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# Laparoscopy-Assisted Distal Pancreatectomy

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## 1. Introduction

The advantage of laparoscopic surgery is obvious and has been extended to pancreatic and splenic operations. Since 1994, various laparoscopic pancreatectomy, including pancreatoduodenectomy (Gagner & Pomp, 1994), enucleation (Gagner et al., 1996; Dexter et al., 1999), and distal pancreatectomy (Gagner et al. 1996; Sussman et al., 1996), have been performed. As for laparoscopic splenectomy, nowadays it can be conducted safely even for splenomegaly due to portal hypertension (Hama et al., 2008). Open pancreatic surgery requires a relatively large incision for a small lesion, and therefore the potential benefits of the laparoscopic approach are substantial. The most common indications for laparoscopic pancreatic resection were presumed benign pancreatic diseases, such as insulinoma or localized neuroendocrine neoplasms and branch type intraductal papillary mucinous neoplasms. The most common indication for laparoscopic pancreatic resection appears to be enucleations and distal pancreatectomy. Laparoscopic pancreatectomy, however, is still technically rather difficult because of the retroperitoneal position of the pancreas and the complex anatomical relationship between the pancreas and surrounding vessels. Thus, hand-assisted laparoscopic pancreatectomy is gaining recognition as a new and feasible technique that introduces a surgeon's hand into the abdominal cavity during laparoscopic surgery (Klingler et al., 1998; Shinchu et al., 2001; Kaneko et al., 2004). As a modification of hand-assisted laparoscopic pancreatectomy, we devised a method of spleen and gastrosplenic ligament preserving distal pancreatectomy, in which pancreatic resection is performed under direct vision extracorporeally (Hirota et al., 2009). Furthermore, laparoscopic assistance is also helpful in no-touch distal pancreatectomy for pancreatic cancer. For invasive pancreatic ductal cancers, the transection of the pancreas, splenic artery and vein, left gastroepiploic vessels, and short gastric vessels is performed at first to prevent the dissemination of cancer cells. Division of the pancreas, splenic artery, and splenic vein is done under direct vision through minilaparotomy at epigastrium. Division of the left gastroepiploic and short gastric vessels is done under laparoscope with left hand assistance. And then, retroperitoneal dissection is performed laparoscopically. In this way, the same no-touch distal pancreatectomy as open operation can be achieved.

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The three ways of laparoscopy-assisted distal pancreatectomy: 1) for benign lesions, 2) for low-grade malignant lesions, and 3) for invasive pancreatic ductal cancers, are presented in this chapter. Laparoscopic procedure is used for the retroperitoneal dissection under the left hand assistance in all types of lesions including cancers.

## 2. Laparoscopy-assisted distal pancreatectomy for benign lesions

In benign cases, such as insulinoma, branch type intraductal papillary mucinous neoplasm, spleen-preserving pancreatectomy is performed. An 8-cm minilaparotomy incision is made in the middle upper abdomen. For obese patients, 10-cm laparotomy is better. An abdominal wall disc for hand assistance is placed at the site of the minilaparotomy. Ultrasonography probe can be inserted through this site for intrapancreatic imaging. A total of the two trocars are then placed. After abdominal access is established, the gastrocolic omentum is divided, and the splenic flexure is mobilized. The short gastric and left gastroepiploic vessels are not divided to prevent splenic volvulus after the operation. Retrosplenic Gerota's fascia is transected on the surface of the left kidney (Figure 1a). Then, the posterior plane of Gerota's fascia is dissected from lateral to medial direction, allowing the distal pancreas and spleen detached from retroperitoneum.

