doi: 10.67071/3093-9038-2026-3-3-150-158

ISSUES OF DIAGNOSIS, PREVENTION AND TREATMENT OF URGENT CONDITIONS CAUSED BY FOREIGN BODIES OF THE GASTROINTESTINAL TRACT IN CHILDREN

R.H. Shangareeva[1, 2], R.A. Nigametyanov[2], R.R. Khisamutdinov[2], A.K. Alibaev[2], G.R. Gilyazova[2], A.I. Mambetova[2]

[1] Bashkir State Medical University of the Ministry of Health of the Russian Federation, Ufa
[2] GBUZ of the Republic of Bashkortostan City Children's Clinical Hospital No. 17, Ufa

Foreign bodies of the gastrointestinal tract in children are a serious surgical problem that requires timely diagnosis and clear treatment tactics. The results of treatment of 230 children with foreign bodies of the gastrointestinal tract were analyzed. Foreign bodies were often ingested by children under 3 years of age - 110 (48%); 4-6 years of age – 46 (20%); 7 years and older – 74 (32%). There are 143 boys (62%) and 87 girls (38%). Children were more likely to swallow coins-115(50%), batteries-33(14.4%), plastic toys – 21 (9.1%), magnetic balls -20(8.7%), metal objects – 14(6.1%), hydrogel granules and balls -8 (3.5%), decorative stones -7(3%) and others. The main diagnostic method is X-ray of the thoracic and abdominal organs, performed in the presence of the fact of ingestion of a foreign body, abdominal pain syndrome of unknown origin or with the development of a clinic of intestinal obstruction and intraoperative, with the detection of intestinal conglomerate. In 129 (56%) patients, foreign bodies emerged independently through natural pathways, in 90 (39%) children, 15 batteries and 6 interlocked magnetic balls were removed from the esophagus and stomach. In 7 children, batteries in the esophagus caused a 1–2 degree burn. Magnetic foreign bodies in 5 children also came out on their own. In order to prevent the development of obstructive intestinal obstruction, a method developed in the clinic was used to remove hydrogel granules in 8 patients. Surgical intervention was performed in 11 (5%) patients, 9 of them for multiple magnets and in combination with a metal self-tapping screw. Resection of the small intestine with multiple perforations was performed in 2 children. Foreign bodies that have been in the cecum for a long time in 4 patients were removed by moving into the appendix and appendectomy. Most foreign bodies leave the gastrointestinal tract naturally. In cases where foreign bodies are located in the esophagus or stomach, they can be safely removed by esophagoscopy. The presence of abdominal pain, signs of intestinal obstruction and peritonitis are indications for surgical intervention.

Key words: *gastrointestinal tract, foreign bodies, magnets, hydrogel, children.*

Введение. The problem of foreign bodies in the gastrointestinal tract in pediatric practice remains relevant due to the saturation of the consumer market with a variety of products that pose a danger to children [1, 2]. Foreign bodies (FB) of the gastrointestinal tract are one of the most common emergency conditions in pediatric surgery [3, 4, 5, 6]. Due to the non-specificity of clinical symptoms, the difficulty of collecting anamnesis due to the age of the patients, as well as low alertness of both parents and healthcare professionals due to the sluggish and deceptive nature of the symptoms, diagnosis and treatment can be delayed, which can have life-threatening consequences [7, 2, 8]. The peak incidence of this pathology occurs between the ages of 6 months and 7 years [1, 9].

Popular toys are those made of multiple magnetic spheres, up to 100 or more of which are connected to form various geometric structures with a strong magnetic field. Their separation requires significant physical force, which is why children often use their teeth and swallow them [10]. In children, 80-90% of swallowed foreign bodies can pass spontaneously through the gastrointestinal tract. However, 10–20% of swallowed foreign bodies require endoscopic removal, and 1% or less ultimately require surgical intervention [11, 12]. Patients and their families are rarely aware of swallowed foreign bodies, which can cause complete intestinal obstruction or even intestinal perforation [12].

Hydrogel, a type of foreign body that can be dangerous, comes in the form of multicolored granules that expand tenfold when absorbing water. They are often used by florists to provide plants with moisture and as a decorative element, as the beads are very attractive [1]. Parents often buy them for their children as toys. When swallowed, the hydrogel granules swell and cause intestinal obstruction [2].

Incidents involving foreign bodies in the gastrointestinal tract are becoming increasingly common due to the widespread availability of the aforementioned toys and accessories, which are easily accessible to children. This exacerbates the need to develop clear strategies for the conservative and surgical treatment of such patients.

In recent years, the incidence of surgical complications associated with foreign bodies in the gastrointestinal tract (GI) in children has increased.

The aim of the study. To examine the structure of surgical complications associated with foreign bodies in the gastrointestinal tract in children.

Material and methods. An analysis of the examination and treatment results was conducted for 230 children with gastrointestinal tract IT, from 01/01/2021 to 01/04/2025, who were inpatients in the surgical department of Ufa City Children's Clinical Hospital No. 17. Foreign bodies were most often swallowed by children under 3 years old – 110 (48%); 4–6 years old – 46 (20%); 7 years and older – 74 (32%). There were 143 boys (62%), 87 girls (38%). Children most often swallowed coins – 115 cases (50%), batteries – 33 (14.4%), plastic toys – 21 (9.1%), magnetic balls – 20 (8.7%), metal objects – 14 (6.1%), hydrogel granules and balls – 8 (3.5%), decorative stones – 7 (3%), glass – 6 (2.6%), self-tapping screw – 2 (0.9%), pin – 2 (0.9%), ring – 1 (0.4%), hair (trichobezoar) – 1 (0.4%).

