The aim of this study was to determine the computed tomography (CT) appearance of small intestine bezoar (SIB). Eight cases of proven SIB were included in this study. Four of these patients had undergone previous abdominal surgeries, including one patient who had undergone gastric surgery, and one patient who had jejunal diverticular disease. Six patients had bezoars in the ileum and two patients had bezoars in the jejunum. From the CT scans, small bowel obstruction (SBO) was noted in all eight patients. The most common and characteristic CT finding of SIB was a well-circumscribed inhomogenous intraluminal mass with a mottled gas pattern at the site of obstruction. This finding was noted in seven patients. The other patient had a dense compact calcified stone in the small intestine. With the increased use of CT in the evaluation of patients with SBO, it is important to recognize the CT appearance of SIB, as this diagnosis is often not suggested clinically. Identification of a well-circumscribed inhomogenous intraluminal mass with a mottled gas pattern at the site of obstruction is diagnostic of small intestine bezoar.

**Key words:** Intestine, Bezoar, Enterolith, Diverticulum, Computed tomography(CT)

Bezoars are concretions of foreign matter composed of ingested material in the stomach or small intestine [1]. The two most common bezoars are trichobezoars and phytobezoars, which are false enteroliths [2, 3]. Intestine contents stagnating in the duodenal or jejunal diverticulum may form a concretion (enterolith or bezoar) which, upon discharge from the diverticulum into the intestinal lumen, may be large enough and firm enough to obstruct the intestine [2].

Small bowel obstruction (SBO) due to bezoar has rarely been diagnosed preoperatively [4]. The diagnosis of small intestine bezoar (SIB) may be suggested or confirmed using plain abdominal radiography, sonography and barium meal study [5, 6]. However, they are nonspecific, operator dependent and time consuming. Computed tomography (CT) diagnosis of SIB has rarely been mentioned [1, 6, 7], but several reports have discussed the various radiologic manifestation of enterolith (bezoar) in the jejunal diverticulosis [2, 3]. We described the CT appearance of eight patients with SIB, which was not clinically suggested. From the characteristic CT findings, however, we accurately diagnosed SIB preoperatively.

**MATERIALS AND METHODS**

From January 1994 through March 2001, eight proven cases of SIB, in which whole abdominal CT were performed, were included in this study. The patients were 10-85 years of age (mean, 59 years), including five male and three female patients. Plain abdominal radiography and sonogram were performed in all patients and only one patient had barium meal study. Whole abdominal CT with and or without oral contrast and intravenous contrast enhancement were
performed on a Toshiba helical CT Xvision/GX, 120 KV, 150 mAs, 10 mm collimation and 1.0 second scanning time contiguous sections. We retrospectively analyzed the CT appearance of SIB in these eight patients.

RESULTS

Eight patients were enrolled in this study. All of them complained of abdominal pain and intestine obstruction. Three patients had history of appendectomy and one patient had undergone a gastric operation for a perforated peptic ulcer. One patient had jejunal diverticulosis. At surgery, six patients had bezoars in the ileum (Fig. 1, 2). Two patients had bezoars in the jejunum, including one patient who was associated with jejunal diverticulosis (Fig. 3). On “running” the small bowel and stomach during surgery, the presence of additional bezoar in the proximal small intestine was noted in one patient (Fig. 4).

(Table 1) shows the clinical features, radiological findings and surgical treatment in the eight patients. Plain abdominal radiography and sonography were nonspecific and inconclusive. In one patient, the barium meal study showed jejunal diverticulosis (Fig. 3).

Proximal small bowel dilatation and collapsed

![Figure 1. Case 4. Enhanced CT shows a well-circumscribed smooth marginated intraluminal mass with a mottled gas pattern in the distal ileum (arrows). Proximal small bowel loops dilatation and distal bowel loops collapse are seen.](image1)

![Figure 2. Case 2. Non-enhanced CT shows a well-circumscribed, irregularly marginated intraluminal mass with a mottled gas pattern in the distal ileum (arrow). Dilated small bowel loops proximal to the bezoar is noted.](image2)

![Figure 3. Case 8. a. Note several diverticula at the mild dilated proximal jejunum, (arrows). b. A bezoar (arrows) within the lumen of mid portion of jejunum is seen just anterior to the descending colon. Small bowel series shows several variable size diverticula at the jejunum (not showed).](image3)
Small intestine bezoar: CT appearance

