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Gastrointestinal bezoars, a challenge to research and practice: A review

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Abstract

Bezoars are relatively uncommon concretions of undigested or partially digested material in the gastrointestinal tract, mostly in the stomach. Their prevalence varies among geographic locations and ethnic groups with different dietary habits. They are classified according to their predominant component. Main predispositional factors to bezoar formation are altered anatomy and disordered motility of the gastrointestinal tract. Patients remain asymptomatic for a long time and symptoms develop as these accumulations adhere to mucosa, causing ulceration and bleeding, or increase in size to the point of obstruction or perforation and peritonitis. Endoscopy and computed tomography play major role in timely diagnosis; otherwise, the diagnosis can be made intraoperatively and it is challenging. The optimal treatment strategy remains under question and differs for each patient, especially for complicated cases. The available treatment options for bezoars include chemical dissolution for elective cases, and removal by endoscopy or surgery for elective or emergent cases. Better understanding of the etiology, epidemiology and clinical manifestation of each type of bezoar will facilitate prompt diagnosis and management, avoiding significant morbidity and mortality. Here, we briefly review relevant basic knowledge and research.

Keywords: Phytobezoar; Trichobezoar; Endoscopy; Gastric outlet obstruction; Bowel obstruction; Treatment

1. Introduction

Bezoars are uncommon concretions of indigestible food (i.e. rich in cellulose) or swallowed undigested material (foreign or not, intentionally or accidentally ingested, i.e. food, cotton or hair) in the gastrointestinal (GI) tract, mostly occurring in the stomach [1-5]. They are classified into four types according to their composition, including phytobezoars (fibers, fruit remnants and skins of vegetables- e.x. percimmons, pineapples, and coconut with great amounts of cellulose), trichobezoars (ingested hair), pharmacobezoars (medications) and lactobezoars (milk curds in low-birth weight and premature neonates) [2, 4-8].The phytobezoar (especially, gastric phytobezoar=GPB) and the trichobezoar, having the Greek prefixes *phyto* (plant) and *tricho* (hair) respectively, which indicate their composition, are the most common [1, 5, 7, 8].Bezoars are a curable condition, but late diagnosis or misdiagnosis can lead to significant morbidity or mortality [3, 5, 9]. Therefore, the importance of these entities lies in their possible serious complications [5, 9].

Here we provide an overview of the prevalence, classification, predisposing factors, manifestations, methods of diagnostic evaluation and management of bezoars. A comprehensive search of the electronic databases (PubMed, Google Scholar) regarding recent progress in basic research was accordingly conducted.

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2. Discussion

2.1. Prevalence

The prevalence of bezoars, especially the GPBs, varies among many geographic areas and ethnic groups since it is mostly affected by food culture differences [7, 10-12]. Overall, bezoars can be found in the stomach in less than 0.5% of individuals undergoing upper GI endoscopy (UGE), and in the small bowel in 0.4-0.8% of all cases of small bowel obstruction [7]. Ahn et al [13] reported an incidence of 0.43% (14 bezoars/ 3247 esophagogastroduodenoscopies) over a 7-year period. In a meta-analysis by Ghosheh et al [14], reviewing 19 reported studies published from 1994 to 2005, laparoscopy was attempted in 1061 patients presenting with acute small bowel obstruction and bezoars represented the 5th most common cause, accounting for 0.8% .

