A Simple Method for Endoscopic Treatment of Large Gastric Phytobezoars: "Hand-Made Bezoaratome"

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ABSTRACT

Background: *Large gastric phytobezoars are generally resistant to standard chemical or endoscopic treatments. We presented our experience of an alternative endoscopic method using a hand-made tool called a "hand-made bezoaratome" for the treatment of large gastric phytobezoars.*

Methods: *Patients who consulted or who were diagnosed with gastric bezoars at an education and research hospital between January 2015 and December 2018 were prospectively included in the study. Patients with phytobezoars of 50 mm and larger were included in the study. Patients with trichobezoars, lactobezoars, pharmacobezoars, under 18 years of age, and pregnant women were excluded. A 0.25 mm diameter guidewire and a mechanical lithotripter sheath were used to prepare the "hand-made bezoaratome." After the first procedure, patients were advised to consume 2500 mL of Coca Cola® or the same amount of pineapple juice per day, until the next procedure. Endoscopic procedures were performed at 5-day intervals until complete reabsorption of the bezoar was achieved. Patients were followed up for 6 weeks.*

Results: *The study group included 37 (21 males, mean age: 57.6 ± 12.5 years) patients. The median size of the phytobezoars was 71 mm (50-90). The median endoscopic procedure time was 853 s (380-1940 s). The success rate for endoscopic fragmentation was found to be 100%. No major complications occurred during the endoscopic procedures, but 1 patient (2.7%) required surgery for ileus due to an obstruction at the distal part of the jejunum, 61 h after the second endoscopic session. The overall success rate of the endoscopic treatment was 97.3%.*

Conclusion: *Using a "hand-made bezoaratome" is effective and reliable for the endoscopic treatment of large gastric bezoars.*

Keywords: *Gastric bezoars, phytobezoars, endoscopy, treatment, hand-made bezoarotome.*

INTRODUCTION

Gastric bezoars are defined as foreign bodies that result from the accumulation of ingested materials and most commonly seen as hard masses or concretions in the stomach. They are usually found incidentally during upper gastrointestinal system endoscopy or imaging.[1] Gastric bezoars are classified into four types according to their composition: phytobezoars, trichobezoars, pharmacobezoars, and lactobezoars. Phytobezoars, the most common type of bezoar, are composed of vegetable and fruit fibers and seeds.[2] The most common phytobezoar type is diospyrobezoar, which is common in those who consume the fruit of the persimmon tree (Diospyros kaki).[3]

Phytobezoars usually cause non-specific dyspeptic symptoms and occur in 0.4-0.6% of the population.[4] Bezoars often present in people with impaired digestive function or motility of the stomach.[5] The main predisposing factors include dietary habits and a history of truncal vagotomy, pyloroplasty, gastric surgery (such as partial gastrectomy), peptic ulcer disease, chronic gastritis, gastrointestinal masses, dehydration, or hypothyroidism.[6]

Current treatment options for gastric phytobezoars include chemical dissolution using drinks such as cola or pineapple juice, fragmentation by endoscopic device, or removal by laparotomy or laparoscopic surgery.[7] As diospyrobezoars are generally resistant to chemical dissolution due to their extremely hard consistency, they usually require endoscopic or surgical removal, especially if they are large.[8,9] However, existing endoscopic devices are inadequate for this purpose, as they are not wide enough to grasp large-size bezoars.

In this study, we presented our experience of using a hand-made tool called "hand-made bezoaratome" for the endoscopic treatment of large gastric phytobezoars.

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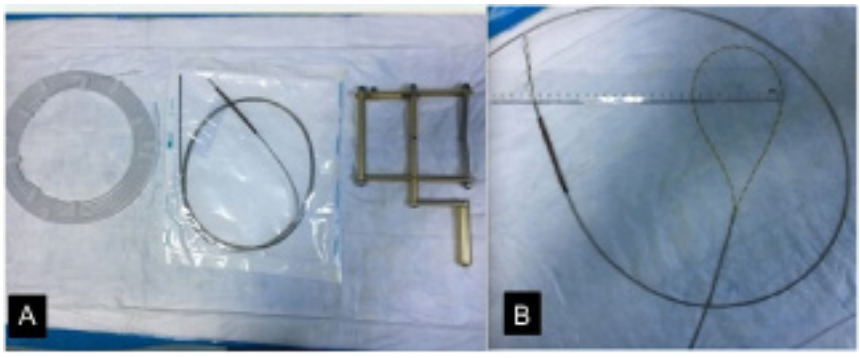

Figure 1. The materials used for the "hand-made bezoaratome." A 0.25 mm diameter guidewire, a mechanical lithotripter sheath and spinning wheel (A). By pushing the protruding tips of the guidewire back into the sheath, a "snare" mechanism opening to the required size within the stomach was obtained (B).

