

<https://www.helicojournal.org>

Received May 3, 2024

Revised May 24, 2024

Accepted June 3, 2024

Corresponding author

Cheol Woong Choi, MD, PhD
Department of Internal Medicine,
Pusan National University School of
Medicine and Research Institute for
Convergence of Biomedical Science and
Technology, Pusan National University
Yangsan Hospital, 20 Geumo-ro,
Mulgeum-eup, Yangsan 50612, Korea
E-mail: luckyace@hanmail.net

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Conflicts of Interest

Dae Gon Ryu, a contributing editor of the *Korean Journal of Helicobacter and Upper Gastrointestinal Research*, was not involved in the editorial evaluation or decision to publish this article. All remaining authors have declared no conflicts of interest.

Funding Statement

This study was supported by a 2024 research grant from Pusan National University Yangsan Hospital.

Acknowledgements

None

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Clinical Outcomes of Patients With Gastric Phytobezoars: Implication of Drinking Carbonated Beverages as a Treatment

Jin Ook Jang, Cheol Woong Choi, Dae Gon Ryu,
Su Bum Park, and Su Jin Kim

Department of Internal Medicine, Pusan National University School of Medicine and Research Institute for Convergence of Biomedical Science and Technology, Pusan National University Yangsan Hospital, Yangsan, Korea

Objectives: Although phytobezoars are the most common type of gastric bezoar, a standardized treatment method has not been adopted. **Methods:** In this study, we evaluated patient clinical features and treatment outcomes following the use of different treatment methods, with a focus on the efficacy of carbonated beverage consumption. A review of medical charts and endoscopic reports revealed 15 cases of gastric phytobezoars from September 2008 to May 2016. Patient medical records were retrospectively reviewed to assess patient clinical characteristics and treatment results. **Results:** The mean patient age was 71.3 ± 11.1 years. The most common symptoms were epigastric pain (46.7%) and bloating (40.0%). A history of intra-abdominal surgery was found in 26.7% of the patients. The mean bezoar size was 47.3 ± 14.5 mm. The final successful treatment methods were consumption of a carbonated beverage alone ($n=7$, 46.7%), endoscopic removal ($n=5$, 33.3%), and surgery ($n=3$, 20.0%). During the treatment course, few patients (3/15, 20.0%) experienced small bowel obstructions after the consumption of the carbonated beverage and endoscopic fragmentation; these obstructions required surgical interventions. There was no significant difference in the baseline characteristics between patients successfully or unsuccessfully treated with the carbonated beverage. **Conclusions:** Most patients presenting with gastric phytobezoars can be successfully treated by consuming carbonated beverages in conjunction with endoscopic therapy. However, small bowel obstructions may occur due to the migration of a fragmented bezoar, necessitating surgical intervention.

Keywords Bezoar; Phytobezoar; Endoscopy; Carbonated beverage.

INTRODUCTION

A bezoar is a conglomeration of indigestible materials within the gastrointestinal tract, resulting from the accidental ingestion of various substances. The incidence of gastric bezoars reported in endoscopic examinations ranges from 0.43%–0.68%.^{1,2} Although bezoars can be found in any part of the gastrointes-

tinal tract, the stomach is the most commonly affected site. Most gastric bezoars are dissolved and discharged without treatment. However, they can occasionally cause gastric ulceration and bleeding,³ and can also migrate to the small intestine and cause mechanical obstructions. Bezoars represent a rare cause of small bowel obstruction; among patients surgically treated for mechanical small bowel obstruction, 0.8% of cases were

associated with bezoars.⁴ Therefore, removal of gastric bezoars should be considered in cases of large bezoars (>3 cm) or in symptomatic patients.^{5,6}

Although the majority of gastric bezoars comprise plant materials, such as fibers, skins, or seeds of vegetables and fruits (phytobezoars), ingested hair (trichobezoar), medications (pharmacobezoar formation due to bulk-forming laxatives, extended-release tablets, or enteric-coating drugs), and other ingested foreign bodies may also result in gastric bezoars.^{3,7} The primary predisposing factor for gastric bezoars is delayed gastric emptying. Gastric dysmotility and reduced acid secretion may induce gastric bezoar formation. Conditions associated with gastric dysmotility or decreased gastric acid secretion include previous gastric resection, vagotomy, peptic ulcer disease, advanced age, Crohn disease, and diabetic neuropathy.^{8,9} Moreover, there have been reports indicating that certain ingested materials are more prone to cause bezoars.¹⁰⁻¹³

