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【 CASE REPORT 】

A Magnesium Oxide Bezoar

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Abstract:

A 75-year-old Japanese woman presented with nausea and appetite loss. Computed tomography showed a radiopaque substance in the stomach. Esophagogastroduodenoscopy revealed bezoars in the stomach, which were endoscopically retrieved. The bezoars were mainly composed of magnesium and oxide. Although bezoar formation associated with magnesium oxide consumption is infrequently encountered, the present case indicates that pharmacobezoar should be considered among the differential diagnoses in patients who demonstrate a radiopaque mass in the digestive tract and have a history of magnesium oxide use.

Key words: bezoar, esophagogastroduodenoscopy, laxative, magnesium oxide

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Introduction

Bezoars are masses of indigestible material that accumulate in the gastrointestinal tract secondary to the intentional or accidental ingestion of a variety of materials/substances (1, 2). Phytobezoars comprising plant materials, such as fibers, skin, and seeds of vegetables and fruits, are the most common bezoar type. Phytobezoars are commonly visualized using computed tomography and appear as ovoid or round occupational masses resembling food debris (3-6).

Bezoars that form by the accumulation or precipitation of medications are called pharmacobezoars. Because extended-release drug products are coated with less soluble substances, such as polymers and cellulose acetate, they can cause pharmacobezoar formation (7-9). Laxatives, e.g., perdium, psyllium, and guar gum, also contribute to pharmacobezoar formation because of their hygroscopic properties and bulk-forming nature (10, 11). In contrast, pharmacobezoars caused by magnesium oxide ingestion are quite infrequently encountered.

We recently encountered a patient with bezoars in the stomach. Based on the results of infrared spectroscopy and energy dispersive X-ray spectrometry (EDX), we determined the bezoars to consist of magnesium oxide.

Case Report

A 75-year-old Japanese woman presented with nausea and appetite loss. She had been treated with bevacizumab and capecitabine for advanced rectal cancer for three months. She reported receiving 1,500 mg/day of magnesium oxide for constipation and the additional use of rabeprazole, domperidone, pyridoxal, mianserin, aspirin, and the herbal medicine daikenchuto. The patient reported the use of magnesium oxide tablets and not wafers. Her height was 163 cm, and her weight was 47.8 kg. A physical examination revealed no abnormalities, including within the abdomen. Laboratory testing revealed decreased levels of white blood cells (2,830/μL), red blood cells (284×10^4/μL), protein (5.2 g/dL), and albumin (3.0 g/dL). The serum magnesium concentration was within the reference range (2.3 mg/dL). Computed tomography (CT) showed a radiopaque substance in the stomach (Fig. 1A). Esophagogastroduodenoscopy revealed bezoars in the stomach, which were endoscopically retrieved using a net device (Fig. 1B and C). These bezoars were used in the subsequent analysis (Fig. 2). The cut surface of the bezoar appeared yellowish (Fig. 2B). Close-up observation of the cut surface showed that it was composed of granules resembling grains of sand (Fig. 2C).