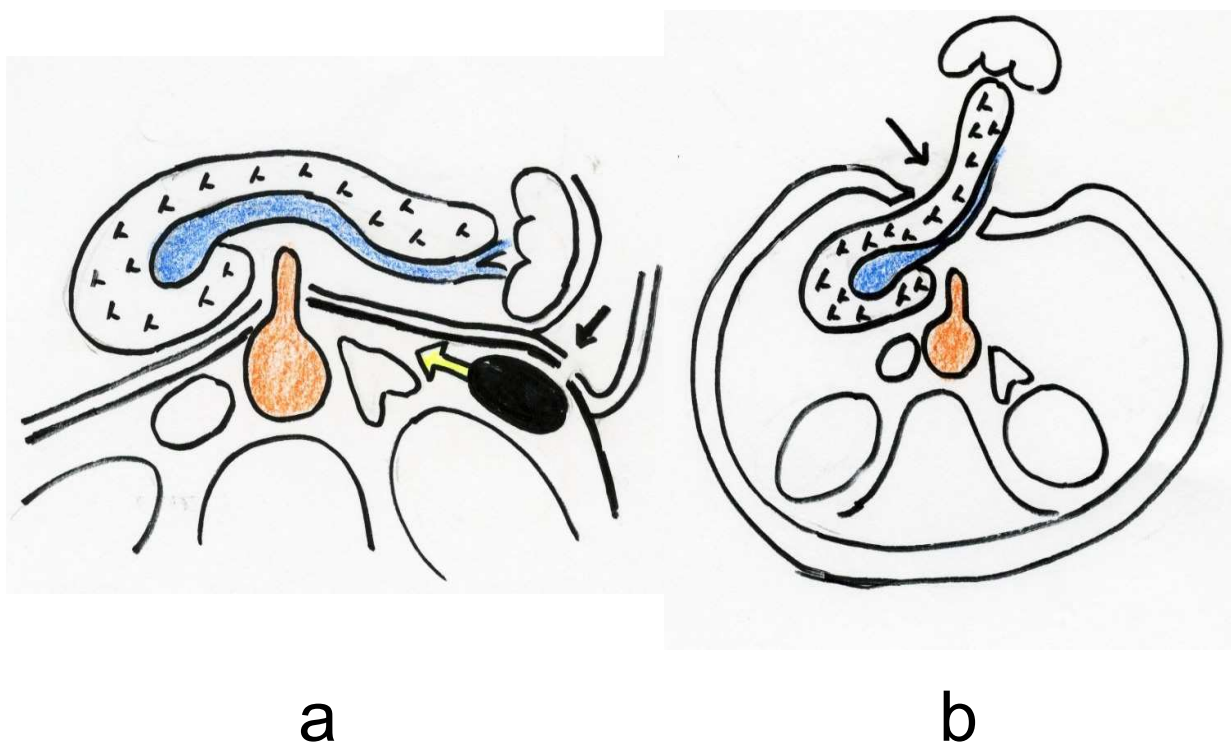


Fig. 1. Procedures in laparoscopy assisted distal pancreatectomy a) Retrosplenic Gerota's fascia is transected on the surface of the left kidney. Then, the posterior plane of Gerota's fascia is dissected from lateral to medial direction, allowing the distal pancreas and spleen detached from retroperitoneum. b) The distal pancreas and spleen are pulled out of the peritoneal cavity through the minilaparotomy for hand assistance at the epigastrium.

The distal pancreas, spleen, and left side of stomach are then pulled out of the peritoneal cavity through the minilaparotomy for hand assistance at the epigastrium (Figure 1b).

Spleen and gastrosplenic ligament preserving pancreatectomy is performed under direct vision (Figure 2). The advantage of extracorporeal procedure is the safety and certainty in dissection of the splenic vessels and preparation of the pancreatic stump. The transected main pancreatic duct is doubly ligated, and the transected pancreatic stump is sewn manually. The preserved spleen, stomach and splenic vessels are placed back in the peritoneal cavity after resection.