Unfortunately, a standardized method for treating gastric phytobezoars has not been adopted. Surgical removal should be attempted in cases with complications such as massive gastrointestinal bleeding or gastrointestinal obstruction. However, outside of emergency situations, chemical lysis using carbonated beverages, proteolytic enzymes, and cellulases has been employed, either alone or in conjunction with endoscopic bezoar removal.^{3,14-16} In this study, we reviewed the clinical outcomes and safety of various gastric phytobezoar treatment methods, particularly the consumption of carbonated beverages prior to therapeutic endoscopy.

METHODS

Patients

A review of medical records and endoscopic reports revealed

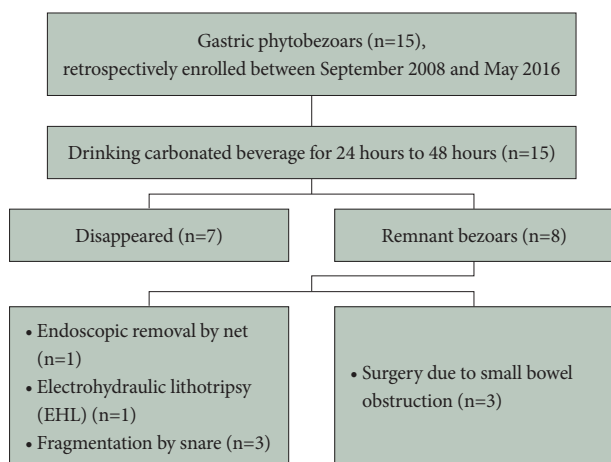


Fig. 1. Flowchart of the course of the study and the treatment of gastric phytobezoars.

15 patients with gastric phytobezoars who were admitted to Pusan National University Yangsan Hospital, South Korea between September 2008 and May 2016. The data were analyzed retrospectively (Fig. 1). This study was reviewed and approved by the Institutional Review Board of Pusan National University Yangsan Hospital. The requirement for written informed consent was waived due to the retrospective nature of this study.

Treatment method

All gastric phytobezoars were diagnosed following endoscopic examinations. Abdominal computed tomography (CT) was performed to exclude intestinal obstructions in patients with abdominal pain and vomiting. Surgical removal was recommended for patients who initially presented with symptoms of small bowel obstruction. For patients with gastric phytobezoars, without evidence of intestinal obstruction, chemical dissolution through carbonated beverage consumption (Coca-Cola) was initially attempted. Patients eligible for chemical dissolution were instructed to drink carbonated beverages (Coca-Cola, 1.5–3 L/day) for 1–2 days.

Each patient underwent repeat endoscopy after consuming the carbonated beverage. If the patient was initially examined in the emergency department, endoscopy was performed daily, except on holidays, until the gastric bezoar resolved. If the initial visit was an outpatient visit, follow-up endoscopy was performed at 1–2 week intervals.

If the phytobezoars remained in the stomach, endoscopic removal of the bezoar was attempted using various endoscopic devices, including electrohydraulic lithotripsy and net and polypectomy snares (Fig. 2). If the endoscopic maneuvers failed to remove the bezoars or if the patient's symptoms worsened, the bezoars were surgically removed. If the gastric bezoars disappeared after carbonated beverage consumption, without endoscopic treatment or complications, the patient was included in the successful carbonated beverage treatment group. However, if a patient required endoscopic or surgical removal of a small bowel obstruction due to a migrated bezoar, the patient was included in the carbonated beverage treatment failure group.

To identify factors associated with treatment outcomes, we retrospectively examined patients' sex, age at diagnosis, history of intra-abdominal surgery, symptoms, complications, and modalities used to treat the bezoars. The bezoar size was determined using endoscopic imaging, CT, or by measuring extracted specimens. After successful treatment, regular endoscopic follow-ups were recommended for all patients. The first endoscopic examination was scheduled two months after successful treatment. Thereafter, endoscopic examinations were scheduled annually in the absence of recurrence.

