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Case Report

# Laparoscopic Distal Pancreatectomy Using a Double-Balloon Catheter for Treatment of a Large Pancreatic Mucinous Cystic Neoplasm

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**ABSTRACT:** We report a case of a large (diameter >20 cm) mucinous cystic neoplasm (MCN) treated with laparoscopic distal pancreatectomy (LDP) using a double-balloon catheter. A 70-year-old woman presented to our hospital with epigastric pain and abdominal distention. Imaging studies revealed a large cystic mass in the left upper abdominal quadrant. No mural nodule was observed in the cyst. On the basis of these findings, we diagnosed a large pancreatic MCN. There was no evidence of malignancy, and LDP was considered to be the most appropriate treatment for this patient. Under pneumoperitoneum of 10 mmHg CO<sub>2</sub>, 5 trocars were inserted. Laparoscopic findings revealed that the cystic lesion occupied the left upper abdominal quadrant and that the surgical fields were limited. After dissecting the anterior surface of the cystic wall, a double-balloon catheter was used for intracorporeal aspiration of cystic fluid, as the initial step of surgery. In total, 3000 ml of serous brown fluid was aspirated, and no fluid leaked into the abdominal cavity during aspiration. A satisfactory laparoscopic view was obtained after aspiration, and LDP was performed safely. Pathologic findings revealed pancreatic mucinous cystic adenoma with ovarian-type stroma. The patient's postoperative course was uneventful, and she was discharged 10 days after surgery. Use of a double-balloon catheter for large MCNs is extremely important because it is safe laparoscopically and prevents leakage of cystic fluid into the abdominal cavity.

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**KEYWORDS:** laparoscopic distal pancreatectomy (LDP), mucinous cystic neoplasm (MCN), double-balloon catheter

The use of laparoscopic distal pancreatectomy (LDP) is increasing, and some systematic reviews with meta-

analyses reported that LDP was associated with better short-term postoperative outcomes in terms of postopera-

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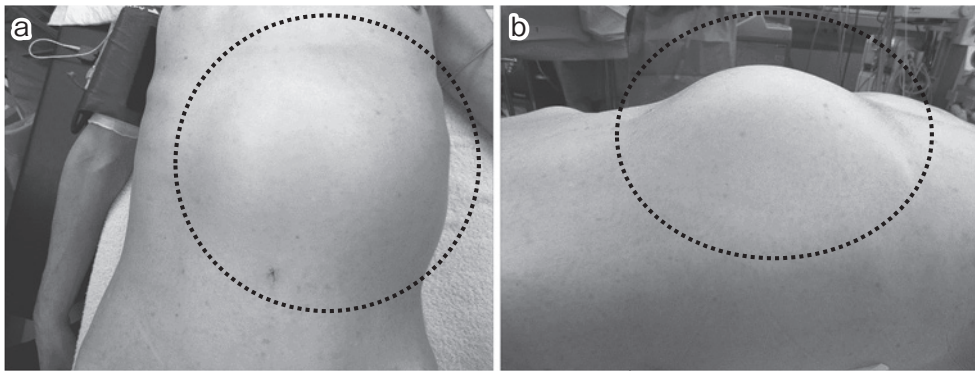


Fig. 1 Physical examination revealed severe abdominal distention.

tive pain, recovery time, length of hospital stay, rate of postoperative pancreatic fistula, and postoperative morbidity, as compared with open distal pancreatectomy.<sup>1-3)</sup> Furthermore, a recent Japanese nationwide survey using propensity score-matching analysis found that LDP resulted in significantly lower incidences of postoperative pancreatic fistula and postoperative complications and significantly shorter postoperative hospital stays as compared with open distal pancreatectomy.<sup>4)</sup>

Mucinous cystic neoplasms (MCNs) of the pancreas are cystic neoplasms that produce mucin with ovarian-type stroma and frequently develop in the distal pancreas of women. Therefore, although MCNs have malignant potential, laparoscopic surgery may be indicated because of its cosmetic benefits and ease of surgery.<sup>5-10)</sup> However, MCNs are often large, greater than 10 cm in diameter.<sup>11-13)</sup> LDP may be indicated for large MCNs; however, this procedure has some technical limitations, including a limited surgical field and risk of cystic rupture. In this article, we report a case of a large (diameter >20 cm) MCN treated with LDP using a double-balloon catheter.