2.2. Predispositions to formation

Some foods contain high amounts of cellulose, hemicelluloses, tannins and lignin, which are the main components of phytobezoars [5]. Under special circumstances, upon digestion, agglutination may occur between these structures and dietary proteins leading to the insidious and slow formation of one of the most common bezoars, the GPB (over 40% of cases) [1, 7, 8].It is believed that, upon reaction with stomach acids, persimmon tannin is polymerized and forms a conglomerate in which cellulose, hemicellulose, and various proteins are accumulated [2, 7, 15].Risk or contributory factors to the formation of the GPBs are disordered motility (gastric stasis), altered anatomy (pyloric stenosis), and decreased gastric acidity [1, 2, 4-9, 11].According to the literature, a variety of factors, such as partial gastrectomy, vagotomy and pyloroplasty, peptic ulcer disease, chronic gastritis, gastroparesis, Crohn's disease, cancers of the GI tract, diabetes mellitus, dehydration, malnutrition/dietary habits and aging, are associated with increased chance of phytobezoar formation [2, 3, 5-7, 13, 16]. Specifically, duodenal bezoars can develop after fragmentation and migration of GPB; they can also develop in patients with previous gastric surgery, deformed duodenal bulb or diverticulum [4, 10, 11, 16]. Similarly, small bowel bezoars may be satellites due to migration of fragments of GPB, forced by rapid increase in the endogastric pressure from coughing and vomiting;they could also be formed in association with stricture, tumour or diverticulum[4, 6, 11, 14, 17].

Trichobezoars, in particular, are observed almost exclusively in young girls (90%) aged less than 30 years, who are predisposed to trichotillomania and trichomania (hair pulling), due to possible environmental or psychological factors: refusal attitude, compulsion and depressive syndromes may be noted in these patients [1, 9, 10, 18]. Alopecia may also be present [10]. It has been reported that trichobezoars may represent up to half of the bezoar cases [1, 18].Rapunzel syndrome has been described since 1968 as a rare form of gastric trichobezoar with duodenal and jejunal extension [1, 7, 10, 18]. Trichobezoars may also occur in patients with digestive antecedents, as in pyloroantrectomy or esophagoplasty [10] .

2.3. Clinical picture-complications

The symptoms usually develop insidiously as these accumulations increase in size to the point of detachment/migration and obstruction or perforation [4, 7, 12, 14].This may take a long time for a bezoar formed in the stomach where it can expand to a large volume, or just a few days if it occurs (i.e. following migration) in a small-volume region such as the duodenum [3, 4, 7, 11, 12, 17]. Depending on the location, type of bezoar and its duration, clinical manifestations may include epigastric pain (colicky type) or discomfort, early satiety, postprandial fullness or loss of appetite, and diarrhea or constipation, often alternating [1, 3-5, 7, 8, 10-12]. The most characteristic physical finding is a large, readily palpable and freely movable smooth abdominal mass, usually located in the epigastrium, but sometimes occupying other lower positions [1]. Gastric bezoars often cause ulcerative lesions in the stomach and subsequent bleeding, whereas small intestinal bezoars present with small bowel obstruction and ileus [6, 7, 14, 17, 18]. If not timely removed, major complications may occur either insidiously or abruptly [8, 9, 11]. These include upper GI haemorrhage(melena, or even haematemesis) due to ulcerations (gastric or duodenal ulcer, erosive gastritis, reflux esophagitis), mechanical gastric or small bowel obstruction, such as the gastric outlet obstruction (GOO), gastric or duodenal or small intestinal perforation with peritonitis and subphrenic abscess, digestive fistula, cholestasis or acute pancreatitis due to obstruction of the ampulla of Vater (as in Rapunzel syndrome), bleeding intussusception and intestinal necrosis [1-5, 7-12, 17, 18].

Before the 1980s, peptic ulcer disease was the most common cause of GOO, accounting for up to 90% of cases, while 12% of patients with a peptic ulcer presented with GOO as a direct consequence of a pyloric canal ulcer and pylorospasm [4, 7, 11, 12, 17, 19, 20].GOO is also one of the uncommon complications of phytobezoars, being considered very serious as it may rapidly disorder the patient [4, 5].A large GPB may be movable causing intermittent GOO, with most common clinical symptoms including nausea, vomiting and epigastric pain, or it can be lodged into the gastric outlet and cause acute upper obstruction; chronic cases may present with malabsorption and weight loss [4, 5, 8, 10-12, 19, 20]. Similarly,

even a small duodenal bezoar, if impacted, may cause obstruction with abrupt clinical features [4, 11, 12, 14, 17]. The initial bezoar mass is usually in the stomach, and consequently fragmented due to the continuing vomiting or coughing. However, obstruction from migration of fragmented GPBs usually occurs in the ileum. It is unusual for a gastric fragment to be impacted in the duodenojejunal flexure instead of going through it and cause a distal obstruction, as it is also exceptional for it to have a reverse migration to the esophagus and result in high obstruction [4, 6, 10, 11, 17, 21].