Statistical analysis

The data underwent retrospective univariate analysis using the chi-squared test or Fisher's exact test for categorical variables and the Student's t-test for continuous variables. A p -value <0.05 was considered statistically significant. Statistical analyses were performed using SPSS (Version 21.0; IBM Corp., Armonk, NY, USA).

RESULTS

Characteristics of patients and bezoars

A total of 15 patients with gastric phytobezoars were includ-

ed in this study. The mean age of the patients was 71.3 ± 11.1 years, and the patients were predominantly female (8/15, 53.3%). The mean bezoar size was 47.3 ± 14.5 mm. The most prevalent symptoms were epigastric pain (7/15 patients, 46.7%) and bloating (6/15 patients, 40.0%). A history of intra-abdominal surgery was identified in 4/15 (26.7%) of the patients (Tables 1 and 2).

Treatment outcomes

A flowchart depicting the course of the study is shown in Fig. 1. The treatment methods were as follows: drinking the carbonated beverage alone ($n=7$, 46.7%) and drinking the carbonated beverage in conjunction with endoscopic fragmen-



Fig. 2. Endoscopic images of a persimmon bezoar. A: A large brown bezoar observed in the gastric body. B: A peptic ulcer observed in the gastric antrum. C: Performance of the electrohydraulic lithotripsy procedure. D: A hole observed after electrohydraulic lithotripsy. E: Fragmentation of the bezoar was performed using polypectomy snares. F: Visualization of the fragments. G: A hard bezoar observed before Coca-Cola administration. H: Direct injection of Coca-Cola into the bezoar. I: Softening of the bezoar following Coca-Cola infusion, facilitating subsequent crushing.

Table 1. Summarized characteristics of patients with gastric phytobezoars

No	Sex	Age (yr)	Symptoms	Size of bezoar (mm)	Number of bezoar	Past history of intra-abdominal surgery	Final treatment methods	Hospital days	Complications	Comorbid conditions
1	M	77	Bloating	20	1	No	Endoscopic net removal	1	Duodenal ulcer	Diabetes mellitus
2	F	65	Epigastric pain	25	2	No	Carbonated beverage drinking only	0	Duodenal ulcer	No
3	F	66	Epigastric pain	50	1	Appendectomy	Carbonated beverage drinking only	0	Gastric ulcer	Liver cirrhosis
4	F	77	Epigastric pain	60	1	No	Endoscopic electrohydraulic lithotripsy (EHL)	4	Gastric ulcer	Hypertension
5	F	88	Bloating	50	1	No	Endoscopic snare fragmentation	1	Gastric ulcer	No
6	F	60	Bloating	50	1	No	Carbonated beverage drinking only	0	No	No
7	M	53	Nothing	40	1	No	Carbonated beverage drinking only	0	No	No
8	F	75	Epigastric pain	35	1	No	Gastrotomy & gastrojejunostomy*	14	Small bowel obstruction	Liver cirrhosis
9	M	59	Epigastric pain	50	1	Subtotal gastrectomy, Billroth II	Carbonated beverage drinking only	0	No	No
10	F	85	Vomiting	50	2	No	Gastrotomy & gastrojejunostomy*	35	Gastric ulcer Small bowel obstruction	Diabetes mellitus
11	M	70	Epigastric pain	70	1	Ivor-Lewis operation	Endoscopic snare fragmentation	17	Gastric ulcer	Lung cancer
12	M	81	Bloating	70	1	No	Endoscopic snare fragmentation	4	Gastric ulcer	Old cerebral infarction
13	F	79	Bloating	40	1	No	Carbonated beverage drinking only	0	No	Hypertension
14	M	55	Epigastric pain	60	3	Primary repair for duodenal ulcer	Gastrotomy & gastrojejunostomy†	14	Gastric ulcer Duodenal ulcer Small bowel obstruction	No
15	M	80	Bloating	40	1	No	Carbonated beverage drinking only	0	Gastric ulcer Duodenal ulcer	Metastatic liver cancer

*Prior to surgery, carbonated beverages were consumed and endoscopic fragmentation was attempted; †Prior to surgery, carbonated beverages were consumed without endoscopic fragmentation.

