Abstract
There are 8 reported cases in which laparoscopic procedures were selected to treat small bowel obstruction caused by a mesodiverticular band. We herein report the case of a 9-year-old male who presented with intermittent abdominal pain around the umbilicus. He was diagnosed with small bowel obstruction associated with Meckel’s diverticulum based on the CT findings. Laparoscopy was performed and a diagnosis of small bowel obstruction caused by a mesodiverticular band was made. Subsequently, we performed laparoscopic-assisted diverticulectomy and band resection. The patient’s postoperative course was uneventful. Laparoscopic-assisted surgery for small bowel obstruction caused by mesodiverticular bands has advantages over open procedures due to its ability to be used to make a diagnosis, reduced invasiveness and better cosmesis.

Key words: laparoscopic surgery, meckel’s diverticulum, mesodiverticular band

Introduction
A mesodiverticular band is a remnant of the vitelline artery that supplies blood flow to the omphalomesenteric duct. There are right and left vitelline arteries, either or both of which can remain as mesodiverticular bands that are often associated with Meckel’s diverticulum. Small bowel obstruction caused by mesodiverticular bands has been previously reported. However, there are only a few reported cases in which laparoscopic procedures were selected to treat this condition. We performed laparoscopic-assisted surgery for small bowel obstruction caused by a mesodiverticular band in a 9-year-old male patient. The case is presented and the advantages of laparoscopic procedures for treating this condition are discussed.

Case Report
The patient was a 9-year-old male who presented with intermittent abdominal pain around the umbilicus that developed at approximately 6 AM on the day of admission. The patient was transferred to our hospital three hours after the onset of symptoms. He had a history of bronchial asthma with no additional illnesses. There was no history of laparotomy. On admission, the patient was in agony with intermittent abdominal pain. An elastic soft tumor measuring approximately 6cm in the long axis was palpable on the right lateral side of the umbilicus. There were no signs of peritoneal irritation. The patient’s body temperature was 36.7 degrees Celsius. The laboratory data showed a WBC count of 9,720/μl with a neutrophil proportion of 77.3%. Other data showed no particular abnormalities, except for a slight rise in the levels of LDH and ALP at 248 and 454, respectively. A scout abdominal X-ray showed a small amount of gas in the small intestine without any air-fluid levels. An enhanced CT scan revealed dilated loops of the small intestine and a dilated blind loop branching off from the ileum. Stenosis of the ileum was observed distal to the branching of the blind loop (Fig. 1). The bowel wall in the dilated segments of the small in-
testine was well enhanced with intravenous contrast media, and no bowel ischemia was suspected.

Under a diagnosis of small bowel obstruction possibly related to Meckel’s diverticulum, laparoscopic-assisted surgery was performed nine hours after the onset of symptoms. The laparoscopic observation revealed a dilated segment of the ileum and a dilated diverticulum originating from the ileum approximately 20cm proximal to the ileocecal area. The ileum was compressed approximately 5cm distal to the diverticulum by a band-like structure running from the small bowel mesentery to the diverticulum (Fig. 2). The ileal segment around the band-like structure did not exhibit any signs of ischemia. Division of the band-like structure may not have necessarily resolve the distension of the ileum or diverticulum because the distended ileum was filled with semisolid bowel contents. Therefore, the following procedures were performed extracorporeally.

The umbilical port site was extended to create a 5-cm-long incision. The diverticulum and compressed segment of the ileum were exteriorized. The band-like structure was divided extracorporeally to release the compression of the ileum. The diverticulum was resected at its origin and the bowel contents of undigested food, consisting primarily of edible seaweeds (Laminariaceae Bory), were evacuated through the enterotomy (Fig. 3). The defect in the ileal segment created during resection of the diverticulum was closed using one layer of continuous sutures with 4-0 PDS. The small abdominal incision was closed in two layers. The patient’s postoperative course was uneventful and he was discharged seven days after the operation without any complications.

The resected band-like structure was histologically examined, and the results revealed a patent artery, vein and associated nerve fibers (Fig. 4). A diagnosis of Meckel’s diverticulum with a mesodi-
Mesodiverticular band

verticular band was made, and the mesodiverticular band and excessive seaweed intake were considered to be the causes of the small bowel obstruction. A histologic examination of the diverticulum did not reveal an ectopic gastric mucosa or pancreatic tissue. After having recovered from the surgical procedure, the patient stated that he had ingested two packages of edible seaweed snacks one day before developing abdominal pain.