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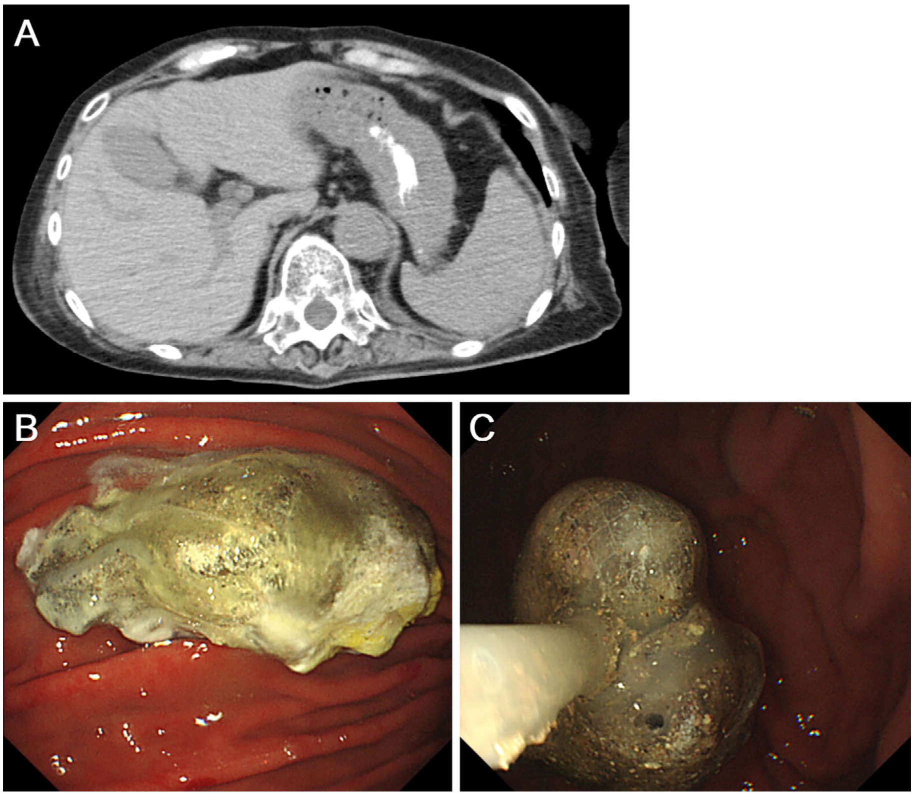

Figure 1. Images of a gastric bezoar. Computed tomography showing a radiopaque substance in the stomach (A). Esophagogastroduodenoscopy revealing bezoars (B), which were endoscopically retrieved using a net device (C).

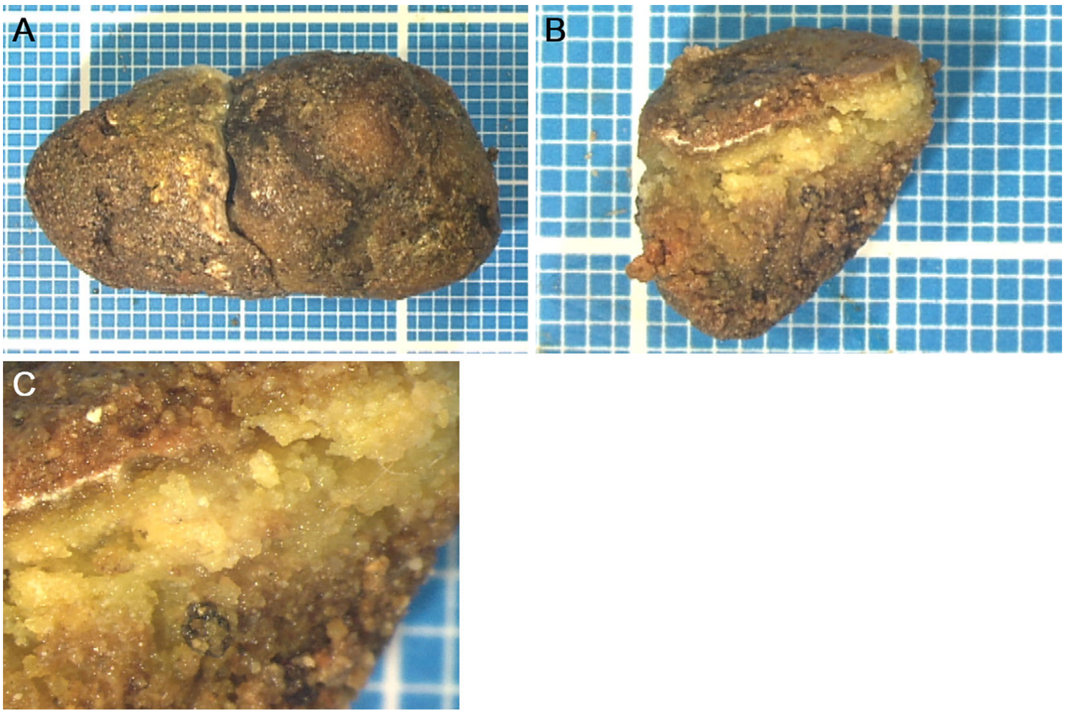

Figure 2. Photographs of the retrieved bezoars. The surface is brown (A), while the cut surface is yellowish (B). The cut surface is composed of granules resembling grains of sand (C).