A clinical and radiological examination was conducted. The primary examination method was plain radiography of the neck, chest, and abdomen. Foreign bodies from the gastrointestinal tract passed spontaneously through the natural passages in 129 (56%) patients, were removed from the esophagus and stomach in 90 (39%), and were surgically removed in 11 (5%). Surgical treatment was performed in seven children with multiple magnetic FBs of the gastrointestinal tract, two patients with a metal object and a magnetic ball, and one case each of a self-tapping screw and trichobezoar.

Results and their discussion. Access to medical care in urban settings allows for the possibility of removing foreign bodies before surgical complications arise, provided parents and children seek prompt medical attention. Children with esophageal intussusception (FI) were admitted to the hospital emergency department with complaints of dysphagia and hypersalivation. Sixty-one patients had foreign bodies (coins, batteries, etc.) lodged in physiological stenosis of the esophagus. Batteries lodged in the esophagus pose a danger, as they can quickly cause esophageal burns due to the release of alkali and exposure to electric current. According to our data, batteries caused first- and second-degree esophageal burns in seven children. When batteries enter the stomach, the alkali is neutralized by gastric hydrochloric acid. According to our data, batteries were removed from the esophagus in 19 children, from the stomach in six, and the remaining eight passed spontaneously. The majority (56%) of foreign bodies passed naturally after passing through the pyloric region of the stomach. To improve the evacuation of foreign bodies, a diet rich in fiber was administered, which is especially important for the removal of hydrogel granules and balls. Obstructive obstruction is caused by swelling of hydrogel granules in the gastrointestinal tract [1,13]. Hydrogel balls, if remaining in the intestine for a long time, can cause perforation of the intestinal wall, with the development of peritonitis and may be fatal [14]. When parents sought medical attention for swallowing hydrogel granules, we hospitalized 8 children in the surgical department for conservative therapy aimed at removing them from the gastrointestinal tract before obstructive intestinal obstruction developed. The technique includes: exclusion of enteral fluid intake; infusion therapy in the amount of physiological needs; oral administration of olive oil 1 tbsp every hour; foods with a high fiber content (porridge, apples, bananas); oil enemas 2 times a day.

The feasibility of this tactic is supported by an in vitro experiment we conducted after the first case of a child presenting with this pathology [15]. For the experiment, hydrogel beads, each 2-3 mm in size, were placed in three containers. Vegetable oil was added to the first container containing the hydrogel beads. Warm water was added to the second and third containers. After an hour, the beads in the vegetable oil remained unchanged in shape and size, while those in the second and third containers with warm water had swollen to 1 cm. Vegetable oil was then added to the second container, containing the now-swollen hydrogel beads. After 3 hours, the growth of the beads in the second container slowed sharply, while in the third container, the beads continued to grow. Throughout the experiment, the beads in the first container remained unchanged. The positive effect of our proposed therapy is due to the fact that eliminating enteral fluid intake helps slow the growth rate of the hydrogel beads, while the body's physiological need for fluid is replenished parenterally. As the experiment showed, vegetable oil coats the granules, thereby reducing the rate of swelling. Furthermore, oral administration of oil and therapeutic oil enemas promote increased peristalsis. A high-fiber diet increases the amount of chyme, which will carry foreign bodies, and reduces the likelihood of conglomerate formation. We received patent No. 2681653, "Method for the Prevention of Intestinal Obstruction Caused by Hydrogel Beads in Children," dated March 12, 2019.

In recent years, the number of hospitalizations of children with magnetic foreign bodies has increased significantly. Most authors note that single magnets pass freely through the gastrointestinal

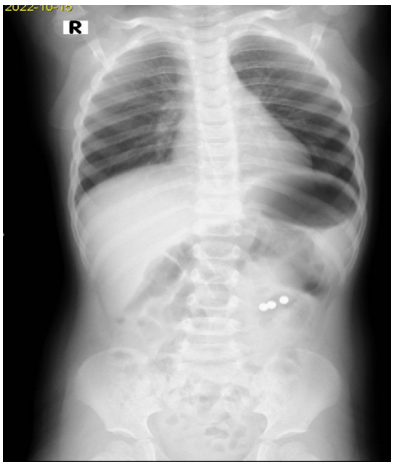


Fig. 1. General X-ray of the abdominal cavity and pelvic organs of child G

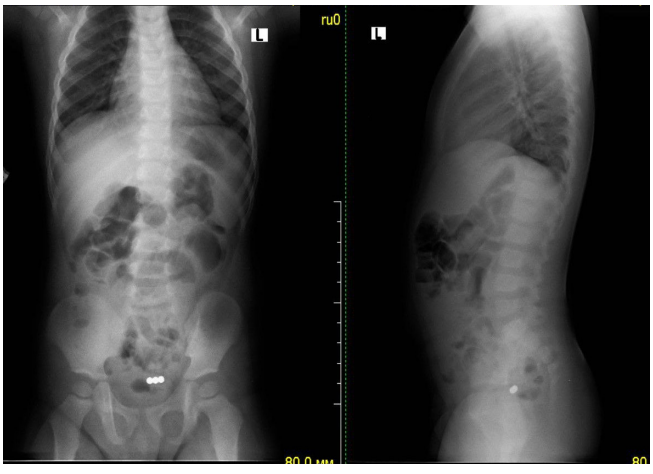


Fig. 2. Plain abdominal radiography. Foreign body shadows are visible in the pelvis

