Pediatr Pract Res 2023; 11(3): 208-213
DOI: 10.21765/pprjournal.1346343

ORIGINAL ARTICLE
ORİJİNAL ARAŞTIRMA

Single Center Experience of Magnetic Foreign Object Swallowing in Pediatric Patients

Pediatrik Hastalarda Manyetik Yabancı Cisim Yutulmasının Tek Merkezli Deneyimi

Fatma Özcan Sıkı, Mehmet Sarıkaya, Metin Gündüz, Tamer Sekmenli, İlhan Çiftci

Department of Pediatric Surgery, Selcuk University, Faculty of Medicine, Konya, Turkey

ABSTRACT

Aim: Foreign body (FB) ingestion is a common accident in children. In recent years, the number of patients presenting with magnetic foreign body ingestion has increased due to the production of toys from magnetic foreign bodies. In this study, we investigated the treatment algorithm in patients with multiple magnetic FB ingestion, together with the literature studies conducted in recent years. We aimed to share the common result by evaluating the treatment algorithm of different studies.

Materials and Methods: Patients treated for magnetic foreign body ingestion in our clinic between January 2015 and December 2022 were retrospectively analyzed. The demographic data of the patients, the time of swallowing FB, the time of admission, the number of times they swallowed, the surgical notes, and the length of hospital stay were recorded.

Results: In seven years, 13 patients were treated for magnetic FB ingestion. There were seven male and six female patients. The mean age was 5.3±4.2 years. Five patients swallowed a single magnetic FB, one of them was removed from the esophagus by endoscopy, and four of them were spontaneously removed from the gastrointestinal tract. Three of the eight patients who ingested multiple magnetic FB had spontaneous gastrointestinal tract removal of the FB. FBs were removed by laparotomy in five patients, two of whom were emergency.

Conclusion: Ingestion of a single magnetic object occurs without the need for intervention, such as an isolated foreign body, without causing any damage to my gastrointestinal tract. Ischemia, necrosis, perforation, and even strangulation can be seen due to sandwich compression in most patients who swallow multiple magnetic foreign bodies. In rare cases, the spontaneous gastrointestinal release is possible in multiple magnetic FB ingestion. In case of multiple magnetic FB ingestion, patients who are asymptomatic can be followed. Successful results are obtained with more non-invasive treatment by applying timely and correct procedures.

Keywords: Child, buckyball, intestinal perforation, magnetic foreign body

ÖZ

Amaç: Yabancı cisim (YC) yutulması çocuklarda sık görülen bir kazadır. Son yıllarda manyetik yabancı cisimlerden oyuncak üretimine bağlı olarak manyetik yabancı cisim yutulması ile başvuran hastaların sayısı artmıştır. Bu çalışmada çoklu manyetik YC yutulması olan hastalarda tedavi algoritmasını son yıllarda yapılan literatür çalışmaları ile birlikte araştırdık. Farklı çalışmaların tedavi algoritmalarını değerlendirerek ortak sonucu paylaşmayı amaçladık.

Gereç ve Yöntem: Ocak 2015 ile Aralık 2022 tarihleri arasında kliniğimizde manyetik yabancı cisim yutulması nedeniyle tedavi gören hastalar geriye yönelik olarak incelendi. Hastaların demografik verileri, YC yutma zamanı, başvuru zamanı, kaç kez yutkundukları, ameliyat notları ve hastanede kalış süreleri kaydedildi.

Bulgular: Yedi yıl içinde 13 hasta manyetik YC alımı nedeniyle tedavi edildi. Yedi erkek ve altı kadın hasta vardı. Ortalama yaş 5,3±4,2 yıldı. Beş hasta tek manyetik YC yuttu, bunlardan biri endoskopi ile yemek borusundan çıkarıldı, dördü ise spontan olarak gastrointestinal sistemden çıktı. Çoklu manyetik YC alan sekiz hastanın üçünde, YC'in kendiliğinden gastrointestinal sistemden çıkarılması gerçekleşti. İkisi acil olmak üzere beş hastada laparotomi ile YC çıkarıldı.