### Case Report

A 70-year-old woman presented to our hospital with epigastric pain, high fever, and abdominal distention. Her past medical history included hypertension and hyperlipidemia, for which she was receiving medical treatment. Physical examination revealed severe abdominal distention (Fig. 1) and fever. Laboratory tests showed evidence of severe inflammation (white blood cell count, 9230/mm<sup>3</sup>; C-reactive protein, 18.41 mg/dl). Tumor markers, including carcinoembryonic antigen (CEA) and carbohydrate antigen 19-9 (CA 19-9), were within normal limits. Abdominal computed tomography (CT) findings revealed a large cystic

mass (diameter, >20 cm) in the left upper abdominal quadrant, with a slightly enhanced cystic wall (Fig. 2a). No mural nodule was observed in the cyst. Peripheral septum was suspected, and the fluid-fluid level was observed in magnetic resonance (MR) images (Fig. 2b, c). These findings were strongly suggestive of a large MCN of the pancreas. Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) was not performed, to eliminate the risk of cystic fluid leakage, which could result in peritoneal dissemination after the procedure. There were no findings consistent with malignancy, such as elevations in relevant tumor markers or image findings. Therefore, LDP was considered to be an appropriate intervention in this patient.

### Surgical findings

The patient was placed in the supine position. First, an umbilical incision approximately 4 cm in length was made with a wound protector. Under pneumoperitoneum of 10 mmHg CO<sub>2</sub>, 5 trocars were inserted. Laparoscopic findings revealed that the cystic lesion occupied the left upper abdominal quadrant and that the surgical fields were thus limited (Fig. 3a). After dissecting the anterior surface of the cystic wall, a double-balloon catheter (S.A.N.D. balloon catheter; Hakko Co., Ltd., Chikuma, Japan) was used for intracorporeal aspiration of cystic fluid, as the initial step of surgery. After needle insertion, the inner balloon was immediately inflated with 10 cc of air; then, the outer balloon was inflated with 10 cc of air (Fig. 3b). The cystic wall was thus sandwiched between the inner and outer balloons. Aspiration of cystic fluid released the tension in the cystic wall, and the puncture site gradually protruded outside the body, through the umbilical incision (Fig. 3c). In total, 3000 ml of serous brown fluid was aspirated. The air was released from the balloons while the cystic wall was grasped with forceps, and the catheter was removed ex-

