

# Systematic review: Coca-Cola can effectively dissolve gastric phytobezoars as a first-line treatment

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## SUMMARY

### Background

Gastric phytobezoars represent the most common bezoars in patients with poor gastric motility. A variety of dissolution therapies and endoscopic fragmentation techniques have been evaluated as conservative treatment so as to avoid surgery.

### Aim

To investigate the effectiveness of Coca-Cola for gastric phytobezoars dissolution.

### Methods

We performed a systematic search to identify publications on gastric phytobezoars to assess the efficacy of Coca-Cola as a dissolution therapy. Diospyrobezoars, formed after persimmon ingestion, are a distinct type of phytobezoars characterized by their hard consistency. Thus, these two sub-groups of bezoars were compared in terms of successful dissolution.

### Results

Over a 10-year period (2002–2012), 24 papers including 46 patients have been published. In 91.3% of the cases, phytobezoar resolution with Coca-Cola administration was successful, either as a single treatment (50%) or combined with further endoscopic techniques, whereas only 4 patients underwent surgery. Phytobezoars were more likely to dissolve after initial attempt with Coca-Cola compared with diospyrobezoars (60.6% vs. 23%,  $P = 0.022$ ).

### Conclusions

Coca-Cola alone is effective in gastric phytobezoar dissolution in half of the cases and, combined with additional endoscopic methods, is successful in more than 90% of them.

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## INTRODUCTION

Bezoar is a type of a foreign body in the intestinal tract consisting of animal or vegetable material, most commonly found as hard masses in the stomach.<sup>1</sup> Their incidence has been reported to be about 0.4%.<sup>2</sup> Predisposing conditions include gastric dysmotility usually because of diabetic gastroparesis and previous gastric surgery. According to their composition, they are classified into five types: phytobezoars, trichobezoars, medication bezoars, lactobezoars and food bolus. Phytobezoars, the most common type of bezoars, are composed of indigestible cellulose, tannin and lignin from ingested vegetables and fruits. In some Asian countries, phytobezoars are formed after ingestion of persimmons and pineapples and are called diospyrobezoars, which are more difficult to treat because of their hard consistency.<sup>3, 4</sup> Phytobezoars' conservative management includes administration of proteolytic enzymes, cellulase, carbohydrate beverages, either orally or by gastric lavage, and endoscopic fragmentation. We first published a report about Coca-Cola efficacy in dissolving gastric phytobezoars in 2002.<sup>5</sup> Since then, more than 20 reports have followed the same treatment modality. Our aim was to review all studies evaluating Coca-Cola dissolution therapy, concerning patients' characteristics and outcome.

## METHODS

A systematic literature search was performed using PubMed, Embase and Google from 2002 to end of June 2012. We combined the keywords phytobezoars treatment and Coca-Cola lysis. We selected only studies with adult patients, initially treated with Coca-Cola, published in English or in other languages with English abstracts. We examined the efficacy of this therapy in dissolving phytobezoars either completely or partially. The outcome was considered favourable in case of bezoar complete resolution either initially or following further endoscopic fragmentation not necessitating surgical treatment. We compared phytobezoars and diospyrobezoars in terms of dissolution because the latter develop into very hard masses difficult to manage.

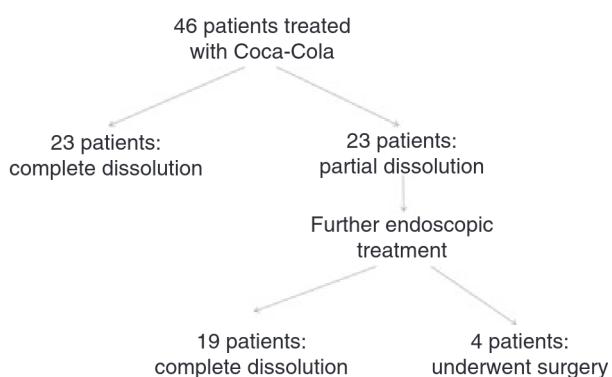
Chi square test was used to compare differences and  $P < 0.05$  was considered statistically significant.