Infrared spectroscopy revealed that the bezoar was primarily composed of magnesium oxide. We subsequently performed an EDX analysis as described previously (12). A paraffin-embedded section was deparaffinized with xylene (10 minutes twice) and then washed with a serial dilution ethanol series (100% for 5 minutes, 3 times; 80%, 5 min-

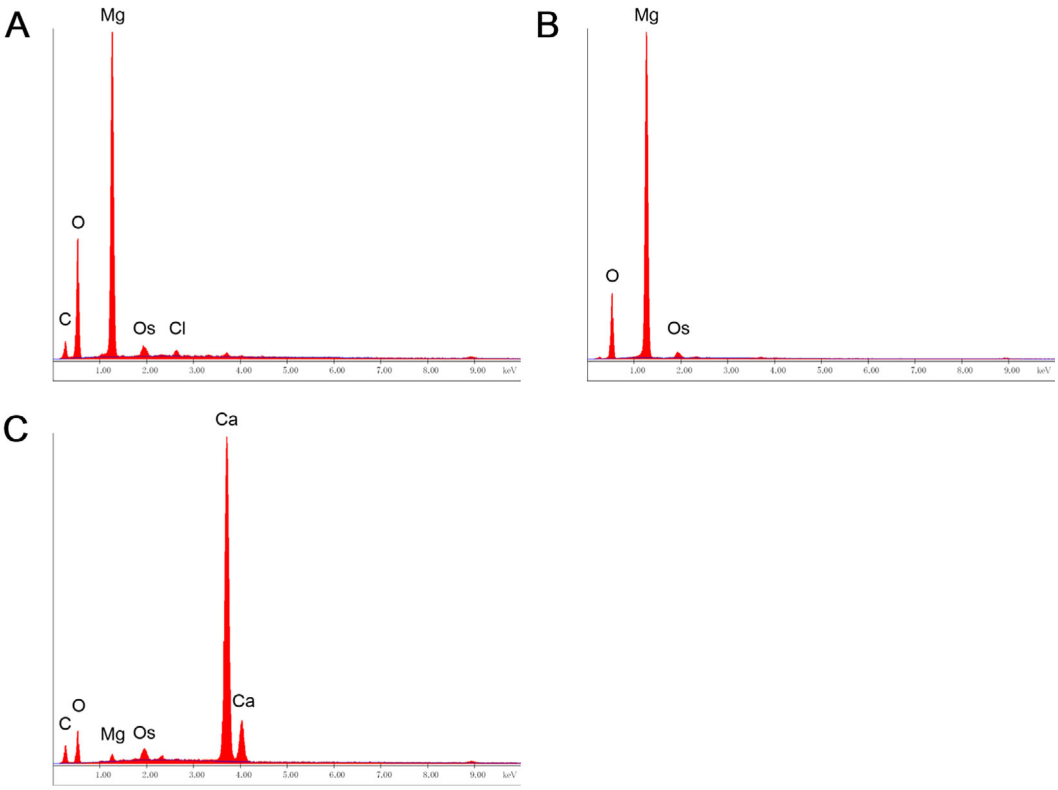

Figure 3. Spectra obtained from the energy dispersive X-ray spectrometry analysis. The cut surface of the bezoar contains high concentrations of magnesium and oxide (A). The spectra obtained from the cut surface of the bezoar are similar to those obtained from magnesium oxide tablets (B). The external surface of the bezoar contains a greater quantity of calcium and lower quantities of magnesium and oxide (C).