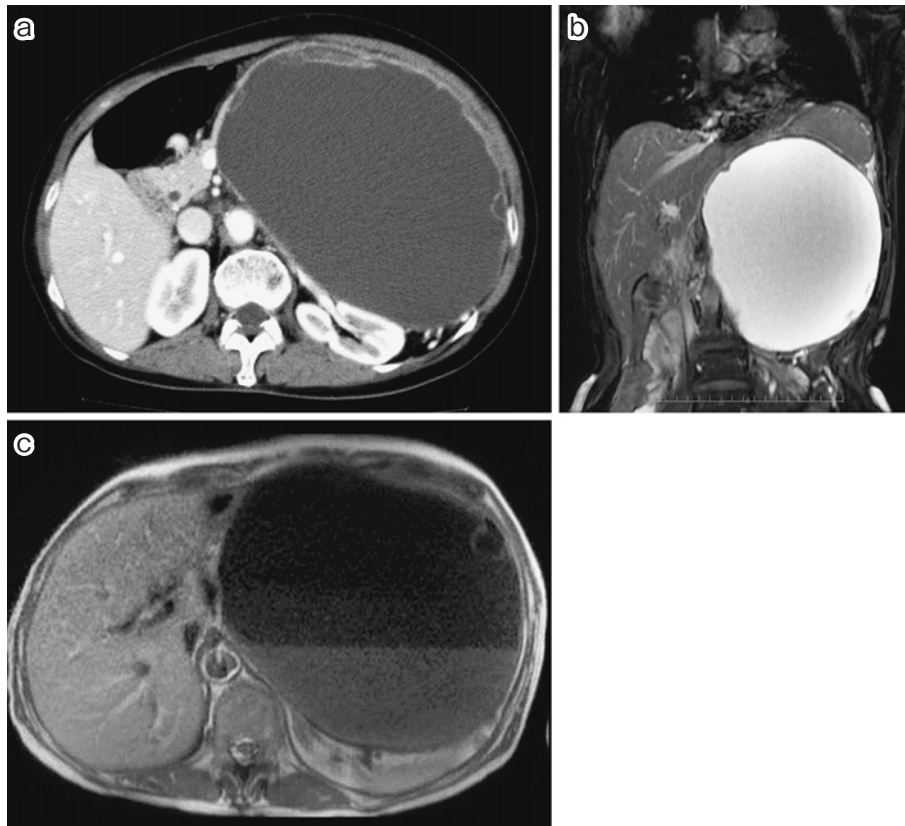


Fig. 2 Abdominal computed tomography (CT) showed a large cystic mass (diameter, >20 cm) in the left upper abdominal quadrant and a slightly enhanced cystic wall (a). Magnetic resonance imaging (MRI) findings showed no mural nodule in the cyst; however, peripheral septum was suspected and fluid-fluid level was observed (b, c).

tracorporeally. The puncture hole was sutured under direct observation (Fig. 3d). There was no fluid leakage into the abdominal cavity during aspiration. Intraoperative cytologic examination showed no malignant cells, and LDP was continued. After aspiration, a satisfactory laparoscopic view was obtained, which allowed LDP to be performed safely. First, before pancreatic tunneling, the superior mesenteric vein and portal vein were dissected and taped. Then, pancreatic resection was performed above the portal vein by using a laparoscopic linear stapler. After that, the cut end of the pancreas on the resected side was grasped and pulled upward and forward, and the splenic artery was identified and divided. Severe inflammatory markers were observed around the splenic vein; therefore, dissection of the posterior side was performed first. Then, the splenic vein was divided by using a linear stapler. The resected specimens were placed in a sterilized bag, which was then removed from the umbilical incision. At that time, the spleen was crushed inside the bag. Two drains were placed near the pancreatic stump and in the left sub-

phrenic space (Fig. 3e). Operative time was 10 hours, and the estimated intraoperative blood loss was 500 ml.

#### Intracystic fluid analysis and pathological findings

The results of intracystic fluid biochemical analysis were as follows: amylase, 11548 IU; CEA, 8183 ng/ml; CA 19-9, 4780 U/ml; and CA 125, 33.2 U/ml. Although cystic infection was suspected at the time of admission, microbiological analysis revealed no evidence of bacteria.

Macroscopic findings showed a large (diameter, >20 cm) cystic mass in the pancreatic body to tail (Fig. 4a). A thick wall was observed inside the cystic wall; however, there was no evidence of mural nodules or papillary components. Furthermore, we could not identify a connection between the main pancreatic duct and cyst. Microscopic findings showed a low papillary structure at the cystic surface (Fig. 4b). However, atypical structures and cells were not observed. In addition, ovarian-type stroma was identified, and staining was positive for estrogen and progesterone receptors. The cells were also immunohistochemically positive for CEA and CA 19-9 (Fig. 4c, d). These findings