tract and exit on their own [5, 9]. Two or more magnets, swallowed over a period of time and located in different parts of the gastrointestinal tract and connected to each other, cause intestinal obstruction, perforation, or intestinal fistulas [3, 5, 8, 12]. Taking into account the above, all 20 children with multiple magnetic foreign bodies were examined in a hospital setting, and treatment tactics were determined during dynamic observation. Foreign magnets swallowed within a short period of time and connected to each other in the esophagus or stomach also exit the gastrointestinal tract on their own. However, it should be borne in mind that magnets in the stomach can penetrate the mucosa and cause strangulation [10].

The absence of pain syndrome and clinical signs of surgical complications in the presence of two or more magnets was an indication for dynamic observation.

Clinical example No. 1. Boy G., 2 years old, was admitted to the pediatric surgical department as an emergency 20 minutes after sustaining an injury. His mother witnessed him swallow two magnetic balls.

Objectively: the patient's condition is satisfactory, with no complaints. The abdomen is normal, soft, and painless, and is fully functional. A plain abdominal X-ray was performed (Fig. 1).

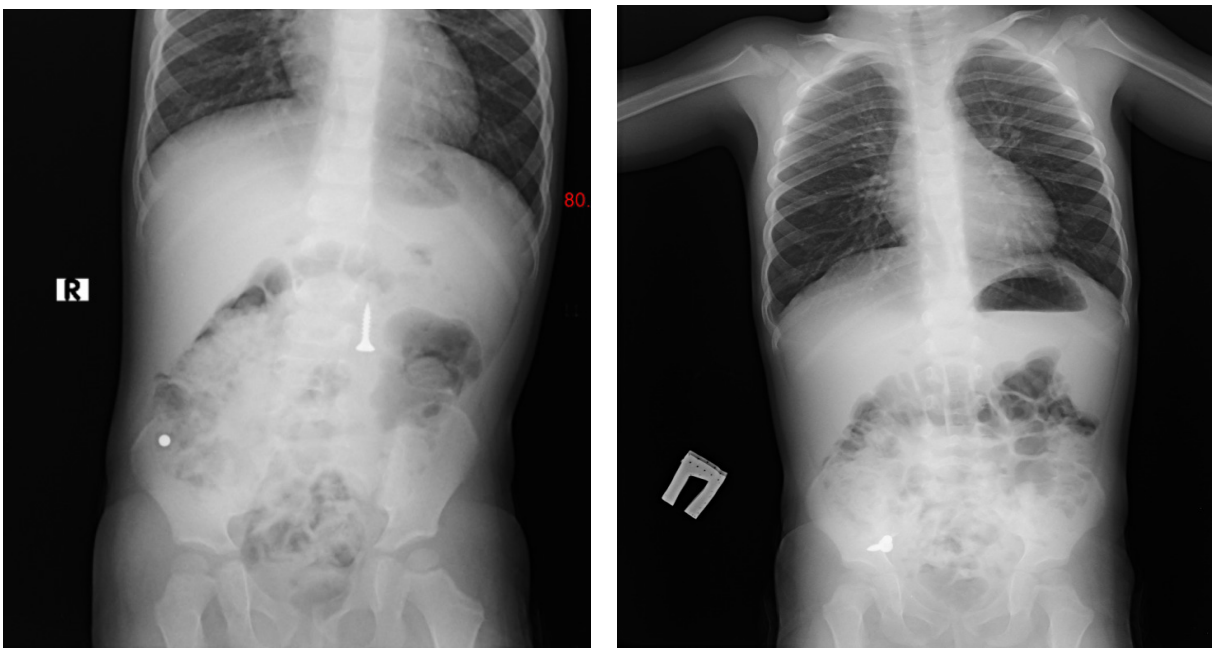
The radiograph shows three rounded foreign body shadows at the L3 level on the left, up to 5 mm in diameter. Two of them are interlocked, and the third is 3 mm away. There are no signs of intestinal obstruction or free gas in the abdominal cavity. There are unevenly distended intestinal loops and a gas bubble in the stomach.

The distance between the two interlocked and single magnetic foreign bodies (MFB) raised concerns about their location in different parts of the gastrointestinal tract. The child was observed for a period of active illness and had no complaints. The abdomen remained soft and painless, and intestinal peristalsis was normal. Ten hours after admission, an abdominal X-ray was performed, revealing three rounded foreign body shadows in the left pelvis (Fig. 2).

Thirty-five hours after ingestion, the magnetic foreign bodies passed spontaneously. Thus, during the observation period, the free passage of three interlocked magnetic balls through the gastrointestinal tract was confirmed. A.N. Shapkina and co-authors note that a wait-and-see approach to monitoring the passage of swallowed magnetic balls through the gastrointestinal tract is not justified. This clinical example demonstrates the justification for follow-up with radiographic monitoring in the absence of abdominal pain and signs of surgical complications. However, if pain occurs over the interlocked foreign bodies, surgical intervention is advisable, as presented in the following clinical case.