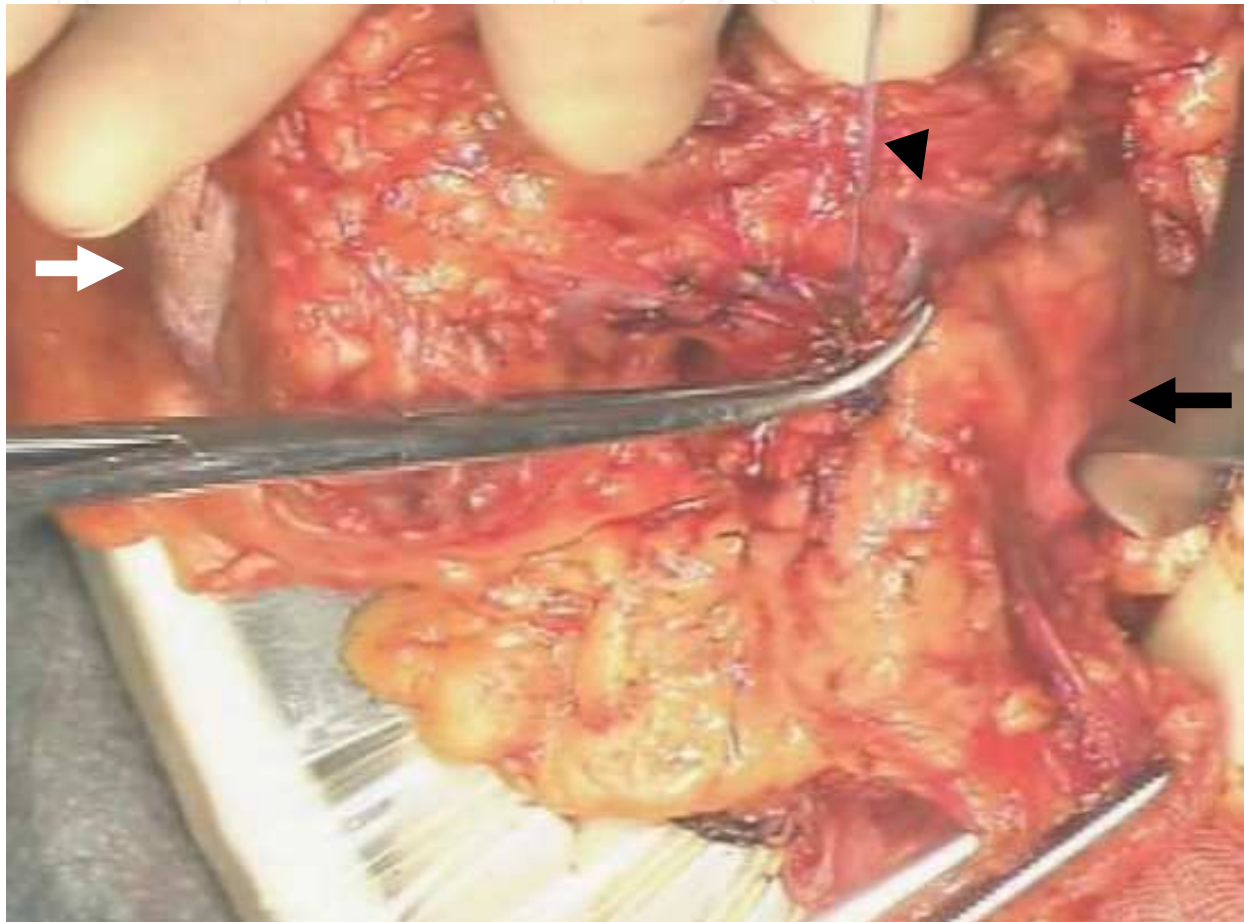


Fig. 2. Dissection of the distal pancreas. The distal pancreas (black arrow) is dissected from the surrounding tissues (spleen, splenic artery, splenic vein, stomach) under direct vision extracorporeally. White arrow: spleen, black arrow head: splenic vessels.

Distal pancreatectomy with preservation of the spleen was first reported in 1988 (Warshaw, 1988). The advantage of preserving the spleen is obvious; it reduces the risk of postoperative severe inflammation and peripheral blood count aberration. Preserving the spleen has been a major procedure in distal pancreatectomy. Warshaw reported a case of splenic abscess that occurred after sacrificing the splenic artery and vein (Warshaw, 1988). Kimura et al. reported five patients successfully treated with splenic vessel-preserving distal splenic vessel-preserving distal pancreatectomy to maintain the blood supply to the spleen and to avoid splenic necrosis and abscess (Kimura et al., 1996; Kimura et al., 2010). Spleen-preserving pancreatectomy has recently been shown to have comparable risk of complication to standard pancreatectomy where the spleen is removed. Nevertheless, spleen-preserving pancreatectomy remains an uncommon and technically demanding operation, due to the difficulty in dissecting the



distal pancreas from the splenic vessels. Another advantage of our procedure is the safety in dissecting the distal pancreas from the splenic vessels. The displacement of the spleen with the inherent risk of torsion or hemorrhage is another disadvantage of spleen-preserving pancreatectomy. If spleen-preserving pancreatectomy is performed, the spleen is often free in the abdomen, where it is prone to torsion or trauma. Various techniques have been described to reposition the spleen (splenopexy). Appu et al. report a novel technique for splenic repositioning and fixation, using peritoneal pocket (Appu et al., 2005). We experienced one case of splenic bleeding due to venous congestion after spleen-preserving pancreatic tail resection using Appu's splenopexy. After that experience we are preserving the gastrosplenic ligament.