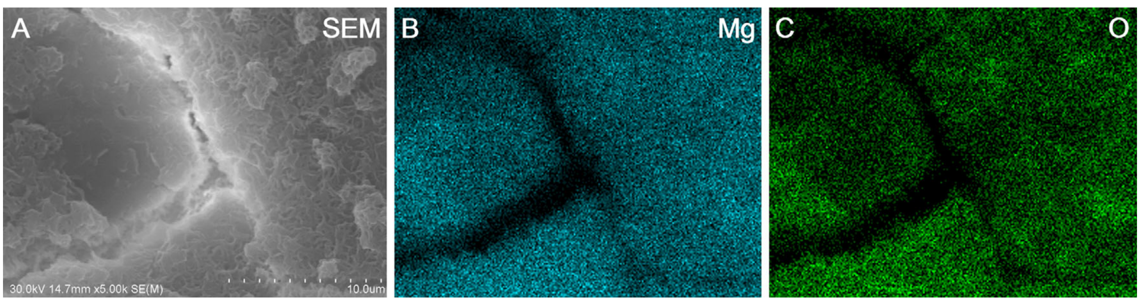

Figure 4. Electron microscopy images. Scanning electron microscopy (A) and elemental mapping confirm the diffuse distribution of magnesium (B) and oxide (C) within the cut surface of the bezoar.

utes; 50%, 5 minutes). The surface of the sample was coated with osmium for 10 seconds (HPC-1S-type osmium coater; Shinku Device, Mito, Japan). To investigate the elements contained within the bezoar, an EDX analysis was performed using an S4800 scanning electron microscope (Hitachi, Tokyo, Japan) with an accelerating voltage of 25 kV and an EDAX Genesis APEX2 EDX system (AMETEK, Paoli, USA). Scanning electron microscopy images were taken using an S4800 electron microscope, and mapping images of each element were obtained.

An EDX analysis of the cut surface of the bezoar showed high concentrations of magnesium and oxide (Fig. 3A). The spectra obtained from the cut surface of the bezoar resembled those obtained from magnesium oxide tablets (Fig. 3B). In contrast, the spectra obtained from the external surface of the bezoar revealed the existence of a higher quantity of calcium and lower quantities of magnesium and oxide (Fig. 3C). Scanning electron microscopy (Fig. 4A) and elemental mapping confirmed the diffuse distribution of magnesium (Fig. 4B) and oxide (Fig. 4C) within the cut surface. Thus, the patient's gastric bezoar was diagnosed as a magnesium oxide bezoar.

Discussion

Magnesium oxide is used as an antacid, magnesium supplement, or laxative. In particular, it has been widely used to treat constipation in Japan. Although magnesium oxide is usually a safe medication, its use can be associated with adverse events, including diarrhea and hypermagnesemia. The clinical manifestations of hypermagnesemia include general weakness, hyporeflexia, hypotension, bradycardia, heart block, and stupor (13). Because excessive hypermagnesemia is a potentially lethal complication, magnesium oxide should be carefully used in patients with renal dysfunction (14). In contrast, pharmacobezoar formation by magnesium oxide ingestion is rare. To our knowledge, only two other cases of magnesium oxide pharmacobezoar have been reported.