Table 2. Analysis of baseline characteristics of patients with phytobezoars

Characteristics	Value (n=15)
Age (yr)	71.3±11.1
Sex, male	7 (46.7)
Symptoms	
Bloating	6 (40.0)
Epigastric pain	7 (46.7)
Vomiting	1 (6.7)
Nothing	1 (6.7)
Past history of intra-abdominal surgery	
Nothing	11 (73.3)
Subtotal gastrectomy Billroth II	1 (6.7)
Appendectomy	1 (6.7)
Ivor-Lewis operation	1 (6.7)
Primary repair due to duodenal ulcer perforation	1 (6.7)
Bezoar size (mm)	47.3±14.5
Diabetes mellitus	2 (13.3)
Hypertension	2 (13.3)
Comorbid malignancy	2 (13.3)
Liver cirrhosis	2 (13.3)
Cerebral infarction	1 (6.7)

Data are presented as mean±standard deviation or n (%).

Table 3. Outcomes of gastric phytobezoar treatments

	Value (n=15)
Carbonated beverage dinking and spontaneous removal	7 (46.7)
Endoscopic removal with carbonated beverage drinking	5 (33.3)
Surgical removal due to small bowel obstruction	3 (20.0)
Endoscopic treatment time (min)	40.0±24.7
Follow-up period (month)	12 (12–47)

Data are presented as mean±standard deviation, n (%), or mean (range).

tation and removal (n=5, 33.3%). Three patients (n=3, 20.0%) experienced small bowel obstructions that were treated surgically (Table 3). All cases of small bowel obstruction were attributed to migrating gastric bezoars following carbonated beverage consumption, with or without endoscopic fragmentation.

The group that was successfully treated with the carbonated beverage had a gastric and duodenal ulcer prevalence of 57.2% (n=4), compared to 100% (n=8) of the patients in the group that was not successfully treated with the carbonated beverage. A comparison of the baseline characteristics between the carbonated beverage treatment success and failure groups revealed no statistically significant differences (Table 4). There is some concern that carbonated beverages may increase acidity in the digestive tract; however, no serious complications,

such as ulcer bleeding, have been observed in patients with peptic ulcers who consume carbonated beverages.^{17,18}

DISCUSSION

Gastric bezoars are rarely encountered clinically, but when encountered, phytobezoars are the most common. Phytobezoars are formed from indigestible food materials, such as celery, pumpkins, grape skins, prunes, raisins, and persimmons. In particular, persimmon phytobezoars are challenging to treat due to their hardness compared with other types of phytobezoars.¹⁹

Gastric phytobezoars may be encountered incidentally during routine endoscopies or as a result of an endoscopic examination of a symptomatic patients. However, the optimal treatment approach remains uncertain due to a lack of a consensus regarding the most effective treatment method. For small gastric bezoars, a conservative observational approach may be appropriate because spontaneous passage or dissolution may occur. However, additional treatment modalities may be necessary for gastric bezoars that present symptomatically or are associated with peptic ulceration. In the present study, gastric and duodenal ulcerations were identified in 53.3% (8/15) and 26.7% (4/15) of the cases, respectively. A total of 93.3% of patients exhibited symptoms, including bloating, epigastric pain, and nausea.

To date, the following treatment methods have been identified for phytobezoars. Chemical dissolution, using carbonated beverages or enzymes such as papain and cellulase, is a common treatment method for phytobezoars. In recent years, several studies have been conducted on the use of carbonated beverages for the dissolution of gastric phytobezoars.^{3,16,20} In the present study, we used Coca-Cola as the therapeutic carbonated beverage. Here, 46.7% of the patients with gastric phytobezoars experienced spontaneous resolution after drinking the carbonated beverage over a 24–48-hour period. More than half of the patients with gastric bezoars that persisted after the consumption of the carbonated beverage (n=8) were successfully treated with additional endoscopic procedures (n=5). Including patients treated with the carbonated beverage alone (n=7, 46.7%) and with an additional endoscopic therapy (n=5, 33.3%), 80% of the patients (n=12) were successfully treated.