2.4. Diagnosis

Diagnosis may be suspected based upon history, clinical features and physical examination, and confirmed by radiologic imaging and UGE [1, 4, 6, 7, 11, 12]. In some cases, gastric bezoars may be found incidentally [19].UGE is generally the examination of choice to establish the diagnosis of gastroduodenal bezoars and determine their composition, and also it may help to treat the underlying pathology [1, 5, 7, 10, 12].A normal endoscopy does not exclude diagnosis of a jejunal trichobezoar, as reported in cases of Rapunzel syndrome [6, 10]. In patients evaluated by computed tomography (CT) scan for obstruction (=examination of choice) or other indications, a well-defined round or ovoid intraluminal occupational mass, movable or adherent to one side, with air bubbles retained within the interstice or a mottled appearance, is a mark of bezoar [5, 6, 10, 12, 17]. Contrast-enhanced abdominal CT scan may define the location of obstruction, and also enables visualization of multiple bezoars [5, 7, 10, 12].In some cases, an abdominal x-ray can suggest the diagnosis by showing heterogenous density, and abdominal ultrasound can confirm an intraluminal mass with a hyper-echoic surface and a marked acoustic shadow suggestive of a bezoar [1, 10, 12]. The barium (or gastrographin) follow-through examination may show an intraluminal gastric filling defect (Figures 1-4) [1, 4, 6, 10, 18, 21].In case of Rapunzel syndrome, the contrast media imaging is associated with a duodenal or jejunal extension corresponding to the trichobezoar prolongation [10]. Finally, magnetic resonance imaging (MRI) may also facilitate the diagnosis as the mass has variable signals in T1 and T2, but at a substantially increased cost [10]. Reportedly, it has been also supported that further analysis by microscopy and spectroscopy (*in vitro*) of the composition of the extracted bezoars following surgery may contribute to their more targeted management [7].

2.4.1. Figures

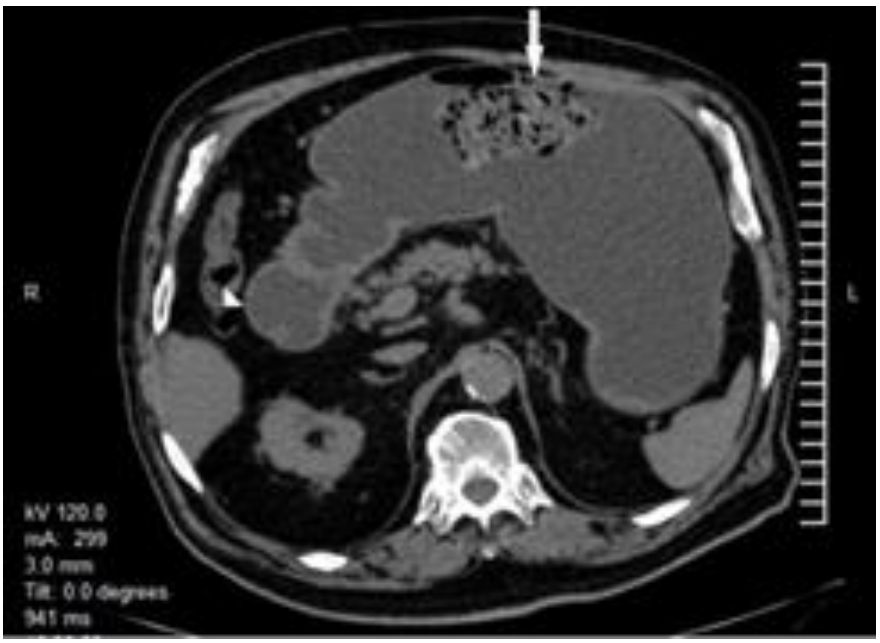

Figure 1 Abdominal CT with no use of per os contrast media: Gastric dilatation, undigested mass in mid-stomach (arrow), duodenal obstructive stenosis/GOO (arrowhead)(own material)