Table 1. Bezoars in the Small Intestine

<table>
<thead>
<tr>
<th>Case</th>
<th>Age/Sex</th>
<th>Sign/Symptom</th>
<th>Operation history</th>
<th>CT Location</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>73/F</td>
<td>Abd. Pain vomiting</td>
<td>(–)</td>
<td>SBO (++) MGP mass ileum Enterolysis F &amp; M</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>79/F</td>
<td>Abd. Pain vomiting</td>
<td>appendectomy</td>
<td>SBO (++) MGP mass ileum enterotomy</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>10/M</td>
<td>Abd. Pain vomiting</td>
<td>(–)</td>
<td>SBO (++) MGP mass ileum enterotomy</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>19/F</td>
<td>Abd. Pain vomiting</td>
<td>appendectomy</td>
<td>SBO (++) MGP mass ileum enterolysis F &amp; M</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>66/M</td>
<td>Abd. Pain</td>
<td>Billroth 2</td>
<td>SBO (++) MGP mass ileum enterolysis enterotomy</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>70/M</td>
<td>Abd. Pain vomiting</td>
<td>appendectomy</td>
<td>SBO (++) Calcified Abscess ileum resection</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>72/M</td>
<td>Abd. Pain vomiting</td>
<td>(–)</td>
<td>SBO (++) Calcified Stone jejunum Enterolysis enterotomy</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>85/M</td>
<td>Abd. Pain vomiting</td>
<td>(–)</td>
<td>SBO (++) MGP mass Diverticula jejunum resection</td>
<td></td>
</tr>
</tbody>
</table>

*Abd.-abdomen, (++)-high grade, (+)-low grade, SBO-small bowel obstruction (–): No past history of operation MGP-mottled gas pattern, F & M-fragmentation and milking

**DISCUSSION**

The incidence of phytobezoars as a cause of mechanical SBO was 2% [8]. A bezoar is a large conglomerate of vegetable fibers, hair, or milk curds or a concentration of other substance in the stomach or the intestine [9]. Bezoars can be classified as trichobezoars, phytobezoars, lactobezoars, disopyrobezoars or bezoars from other sources, according to their contents. Trichobezoars, composed of hair, occur mainly in the young women who chew and swallow their hair. It is usually confined to the stomach. Phytobezoars are composed of poorly digested fibers, fruit seeds, and pulpy fruits especially persimmons and oranges [10]. The phytobezoars, although formed in the stomach, are most often found after migrating to the small bowel. They may then become impacted in the small bowel and cause partial or complete SBO [1, 4, 7]. The obstruction caused by small bowel phytobezoars frequently occur in the jejunum or proximal ileum [5].

The reason bezoars develop is unknown and it is thought to be multifactoral. Factors predisposing patients to phytobezoar formation are previous gastric surgery, alterations in dentition and mastication and excessive consumption of foods with high fiber content [4, 5]. In 1989, Verstandig et al reported a series of small bowel phytobezoars with high incidence of previous gastric surgery history (84.2%) [5]. In 1994, Escamilla et al reviewed 87 cases of intestine obstruction and bezoars and found high incidence of previous operative treatment (76.3%) and excessive intake of vegetable fiber (39.5%) [4]. Vagotomy may decrease gastric motility and pyloroplasty or gastroenterotomy may result in an enlarged gastric outlet that allows large fragments of bezoar to enter the small bowel [4]. Postoperative adhesions are also predisposing factors for SIB formation. In our series, the incidence of predisposing factors such as history of gastric surgery and previous operative treatment was low when compared with the previous reports. None of our patients had history of excessive intake of vegetable fiber. The cause of the low incidence in our series may be because many patients had undergone abdomen surgery and adhesions were assumed at that time. Whole abdominal CT was not performed and they were not included in this study. In addition, the dietary history of our distal small bowel and colon were seen on the CT scans in all patients. The most common CT finding of SIB was a well-circumscribed inhomogenous intraluminal mass with a mottled gas pattern and associated with bowel wall thickening (arrows). One on the right side and the other one on the left side of the upper pelvis are noted.

Figure 4. Case 5. Two ileal bezoars present as two well circumscribed inhomogenous intraluminal masses with a mottled gas pattern and associated with bowel wall thickening (arrows). One on the right side and the other one on the left side of the upper pelvis are noted.
patients was not accurately taken preoperatively. Small bowel bezoars can arise in small bowel diverticula, in a segment of the bowel associated with stricture formation or proximal to the small bowel tumor [2, 11]. Complications of jejunoileal diverticular disease include bleeding, intestine obstruction, perforation, diverticulitis, intussusception, tumors originating in the diverticulum, volvulus and enterolith (bezoar) formation [12]. Intestine contents stagnating in the diverticulum of the small intestine may form concretions (enteroliths or bezoars) which upon discharge from the diverticulum into the intestine lumen may obstruct the intestine (Fig. 3).