MATERIALS AND METHODS

Study Population

Patients who consulted or who were diagnosed with gastric bezoars at an education and research hospital between January 2015 and December 2018 were prospectively included in the study. Patients with gastric phytobezoars less than 50 mm diameter or classified as a trichobezoar, lactobezoar, or pharmacobezoar, under 18 years of age, and pregnant women were excluded. Patients' age, sex, smoking/alcohol history, surgical history, comorbidity, clinical findings, characteristics of the bezoars, endoscopic features, and complications observed during the procedure were recorded. The study protocol was approved by the Ethics Committee of the University.

Bezoaratome Preparation

A 0.25 mm diameter guidewire (Boston Scientific®, Jagwire Guidewire ST 450 mm) was folded in two along the center-line and passed through a mechanical lithotripter sheath (Medwork®, lithotripter spring LIT1-G4-26-185) that is used for the fragmentation of the biliary stones during endoscopic retrograde cholangiopancreatography (ERCP). The lithotripter has a diameter of 2.6 mm and can easily pass through a standard gastroscope with a working channel of 2.8 mm. By pushing the protruding tips of the guidewire back into the sheath, a "snare" mechanism opening to the required size within the stomach was obtained (Figure 1).

Endoscopic Fragmentation of Bezoar

All procedures were performed by gastroenterologists experienced in therapeutic endoscopy (BT, ATE, ASK, EP). Prior to endoscopy, sedo-analgesia (2-5 mg midazolam) and topical anesthesia (lidocaine spray) were administered. Standard Olympus® GIF-Q150 gastroscopes were used for the endoscopic procedure. After detecting phytobezoars in the stomach, a large polypectomy snare (Micro-Tech® PS51121 Jumbo 129-0193, full diameter 40 mm) was used to evaluate the dimensions of the bezoar (Figure 2).

After grasping the phytobezoar at its widest part with the "hand-made bezoaratome," both ends of the guidewire were attached to the spinning wheel (Soehendra® Lithotriptor G 21860 SLH-1). The spinning wheel was rotated with a similar mechanism to the mechanical lithotripsy applied in ERCP, and the bezoar was fragmented. This process was repeated until the phytobezoar was split into pieces small enough to be held by other instruments (Figure 3A–F). The fragmentation of the bezoar was then continued with a polypectomy snare (Micro-Tech® PS51121 Jumbo 129-0193, full diameter 40 mm) and/or a biliary stone extraction basket (Boston® Trapezoid RX Wireguided Retrieval Basket). The process was finalized

MAIN POINTS

- *The most common symptoms of large (>50 mm) gastric bezoars were epigastric pain (73%) and nausea (59.4%).*
- *Endoscopic examination revealed 23/37 (62.2%) patients with gastric ulcers and 4 patients (10.8%) with gastric outlet obstruction due to bezoars.*
- *Endoscopic fragmentation success rate was 100% in patients with large gastric phytobezoars, using hand-made bezoaratome.*
- *No major complications occurred during the endoscopic procedures. However, one patient required surgery for ileus associated with an obstruction at the distal part of the jejunum.*
- *Using a "hand-made bezoaratome" is effective and reliable for the endoscopic treatment of large gastric phytobezoars.*

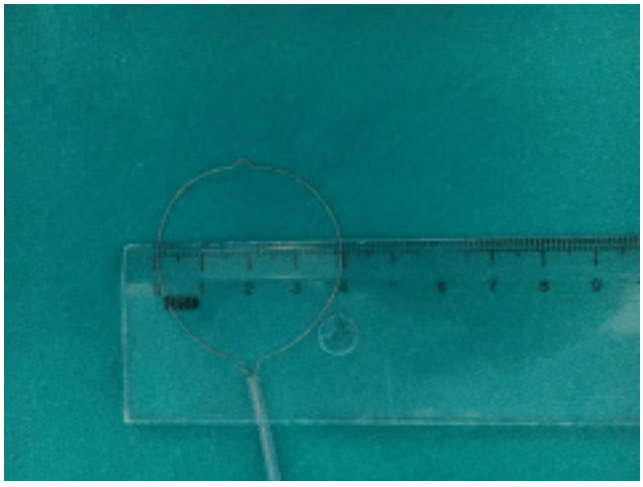

Figure 2. The large polypectomy snare (Micro-Tech® PS51121 Jumbo 129-0193, full diameter 40 mm).