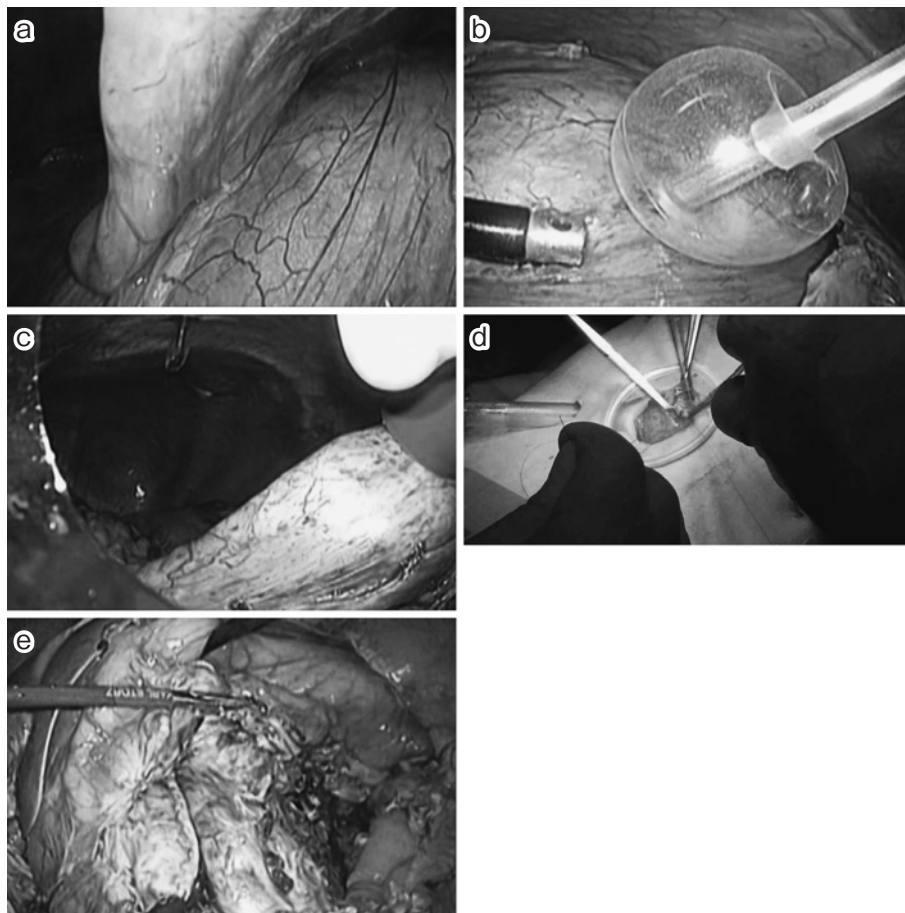


Fig. 3 Surgical findings.

- a) The cystic lesion occupied the left upper abdominal quadrant, and surgical fields were limited.
- b) After needle insertion, the inner and outer balloons were immediately inflated with 10 cc of air.
- c) The puncture site gradually protruded outside the body through the umbilical incision.
- d) The puncture hole was sutured under direct observation.
- e) The surgical field after resection

were consistent with a diagnosis of pancreatic mucinous cystic adenoma.

#### Postoperative course

The postoperative course was uneventful, and abdominal distention resolved (Fig. 5). The patient was discharged 10 days after surgery. Fourteen months after surgery, she remains well, without evidence of recurrence.

#### Discussion

LDP was first reported in 1996, by Gagner and Cuschieri,<sup>14,15)</sup> and has since become a common treatment for benign and premalignant pancreatic tumors, because of the development of improved surgical instruments and techniques. A recent Japanese nationwide survey found that LDP is widely performed in Japan and that postoperative pancreatic fistula and postoperative complications were

significantly less frequent, and postoperative hospital stays were significantly shorter, for LDP than for open distal pancreatectomy.<sup>4)</sup>

LDP is indicated for MCNs with appropriate biological characteristics. The prevalence of malignancy in MCNs was recently reported to be less than 20%.<sup>5-9)</sup> Malignant MCN has not been reported in patients with tumors less than 4 or 5 cm in diameter without mural nodules.<sup>5,9)</sup> Therefore, international consensus guidelines for the management of MCNs of the pancreas recommend that patients with MCNs undergo organ-preserving pancreatectomy, including spleen-preserving distal pancreatectomy or laparoscopic surgery, only if these tumors are less than 4 cm in diameter and without mural nodules.<sup>10)</sup> Otsuka et al.<sup>13)</sup> reported that pathologic examination of 21 resected specimens, including 11 from patients with MCNs larger