Sonuç: Tek bir manyetik nesnenin yutulması, izole yabancı cisim gibi herhangi bir müdahale gerektirmeden, mide-bağırsak sistemime herhangi bir zarar vermeden gerçekleşmektedir. Çoklu manyetik yabancı cisim yutan hastaların çoğunda sandviç basısı nedeniyle iskemi, nekroz, perforasyon ve hatta boğulma görülebilmektedir. Nadir durumlarda, çoklu manyetik YC spontan gastrointestinal yolla çıkması mümkündür. Çoklu manyetik YC alımı durumunda asemptomatik hastalar takip edilebilmektedir. Zamanında ve doğru işlemler uygulanarak daha noninvaziv tedavi ile başarılı sonuçlar elde edilir.

Anahtar Kelimeler: Çocuk, buckyball, bağırsak delinmesi, manyetik yabancı cisim

Corresponding Author: Fatma ÖZCAN SIKI
Address: Department of Pediatric Surgery, Selcuk University, Faculty of Medicine, Konya, Turkey
E-mail: doktorozcan@hotmail.com

Başvuru Tarihi/Received: 19.08.2023
Kabul Tarihi/Accepted: 09.10.2023

INTRODUCTION

FB ingestion is a common accident in children. It is usually seen under the age of five (1). Studies have shown that 80% of ingestions cause no harm, with FB being expelled from the digestive tract without any damage (2). However, magnetic FBs are a special type of foreign body, as they can cause serious injury to the gastrointestinal tract and even be life-threatening. When swallowed alone, they pass through the gastrointestinal tract without any problems. However, if multiple magnetic FBs, whether metal foreign or not, are swallowed, they can attract each other in the gut and cause serious problems by causing ischemia, pressure necrosis, intestinal perforation, or volvulus. Deaths have been reported following multiple magnet ingestion (3). Magnets are widely used in daily life as gluing tools or toys used to attach documents or photos to metal products such as whiteboards and refrigerators. Especially recently, the increase in some toys made using magnets has increased the number of patients coming to the emergency services with the complaint of swallowing magnets. (4). Whether the swallowed FB is metallic or magnetic will change the clinical course considerably, so first of all, the process of questioning the witnesses should be done very carefully. Since this distinction cannot be made clearly with imaging studies, patients may need to be kept under observation (5). In this study, we present the treatment protocols of patients who ingested magnetic FB in our clinic in the last seven years, accompanied by literature information to discuss an optimized treatment strategy after magnetic FB ingestion.

MATERIAL AND METHOD

Patients treated for magnetic foreign body ingestion in our clinic between January 2015 and December 2022 were retrospectively reviewed. Demographic data of the patients, complaints on admission, examination findings, imaging tests, time of swallowing FB, time of admission, how many swallows, surgery notes, and hospitalization times were recorded. Treatment protocols for single or multiple magnetic FB ingestion were reviewed. Ethics committee approval was not required because the study was a retrospective file review.

RESULTS

It was seen that 13 patients were treated for magnetic FB ingestion in 7 years. There were seven male and six female patients. The mean age was 5.3 ±3.6 years. There were nine (69.3%) patients aged five years and younger. Among the reasons for swallowing, curiosity was in question in children aged five and under, while it was accidentally swallowed in children aged six and above. After ingestion, application times to our clinic ranged from 4 hours to 35 days. The mean hospital stay of the patients varied between those who swallowed single and multiple magnetic FBs. Individuals who swallowed single FB were generally followed up with family education. In patients who swallowed two or more magnetic FBs, the hospitalization period was 4.5±3.5 days. Five patients swallowed a single magnetic FB, one of which was removed from the esophagus by endoscopy. Four of them exited spontaneously through the gastrointestinal tract. Spontaneous gastrointestinal tract FB was detected in three of eight patients who swallowed multiple magnetic FBs. FBs were removed by laparotomy in five patients, two of whom were emergency.

Admission to hospital complaints, physical examination findings, and X-ray images of eight patients who swallowed multiple magnetic FB were carefully evaluated. Foreign bodies were evaluated in standing X-ray imaging of non-vomiting patients with normal physical examination findings, and these patients with normal intestinal gas distribution were followed up with close imaging. Early intervention was performed in patients who had abdominal tenderness and defense in their physical examination, who complained of vomiting, and who were suggestive of obstruction in standing X-ray imaging.