when the largest piece of the bezoar was reduced to less than 15 mm or when the patient could no longer tolerate the endoscopic procedure. Bezoar pieces were left in the stomach to be discharged spontaneously through the intestines. After the first procedure, patients were advised to consume 2500 mL of Coca Cola® per day or the same amount of pineapple juice if Coca Cola® could not be tolerated, until the next procedure. Endoscopic procedures were repeated at 5-day intervals until complete reabsorption of the bezoar was achieved. After complete reabsorption of bezoars, patients were followed up for 6 weeks.

Outcomes

The primary outcome of the study was the complete and successful fragmentation of phytobezoars. Secondary outcomes were determined on the basis of the time to achieve complete resorption, need for surgical treatment, overall endoscopic treatment success, and complications.

Statistical Analysis

Statistical analyses were performed by using IBM SPSS® 24.0 (Statistical Package for Social Sciences) for Windows. (IBM Corp.; Armonk, NY, USA) Categorical variables presented as numbers and percentages were compared using Fisher's exact test. Continuous variables were presented as median and interquartile rangeusing Mann-Whitney U test. *P* values <.05 were considered to be statistically significant. Results were expressed as mean ± standard deviation or median (minimum-maximum).

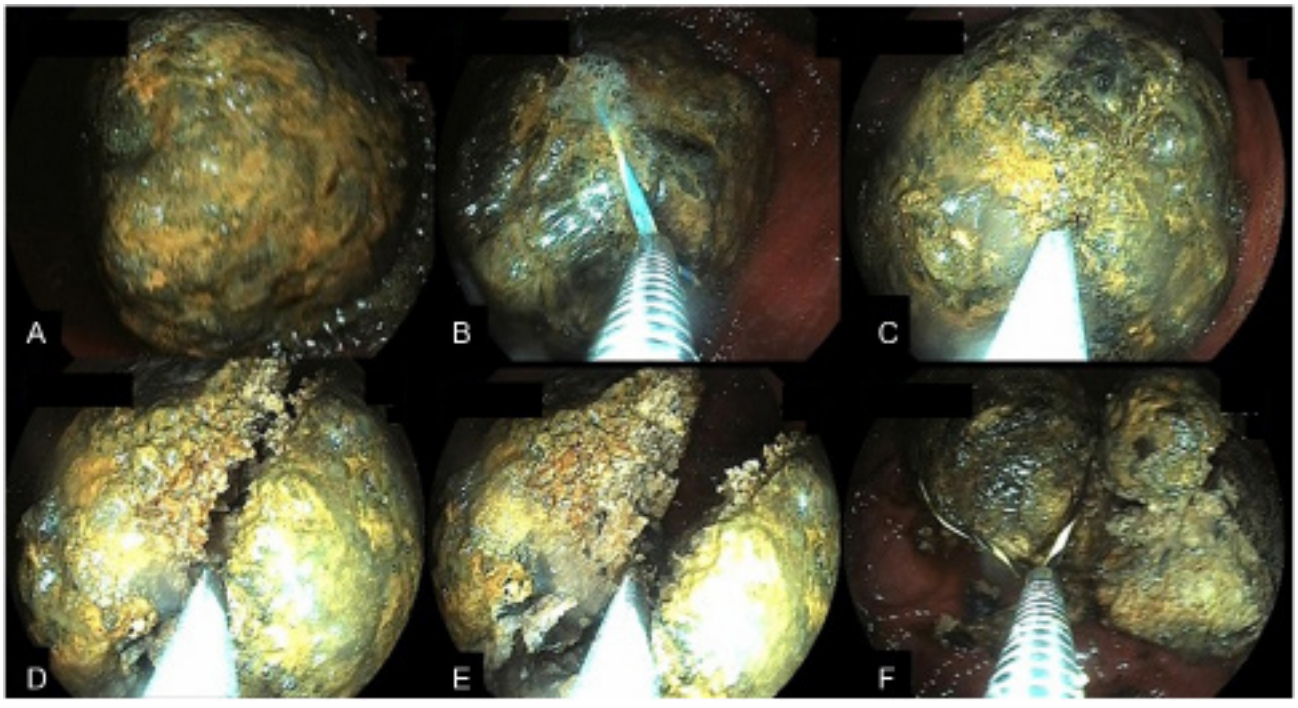

Figure 3. Large-size bezoar revealed during a gastroscopy (A). Grasping the bezoar at its widest part with the hand-made bezoaratome, both ends of the guidewire were attached to the spinning wheel. The spinning wheel rotated and the bezoar was fragmented (B, C, D, E) and the process was repeated until the bezoar was split into pieces small enough to be held by other instruments (F).

