, and propofol is preferred over ketamine to avoid hypersalivation.

BACK TO THE CASE

This patient with multiple-magnet ingestion causing jejunoileal fistula and perforation required a mid small bowel resection with primary anastomosis and fortunately did well postoperatively.

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