One of the patients who underwent laparotomy presented with the complaint of swallowing magnets 18 hours ago and later developing abdominal pain and vomiting. On examination, she had abdominal distension, diffuse tenderness, and defense. In the standing X-ray, 8 round FBs and one disc-shaped FB were seen. In addition, there was an appearance suggestive of ileus with broad-based levels (**Figure 1a**). There was acute phase elevation. In laparotomy, it was observed that there were 4 perforations in the jejunal segment due to sandwich compression, and there was ischemia-dependent necrosis in the approximately 50 cm jejunal segment due to compression of the mesentery (**Figure 1b, 1c**). The perforated areas were primarily repaired and the ischemic segment was removed, and a total of 9 magnets (**Figure1d**) in the form of 8 buckyballs and one disc, which caused the clinic, were taken out of the intestine, and an end-to-end anastomosis was performed.

Another patient who underwent laparotomy was a 16-month-old male. The patient who presented with the complaint of vomiting had widespread defense in the abdomen. He had acute phase elevation. FB, which is thought to be five spherical magnets, was seen in the X-ray graphy (**Figure 2a**). In laparotomy, there was a perforation due to sandwich compression, connecting the posterior surface of the stomach and the jejunal intestine 20 cm distal to the treitz. There were multiple perforations due to sandwich compression at 20-40-50-70 cm from the treitz (**Figure 2b, 2c**). All perforations were repaired primarily by removing the magnets from the intestine. A total of five buckyball magnets were removed (**Figure 2d**).