Previous studies have demonstrated that the resolution rate of phytobezoars using carbonated beverages, with or without endoscopic maneuvers, was 84.0%–91.3%.¹⁴ However, during treatment with carbonated beverages that dissolve phytobezoars, migration of small or fragmented bezoars may cause small bowel obstruction. In the present study, small bowel obstructions occurred in 20.0% (n=3) of the patients who con-

Table 4. Comparison between carbonated beverage treatment success and failure groups

	Carbonated beverage treatment success group (n=7)	Carbonated beverage treatment failure group (n=8)	Total (n=15)	p-value
Age (yr)	66.0±10.2	76.0±10.2	71.3±11.1	0.080
Bezoar size (mm)	42.1±9.1	51.9±17.3	47.3±14.5	0.206
Number of bezoar	1.1±0.4	1.4±0.7	1.3±0.6	0.470
Persimmon bezoar	0 (0)	1 (12.5)	1 (12.5)	
Male	3 (42.9)	4 (50.0)	7 (46.7)	0.782
Symptoms				0.555
Nothing	1 (14.3)	0 (0)	1 (6.7)	
Bloating	3 (42.9)	3 (37.5)	6 (40.0)	
Epigastric pain	3 (42.9)	4 (50.0)	7 (46.7)	
Vomiting	0 (0)	1 (12.5)	1 (6.7)	
History of intra-abdominal operation	2 (28.6)	2 (25.0)	4 (26.7)	0.876
Gastric ulcer	2 (28.6)	6 (75.0)	8 (53.3)	0.072
Duodenal ulcer	2 (28.6)	2 (25.0)	4 (26.7)	0.876
Diabetes mellitus	0 (0)	2 (25.0)	2 (13.3)	0.155
Hypertension	1 (14.3)	1 (12.5)	2 (13.3)	0.919
Comorbid malignancy	1 (14.3)	1 (12.5)	2 (13.3)	0.919
Liver cirrhosis	1 (14.3)	1 (12.5)	2 (13.3)	0.919
Cerebral infarction	0 (0)	1 (12.5)	1 (6.7)	0.333

Data are presented as mean±standard deviation or n (%).

sumed carbonated beverages. The use of carbonated beverages as a treatment for phytobezoars was first introduced in 2002 by Ladas et al.^{14,21} Following the publication of the initial study report, numerous subsequent studies have demonstrated the efficacy of carbonated beverages for the treatment of gastric phytobezoars.^{3,16,20} In addition to carbonated beverages, chemical dissolution agents, such as papain and cellulase, can also be used. Papain, a proteolytic enzyme extracted from *Carica papaya*, hydrolyzes a wide variety of proteins. A recent study showed that papain was effective in the treatment of proteinaceous esophageal food impaction without complications.²² However, esophageal perforation, aspiration pneumonitis, and hemorrhagic pulmonary edema have been reported as potential complications associated with the use of proteolytic enzymes.²³ Although the exact mechanism is unknown, these complications are suspected to arise due to the non-target action of such proteolytic enzymes.^{24,25} Another useful enzyme is cellulase, which degrades the cellulose that is abundant in vegetables and fruits; therefore, it may be useful for phytobezoar treatment.¹⁵ Additionally, there are also reports of the use of acetylcysteine to treat bezoars, although the literature on it is limited.²⁶⁻²⁸

Although the exact mechanism of action of carbonated beverages is not fully understood, the actions of its ingredients are likely contributory: sodium bicarbonate is mucolytic, carbonic and phosphoric acids have an acidifying effect, and carbon dioxide bubbles penetrate the bezoar through microscopic

pores.^{14,19} A recent in vitro study reported on the dissolution of phytobezoars by chemical dissolution agents. The study showed that chemical dissolution agents (Coca-Cola, papain, and cellulase) were more effective at dissolving phytobezoars than the control (water). Further, Coca-Cola was more effective than papain and cellulase.²⁵ If a phytobezoar is resistant to the aforementioned chemical dissolution methods, endoscopic fragmentation and removal may be considered. Despite the favorable factors associated with the use of carbonated beverage dissolution (ease, cost, and effectiveness), clinicians should be aware of the possibility of small bowel obstruction due to the migration of fragments of or the whole gastric bezoars, which can occur up to six weeks after migration from the stomach.¹⁴ Consequently, patients should be meticulously monitored for symptoms indicative of small bowel obstruction, such as vomiting and abdominal discomfort, throughout the follow-up period. In cases where such symptoms manifest, CT should be performed.