Discussion
During the five to eight weeks of the embryonic stage, the omphalomesenteric duct and its supplying vessels undergo degeneration leaving behind no remaining tissue. Meckel’s diverticulum is a remnant of the bowel component and a mesodiverticular band is a remnant of the vascular component of the omphalomesenteric duct. The incidence of Meckel’s diverticulum is reported to be 1-3%, and 4-34% of affected patients develops complications. Bleeding is the most frequent complication of Meckel’s diverticulum in pediatric patients, while bowel obstruction is the most frequent complication in adults. The causes of intestinal obstruction in patients with Meckel’s diverticulum include intussusception, volvulus, incarceration into hernial sac (Littre’s hernia), fibrous cords and mesodiverticular bands.

A mesodiverticular band is considered to be a remnant of the vitelline vessels that supply the om-

Table 1 Eight reported cases of laparoscopic surgery for small bowel obstruction caused by mesodiverticular band

<table>
<thead>
<tr>
<th>Author</th>
<th>Reference number</th>
<th>Year</th>
<th>Patients (n)</th>
<th>Sex</th>
<th>Age</th>
<th>Operation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chang YT, et al.</td>
<td>11)</td>
<td>2010</td>
<td>1 male</td>
<td>3</td>
<td>Laparoscopic resection of mesodiverticular band and Meckel diverticulectomy.</td>
<td></td>
</tr>
<tr>
<td>Chan K.W, et al.</td>
<td>9)</td>
<td>2008</td>
<td>1 male</td>
<td>3</td>
<td>Conversion to laparotomy Small bowel resection.</td>
<td></td>
</tr>
<tr>
<td>Sai Prasad TR, et al.</td>
<td>4)</td>
<td>2007</td>
<td>3 males, 1 female</td>
<td>8-12</td>
<td>8-12</td>
<td>Laparoscopic division of mesodiverticular bands. Laparoscopic-assisted trans-umbilical meckel’s diverticulectomy.</td>
</tr>
<tr>
<td>Tashjian DB, et al.</td>
<td>1)</td>
<td>2003</td>
<td>1 female</td>
<td>17</td>
<td>17</td>
<td>Laparoscopic Meckel’s diverticulectomy using an endovascular GIA stapler.</td>
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</tbody>
</table>

Fig. 4 Histopathology of the band shows a patent artery, vein and associated nerve fibers (Elastica Van Gieson staining, original magnification ×40).
phalomesenteric duct in the embryonic stage. According to the literature regarding developmental anatomy, there are two vitelline vessels in the fetus. The left vitelline artery originates directly from the aorta and the right vitelline artery originates from the superior mesenteric artery or from one of its branches. When these vessels remain after birth, the left vitelline artery locates on the ventral side and the right vitelline artery locates on the dorsal side of the mesentery. According to reports of clinical cases, either or both of these vessels can remain as mesodiverticular bands that are frequently associated with Meckel’s diverticulum. It was confirmed that the mesodiverticular band observed in our case ran along the ventral side of the small bowel mesentery.

There are reports of small bowel obstruction caused by mesodiverticular bands. However, laparoscopic procedures were performed in 8 of these case reports (Table 1). There are disadvantages to performing intracorporeal resection of Meckel’s diverticulum, including leakage of the bowel contents during stapling and incomplete resection of the ectopic gastric mucosa. It has been reported that laparoscopic-assisted transumbilical extracorporeal resection of the diverticulum is a safe and appropriate procedure for treating Meckel’s diverticulum.

Considering the tendency of patients who suffer from bowel obstruction caused by mesodiverticular bands to be young, the better cosmesis achieved with a small wound is considered to be a significant advantage of laparoscopic surgery. Although in our case the preoperative examinations did not lead to a diagnosis of a mesodiverticular band as the cause of the small bowel obstruction, the use of laparoscopy to diagnose and subsequently treat small bowel obstruction related to Meckel’s diverticulum is appropriate.

References
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8) Sethi NT, Chauhan A, Tiwari S: Meckel’s Diverticulum with Mesodiverticular Band: An Unusual Presentation. MJAFI 65: 75-76, 2009