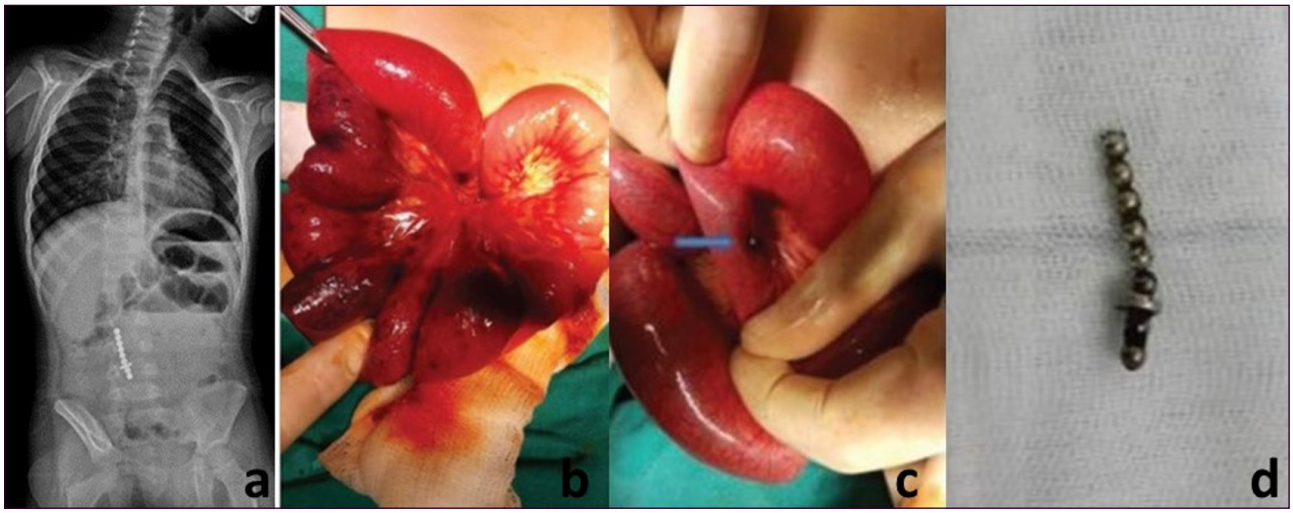

Figure 1a-1d

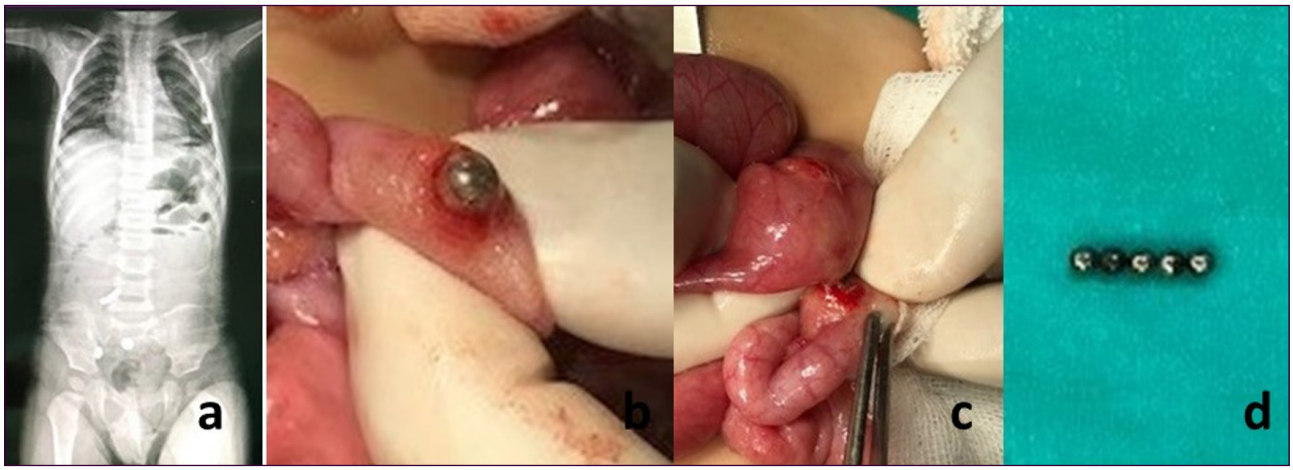

Figure 2a-2d

Esophagogastroduodenoscopy was first performed on three patients who underwent laparotomy and swallowed multiple magnetic FBs. FBs were removed by gastrotomy in a patient whose FB was found to be embedded in the gastric mucosa. In the other patient, the location of the magnets was fixed for about 1 month, when the endoscopy revealed that the stomach mucous was buried, gastrotomy was performed and it was seen that 5 of the magnetic FBs, in which a fistula was formed with the 5 cm of the jejunum, merged with the two FBs in the stomach to form a ring in the jejunum. In another patient, a gastrotomy had to be performed because removal by endoscopy was not successful.

In a patient who swallowed a single magnetic FB, esophagoscopy was performed and the esophagus was removed from the 15th cm because the FB was in the esophagus for about 4 hours and caused compression.

The clinical features of the patients who underwent surgery after magnet ingestion are summarized in **Table 1**.

DISCUSSION

In pediatric patients, swallowed FBs are typically small objects such as coins, fish bones, marbles, and drugs; A recent meta-analysis showed that batteries and sharp objects should be removed immediately, but other ingested FBs can pass through the gastrointestinal tract without intervention (5). Recently, multiple magnetic FB ingestion has become more common in children due to the increasing use of magnetic elements (4). This increase is mainly due to the increasing popularity of round ball-shaped (Buckyballs) toys, a toy with a strong neodymium magnet, and are usually sold in 125 or 216 spheres about 5mm in diameter or as part of a toy. A single magnetic FB does not cause serious morbidity because it only acts as an isolated FB. However, multiple magnetic FBs attract each other along the intestinal walls, resulting in sandwich compression, and consequently; they may lead to intestinal obstruction, fistulas, or perforation (5,6). Previous case reports have recommended endoscopic or surgical removal of ingested magnets by clinicians before FB-related symptoms develop (7, 8). Literature reviews have shown that emergency surgical intervention is required

in cases involving ingestion of multiple magnetic FBs and any symptoms suggestive of the surgical abdomen, but conservative treatment may be appropriate in cases involving ingestion of a single magnetic FB and without definitive evidence of intestinal obstruction (5). Most patients are asymptomatic or show atypical symptoms in the early stages. Most symptoms appear 1 to 7 days after ingestion. Abdominal pain gradually increases over time. However, the number of magnets ingested is not related to the severity of the disease (4). In the literature, two patients who were followed up with no other complaints other than abdominal pain at intervals of 3-6 months after swallowing multiple magnets were reported (4,9). In our study, patients with surgical abdominal symptoms were treated in accordance with the new literature. We had two patients who complained of intermittent abdominal pain and underwent laparotomy approximately 1 month later.

In another study with similar results to our study; 35 patients who swallowed multiple magnetic FB were evaluated; 6 of them were followed conservatively and it was seen that they were removed spontaneously in 3-7 days with x-ray imaging without clinical symptoms. Of the remaining 29 patients, 3 underwent laparoscopy and 2 underwent laparotomy; Laparotomy was performed in 26 of them. 22 patients who underwent laparotomy were operated under emergency conditions due to surgical abdominal findings. All patients who underwent laparotomy had multiple perforations, and primary repair was performed. It has been stated that complications can be reduced with timely diagnosis and effective treatment methods (4).