RESULTS

Sixty-one patients were diagnosed with gastric bezoars during endoscopic examination at an education and research hospital between January 2015 and December 2018. Out of them, 24 were excluded from the study because they had bezoars less than 50 mm diameter (20), were classified as a trichobezoar (2), were under 18 years of age (1), and were pregnant women (1). Thirty-seven patients were included in the study.

The mean age of patients was 57.6 ± 12.5 years, and 21 (56.8%) were male. The median body mass index was 28.9 kg/m^2 (21-36). All patients had a history of persimmon consumption. Thirteen (35.1%) patients had a history of type 2 diabetes mellitus, and 5 (13.5%) had previously undergone gastric surgery. The most common symptoms at admission were epigastric pain (73%) and nausea (59.4%) (Table 1). Endoscopic examination revealed 23 (62.2%) patients with gastric ulcers and 4 patients (10.8%) with gastric outlet obstruction due to bezoars. Thirty (77%) patients had only 1 phytobezoar, while no patient had more than 3. The median size of the phytobezoars was 71 mm (50-90 mm). The median endoscopic procedure time was 853 s (380-1940 s). In 22 patients (59.5%), the fragmentation of the bezoar was completed in 1 session, while a maximum of 3 endoscopic procedures was required for 6 patients. No major complications occurred during the endoscopic procedures, except superficial mucosal erosions. However, one patient required surgery for ileus associated with an obstruction at the distal part of the jejunum, 61 h after the second endoscopic session (Table 2).

Table 1. The Demographic and Clinical Features of the Patients

Parameter	
Age, years (mean ± SD)	57.6 ± 12.5
Male, *n* (%)	21 (56.8)
BMI, kg/m^2	28.9 (21-36)
Symptoms	
Epigastric pain, *n* (%)	27 (73)
Nausea and Vomiting, *n* (%)	22 (59.4)
Weight loss, *n* (%)	5 (13.5)
Dyspepsia, *n* (%)	2 (5.4)
Hematemesis, *n* (%)	1 (2.7)
Asymptomatic, *n* (%)	2 (5.4)
Previous gastric resection, *n* (%)	5 (13.5)
Comorbidity	
DM, *n* (%)	13 (35.1)
HT, *n* (%)	5 (13.5)
CHF, *n* (%)	1 (2.7)
History of persimmon consumption, *n* (%)	37 (100)

SD, standard deviation; BMI, body mass index; DM, diabetes mellitus; HT, hypertension; CHF, congestive heart failure.

DISCUSSION

In this study, our success rate for endoscopic fragmentation of large size phytobezoars using a "hand-made bezoaratome" was found to be 100%. Only one patient (2.7%) required surgical treatment for ileus in the follow-up period. The overall success rate of the endoscopic treatment is 97.3%. No other patients had any other major treatment-related complications.

Table 2. Results of the Endoscopic and Procedural Features

Parameters	
The number of the bezoars	
1, *n* (%)	30 (81.1)
2, *n* (%)	6 (16.2)
3, *n* (%)	1 (2.7)
Size of the bezoar, mm median (min-max)	71 (50-100)
Endoscopic findings	
Gastritis, *n* (%)	10 (27)
Peptic ulcer, *n* (%)	27 (73)
Gastric outlet obstruction, *n* (%)	4 (10.8)
Status of the pylorus	
Normal, *n* (%)	27 (73)
Deformed, *n* (%)	5 (13.5)
Operated, *n* (%)	5 (13.5)
Number of the endoscopic sessions	
1, *n* (%)	22 (59.5)
2, *n* (%)	9 (24.3)
3, *n* (%)	6 (16.2)
Total procedure time, second median (min-max)	853 (380-1940)
Chemical theraphy	
Coca Cola®, *n* (%)	30 (81.1)
Pineapple juice, *n* (%)	7 (18.9)
Complete fragmentation success, *n* (%)	37 (100)
Complications, *n* (%)	
İleus	1 (2.7)
Need for surgery, *n* (%)	1 (2.7)
Overall endoscopic success, *n* (%)	36 (97.3)

It is commonly accepted that the main predisposing factor for bezoar formation is delayed gastric emptying. Although, recent studies reveal that many patients have normal or even increased gastric motility and consider the composition of ingested materials to play an important role in bezoar pathogenesis. The clearest evidence for this is the frequent occurrence of phytobezoars in persimmon-consuming patients, despite often-normal gastric functions.[10] The persimmon fruit contains a high amount of tannin, especially in its unripe form, and this tannin forms a coagulum when mixed with gastric acid. It is also thought that proline-rich proteins secreted from the parotid and submandibular glands play a role in phytobezoar development by combining with the tannin.[10,11] Once formed, bezoars continue to increase in size due to the ongoing ingestion of food, rich in cellulose and other indigestible materials.