Clinical example No. 2. A 3-year-old boy, M., was admitted to the emergency department 5 hours after swallowing a metal screw. His parents confirmed that the child had a magnetic construction set. An abdominal X-ray was performed, which revealed the shadow of the screw and a round foreign body (Fig. 3a). Because 5 hours had passed since the foreign body was swallowed, and the boy had recently eaten, an EGD was deferred.

The child was hospitalized for observation. During this period, his condition remained satisfactory. The abdomen was regular, not distended, and was soft and responsive to breathing. Eighteen hours after ingestion of the screw, moderate tenderness in the right iliac region was noted upon abdominal palpation. Symptoms of peritoneal irritation were negative.



а в

Fig. 3. a) Plain abdominal radiography. The shadow of a self-tapping screw and a round foreign body are visualized in different parts of the intestine. b) Interlocking foreign bodies in the right iliac region.

On a control abdominal radiograph, the shadow of the interlocked foreign bodies is visualized in the right iliac fossa (Fig. 3b).

The presence of tenderness over the location of the foreign bodies was interpreted as difficulty in passing the interlocked screw and magnet through the Baugin valve. This was an indication for surgical intervention. Under general anesthesia, a laparotomy was performed using the Volkovich–Dyakonov approach. The dome of the cecum with the vermiform appendix was brought out into the wound. The foreign bodies were palpated in the cecum. The vermiform appendix was 8.0 cm long, rigid, edematous, thickened, and injected with vessels along its entire length, indicating macroscopic secondary phlegmonous changes. The foreign bodies were removed one by one from the dome of the cecum to the appendix. An antegrade appendectomy was performed. The histological conclusion was acute phlegmonous appendicitis. The patient was discharged home after 7 days.

Long-term presence of adherent foreign bodies in the right iliac region in 4 children was also associated with difficulty in their passage through the Bauhinia valve, which was an indication for surgical intervention.

Clinical example No. 3. The parents of a 2-year-old girl, G., sought medical attention after finding missing magnetic balls from her older brother's construction set. The child's condition is satisfactory. The abdomen is regular, non-distended, and respirable, soft, and painless throughout. A plain abdominal X-ray was performed: the shadow of interlocking magnetic balls is visible in the right iliac fossa (Fig. 4 a).

During follow-up, the girl's condition was satisfactory; she was able to digest food. The abdomen was soft and painless. Stool was spontaneous. Since the foreign body was not passed despite stool, a control X-ray was taken. It showed magnetic beads linked in a ring-shaped formation, located in the right iliac region (Fig. 4b). The absence of foreign body movement through the gastrointestinal tract for 4 days was an indication for surgical removal. A 4.0 cm long abdominal incision was made using the Volkovich-Dyakonov approach in the right iliac region. Ring-shaped foreign bodies were detected in the dome of the cecum upon palpation. Eight magnetic beads were displaced into the lumen of the appendix. An appendectomy was performed (Fig. 5a, b).

Four patients underwent removal of foreign bodies using a similar method, including displacement into the appendix and appendectomy.

The management strategy for patients with multiple magnetic foreign bodies in the absence of signs of an acute abdomen was determined during follow-up.

Clinical case No. 3. Boy Z., 3 years old. History: According to his mother, the child swallowed magnetic balls 40 minutes prior to admission. No active complaints were present.

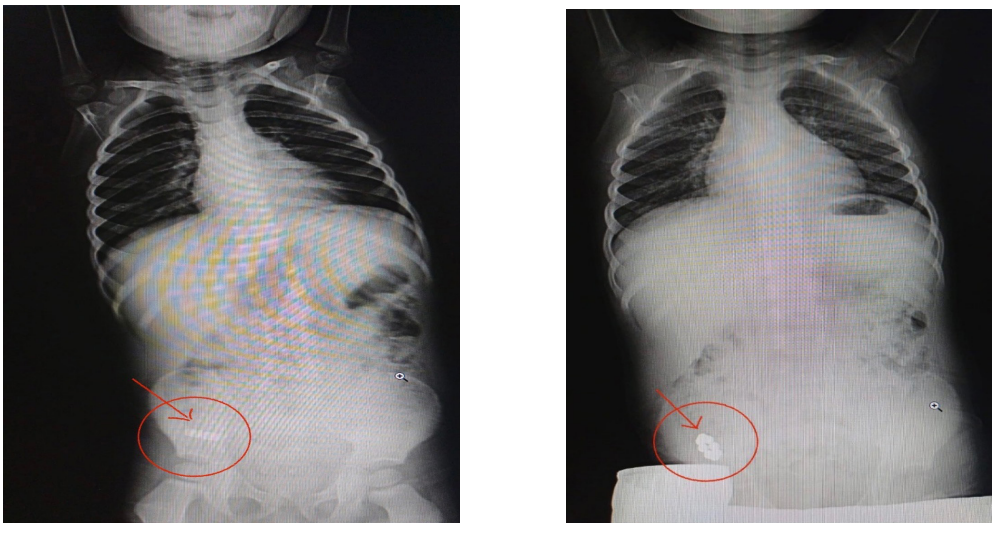


Fig. 4. a) Abdominal plain radiography. A linear shadow of a foreign body is visible in the right iliac fossa. b) Abdominal plain radiography 4 days after foreign body ingestion. A ring-shaped shadow of a foreign body is visible in the right iliac fossa

The abdomen is of normal shape, soft, painless, and participates in the act of breathing.