In a survey study, a total of 104 patients who swallowed magnetic FB were reached. A single magnetic body was detected in 71 of them and esophagogastroduodenoscopy was performed in 8 of them. Other patients spontaneously removed the single magnetic FB within 1-9 days. The remaining 33 patients were followed up for multiple magnetic FB swallowing. 19 patients were followed up because they were asymptomatic. Endoscopy was performed in 4 patients, but laparotomy was performed in 2 patients. Laparotomy was performed in 10 patients and multiple perforation repair was performed. According to this study, gastrointestinal injury was seen in only 11 patients out of 104 patients (10).

In another study whose findings were consistent with this study, 56 patients who swallowed magnetic FB were evaluated. Thirteen patients were followed up asymptomatically and spontaneous removal was observed between 1-6 days. The shock was seen in 2 of 26 patients who were symptomatic. 43 patients underwent surgical procedures. Laparoscopy was performed in 4 patients, and in 3 of them, they were switched to laparotomy. Laparotomy was performed on 39 patients.

Table-1 Clinical Features Of Patients Who Underwent Endoscopy And Laparotomy

	Patient -1	Patient -2	Patient-3	Patient -4	Patient -5	Patient -6
Age (year)/ gender	4,5/boy	1,5/girl	1,5/boy	5/ girl	4/ girl	4/boy
complaint	Abdominal pain-vomiting	Abdominal pain	Abdominal pain-vomiting	Fixed FBs on Xray	Abdominal pain	Difficulty swallowing
Physical examination	Abdominal tenderness, distension	Normal	Abdominal tenderness, distension	Normal	Epigastric tenderness	Difficulty swallowing
Laboratory findings	Acute phase elevation	Normal	acute phase elevation	Normal	Normal	Normal
Initial treatment plan	Laparotomy	Esophagogastroduodenoscopy	Laparotomy	Esophagogastroduodenoscopy	Esophagogastroduodenoscopy	Esophagoscopy
Reason for surgery	Physical examination findings	Physical examination findings	Physical examination findings	Fixed FBs	Epigastric tenderness	Difficulty swallowing
Surgical findings	There is perforation and strangulation	No perforation	There is perforation	There is perforation	Gastric Mucosa damage	Esophageal mucosal damage
Number of perforations	4	0	6	3	0	0
Number/ shape of magnets swallowed	8 buckyballs/1 disc	5 disc	5 buckyball	5 buckyball	5 buckyball	1 disc
Discharge time from the hospital (days)	7	4	6	6	3	2

In one patient who underwent laparotomy, end-to-end anastomosis was performed after resection due to intestinal strangulation and necrosis, while another symptomatic patient had an esophagotracheal fistula. In this study, it was stated that longer-term follow-up is required for the follow-up of possible complications, and it was stated that access to buckyball-type toys should be restricted in order to decrease the number of cases (11).

In another study, 74 patients who swallowed multiple magnetic FBs were evaluated. The treatment algorithm of the North American Society of Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) was used in the follow-up of all patients. According to this algorithm; Gastroscopy, colonoscopy, laparoscopy, and laparotomy were performed, respectively, depending on whether the patients were symptomatic or not. According to this algorithm, 17 patients underwent endoscopy (asymptomatic patients); laparoscopy in 6 patients; Laparotomy was performed in 41 patients. Conversion to laparotomy was made in 10 patients. In this study, two peaks were observed in the patient groups between the ages of 1-3 and 6-11, and it was thought that the increase in cases in recent years was related to the increase in buckyball toys. It has been observed that the appearance of symptoms can vary between 4 hours and 40 days. In the study, it was stated that the number of cases increased each year and the NASPGHAN algorithm should be used for treatment (12). The necessity of performing an invasive procedure in asymptomatic patients is noteworthy here. Consistent with other studies, we only followed asymptomatic patients. We have seen that magnetic FBs are excreted spontaneously through the gastrointestinal tract in an average of 2-9 days.