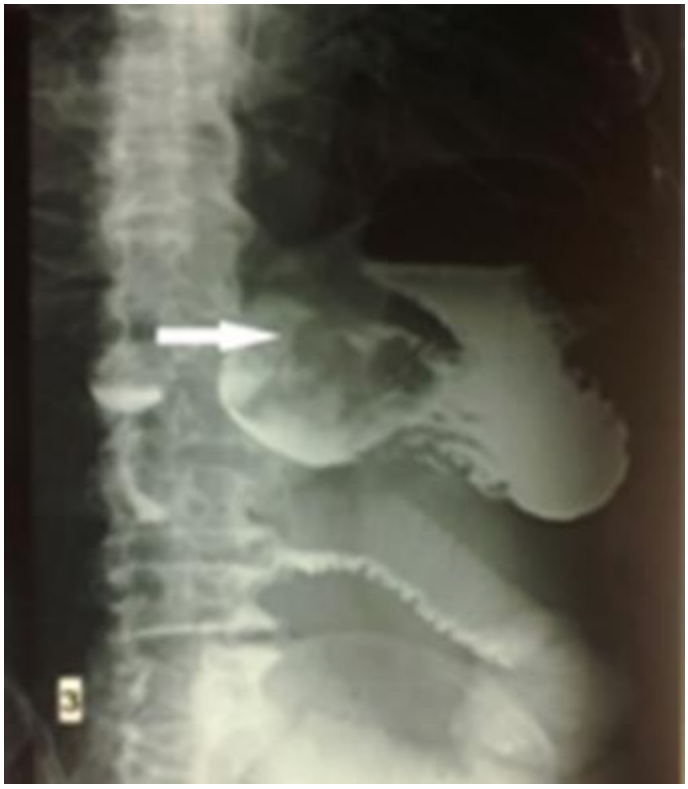

Figure 2 Abdominal x-ray utilizing per os gastrographin, after decompression: Gastric dilatation, antral mass with mixed density (arrow), gastrographin in jejunum (own material)