## RESULTS

We identified 24 publications that included case reports with 1 up to 5 patients and one retrospective study with 17 patients.<sup>5–28</sup> Patients' characteristics and outcome are shown in detail in Table S1. A total of 46 subjects (mean age: 60, range: 25–87 years, female: 25, male: 21) with phytobezoars were initially offered a

Coca-Cola lysis. Main symptoms included abdominal pain, dyspepsia and vomiting. Sixteen (34.8%) patients had a history of diabetes mellitus with diabetic gastroparesis and 8 (17.4%) previous gastric surgery. In 10 cases (21.7%), endoscopy revealed a gastric ulcer, in 9 (19.5%) pyloric stenosis and in one, a gastric adenocarcinoma. Bezoar size is not mentioned in 20 patients, whereas it is grossly estimated in most of the rest cases (huge, large or very large:  $n = 5$ , occupying  $\frac{1}{2}$  of the lumen:  $n = 1$ , 4 cm:  $n = 1$ , 7 cm:  $n = 1$ , 8–10 cm:  $n = 1$ ). In a series with 17 patients, bezoar occupied  $>50\%$  of the lumen in 7, and  $<50\%$  in 10 of them.<sup>21</sup> Coca-Cola was administrated either as drinking beverage ( $n = 22$ ) or as lavage ( $n = 16$ ), whereas 8 patients had various combinations with drink, injection and irrigation. Coca-Cola volume used, in case of oral administration, varied among studies, concerning daily dose and time of treatment. Daily amount varied from 500 mL up to 3000 mL and time from 24 h up to 6 weeks. Lavage was performed either with a double-lumen nasogastric tube or with 2 separate tubes using 3000 mL of Coca-Cola over a 12-h period.

Figure 1 shows the outcome of the total number of patients treated. After initial attempt, phytobezoars were completely dissolved in 23 (50%) of the cases. Nineteen of the remaining 23 patients finally achieved complete dissolution with further endoscopic modalities, whereas 4 (8.7%) patients, 1 without and 3 with partial dissolution, developed small bowel obstruction leading to surgical treatment. Consequently, 91.3% (42/46) of the patients had a favourable outcome. Interestingly, 2 patients with complete dissolution developed small bowel obstruction 1 and 6 weeks later necessitating surgical intervention.<sup>24, 26</sup> Types of further endoscopic treatment and outcome are



**Figure 1** | Flow diagram showing the outcome of the total number of patients initially treated with cola in 24 studies.

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**Table 1 | Types of endoscopic treatment performed in 23 patients dissolution with Coca-Cola**

Endoscopic treatment	No. of patients	Outcome
Polypectomy snare	6	5: Favourable, 1: Surgery
Biopsy forceps	2	Favourable
Mechanical lithotripsy with basket	8	Favourable
Cellulase lavage	1	Favourable
Polypectomy snare + biopsy forceps	1	Favourable
Biopsy forceps + injection	1	Favourable
None	4	3: Surgery, 1: Favourable

shown in Table 1. Patients with phytobezoars ( $n = 33$ ) were more likely to achieve complete resolution after initial attempt with Coca-Cola compared with those with diospyrobezoars ( $n = 13$ ) (60.6% vs. 23%;  $\chi^2 = 5.25$ ,  $P = 0.022$ ). Further treatment produced comparable results between these two types of bezoars. It is of note that among the 4 subjects who finally underwent surgery, 2 had phytobezoars and 2 diospyrobezoars (Table 2).