In the present study, small bowel obstruction occurred in 20.0% (n=3) of the patients following carbonated beverage therapy. Various methods can be employed for endoscopic fragmentation, including the use of endoscopic forceps, polypectomy snares, water jets, neodymium:yttrium-aluminum-garnet lasers, extracorporeal shockwave lithotripsy, and endoscopically guided electrohydraulic lithotripsy. Endoscopic treatment of bezoars is essentially a mechanical crushing process that can be achieved using a variety of instruments available at the

institution, including forceps, lithotripters, snares, and argon plasma coagulation.²⁹⁻³² Because of the risk of migration, bezoar fragments should be removed during the endoscopic procedure, if possible.

A well-known gastric phytobezoar that is refractory to the aforementioned treatment modalities is the persimmon bezoar. The skin of unripened persimmons contains a high concentration of tannins that react with gastric acid, and then polymerize to form a conglomeration in which cellulose, hemicellulose, and various proteins accumulate.³³ In this study, only one patient was diagnosed with a persimmon gastric bezoar.

In general, delayed gastric emptying, with or without decreased gastric acid secretion, is the mechanism of gastric bezoar formation. A variety of conditions may be predisposing factors, including certain ingested materials such as persimmons, advanced age, diabetic neuropathy, prior gastrectomy history, Crohn disease, gastrointestinal malignancy, dehydration, hypothyroidism, and the use of medications (such as anticholinergics and narcotics).^{3,8,9} In the present study, most patients were of older age, with a mean age of 71.3 years, and 26.7% of the patients (n=4) had a history of intra-abdominal surgery.

We compared the carbonated beverage treatment success and failure groups to evaluate the factors that increased the risk of treatment failure. Although, there was no significant difference between the two groups, the patients who failed the carbonated beverage treatment were older (76.0 years vs. 66.0 years) with larger bezoar sizes (51.9 mm vs. 42.1 mm) than the successful treatment group's patients. In our study, one patient with a bezoar was asymptomatic (the bezoar was identified during a routine health screening examination), demonstrating that gastric phytobezoars can be observed in asymptomatic patients. However, most patients were symptomatic, with the most common symptoms being epigastric pain (n=7) and bloating (n=6). Several methods, including endoscopy and CT, can be used to diagnose gastrointestinal bezoars. Endoscopy may be the most useful diagnostic method because it allows direct visualization. In CT images, a phytobezoar can be identified as a round mass containing air bubbles. Furthermore, CT is an essential imaging modality, especially when surgery is considered, as it permits visualization of the obstructed segment of the bowel and identification of multiple bezoars.³⁴

This study had several limitations. First, it was conducted retrospectively in a single center and included a small number of cases. Furthermore, we could not evaluate recurrence rates, as the majority of the patients did not adhere to the recommended follow-up examinations or hospital visits. The relapse rate has been reported to be as high as 14%, especially in patients with psychiatric conditions or gastrointestinal dysmotility.³⁵ In this study, although only four patients (26.7%) returned

for follow-up visits; there was no evidence of recurrence during the 12–35 months following successful treatment.

To prevent the recurrence of gastrointestinal phytobezoars, we recommend not consuming stringy vegetables or persimmons and instructed the patients to chew their food thoroughly. Prokinetics such as erythromycin may be used in patients with gastric dysmotility.

