Introduction

Recently, neodymium magnetic beads became popular in Korea. The beads, each 5 mm in diameter, can be connected in dozens to hundreds or even thousands to create the desired shape. As the popularity of magnetic beads increases, ingestion of the beads is presumed to become more frequent. Because infants and toddlers lack communicating skills, the guardians may not recognize swallowing of the beads without witness. This is of particular concern because children who swallow multiple magnets are at risk of abdominal complications such as necrosis, perforation, fistula, and stenosis. Here, we report a child who swallowed multiple neodymium magnetic beads unwitnessed. The case report was exempted by the Institutional Review Board with a waiver for the requirement of informed consent (IRB no. PC20ZAS10072).
Case

A previously healthy, 33-month-old boy presented to the emergency department with mild periumbilical abdominal pain lasting for 3 days. There were no accompanying vomiting, diarrhea, bloody stool, and dehydration. Three days earlier, he visited a local clinic, and took medication under suspicion of gastroenteritis, but there was no remission. The boy visited another pediatrician one day before the visit, and underwent enema under suspicion of constipation.

The initial vital signs were as follows: blood pressure, 101/60 mmHg; heart rate, 93 beats per minute; respiratory rate, 22 breaths per minute; and temperature, 37.3°C. Physical examination showed mild periumbilical tenderness without rebound tenderness.

Initial laboratory evaluation showed a hemoglobin concentration of 12.5 g/dL, white blood cell count of 14,300/μL (neutrophils, 40.3%), and platelet count of 524 × 10^3/μL, and C-reactive protein of 0.30 mg/dL. The serum electrolytes, creatinine, and liver function tests were all within normal limits. A plain abdominal radiograph showed seven magnetic beads, each 5 mm in diameter, which were located possibly in the small intestine (Fig. 1). No other abnormalities were seen on the radiograph, such as free air. At this point, additional history taking revealed that his parents bought neodymium magnetic beads 10 days before the onset of the symptom. The time of swallowing was unclear because it went unwitnessed.

The boy was referred to a pediatric surgeon on the same day. The surgeon decided to operate immediately in suspicion of micro-perforation of the small intestine. Just prior to the surgery, a follow-up radiograph showed no change in location of the magnetic beads, suggesting the beads were strongly attached to each other within the bowel. Laparoscopic exploration revealed several perforations in the small intestine and mesocolon, and the perforations were primarily repaired (Fig. 2). After the operation, the boy recovered, and oral intake began on postoperative day 2. He had mild, focal abdominal tenderness without signs of residual foreign bodies, obstruction or peritonitis. On postoperative day 5, he was discharged without a complication. At 1-month follow-up, the boy was in good con-

![Fig. 1. Plain supine abdominal radiograph showing 7 magnetic beads (A). On erect abdominal radiograph, the beads were presumed to be located in the small intestine without free air (B).](image-url)
dition without abnormal findings on a follow-up radiograph.

Discussion

There are differences among countries in common types of ingested magnets. In the United States, samarium cobalt (Sm–CO) and neodymium iron boron (Nd–Fe–B) are most commonly used as educational toys, thus the incidence of swallowing these magnets is highest (43.1%). Recently, magnetic beads have become popular among Korean children, so it is likely that the ingestions of the beads become more frequent in them5,6). It is necessary to insert a warning statement regarding the danger of swallowing on the packaging of the beads.

The neodymium magnetic beads are 5 mm in diameter, and have bright and shiny colors, which makes them prone to swallowing by infants and children. Due to difficulty in communication, it may not be possible to notice whether young children swallowed magnetic beads. Therefore, if a child complains of abdominal pain and they were recently exposed to magnetic beads, it is necessary to suspect the ingestion of the beads.

The problem with the ingestion is the stronger magnetism of magnetic beads than that of other magnets. Previously, the magnetism of magnets was reported to be 1,300 G7. However, the magnetism of the magnetic beads removed in this case was 2,500–5,000 G. Complications of the ingestion include necrosis, ulceration, fistulation, perforation, peritonitis, sepsis, and even death1–4. Stronger magnetism implies risk of more severe complications.

Multiple magnetic beads that have entered into the small intestine need surgical removal immediately upon detection. There are debates on the treatment modalities of multiple and separate magnets. Naji et al.4 reported that the practitioners should try conservative management with daily imaging for several days. However, this plan is dangerous for ingestion of multiple magnets due to the stronger magnetism. Given the complexity and outcome in ingestion of multiple magnets, we advocate prompt and immediate operation4,8. In the present case, the plain radiographs showed 7 beads without free air. However, in operation, several micro-perforations were identified. Thus, perforation should not be judged by plain radiographs alone, and it is necessary to examine the entire intestine during the operation.

Briefly, it is necessary to suspect the ingestion of magnetic beads in children with abdominal pain if their guardians recently obtained the beads. In addition, the author advises an immediate operation upon diagnosis in a child who swallowed multiple magnets.

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Conflicts of interest

No potential conflicts of interest relevant to this article were reported.
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