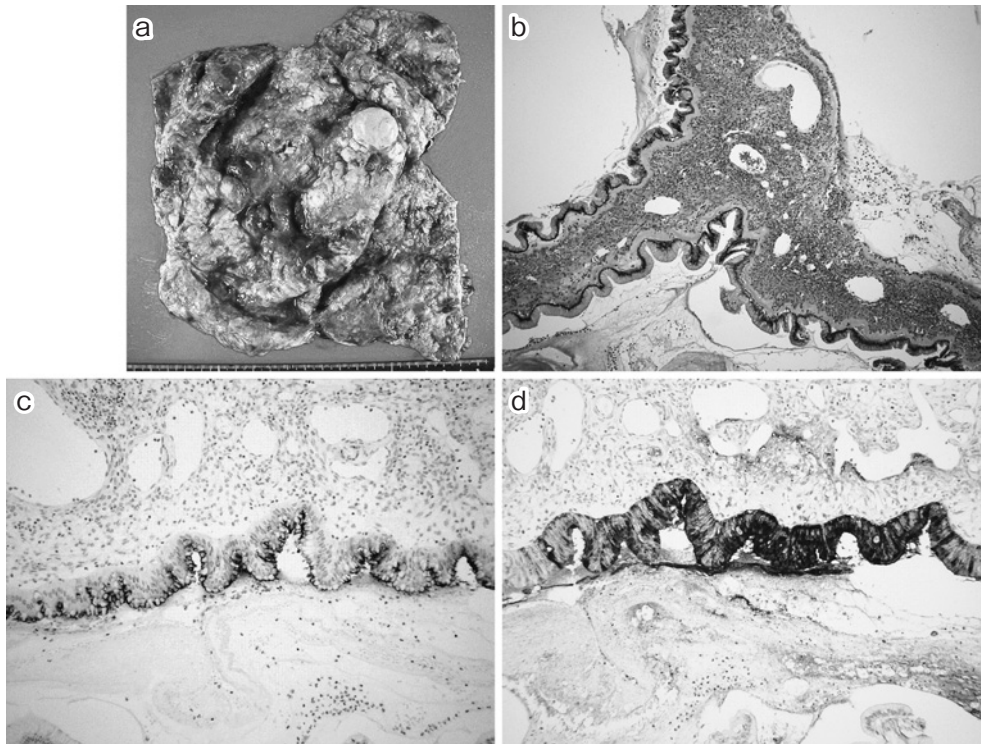


Fig. 4 Pathologic findings.

- a) Macroscopic findings.
- b) Hematoxylin-eosin stain,  $\times 40$ .
- c) Immunohistochemical staining (CEA),  $\times 200$ .
- d) Immunohistochemical staining (CA 19-9),  $\times 200$ .

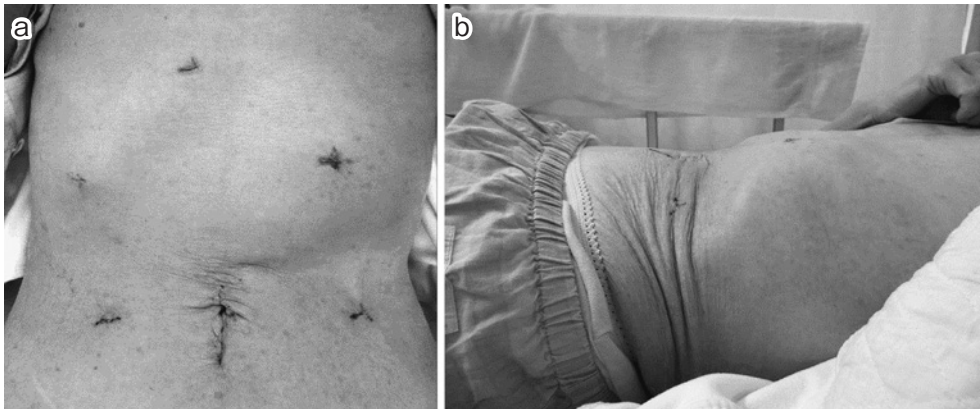


Fig. 5 Abdominal distention resolved after laparoscopic surgery.

than 45 mm in diameter, showed that all lesions exhibited low-grade dysplasia. None of these patients developed recurrence during a median follow-up of 12 months. Furthermore, more than 80% of resected MCNs are benign.<sup>5-9)</sup> These findings suggest that laparoscopic surgery may be applicable in selected patients with MCNs larger than 4 cm in diameter.