In the emergency room, a general radiography of the abdominal organs was performed (Fig. 6.a), foreign bodies were found - 17 magnets; 5 magnets were located in the projection of the stomach, the remaining 12 - in the projection of the right iliac region.

Under general anesthesia, a rigid esophagoscopy was performed, and 5 magnetic balls were removed from the stomach.

Considering the absence of clinical signs of intestinal obstruction and peritonitis and the position of the remaining magnets on the radiograph in the coupling, the surgeons on duty decided to monitor the child dynamically.

Twenty hours after presentation, the child developed anxiety and abdominal pain. A repeat abdominal X-ray was performed (Fig. 6 b). The MIT chain showed no signs of moving through the intestines; it remained in the right iliac fossa with a slightly altered shape, indicating the presence of magnetic beads in various parts of the intestines.

A midline laparotomy was performed. Four perforations were identified in the ileum 40 cm from the ileocecal angle, extending for 8 cm. Eleven magnets were removed. This section of intestine was resected, and an end-to-end anastomosis was performed. One perforation was identified 60 cm from the ligament of Treitz. One magnet was removed from the jejunum. The perforation was sutured. The postoperative period was uneventful. The outcome was favorable.

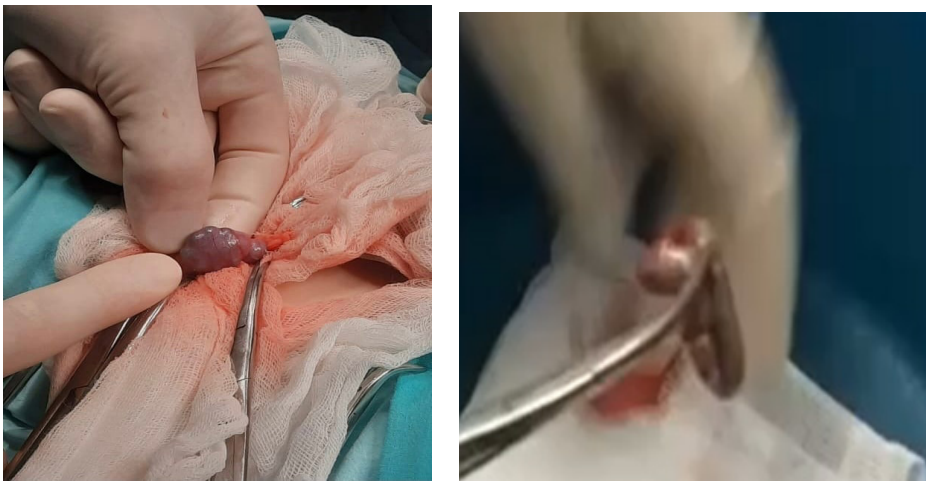


Fig. 5. a) Foreign bodies moving into the appendix; b) Removal of the appendix with foreign bodies

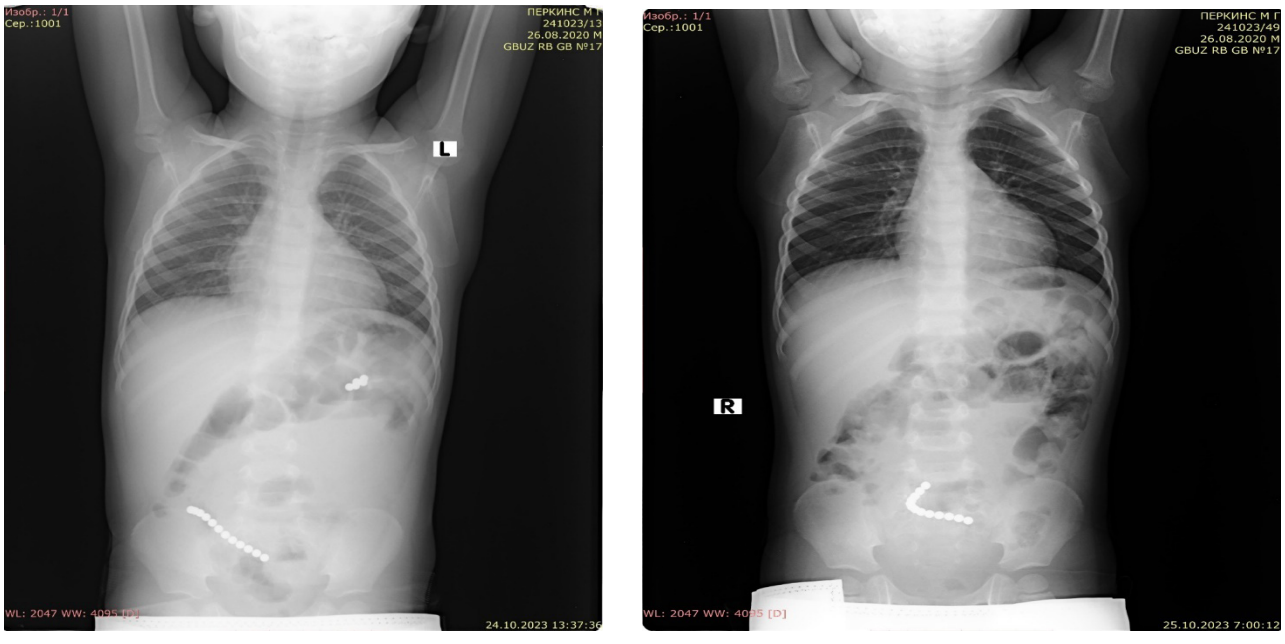


Fig. 6. a) General radiograph of the abdominal organs, in the projection of the stomach and in the right iliac region there are multiple foreign bodies; b) Foreign bodies remained in the right iliac region