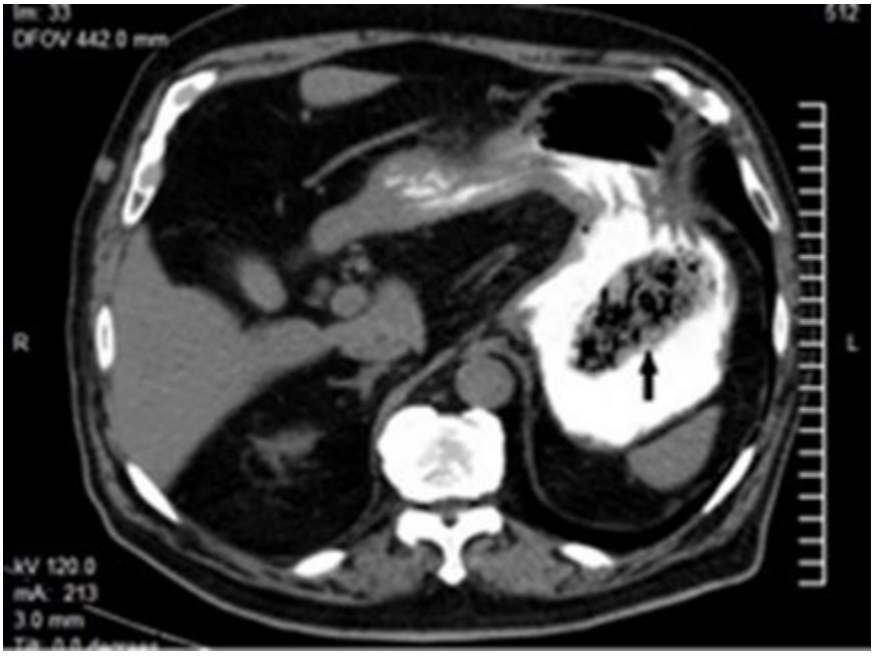

Figure 3 Abdominal CT utilizing per os gastrographin after decompression (GOO): Movable, hard solid mass (arrow) in gastric fundus(own material)

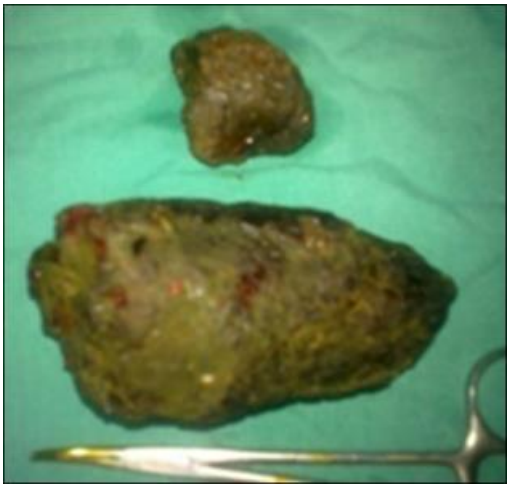

Figure 4 Findings from an emergently operated elder man with GOO: Greenish stoned bezoar from stomach (big) and ileum (own material)

2.5. Treatment options

There is currently no optional treatment strategy for bezoars [3]. Treatment should be individualized, based on the type of presentation of the bezoar (acute or not), location, combination and underlying etiology [2, 3, 7-9, 11].In most of the uncomplicated cases, the first line treatment is conservative, using a chemical dissolvent for smaller (phyto)bezoars or endoscopy and endoscopic fragmentation for the larger ones, or a combination of the two modalities, possibly in a repeat manner (bezoars with a hard consistency) [2, 3, 5, 7-10, 12, 15]. This is particularly true for gastric and esophageal bezoars. Chemical (enzymatic) dissolution should be considered for phytobezoars producing mild symptoms and plays thus a crucial role in selected cases [5, 7, 8, 11, 12, 15, 17]. In previous studies, papain, cellulase, diet soda, sodium bicarbonate solution, acetylcysteine, ursodeoxycholic acid, pancreatin, traditional Chinese medicine purgative and Coca-Cola® have all been tried with success in the dissolution of GPBs [2, 3, 5, 7, 8, 10-12, 15, 17, 22, 23]. However, problems in the administration of these products, including adverse events (i.e., papain) or unavailability for ingestion as commercial products (i.e., cellulase), have also been reported [7].Recently, dissolution with cola (i.e., at least 3 liters consumed by lavaging or drinking over 12 hours) has been described to be an effective treatment option [7, 15, 22]. A large series of this treatment showed a 23.5% success rate for complete dissolution, particularly for GPBs, excluding diospyrobezoars, and the authors recommended the use of cola for pre-treatment to facilitate endoscopic fragmentation [22]. Furthermore, the administration of prokinetics [3, 7], such as itopride, mosapride and metoclopramide, was reportedly effective in resolving gastric (phyto)bezoar in some patients, since these agents may improve gastric emptying and facilitate the break-down of the mass by enhancing contractions of the GI tract and increasing their frequency. However, this option requires that the specific bezoar is soft enough to be digested with GI peristalsis [7]. The endoscopic removal of (phyto)bezoars, mainly the gastric ones, involves fragmentation into smaller parts using water jet, direct suction, biopsy forceps or snares, electrosurgical knife, mechanical or extracorporeal/electrohydraulic lithotripsy, and Nd:YAG laser or argon plasma coagulation energy;fragments can then be removed endoscopically(sometimes, repeatedly) or passed through the GI tract [3, 5, 7-10, 12, 18, 19]. The possibility though that fragments may migrate, coalesce distally and cause intestinal obstruction should always be considered [3, 4, 17]. Surgical treatment via laparotomy or laparoscopy is required after failure of conservative methods due to bezoar hardness, size, location or impaction. It is also mandatory in cases of initially complicated disease or complications during endoscopy (obstruction, bleeding) [3-10, 12, 14]. Severe concomitant disease and possible impairment of patient's cardiopulmonary and renal function require suitable preoperative support, as long as the patient's surgical problem permits this strategy, so as to operate under better conditions. Adequate fluid and electrolyte replacement, gastric decompression and protein pump inhibitors is the first step in the treatment of GOO and some other complicated cases [7, 11, 12, 19]. GOO due to (phyto)bezoar requires early surgery as it rarely improves with conservative treatment [11, 12]. Intestinal bezoars are generally removed by a surgical procedure, since these often present with intestinal obstruction and ileus [7].