In conclusion, this study demonstrated that 80% of patients with gastric phytobezoars were successfully treated with carbonated beverages alone or in conjunction with additional endoscopic management. However, small bowel obstructions occurred in 20% of the patients due to the migration of a fragmented bezoar. Given the potential for bezoar migration and subsequent complications, clinicians should educate patients about the possibility of bowel obstructions before recommending carbonated beverage treatment, with or without endoscopic treatment. During endoscopic procedures, the fragmented bezoars should be removed, if possible.

Authors' Contribution

Conceptualization: Cheol Woong Choi. Data curation: Jin Ook Jang, Cheol Woong Choi, Dae Gon Ryu. Supervision: Cheol Woong Choi, Su Bum Park. Writing—original draft: Jin Ook Jang. Writing—review & editing: Cheol Woong Choi, Su Jin Kim. Approval of final manuscript: all authors.

ORCID iDs

Jin Ook Jang	https://orcid.org/0000-0002-0144-5082
Cheol Woong Choi	https://orcid.org/0000-0001-8867-3039
Dae Gon Ryu	https://orcid.org/0000-0001-6670-4420
Su Bum Park	https://orcid.org/0000-0003-1573-2792
Su Jin Kim	https://orcid.org/0000-0003-3816-9664

REFERENCES

- Ahn YH, Maturu P, Steinheber FU, Goldman JM. Association of diabetes mellitus with gastric bezoar formation. *Arch Intern Med* 1987; 147:527-528.
- Mihai C, Mihai B, Drug V, Cijevski Prelipcean C. Gastric bezoars—diagnostic and therapeutic challenges. *J Gastrointest Liver Dis* 2013;22:109-112.
- Iwamuro M, Okada H, Matsueda K, et al. Review of the diagnosis and management of gastrointestinal bezoars. *World J Gastrointest Endosc* 2015;7:336-345.
- Ghosheh B, Salameh JR. Laparoscopic approach to acute small bowel obstruction: review of 1061 cases. *Surg Endosc* 2007;21:1945-1949.
- Zissin R, Osadchy A, Gutman V, Rathaus V, Shapiro-Feinberg M, Gayer G. CT findings in patients with small bowel obstruction due to phytobezoar. *Emerg Radiol* 2004;10:197-200.
- Chan JC, Saranasuriya C, Waxman BP. Bezoar causing small bowel obstruction after repeated activated charcoal administration. *Med J Aust* 2005;183:537.
- Zamir D, Goldblum C, Linova L, Polychuck I, Reitblat T, Yoffe B. Phytobezoars and trichobezoars: a 10-year experience. *J Clin Gastroenterol* 2004;38:873-876.
- de Toledo AP, Rodrigues FH, Rodrigues MR, et al. Diospyrobezoar as a cause of small bowel obstruction. *Case Rep Gastroenterol* 2012; 6:596-603.
- Simsek Z, Altinbas A, Yuksel I, Yuksel O. Effective treatment with