In the present patient, intracystic CEA and CA 19-9 values were extremely high. The usefulness of preoperative examinations, including EUS-FNA, has improved recently. Previous reports found that intracystic fluid analyses, especially CEA, were useful in differentiating benign and malignant intraductal papillary mucinous neoplasms (IPMNs).<sup>16,17)</sup> However, a recent report found that intracys-

tic CEA was not a definitive marker for such differentiation; therefore, intracystic fluid analyses should not be considered when developing a treatment strategy.<sup>18,19)</sup> Previous studies reported that intracystic CEA could be used to differentiate mucinous and non-mucinous cystic lesions.<sup>14,19)</sup> In addition, use of preoperative cytology via EUS-FNA has recently increased. However, sensitivity is limited by scant cellularity.<sup>10,17)</sup> Although definitive preoperative diagnosis remains difficult, some evidence suggests that serum CA 19-9 is the best marker for differentiating benign and malignant cystic lesions.<sup>20,21)</sup> International guidelines recommend the use of cytologic analysis with EUS-FNA, especially for evaluation of small, branched, duct-type IPMN without “worrisome features”. However, some researchers recommend against cystic fluid analysis for preoperative diagnosis of mucinous-like cystic lesions. Furthermore, they believe that a cyst should not be aspirated, because it may cause leakage of cyst contents, which may result in peritoneal dissemination after the procedure.<sup>10)</sup> The endoscopist in our center recommended against fluid biochemical analyses and cytology using EUS-FNA for this reason. Therefore, definitive preoperative diagnosis was not possible in our patient. However, imaging findings were strongly suggestive of MCN, and intraoperative cytologic analysis during LDP revealed no malignancy.

Regarding laparoscopic procedure, the most important issue for larger MCNs is to avoid tumor rupture, because cystic fluid leakage in patients with malignant MCNs might result in peritoneal dissemination after surgery. Furthermore, a clear surgical field is necessary in laparoscopic surgery. A double-balloon catheter is ideal for preventing intraoperative rupture of MCNs and improving the surgical field. This device has been used to aspirate fluid from ovarian cysts.<sup>22)</sup> The outer and inner balloons attached to the needle can sandwich the cyst wall and prevent leakage during aspiration. Previous reports<sup>12,13)</sup> detailed the use of this device during LDP for large MCNs. The authors of those studies found that sufficient mobilization of large MCNs and subsequent deflation of the cyst by aspirating the cystic fluid allowed the aspiration hole to be moved to the umbilical incision and closed extracorporeally, without cystic fluid leakage. Furthermore, aspiration of cystic fluid early in the procedure prevents rupture during subsequent procedures. This method makes laparoscopic surgery technically applicable for all MCNs without definitive preoperative findings of malignancy. We should point out, however, that we did not perform detailed ab-

dominal fluid cytologic or biochemical analyses before or after puncture. Our assessment of the absence of intracystic fluid leakage was based only on direct observation and laparoscopic images. Therefore, a few tumor cells may have been deposited into the abdominal cavity during this procedure. Regular careful follow-up is thus necessary, to identify potential peritoneal dissemination.

Patients with MCNs usually present without symptoms. However, our patient presented with severe inflammation, which suggested cystic infection. Cystic infection was reported to be an extremely rare manifestation, even in patients with IPMNs, which connect the pancreatic ducts to the cyst.<sup>23)</sup> To our knowledge, there have been no reports of cystic infection in patients with MCNs. Moreover, the intracystic amylase value was extremely high in our patient, which suggests the presence of a connection between the pancreatic ducts and cyst. However, intracystic amylase values are inconsistent — they can be low for IPMNs and high for MCNs.<sup>24)</sup> In addition, our patient had no previous medical history of acute or chronic pancreatitis; thus, we were unable to determine the cause of the inflammatory findings preoperatively.

In conclusion, we performed LDP using a double-balloon catheter for resection of a large MCN. Use of a double-balloon catheter is necessary for large MCNs, because it is safe laparoscopically and prevents cystic fluid leakage into the abdominal cavity. Furthermore, regular, detailed follow-up is necessary, to identify potential peritoneal dissemination.

**Conflicts of interest (COI):** None of the authors has any conflict of interest regarding the present study.

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