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## **Ingestion of neodymium magnet spheres:-about 3 cases**

Lemoine A <sup>a</sup> (MD), Mamann N <sup>a</sup> (MD), Larroquet M <sup>b</sup> (MD), Tounian P (MD, PhD), Irtan S <sup>b</sup> (MD), Lemale J <sup>a</sup> (MD)

a. Pediatric Nutrition and Gastroenterology Department, Trousseau Hospital, APHP, 26 av du Dr Arnold Netter, 75012 Paris; Sorbonne Université, Paris, France

b. Department of Pediatric Surgery, Trousseau Hospital, APHP, 26 av du Dr Arnold Netter, 75012 Paris; Sorbonne Université, Paris, France .

### **Corresponding author:**

Lemoine Anaïs : [anais.lemoine@aphp.fr](mailto:anais.lemoine@aphp.fr)

Service de Nutrition et Gastroentérologie pédiatrique, 26 av du Dr Arnold Netter, 75012 Paris, France

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A. Lemoine drafted the article and wrote the final version.

S. Irtan, M. Larroquet, J. Lemale, N. Mamann, and P. Tounian gave final approval of the version to be submitted.

## **Résumé**

Nous rapportons 3 cas pédiatriques d'ingestion de 2, 5 et 12 billes aimantées en néodyme. Dans ~~les~~ 2 cas, l'extraction endoscopique a été un échec à cause de la force d'attraction magnétique et une gastrotomie a dû être pratiquée pour extraire les aimants. Dans le troisième cas, les aimants n'étaient pas accessibles par voie endoscopique et ont dû être extraits par laparotomie.

Nous voulons rappeler aux associations de consommateurs et aux pédiatres la dangerosité de ces aimants à base de néodyme.

## **Abstract**

We report 3 pediatrics cases of ingestion of 2, 5 and 12 neodymium magnet spheres in once. In two~~2~~ cases, endoscopic extraction failed because of the strength of the magnetic attraction and a gastrotomy was performed to remove all magnets. In the third case, the magnets were not accessible endoscopically and were removed by laparotomy. We want to warn up consumers association and pediatricians about dangerousness of neodymium magnets.

## **Keyword**

Foreign body; Magnet; Neodymium; Endoscopy; Gastrotomy

## **Introduction**

Ingestion of magnet foreign bodies in children is frequently reported. They account for about 2% of foreign body ingestions in children [1]. Sixty to 67% of children present with multiple magnets [1,2]. The majority of patients are boys aged five to eight years old [1,2] and three out of five children are asymptomatic [1,2].

Small size of the objects favors their involuntary absorption. The ingestion of a single magnet does not lead to complications in the very large majority of cases, but can require an intervention if the object is large, with blockage in the esophagus or stomach. In 88% of cases, the ingestion of several magnets requires endoscopic and / or surgical management [1]. The endoscopic or surgical emergency lies in the fact that the digestive wall or two intestinal loops can be trapped by a magnetic attraction if two or more magnets are ingested, or when one magnet is simultaneously ingested with a piece of iron. Another serious situation can be encountered when only one ingested magnet is attracted by magnetic field as magnetic resonance imaging [3] or iron outside the body as belt buckle or crib bar, with the risk of digestive perforation or necrosis [2,3].

We report three similar situations occurring in the last six months in our center concerning magnetic spheres in construction sets.

## **Observations**

The first case was an 8.5-year-old boy who ingested two neodymium magnetic spheres during a game at school, with no associated symptoms. Abdominal X-ray remained unchanged at 24 hours apart (Figure 1), and abdominal CT scan confirmed the presence of two magnetic spheres in the stomach. Digestive endoscopy and two different experimented operators were unable to extract the magnets with Roth net® and with a Raptor® grasping device because they were contiguously located on either side of gastric mucosal fold. A laparoscopy did not

show any gastric perforation and allowed the removal of magnetic spheres through a gastrotomy. Feeding was resumed on day 5, and the patient was discharged at postoperative day 7.