Chemical dissolution is the first choice of treatment in patients with small size phytobezoars and mild symptoms, as it is non-invasive and cheap. Many studies have shown that some phytobezoars can be treated by enzymatic dissolution with cola, pineapple juice, cellulase, papain, and acetylcysteine.[12-15] However, enzymatic treatments take a long time, and the large quantities of enzymatic liquids may cause adverse effects, such as gastric ulcer and electrolyte imbalances.[16] In addition, since nausea and vomiting are common symptoms in patients with bezoar, it can be hard to tolerate high-volume oral solutions such as 3000 mL of cola per day.[8] The hard structure of diospyrobezoars also makes them difficult to dissolve chemically.[17] Data on enzymatic treatments are variable and partially resorbed phytobezoars carry the risk of intestinal obstruction up to 6 weeks.[8,18,19]

In a review, evaluating 24 studies involving 46 patients with a gastric phytobezoar, gastric lavage with 3000 mL Coca Cola® over 12 h was applied. Complete bezoar resolution was achieved in only 23 (50%) patients, while other treatment methods, mainly endoscopic, were required for the remaining patients. Another significant outcome of the study was that diospyrobezoars are resistant to chemical dissolution therapy alone.[17] Almost all of the patients included in our study had diospyrobezoars.

As chemical dissolution can be inadequate and difficult to tolerate, and surgical treatments can often lead to complications, endoscopic methods for treating bezoars are frequently preferred. Endoscopic treatment usually involves fragmenting the bezoar with instruments such as forceps and snare. After the fragmentation, the remaining small parts should be removed with a large-channel nasogastric tube or left in the stomach for gastrointestinal excretion.[20] In cases where fragmentation with these endoscopic devices have not been successful, a wide variety of methods have been attempted, including Nd:YAG laser, monopolar diathermy knife, extracorporeal shockwave lithotripsy, as well as injections of enzymes and cola.[12,14,21,22] The success rates of combined chemical and endoscopic methods in the treatment of gastric phytobezoars range from 70 to 90%.[7,23] However, bezoar size was not evaluated in these studies and endoscopic treatment success rate would be lower in large phytobezoars. In our study, endoscopic fragmentation success rate was 100% in patients with large gastric phytobezoars.

Surgical methods are applied when phytobezoars are too large to grasp by endoscopic accessories, cannot be treated by enzymatic methods, or complications occur. Laparoscopic, minimally invasive surgical methods are generally preferred.[19] The success rate of surgical methods in the treatment of phytobezoars is high, at around 95%. However, up to 30% morbidity and 10% mortality have been reported after surgery.[24,25] Hand-made bezoaratom significantly reduces the need for surgical treatment.

One of the most important disadvantages of endoscopic treatment is the length of the procedure time and the risk of aspiration. In addition, commonly used instruments such as forceps' and snares can be inadequate for the fragmentation of large-sized gastric phytobezoars.[26] Although there are a few case reports in the literature, no prospective studies exist on endoscopic treatment of large gastric bezoars.[27-30] A large-sized bezoar has been treated successfully with an oval poly-filament snare opening to a width of 70 × 100 mm, which was originally mentioned in a single case report; however, the width of this snare is limited and is not available in practical use.[27] Another study, evaluating 11 cases (≥45 mm), reported successful endoscopic fragmentation of bezoars using a 0.025-inch guidewire.[31] The authors stated that this method risks damaging the tip of the endoscope through contact with the bezoar during fragmentation, but it can be prevented with a transparent cap that will be attached to the tip of the endoscope; also no damage was reported despite the use of the cap. The technique applied in our study can be defined as an advanced version of this method. In addition, managing the guidewire and capturing the bezoar may be difficult without a sheath, especially when the bezoar or its fragments are localized in the proximal side of the corpus and fundus. This may lead to prolongation