Tatekawa et al. reported the case of a 26-year-old woman presenting with abdominal pain, nausea, and vomiting (15). The patient had been taking magnesium oxide cathartics for constipation. Abdominal X-ray revealed a mechanical ileus and a calcified mass approximately 3 cm in diameter in the pelvis. The patient was treated with exploratory laparotomy, and the mass was surgically retrieved. Infrared spectroscopy and chemical analyses revealed that the mass's major component was magnesium oxide. Shigekawa et al. reported another case of a 75-year-old woman who presented with lower abdominal pain and nausea (16). The patient had been taking magnesium oxide cathartics for 30 years. CT and magnetic resonance imaging showed the ileus and a huge calcified mass 6 cm in diameter. Enterotomy was performed, and the bezoar was removed intraoperatively. A chemical analysis of the bezoar showed that its major component was magnesium oxide. Previous reports have described patients with magnesium oxide bezoars in the small intestine (15) and rectum (16). These bezoars might have been formed in the stomach and migrated into the intestine. Another hypothesis suggests that bezoars are primarily formed in the intestine. Irrespective of the mechanism of bezoar formation, bezoars in the small or large intestine should be promptly treated, as they can cause intestinal obstruction.

In addition to magnesium oxide-containing bezoars, those secondary to the use of antacids containing aluminum and magnesium hydroxide (Maalox®, Amphojel®, Mylanta®) have also been reported in the literature (17-20). Kaplan et al. reported a case of a premature infant diagnosed with bezoars (17). The patient had been treated with Maalox® for gastric bleeding. Multiple radiopaque masses were observed on a radiographic examination and were evacuated using rectal lavage. A chemical analysis revealed that the masses contained magnesium. Burruss et al. reported a case of a bezoar impacted in the terminal ileum of a patient who had been administered Maalox® (18). The bezoar was surgically removed and consisted of magnesium and aluminum. Thus, bezoars can be formed in patients who are administered magnesium-containing medications, such as antacids and laxatives.

Radiologically, phytobezoars appear as well-defined, round, or ovoid masses with heterogenous density on CT (3, 6). Because the interiors of phytobezoars have a mottled appearance and contain air bubbles, it is often difficult to differentiate a bezoar from feces by CT findings alone. In contrast, the magnesium oxide pharmacobezoars observed in the present case and the two previously reported cases were radiologically observed as calcified masses. Bezoars detected in patients administered antacids containing aluminum and magnesium hydroxide have been reported to be radiopaque (17). Consequently, although the frequency is low, physicians should consider magnesium-containing pharmacobezoars when a radiopaque substance is identified on X-ray or CT in patients consuming magnesium-containing medications. A magnesium-containing bezoar can cause an ileus when it passes the stomach as previously described. Therefore, it is important to promptly detect a gastric bezoar and remove it endoscopically.

To our knowledge, this is the first study to investigate the differences in structure between the interior and exterior of a magnesium oxide pharmacobezoar. An EDX analysis revealed that the cut surface was mainly composed of magnesium and oxide (Fig. 3A). Therefore, we speculate that the granular substance resembling grains of sand that was observed in the interior of the bezoar was magnesium oxide. The external surface of the bezoar was mainly composed of calcium, whereas the concentrations of magnesium and oxide were low (Fig. 3C). In our earlier work, we investigated the elemental composition of persimmon phytobezoars before and after their dissolution by a cola beverage (21). The amount of calcium in the phytobezoar was significantly reduced after dissolution treatment. In another study, we investigated enteroliths composed of deoxycholic acid (12). The calcium content of the enteroliths was significantly greater than the deoxycholic acid powder content. These results suggest that calcium may contribute to the pathogenesis of gastrointestinal calculi, e.g., bezoars and enteroliths. However, because of the presence of calcium deep within the persimmon phytobezoar and deoxycholic acid enteroliths, we hypothesize that the pathogenesis of magnesium oxide bezoars might be different from that of other bezoars and enteroliths. Although the exact mechanism underlying the formation of magnesium oxide phytobezoars has not been elucidated, the information presented herein may help reveal the pathogenesis of this type of bezoar.

In conclusion, we herein report a case of magnesium bezoar. Although this was a rare presentation, our findings suggest that a pharmacobezoar should be considered among the differential diagnoses in patients who demonstrate a radiopaque mass in the digestive tract and report a history of magnesium oxide use.

The authors state that they have no Conflict of Interest (COI).

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