The second case was a five-year-old boy, having ingested 12 neodymium magnetic spheres at home. He complained to his parents about epigastric pain, with food vomiting. Two abdominal X-ray less than 12 hours apart did not show progression of the magnets forming a linear arc structure (Figure 2A). Endoscopy revealed two magnets at the antrum, prepyloric, and the 10 other magnets at the first duodenum plunging into the second duodenum (Figures 2B and 2C). The two parts were therefore magnetized through the antral and duodenal wall. The endoscopic extraction failed despite the use of several endoscopic instruments (Raptor®, Roth net®) because of both the excessive force of attraction of the magnets between them in the stomach, and the length of the second duodenal part. Raptor grasping device slept on the balls, and attraction with the Roth net was too weak to fight against attraction between the magnetic field of the balls. A laparotomy was performed and the 12 magnets were extracted through a short gastrotomy. The patient was discharged at postoperative day 5 with uneventful recovery.

The third case was about ingestion of 5 neodymium magnetic spheres, similar as previously described, in a 33-month-old boy. Unfortunately, gastroscopy could not be performed when magnets were still in stomach, in a linear presentation (figure 3A). Next day, the magnets were localized in right iliac fossa according to the abdominal X-rays in a “3+2” structure. Twenty-four hours later, magnets did not move (figure 3B), suggesting that magnets were blocked in distal ileon or near the ileo-caecal valve. Patient was asymptomatic. Ileo-colonoscopy until about ten centimeters from the valve, did not allow to visualize the magnets. Indeed, the sphere balls were magnetized along the endoscope through digestive walls (figure 3C). We conclude to a failure of endoscopic extraction, and once again, we

needed help from surgeons. During coelioscopy, magnets were finally found in transversal colon, and the 5 magnets were removed through a short laparotomy with colotomy. We supposed during the colonoscopy, the magnets resumed a linear structure, which allowed the progression through the ileocaecal valve, then colon exsufflation and removal of the endoscope finally attracted the magnets to the transverse colon. The patient was discharged 6 days later.

## **Discussion**

These three children required a surgical extraction of the magnets, after failure of the endoscopic intervention because of the attractive force of the neodymium magnets through digestive walls or endoscopic inaccessibility.

Ingesting multiple magnetic foreign bodies requires close monitoring until the magnets are removed, even if magnets are all ingested at the same time. The greater the number of magnets, the higher the risk of a wall magnet attraction, because of the length of the object created. Moreover, the larger the diameter of magnets, the stronger the attractive force. American adult gastroenterologists recommend at least two X-ray views to determine the number of magnets [4]. The French and European pediatric experts recommend, in case of multiple magnet ingestion, an emergency endoscopic extraction within 24 hours if the foreign bodies are in gastric position [5,6]. For those beyond endoscopic reach, close observation and surgical consultation for non-progression through the gastrointestinal tract is advised [5]. A non-progression of magnets strongly suggests a complication with attraction of the walls, requiring intervention because of the risk of necrosis, perforation, enteroenteric fistulization or volvulus [2]. The initial endoscopic identification may help the surgeon to locate the position of the magnets.

These ingestions were involuntary in these middle-aged children. In the two first cases, we are therefore not in the situation of ingestion in infants with a game inappropriate for their age. In both cases, the magnets came from a building set containing neodymium magnets of 5 mm in diameter, with a force of attraction five times greater than traditional ferrite magnets which most often pass through the digestive tract with no complications [7].

For the past ten years, warnings have been issued against these construction games, or against zen games, containing neodymium magnets, because of potential digestive complications by accidental ingestion. It caused recalls in the United States and Canada for example [4,7]. These recalls were effective because they significantly decreased morbidity [7].

## **Conclusion**

At the light of these three recent cases, we want to alert once again the consumer associations of the potential dangerousness of these games because of important magnetic attraction defeating an endoscopic extraction. We have no fatal cases to deplore in our center, but we think that measures of information should be taken, or even recalls of these games like in other countries.