In 9 of 20 patients with magnetic foreign bodies in the gastrointestinal tract, only 9 had a history of swallowing magnetic beads, which was an indication for radiographic examination as in the clinical examples given.

As practice shows, magnetic foreign bodies occur at any age, but most often in children under 3 years of age [1, 9, 16], and it is believed that they are extremely rare in children during adolescence [17].

Clinical case No. 4. A 14-year-old girl presented to the emergency department complaining of abdominal pain that had begun three days earlier and repeated vomiting. Physical examination revealed peritonitis: the abdomen was distended, weakly involved in respiration, tense to palpation, and tender in all areas, primarily the left lateral region. Symptoms of peritoneal irritation were positive, and intestinal peristalsis was decreased on auscultation. Given that the clinical picture was not typical of appendiceal peritonitis, an abdominal X-ray was performed (Fig. 7).

The girl admitted that, on a dare from her classmates, she swallowed magnets (three in total) for several days in a row. She swallowed the first one eight days before presenting.

Following preoperative preparation, a midline laparotomy was performed. Intestinal and purulent contents were present in all sections of the abdominal cavity. A perforation was identified 10 cm from the ligament of Treitz. Two foreign bodies (interlocked magnets) were found in the lumen of the jejunum. The perforation was sutured. A third foreign body was palpated in the stomach and removed endoscopically. A thorough abdominal debridement was performed. Intensive care was continued postoperatively. The patient was discharged from the hospital in satisfactory condition after spending 10 days in hospital.

When collecting a medical history, patients often reveal a history of foreign body ingestion. The onset of abdominal pain is a reason to seek medical

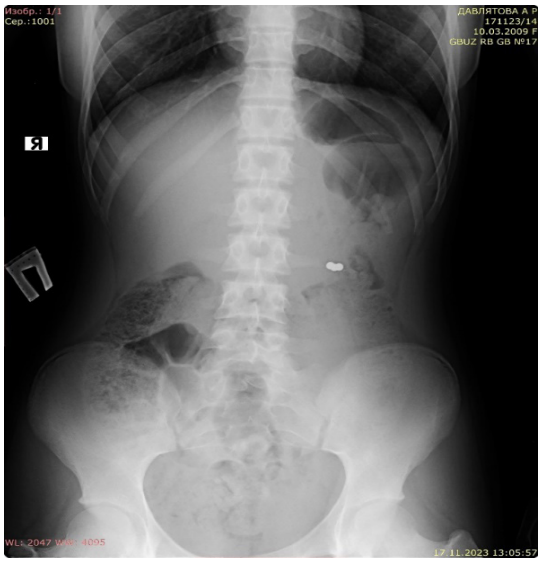


Fig. 7. Plain radiography of the abdominal organs. A foreign body shadow consisting of three small spheres is present in the left abdominal cavity

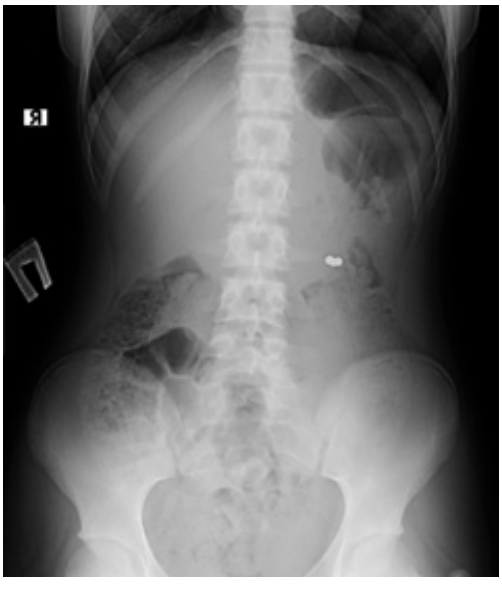


Fig. 8. Intraoperative photo of abdominal organs with magnetic foreign bodies



Fig. 9. Plain abdominal radiograph of a 5-year-old child. Kloiber's cups are present in the upper abdominal cavity, while a chain of 5 magnetic balls is visible against a homogeneous background of darkening in the lower sections

attention. Children are admitted to the emergency department with a diagnosis of acute abdomen and undergo surgery with a suspected diagnosis of acute appendicitis due to persistent pain at the appendix site during follow-up.