Plain abdominal radiography is helpful in the diagnosis of intestine obstruction, but contributes little to the confirmation of bezoars [6]. Though barium meal studies may help detect bowel obstruction, diverticular disease, and SIB, it is time consuming and the retained barium may preclude other imaging studies. In addition, it may be difficult to distinguish bezoars from the intraluminal villous adenomas, leiomyosarcomas, and metastatic melanomas [5]. Sonographic study is operator dependent and visualization of the obstructive lesions may be hindered by overlying gas in the bowel.

There are many advantages of CT over other image modalities. Computed tomography can be used to evaluate the presence, obstructive level, cause, and strangulation of SBO [11, 13, 14]. It can also be used to evaluate the presence of diverticular disease and its complications. The most important feature of the CT is that it can be used to directly detect the bezoar itself [1]. In addition, it can be used to determine the presence of additional bezoars along the gastrointestinal tract [1].

Complete mechanical intestine obstruction is the most frequent clinical presentation of patients with bezoars [4]. SBO manifests as dilated small bowel loops proximal to the obstruction and collapse or normal small bowel loops distal to it [11, 13]. The CT appearance of SIB is very characteristic. It usually presents as a well-circumscribed inhomogenous intraluminal mass with a mottled gas pattern in the dilated small bowel at the site of obstruction and abrupt collapse lumen beyond the lesion [6, 7]. Oral contrast material may be noted surrounding the mass. The margination of the mass may be smooth or irregular. Entrapped air within the mass is a helpful sign that suggests the diagnosis of a bezoar. Whereas the CT appearance may be quite different when calcified bezoars have been reported [1, 2]. The mass may lack the mottled gas pattern and present as an olive stone or a golf ball (Fig. 5).

Small bowel feces sign have been reported in patients with severe stasis of fecal content in the dilated small bowel, usually in patients with cystic fibrosis or high-grade SBO [6, 11]. Small bowel feces is more amphous and affects longer segments. It is often located some distance away from the site of obstruction. On CT, it is easy to differentiate SIB from pneumatosis or abscess. When SIB presents as a calcified stone (olive stone), gall stone ileus should be included in the differential diagnosis. The determination as to whether the obstruction is an enterolith (bezoar) ileus or a gall stone ileus hinges on the normalcy of the gall bladder [2].

Treatment of intestine bezoars must be operative. The treatment of choice for small bowel bezoar is fragmentation and milking the bezoar pieces to the cecum [9]. Enterotomy should be avoided and resection of the small bowel is rarely necessary. The rest of the stomach and intestine must always be checked for residual bezoars during surgery. This precaution is necessary because the incidence of concurrent gastric bezoars is 17-21% [8, 9] and the rate of recurrence was 13.8% [4].

When SBO is noted in patients with history of gastric surgery, besides adhesions, bezoars should be included in the differential diagnosis. Many surgeons will treat post operative obstruction due to adhesions conservatively and resort to

![Figure 5. Case 7. Non-enhanced CT shows a round calcified stone (golf ball) in the distal jejunum just anterior to the ascending colon (arrows). Normal gall bladder on the cephalic scan is noted (not showed).](image-url)
laparotomy only when conservative measures fail. Bezoars are much less likely to respond to conservative methods, and early surgery is recommended to avoid the occurrence of decubitus ulceration and pressure necrosis of the bowel wall [5, 7].

In conclusion, previous abdominal surgery and jejunooileal diverticular disease are the common predisposing factors for bezoar formation. Computed tomography has become a standard diagnostic tool in the evaluation of SBO. It is the first choice of imaging modalities for diagnosing SIB. The contribution of the CT is to detect the bezoar itself directly. The two most common CT findings are a well-circumscribed inhomogenous intraluminal mass with a mottled gas pattern and a calcified stone. Identification of a well-circumscribed inhomogenous intraluminal mass with a mottled gas pattern at the site of obstruction is diagnostic of small intestine bezoar.

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英恭史   吳新華   張泰裕   李宗憲
台中澄清醫院   放射線科

我們回溯性地研究了8例經開刀證實小腸結石的腹部電腦斷層特徵。其中，最常見且最具特異性的小腸結石電腦斷層特徵是：在小腸腔內有一界限清楚、密度不均勻，並合併有斑駁氣體之腫塊。此特徵有7例。另有1例則是在小腸腔內看到一個均勻鈣化的結石。對於一個急性腸阻塞的病人，在電腦斷層上看到以上之特徵，即可正確診斷小腸結石。

關鍵詞：小腸、腸結石、腸囊石、憩室、電腦斷層