This approach is suitable for the very distal lesion of the pancreas. However, if the posterior plane of Gerota's fascia is dissected, this method could be applied to more proximal lesion. For obese patients, because the pulling out through the small laparotomy is difficult, 10 cm incision is preferable. This procedure is applicable only for lesions in the pancreatic body and tail. For the benign head lesions, another approach should be conducted (Hirota et al., 2007).

Preservation of gastrosplenic ligament and extracorporeal preparation of transected pancreatic stump and splenic vessels under direct vision are useful measures for troubles in spleen-preserving distal pancreatectomy under minimal incision approach assisted by laparotomy.

### **3. Laparoscopy-assisted distal pancreatectomy for low grade malignant lesions**

In low-grade malignant cases, such as mucinous cystic neoplasm, solid pseudopapillary neoplasm, medium-sized neuroendocrine neoplasm, the procedure is almost the same as in benign cases except the resection of the spleen and splenic vessels for lymph node dissection. The distal pancreas and spleen are pulled out of the peritoneal cavity through the minilaparotomy at the epigastrium (Figure 3). Pancreatic resection and closure of the residual pancreatic stump is performed safely under direct vision extracorporeally.

The successful management of the pancreatic stump remains the challenge of this procedure. In some laparoscopic enucleation series, the rate for low volume pancreatic fistula is reported to be high (Mabrut et al., 2005). This complication does not create an important problem as long as the main duct is not injured. Even though self-limiting, the pancreatic fistula formation rate remains high after either laparoscopic enucleation or resection. Pancreatic fistula after distal pancreatectomy has been a topic of decades, even in the era of laparoscopic pancreatectomy. Patterson et al. collected data from the literature on morbidity after open and laparoscopic pancreatic resections, and found that the rate of pancreatic fistula ranged from 20% to 33% after laparoscopic pancreatectomy and from 5% to 23% after open pancreatectomy (Patterson et al., 2001). The way in which the surgeon approaches the pancreatic transection seems to be important. Ninety-seven percent of the patients underwent laparoscopic transection of the pancreas by use of a stapling technique (Mabrut et al., 2005). Closing the pancreatic stump with interrupted mattress sutures and selectively ligating the pancreatic duct, the usual practice in open surgery, are more difficult to replicate laparoscopically. This factor could explain the high rate of pancreas-related

complications. Hand-sewn parenchymal closure and duct ligation are an advantage of this extracorporeal pancreatic resection, to prevent pancreatic juice leakage, compared with the procedure done by laparoscopy only. We could safely and securely handle the pancreatic duct and fine branches of the splenic vessels under the direct vision.