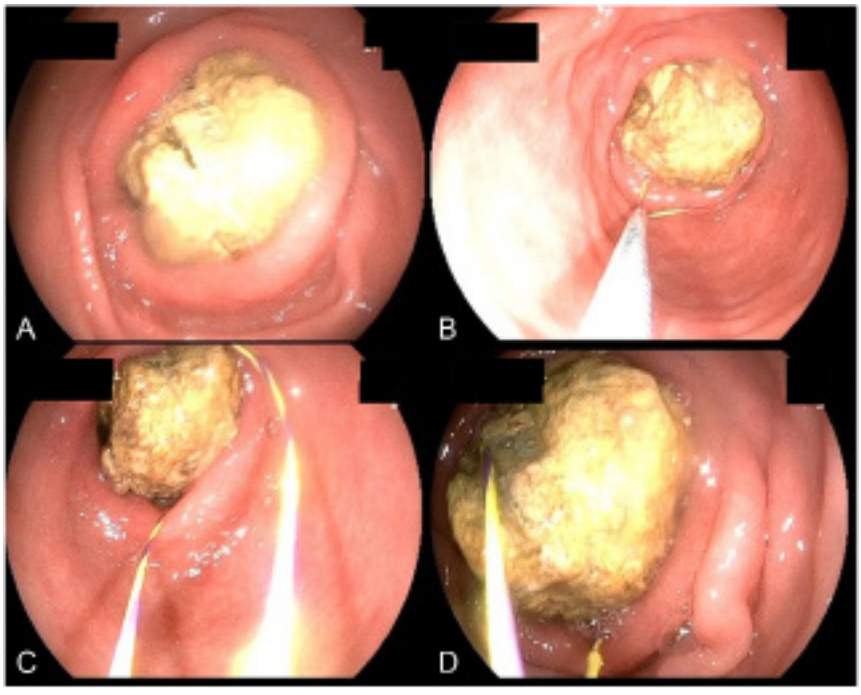

Figure 4. Large bezoar which caused an obstruction in the pylorus (A). Bezoar is captured by the "hand-made bezoaratome" and brought into the stomach (B, C, D).

of the procedure time and reduces treatment success. In our study, hand-made bezoaratome was successfully used to grasp large-sized gastric (≥50 mm) bezoars and fragment them into small pieces in all patients.

The two main advantages of "hand-made bezoaratome" are that the sheath and guidewire can be easily found in almost every endoscopy unit and the procedure can be performed with a standard gastroscope. Furthermore, through the sheath, the guidewire can be easily guided to capture the bezoar, resulting in a significantly shorter procedure time than with other methods. The risk of complication is low, and the sheath prevents the endoscope from mechanical damages. As we have seen in one of our cases, the fragmentation of the bezoars obstructing pylorus is possible with this method, as the bezoar can be grasped, and then brought into the stomach and fragmented (Figure 4A–D). Also, it should be noted that fragmented bezoars can cause ileus, especially in patients with diabetes mellitus.

One of the weakness of our study is that it is a single-center study. Also, all procedures were performed by experienced endoscopists at a tertiary gastroenterology center; clearly, less-experienced centers might produce different results. On the other hand, our study is the first prospective study in the literature about endoscopic treatment of large (≥5 cm) gastric phytobezoars and includes a relatively high number of patients. Further prospective and randomized multi-center studies with large numbers of patients are needed to evaluate the efficacy of the "hand-made bezoaratome."

CONCLUSION

Using a "hand-made bezoaratome" is effective and reliable for the endoscopic treatment of large gastric phytobezoars. It can be especially useful when attempting the treatment of challenging cases such as those obstructing the pylorus.

Ethics Committee Approval: Sakarya University Faculty of Medicine Clinical Research Ethics Committee, No:16214662/050.01/04.

Informed Consent: Informed consent was obtained from all patients.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – B.T., A.T.E., A.S.K.,E.P.; Design - B.T., A.T.E., C.K, A.S.K., E.P.; Supervision - B.T., A.T.E., C.K, M.I.U, A.S.K., E.P.; Resource - B.T., A.T.E., C.K,; Materials - B.T., A.T.E., C.K, A.S.K., E.P.; Data Collection and/or Processing - B.T., A.T.E., C.K, M.I.U.; Analysis and/or Interpretation - B.T., A.T.E., A.S.K., E.P; Literature Search - B.T., A.T.E., M.I.U., A.S.K., E.P.; Writing - B.T., C.K.,A.T.E., M.I.U., A.S.K., E.P.; Critical Reviews - B.T., A.T.E., A.S.K., E.P..

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