In another study, 13 patients who swallowed magnetic FB were evaluated. While 5 patients were spontaneously removed without any intervention, endoscopy was performed in 5 patients, magnetic FBs were removed with the help of basket and grasper in 3 of them, and FBs were removed spontaneously in the other 2 patients. Laparotomy was performed on 3 patients. Deep ulcer and perforation were repaired at laparotomy. With the study, it was concluded that the number of cases increased with the increase in toys containing magnets with high neodymium additives in recent years, and the complications became more serious with the ingestion of multiple magnetic objects. It has been stated that the number of cases can be reduced by restricting access to such toys (13). In our study, gastrotomy was performed in one patient because the endoscopic removal procedure was unsuccessful.

The data of the studies conducted in recent years are summarized in **Table 2**.

CONCLUSION

The increase in the production of toys containing magnetic properties, unfortunately, causes an increase in the number of patients who apply with the complaint of magnetic FB ingestion. Restricting access to such toys and raising awareness among parents will reduce the number of patients. Serious complications can be prevented by careful evaluation of the patient's symptoms and examination findings and timely intervention in the treatment. Asymptomatic patients should be followed up with simple radiographs for at least 2-3 days. According to the symptoms, localization, and examination findings, endoscopy, laparoscopy, or laparotomy procedures can be applied.

ETHICAL DECLARATIONS

Ethics Committee Approval: Ethics committee approval was not required because the study was a retrospective file review.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients for the study.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Table 2. Working time and data chart of articles

Article	Working Time (year)	Patient number	Number of patients followed up asymptomatically	Endoscopy	Laparoscopy	Laparotomy	Transition to laparotomy
Huang et al. (4)	6	35	6	0	3	26	2
Miyamoto* et al (10)	2	33	19	4	0	10	2
Cai et al(11)	10	56	13		4	39	3
Wang et al (12)	10	74	0	17	6	41	10
Lai et al (13)	9	13	5	5	0	3	0
This article	7	13	7	4	0	5	3

*: is a survey study

REFERENCES

1. Mowry JB, Spyker DA, Brooks DE, Zimmerman A, Schauben JL. 2015 annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 33rd annual report. Clin Toxicol (Phila). 2016;54:924–1109
2. Erbes J, Babbitt DP. Foreign bodies in the alimentary tract of infants and children. Appl Ther. 1965;7:1103–9
3. Olczak M, Skrzypek E. A case of child death caused by intestinal volvulus following magnetic toy ingestion. Leg Med (Tokyo). 2015;17(3):184-7
4. Huang X, Hu J, Xia Z, Lin X. Multiple magnetic foreign body ingestion in pediatric patients: a single-center retrospective review. Pediatr Surg Int. 2021;37(5):639-643.
5. Cho J, Sung K, Lee D. Magnetic foreign body ingestion in pediatric patients: report of three cases. BMC Surg. 2017;17 (1):73.
6. Sekmenli T, Ciftci I. Multiple Intestinal Perforation and Necrosis due to Magnet Ingestion. Eurasian J Med. 2016;48 (3):225-7.
7. Honzumi M, Shigemori C, Ito H, Mohri Y, Urata H, Yamamoto T. An intestinal fistula in a 3-year-old child caused by the ingestion of magnets: report of a case. Surg Today. 1995;25:552–3.
8. Nui A, Hirama T, Katsuramaki T, et al. An intestinal volvulus caused by multiple magnet ingestion: an unexpected risk in children. J Pediatr Surg. 2005;40:e9–11.
9. Chung JH, Kim JS, Song YT. Small bowel complication caused by magnetic foreign body ingestion of children: two case reports. J Pediatr Surg 2003;38:1548–50
10. Miyamoto R, Okuda M, Kikuchi S, Iwayama H, Hataya H, Okumura A. A nationwide questionnaire survey on accidental magnet ingestion in children in Japan. Acta Paediatr. 2021;110(1):314-25.
11. Cai DT, Shu Q, Zhang SH, Liu J, Gao ZG. Surgical treatment of multiple magnet ingestion in children: A single-center study. World J Clin Cases. 2020;8(23):5988-98.
12. Wang K, Zhang D, Li X, et al. Multicenter investigation of pediatric gastrointestinal tract magnets ingestion in China. BMC Pediatr. 2020;20(1):95.
13. Lai HH, Lin HY, Chang CH, et al. Magnet ingestion by children: A retrospective study in a medical center in Taiwan. Pediatr Neonatol. 2020;61(5):542-7.