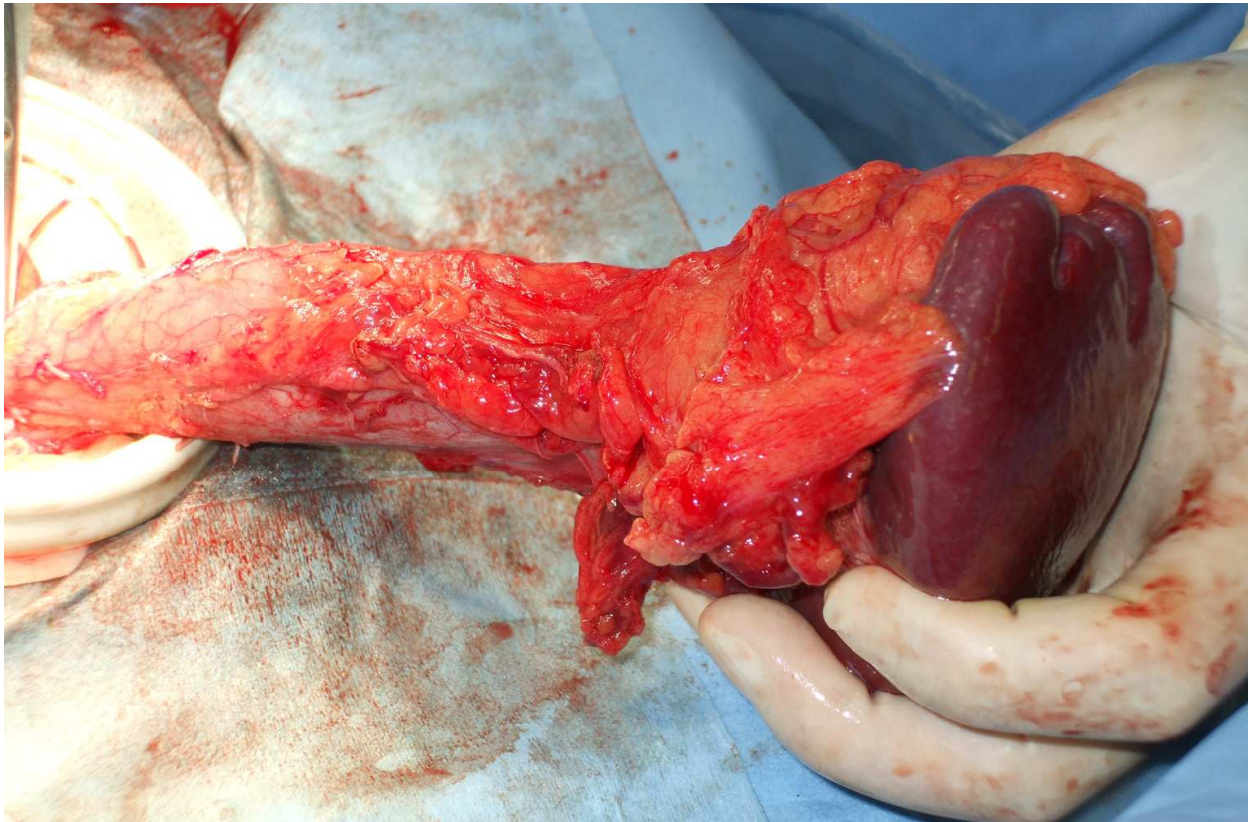


Fig. 3. Dissected distal pancreas and spleen. The distal pancreas and spleen are pulled out of the peritoneal cavity through the minilaparotomy at the epigastrium. Pancreatic resection and closure of the residual pancreatic stump is performed under direct vision.

#### **4. Laparoscopy-assisted distal pancreatectomy for invasive pancreatic ductal cancers**

Laparoscopic assistance is also helpful in no-touch distal pancreatectomy for pancreatic cancer. The aim of no-touch distal pancreatectomy is to decrease the shedding of cancer cells, and to achieve negative transection margins. All drainage vessels from the pancreatic body and tail have been ligated and divided during the early phase of the operation. Squeezing and handling the tumor prior to ligation of the surrounding vessels during pancreatectomy may increase the risk of shedding cancer cells into the portal vein, retroperitoneum and/or peritoneal cavity. Although the no-touch isolation technique has not been shown to increase cancer survival or decrease recurrence, it is theoretically promising (Hirota et al., 2005; Hirota et al., 2010).

Another aim is to resect cancers by wrapping them within Gerota's fascia. Perirenal tissue beyond Gerota's fascia is often protected from the autodigestion in severe acute pancreatitis.

Because cancer cell invasion is dependent on protease activity, Gerota's fascia may function as a barrier against protease-mediated invasion of cancer cells.

Division of the pancreas, splenic artery, and splenic vein is done under direct vision through minilaparotomy at epigastrium. Following the division of the gastrocolic ligament, the posterior surface of the pancreatic neck is tunneled by blunt dissection. The pancreas is transected after ligating the left side of the pancreas. The splenic artery and vein are ligated and divided at the origin and at the confluence with the superior mesenteric vein, respectively. As mentioned by Fagniez and Munoz-Bongrand, early division of the pancreatic neck provides superior access to control the splenic vessels (Fagniez & Munoz-Bongrand, 1999). Then, division of the left gastroepiploic and short gastric vessels is done under laparoscope with left hand assistance. At this point, all drainage vessels from the pancreatic body and tail have been ligated and divided. Lastly, retroperitoneal dissection behind the Gerota's fascia is performed lateral to medial direction laparoscopically.

## 5. Conclusion

Laparoscopic assistance is useful in distal pancreatectomy. This technique can be applied to both benign and malignant lesions. For benign lesions, preservation of gastrosplenic ligament and extracorporeal preparation of transected pancreatic stump under direct vision are useful measures to prevent post-operative complications.

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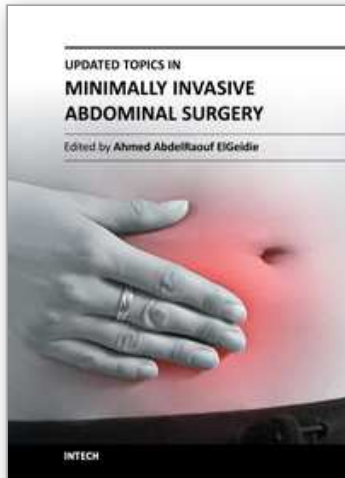
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