## DISCUSSION

The major finding of this review is that Coca-Cola completely dissolves gastric phytobezoars in about half of the cases. Besides, it facilitates complete dissolution by subsequent therapeutic endoscopic techniques in the majority of the patients left, leading to a final success rate up to 91.3%. Mechanical lithotripsy with basket and fragmentation with polypectomy snare or biopsy forceps seems to be the most popular and effective types of further endoscopic treatment to achieve complete dissolution (Table 1). However, clinicians should be aware that even after a favourable outcome with complete dissolution, suggested by an empty stomach on endoscopy, a small bowel obstruction can occur up to 6 weeks later due to small fragments of the initial phytobezoar.<sup>24, 26</sup> Coca-Cola administration is a cheap, easy-to-perform and safe procedure that can be accomplished at

any endoscopy unit. Moreover, lavage can be offered at bedside or even patients may drink the beverage at home. Coca-Cola light, containing aspartame as a sweetener, or zero is available for diabetics and those who would not wish more calories intake and has been reported to be equally effective compared with the regular form as the main contents do not change.<sup>5</sup> In contrast, endoscopic fragmentation, although efficacious as an initial treatment, is more expensive and time consuming. It can be performed with polypectomy snare,<sup>29</sup> electrosurgical knife,<sup>30</sup> mechanical or electrohydraulic lithotripsy,<sup>31</sup> dormia basket,<sup>32</sup> laser destruction,<sup>33</sup> biopsy forceps<sup>34, 35</sup> and endoscopic removal with large channel endoscopy.<sup>36</sup> Apart Coca-Cola, phytobezoar chemical dissolution can also be achieved, either before or after endoscopic fragmentation, with cellulase,<sup>23</sup> acetyl cysteine,<sup>37</sup> papain,<sup>38</sup> pancreatic enzymes, saline solution, 0.1 N HCl and sodium bicarbonate.<sup>39</sup> Walker-Renard, in a review article, reported a 87% (13/15 cases) efficacy with papain and a 100% (19/19) with cellulase, noting adverse effects only with papain such as gastric ulcer, hyponatremia and oesophageal perforation.<sup>40</sup> Also, Bonilla *et al.* achieved resolution in 7/7 patients with cellulase<sup>41</sup> and Gaya *et al.* in 80% using a combination with polypectomy snare and cellulose.<sup>4</sup> However, cases with small bowel obstruction have been described after enzymatic treatment with cellulase.<sup>2, 42</sup> It is of note that cellulase is not available in every country and is more expensive compared with Coca-Cola.

The mechanism of bezoar dissolution by Coca-Cola has not been thoroughly explained, but having an acidity of pH 2.6, due to carbonic and phosphoric acid, it resembles gastric acid, which is thought to be important for fibre digestion.<sup>43</sup> In addition, NaHCO<sub>3</sub> mucolytic effect and CO<sub>2</sub> bubbles enhance the dissolving mechanism.<sup>5</sup>

Diospyrobezoars or persimmon bezoars are considered more difficult to dissolve compared with other phytobezoars because of their hard consistency. They are formed after ingestion of persimmons, which are very popular in many Asian countries. Tanin and shibuol, especially found in the skin of unripe persimmons, react with HCl acid in the stomach and form a coagulum, which is the basis of the bezoar that accumulates cellulose, hemicellulose and protein.<sup>44</sup> After having reviewed all relevant publications, it appears that diospyrobezoars are less likely to be completely dissolved by Coca-Cola, as an initial treatment, compared with other phytobezoars. However, the type of the bezoar does not affect the outcome as complete dissolution is finally achieved even in most diospyrobezoars, by using additional endoscopic fragmentation. It seems that Coca-Cola diminishes the size and