With open surgery, gastric and intestinal (phyto)bezoars are commonly removed via gastrotomy [4, 5, 8, 10-12, 18], and rarely digitally fragmented and washed into the colon [6]. Taking everything into account (i.e., debilitated patient, older age, underlying pathology), if benefits outweigh the possible risks, the surgical intervention should aim to definitely treat a benign pyloric ulcer with deformed duodenal bulb (i.e., GOO), which had possibly been previously biopsied during a preoperative UGE or intraoperatively; a pyloroplasty or gastrojejunostomy (retrocolic, low) with truncal

vagotomy (for acid reduction) may be the selected option [1, 4, 5, 20]. In this case, a distally impacted satellite should be milked in a reverse manner and extracted through the opening of the under construction gastrojejunostomy [4].The small bowel is always explored in order to remove satellites and avoid recurrence of intestinal obstruction [3, 4, 7, 12]. Excision of trichobezoars can also be surgical [10, 18];intentionally, open excision of a jejunal trichobezoar must be done by enterotomy, with enterectomy being necessary in the case of fissured jejunum [7, 10, 17]. In patients with trichotillomania and trichophagia with associated psychopathological problems resort to behavioral treatment becomes necessary [10, 18].

Treatment options have been modified with the advent of minimally invasive techniques such as laparoscopy and advanced endoscopy [14, 20].Laparoscopic techniques should be a treatment option, but particular technical skill and experience requirements, longer operative time, higher cost and retrieval problems remain relative disadvantages [7, 9, 14].).Intraoperative endoscopic removal has rarely been reported [24]. The endoscopic ultrasound-guided gastroenterostomy has been effectively used for GOO due to benign causes, but remains a technically challenging procedure with limited evidence to date [20].

3. Conclusion

The diagnosis of gastrointestinal bezoars is still a challenge, but it may be suspected based on clinical features, physical examination and a CT scan, and confirmed by endoscopic investigation.Late diagnosis or misdiagnosis could lead to significant morbidity or mortality, so physicians are advised to put bezoars in their differential diagnosis list if CT scan indicates a soft tissue mass in the region of stomach or bowel. Therapeutic options differ for each patient. Most of the uncomplicated bezoars are initially treated conservatively.Surgical treatment is required for trichobezoars, intestinal bezoars, failed conservative approach or complicated cases.

Compliance with ethical standards

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Disclosure of conflict of interest

Constantinos Avgoustou declares no competing interests. Dimitrios Jannoussis declares no competing interests. Eirini Avgoustou declares no competing interests.

Authors' contributions

CA-manuscript conception/ design, and manuscript writing/revision; DJ-data processing and reference research; EA-preparation and submission of the manuscript.

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