- pineapple juice in small bowel obstruction due to phytobezoar in a gastrectomized patient. *Dig Endosc* 2011;23:197.
10. Emerson AP. Foods high in fiber and phytobezoar formation. *J Am Diet Assoc* 1987;87:1675-1677.
 11. Fan S, Wang J, Li Y. An unusual cause of duodenal obstruction: persimmon phytobezoar. *Indian J Surg* 2016;78:502-504.
 12. Burgos-Torres MDM, Molina-Lopez VH, Perez Cruz NM, Perez Del Valle C, Sorrentino J. Multivitamin-induced pharmacobezoar: a rare entity of large bowel obstruction. *Cureus* 2023;15:e41688.
 13. Yanari S, Sasaki S, Sato H, et al. Potentially lethal combination of fruit and gastric acid: the persimmon bezoar causing esophageal rupture. *Am J Gastroenterol* 2023;118:1918.
 14. Ladas SD, Kamberoglou D, Karamanolis G, Vlachogiannakos J, Zouboulis-Vafiadis I. Systematic review: Coca-Cola can effectively dissolve gastric phytobezoars as a first-line treatment. *Aliment Pharmacol Ther* 2013;37:169-173.
 15. Zarling EJ, Thompson LE. Nonpersimmon gastric phytobezoar. A benign recurrent condition. *Arch Intern Med* 1984;144:959-961.
 16. Ogawa K, Kamimura K, Mizuno K, et al. The combination therapy of dissolution using carbonated liquid and endoscopic procedure for bezoars: pragmatical and clinical review. *Gastroenterol Res Pract* 2016;2016:7456242.
 17. McCloy RF, Greenberg GR, Baron JH. Duodenal pH in health and duodenal ulcer disease: effect of a meal, Coca-Cola, smoking, and cimetidine. *Gut* 1984;25:386-392.
 18. Archimandritis A, Sipsas N, Tryphonos M, Tsirantonaki M, Tjivras M. Significance of various factors in patients with functional dyspepsia and peptic ulcer disease in Greece. A comparative prospective study. *Ann Med Interne (Paris)* 1995;146:299-303.
 19. Lee BJ, Park JJ, Chun HJ, et al. How good is cola for dissolution of gastric phytobezoars? *World J Gastroenterol* 2009;15:2265-2269.
 20. Bharadwaj S, Meka K, Tandon P, et al. Management of gastroparesis-associated malnutrition. *J Dig Dis* 2016;17:285-294.
 21. Ladas SD, Triantafyllou K, Tzathas C, Tassios P, Rokkas T, Raptis SA. Gastric phytobezoars may be treated by nasogastric Coca-Cola lavage. *Eur J Gastroenterol Hepatol* 2002;14:801-803.
 22. Morse CR, Wang H, Donahue DM, Garrity JM, Allan JS. Use of proteolytic enzymes in the treatment of proteinaceous esophageal food impaction. *J Emerg Med* 2016;50:183-186.
 23. Cavo JW Jr, Koops HJ, Gryboski RA. Use of enzymes for meat impactions in the esophagus. *Laryngoscope* 1977;87:630-634.
 24. Walker-Renard P. Update on the medicinal management of phytobezoars. *Am J Gastroenterol* 1993;88:1663-1666.
 25. Iwamuro M, Kawai Y, Shiraha H, Takaki A, Okada H, Yamamoto K. In vitro analysis of gastric phytobezoar dissolubility by coca-cola, coca-cola zero, cellulase, and papain. *J Clin Gastroenterol* 2014;48:190-191.
 26. Schlang HA. Acetylcysteine in removal of bezoar. *JAMA* 1970;214:1329.
 27. Heinz-Erian P, Klein-Franke A, Gassner I, et al. Disintegration of large gastric lactobezoars by N-acetylcysteine. *J Pediatr Gastroenterol Nutr* 2010;50:108-110.
 28. Guner A, Kahraman I, Aktas A, Kece C, Reis E. Gastric outlet obstruction due to duodenal bezoar: a case report. *Int J Surg Case Rep* 2012;3:523-525.
 29. Mao Y, Qiu H, Liu Q, et al. Endoscopic lithotripsy for gastric bezoars by Nd:YAG laser-ignited mini-explosive technique. *Lasers Med Sci* 2014;29:1237-1240.
 30. Senturk O, Hulagu S, Celebi A, et al. A new technique for endoscopic treatment of gastric phytobezoars: fragmentation using guidewire. *Acta Gastroenterol Belg* 2014;77:389-392.
 31. Ugenti I, Travaglio E, Lagouvardou E, Caputi Iambrenghi O, Martines G. Successful endoscopic treatment of gastric phytobezoar: a case report. *Int J Surg Case Rep* 2017;37:45-47.
 32. Paschos KA, Chatzigeorgiadis A. Pathophysiological and clinical aspects of the diagnosis and treatment of bezoars. *Ann Gastroenterol* 2019;32:224-232.
 33. Krausz MM, Moriel EZ, Ayalon A, Pode D, Durst AL. Surgical aspects of gastrointestinal persimmon phytobezoar treatment. *Am J Surg* 1986;152:526-530.
 34. Altintoprak F, Degirmenci B, Dikicier E, et al. CT findings of patients with small bowel obstruction due to bezoar: a descriptive study. *ScientificWorldJournal* 2013;2013:298392.
 35. Robles R, Parrilla P, Escamilla C, et al. Gastrointestinal bezoars. *Br J Surg* 1994;81:1000-1001.