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**We have no Conflict of Interest to declare.**

**Legend:**

Figure 1: standing abdominal X-ray: 2 magnets

Figure 2A: standing abdominal X-ray: 12 magnets

Figure 2B: endoscopic view: antrum, proximal magnets

Figure 2C: endoscopic view: duodenum, distal magnets

Figure 3A: abdominal X-ray, with ingestion of contrast agent: 5 magnets in stomach

Figure 3B: standing abdominal X-ray: 5 magnets in right iliac fossa

Figure 3C: per endoscopic abdominal X-ray: ileocolonoscopy in right colon in front of appendix, 5 balls in ileum magnetized along endoscope through digestive wall



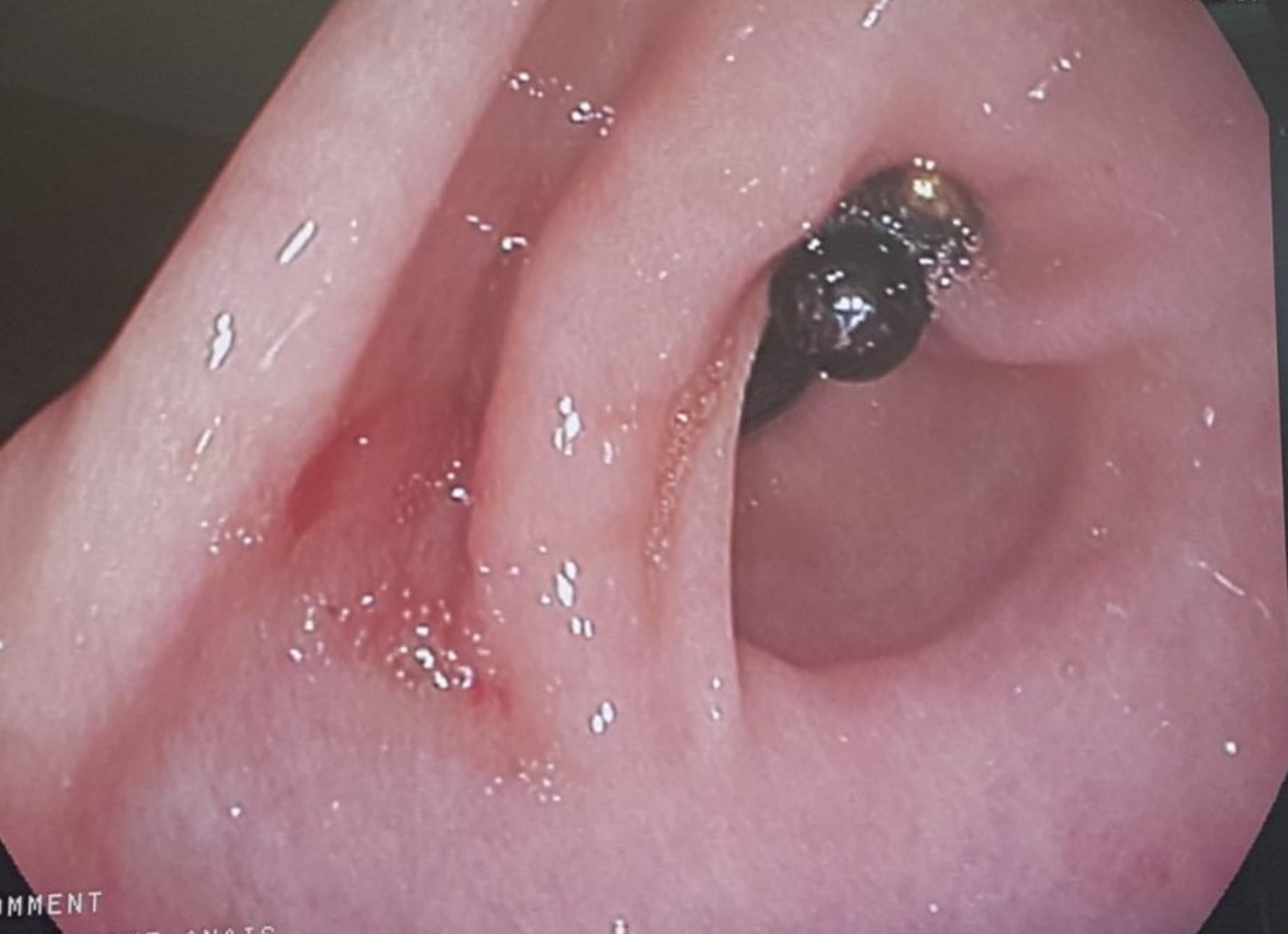
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COMMENT

ANALYSIS