Clinical example No. 5. A 7-year-old boy, P., was admitted to the surgical department with complaints of abdominal pain and a single episode of vomiting. A diagnostic laparoscopy was performed with a preliminary diagnosis of acute subhepatic appendicitis. The appendix was unchanged and located in a typical location. Further abdominal examination revealed a conglomerate consisting of loops of the ileum and transverse colon in the subhepatic region. Using endoscopic clamps, the intestinal loops were separated, revealing preperforation areas on the wall of the ileum and transverse colon measuring 4 x 4 mm with a fibrinous coating. There was significant edema along the edges of these areas. An intraoperative abdominal radiograph was performed (Fig. 8).

Conversion to midline laparotomy: two interlocking magnetic balls were palpated in the ileum. A third magnetic ball located in the transverse colon was moved into the ileum. An enterotomy of 10 mm was performed at the preperforation site of the ileum, and the foreign bodies were removed. The intestinal wall was sutured, and sero-serous sutures were placed at the preperforation site on the transverse colon. The postoperative period was uneventful, and the patient was discharged from the hospital on the 10th day.

Thus, intraoperative abdominal radiography performed during diagnostic laparoscopy or laparotomy can detect the presence of magnetic foreign bodies in the intestine.

Two children were admitted with intestinal obstruction. Radiographic examination revealed that the cause was foreign bodies (Fig. 9).

Clinical example No. 6. Five-year-old boy K. was hospitalized with complaints of abdominal pain and repeated vomiting. According to his mother, the child became ill three days ago, when he developed intermittent abdominal pain and vomiting. Over the past 24 hours, his temperature has risen to febrile levels and he is vomiting green, stagnant fluid.

Objectively: The patient's condition is severe, due to intoxication and dehydration syndrome. The abdomen is moderately distended, with tension in the anterior abdominal wall muscles and positive signs of peritoneal irritation. Intestinal peristalsis is decreased.

Following preoperative preparation under endotracheal anesthesia, a midline laparotomy was performed. Small intestinal loops were dilated, and pus was present throughout the abdominal cavity. Five perforations were identified along a 12-cm stretch of the ileum at a distance of 140 cm from the ileocecal angle. Foreign bodies (five magnets) were found between the intestinal loops. A 15-cm section of the intestine containing the perforations was resected, and an end-to-end anastomosis was performed. The abdominal cavity was debrided.

Diagnosis: Magnetic foreign bodies in the abdominal cavity, multiple perforations of the ileum. Complication: diffuse fecal peritonitis.

Postoperatively, syndromic intensive care was administered. The patient was discharged in satisfactory condition on the 14th day.

We analyzed the treatment outcomes of 230 children with foreign bodies in the gastrointestinal tract. Foreign bodies were most frequently swallowed by children under 3 years of age–110 (48%). In 129 patients (56%), the foreign bodies were expelled spontaneously, including all 8 children with hydrogel foreign bodies and 5 with magnetic foreign bodies, including 3 with multiple interlocking foreign bodies. According to our data, foreign bodies were removed from the esophagus and stomach in 90 children (39%), including 15 batteries and 6 interlocking magnetic beads. In 7 children, batteries in the esophagus caused first- or second-degree burns; conservative treatment was administered. Magnetic beads, swallowed immediately or after a short period of time and adhered to each other, passed spontaneously in 5 children. Surgical intervention was performed in 11 (5%) patients, a higher rate than reported in the literature [11, 12]. Small bowel resection with multiple perforations was performed in 2 children. Foreign bodies that had been lodged in the cecum for a long time were removed in 4 patients by repositioning them in the appendix and performing appendectomy.

Conclusion. Foreign bodies in the gastrointestinal tract in children represent a serious surgical problem requiring prompt diagnosis and a clear treatment strategy. The primary diagnostic method is chest and abdominal radiography, performed in cases of foreign body ingestion, unexplained abdominal pain, or the development of intestinal obstruction. Furthermore, intraoperative radiography, performed when conglomerates are detected during diagnostic laparoscopy and laparotomy, facilitates the detection of magnets. Most foreign bodies from the gastrointestinal tract are excreted naturally. Adequate fiber-rich dietary intake facilitates the safe elimination of many foreign bodies, including hydrogel granules and beads, and several magnets swallowed in a short period of time. To remove hydrogel granules and beads, oral fluid intake should be temporarily discontinued and oil should be administered to slow their swelling. Foreign bodies in the esophagus or stomach can be safely removed using esophagoscopy. Abdominal pain, signs of intestinal obstruction, and peritonitis are indications for surgical intervention and bowel resection in cases of multiple perforations. Prolonged presence of a foreign body in the right iliac fossa is an indication for surgery. Removal of foreign bodies from the cecum can be achieved by repositioning them in the appendix and performing an appendectomy.

Literature/References

1. Petlakh V.I. Foreign bodies in the gastrointestinal tract in children: classification, diagnosis, and treatment tactics. Treatment and Prevention / Vol. 11 No. 2 2021 pp. 52-61(In Russ.).

2. Зайцева Т.В., Золотарева А.В., Игнатьев Р.О., Розинов В.М. Острая обтурационная кишечная непроходимость, вызванная инородным телом, у ребенка 1,5 лет // Российский вестник детской хирургии, анестезиологии и реаниматологии. 2017;VII(1):55-58. [Zaitseva TV, Zolotareva AV, Ignatiev RO, Rozinov VM. Acute obstructive intestinal obstruction caused by a foreign body in a 1.5 year old child // Rossijskij vestnik detskoj hirurgii, anesteziologii i reanimatologii. 2017;VII(1):55-58. (In Russ.)]