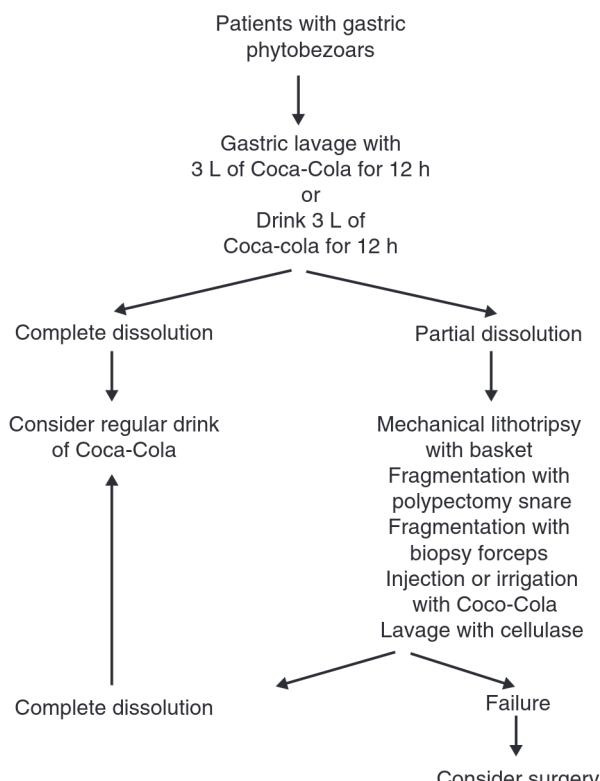
**Table 2 | Comparison of outcome between patients with phytobezoars and diospyrobezoars**

	Phytobezoar $n = 33$	Diospyrobezoar $n = 13$	P-value
Initial complete dissolution	20 (60.6%)	3 (23%)	0.022
Final complete dissolution	31 (94%)	11 (84.6%)	0.312
Surgery	2 (6%)	2 (15.4%)	0.312

softens the consistency of the bezoar, thus facilitating the dissolution by other subsequent modalities. No matter the type of the phytobezoar, a few patients undergo surgery. In a series with 17 patients, by Lee B *et al.*, complete resolution was successful in only 25% of the cases, but further treatment with mechanical lithotripsy or polypectomy snare dissolved nearly all bezoars (16/17) regardless the type.<sup>21</sup> Zamir *et al.* report that in early 1980s, when persimmons became popular in Israel, the incidence of diospyrobezoars was increased. However, when the public was warned formally on TV, cases of persimmon bezoars were dramatically decreased.<sup>45</sup> Initial bezoar size does not seem to influence dissolution, although in most cases it is either not stated or grossly estimated. Lee B *et al.*, in their retrospective study, did not find a difference comparing bezoars occupying <50% or >50% of gastric lumen.<sup>21</sup> An algorithm how to manage a patient with a gastric phytobezoar is provided in Figure 2.

A limitation of this review is that because no follow-up is provided by the majority of the papers, no judgement can be made about patients' relapse. In two papers, 5 patients had a follow-up endoscopy, being on regular use of Coca-Cola, without any evidence of recurrence 3–15 months after initial treatment.<sup>5, 16</sup> Further prospective studies are needed to assess whether continuous Coca-Cola oral intake after bezoar dissolution could be an effective preventive therapy for these patients. Another limitation of our study is that failures of Coca-Cola phytobezoar dissolution may have been underreported. In addition, case reports of successful Coca-Cola lysis may have been rejected from publication due to the high number of case reports published so far.

In conclusion, this study shows that most gastric phytobezoars can be effectively treated with Coca-Cola administration as less than 10% of the cases necessitate surgery. In half of them, complete dissolution is achieved, whereas patients with partial resolution have successful subsequent endoscopic fragmentation. Coca-Cola ingestion should be the treatment of choice considering that less endoscopies and accessories are needed and patients stay less at the hospital. Moreover, availability, low cost, rapid way of action, simplicity in administration



**Figure 2 |** Flow chart showing an algorithm with the management of patients with gastric phytobezoars.

and safety renders Coca-Cola a cost-effective therapy for gastric phytobezoars.

## AUTHORSHIP

*Guarantor of the article:* Prof. S. Ladas.

*Author contributions:* All authors approved the final version of the manuscript and contributed equally to the preparation.

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*Declaration of personal and funding interests:* None.

## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

**Table S1.** Summary of studies with patients treated with Coca-Cola because of gastric phytobezoar.

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