3. Шапкина А.Н., Шмырева Е.С., Яковлева Е.П., Козлова М.В., Чернышенко Т.С. Множественные магнитные инородные тела желудочно-кишечного тракта у детей. Тихоокеанский медицинский журнал. 2021; 4:62–64. doi: 10.34215/1609-1175-2021-4-62-64

4. Донской Д.В., Ионов Д.В., Коровин С.А., Воробьев В.В., Соловова В.П., Туманян Г.Т., Соколов Ю.Ю. Классификация и лечебная тактика при инородных телах желудочно- кишечного тракта у детей. Детская хирургия 2017; 21(3): 127–130. Donskoy D.V., Ionov D.V., Korovin S.A., Vorob'ev V.V., Solovova V.P., Tumanyan G.T., Sokolov Yu.Yu. Classification and treatment of foreign bodies in the gastrointestinal tract. Detskaya khirurgiya 2017; 21(3): 127–130.

5. Бабич И.И., Багновский И.О. Инородные тела пищеварительного тракта у детей. Российский вестник детской хирургии, анестезиологии и реаниматологии 2017; 7(4): 26–30. Babich I.I., Bagnovsky I.O. Foreign bodies in the gastro- intestinal tract of children. Rossiyskiy vestnik detskoy khirurgii, anesteziologii i reanimatologii 2017; 7(4): 26–30.

6. Королев М.П., Антипова М.В. Эндоскопия в диагностике и удалении инородных тел пищевода и желудка. М: МИА; 2010; 124 с. Korolev M.P., Antipova M.V. Endoskopiya v diagnostike i udalenii inorodnykh tel pishchevoda I zheludka [Endoscopy in the diagnosis and removal of foreign bodies of the esophagus and stomach]. Moscow: MIA; 2010; 124 p.

7. Бевз А.С., Бокова Т.А., Елин Л.М. Инородные тела в желудке у ребенка 5 лет: особенности клинической симптоматики (клиническое наблюдение). РМЖ. Мать и дитя. 2022;5(2):173–177. DOI: 10.32364/2618-8430-2022-5-2-173-177

8. Mengqi Wang, Shuai Sun, Qiong Niu, Baoguang Hu, Haiyan Zhao, Lei Geng, Tingliang Fu, Hong Qin, Bufeng Zheng, Hesheng Li. Experience of management of pediatric upper gastrointestinal perforations: a series of 30 cases.Front. Pediatr., 11 October 2023, Volume 11 – 2023 https://doi.org/10.3389/fped.2023.1261336

9. Карпова И.Ю., Стриженок Д.С., Гребченко О.А., Борискина О.С. Множественные инородные тела желудочно-кишечного тракта: диагностика, лечение (клинический случай) Медицинский альманах. 2023. № 3 (76). С. 94–97/

10. Бокова Т.А., Кошурникова А.С., Шишулина Е.Е. Инородные тела желудка с внедрением в слизистую оболочку у ребенка 9лет. Экспериментальная и клиническая гастроэнтерология 2023;215(7): 152–155. DOI: 10.31146/1682-8658-ecg-215-7-152-155

11. Ergun, Ergun; Ates, Ufuk; Gollu, Gulnur; Bahadir, Kutay; Yagmurlu, Aydin; Cakmak, Murat; Aktug, Tanju; Dindar, Huseyin; Bingol-Kologlu, Meltem Diseases of the Esophagus (2021)34,1–7 DOI: 10.1093/dote/doaa051

12. Min Dong, Wanli Zhang, Lulu zheng, Jun Sun, Zhibao Lv and Wei Wu Acute intestinal obstruction caused by gastrointestinal foreign bodies in children: a comparison of laparoscopically assisted approach and open surgery. Dong et al. BMC Surgery (2024) 24:371 https://doi.org/10.1186/s12893-024-02662-2

13. Hodges NL, Denny SA, Smith GA. Rare-Earth Magnet Ingestion-Related Injuries in the Pediatric Population: A Review. Am J Lifestyle Med. 2015 Jul 22;11(3):259-263. doi:10.1177/1559827615594336

14. Mirza B, Sheikh A. Mortality in a case of crystal gel ball ingestion: an alert for parents. APSP J Case Rep. 2012;3(1):6.

15. Шангареева Р.Х., Валеева Г.Р., Чендулаева И.Г., Мирасов А.А., Зайнуллин Р.Р., Солдатов П.Ю. Последствия проглатывания детьми гидрогелевых гранул: клинические наблюдения. Вопросы современной педиатрии. 2019; 18 (5): 374–379. doi: 10.15690/vsp.v18i5.2062.

16. Li, Zhaoshen; Linghu, Enqiang; Fang, Ying Management of foreign bodies in the digestive tract of children in China: a clinical practice guideline. Chinese Journal of Evidence-Based Medicine 22, 1: 2 – 18 January 2022/

17. Теплов В.О., Юсифова У.И., Чундокова М.А., Голованев М.А., Ушаков К.В. Лечение подростка с перфорацией слепой кишки магнитными шариками: клинический случай // Российский вестник детской хирургии, анестезиологии и реаниматологии. 2024. Т. 14, № 4. С. 565–573.

DOI: https://doi.org/10.17816/psaic1804