

Laparoscopic Distal Pancreatectomy Preserving Spleen and Splenic Vessels for Pancreatic Insulinoma

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Abstract

We describe a 43-year-old woman who underwent laparoscopic distal pancreatectomy preserving the spleen and splenic vessels for the treatment of insulinoma in the pancreatic body. The patient experienced cold sweats on fasting, received diagnosis of insulinoma, and was referred to our hospital for laparoscopic surgery. Blood biochemistry studies showed low fasting blood glucose of 42 mg/dL, serial immunoreactive insulin of 15.2 μ U/mL, and a Fajans index (immunoreactive insulin/blood glucose) of 0.36 (normal <0.30). Contrast-enhanced early-phase computed tomography of the abdomen showed a circular, intensely stained, 1.6-cm-diameter tumor in the pancreatic body close to the main pancreatic duct. A solitary insulinoma of the pancreatic body was diagnosed on the basis of the result of hematologic studies, and diagnostic imaging results. Because of the location of the tumor, we elected to perform distal pancreatectomy preserving the spleen and splenic vessels, rather than enucleation. Insulin and blood glucose levels were monitored during surgery. Before removal of the tumor, insulin levels remained consistently high, never decreasing to less than 10 μ U/mL. After surgery, insulin levels decreased rapidly, to less than 5 μ U/mL within 30 minutes and subsequently remained at the new low level, leading us to conclude that the entire tumor had been removed. There were no postoperative complications, and the patient was discharged from the hospital on day 7.

There was no major intraoperative bleeding other than at the resected surface. The patient was ambulatory soon after the procedure, and had a brief hospital stay therefore, the surgery was judged to have been highly useful in this case.

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Key words: laparoscopic pancreatectomy, spleen preserving distal pancreatectomy, insulinoma

Introduction

As surgeons gain in expertise and as tools grow more sophisticated, laparoscopy is being used more often to treat pancreatic disease, and recently an

increasing number of laparoscopic pancreatectomies have been reported^{1–11}. Laparoscopic partial pancreatic resection for pancreatic endocrine tumor was first reported in 1996 by Gagner and colleagues², and laparoscopic pancreatectomy is now considered to be indicated for that condition³.

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Fig. 1 Contrast-enhanced early-phase CT of the abdomen showed a circular, densely stained tumor 1.6 cm in diameter in the pancreatic body (arrow). This tumor had developed within the pancreatic parenchyma, close to the MPD.

We report a case of laparoscopic distal pancreatectomy preserving the spleen and splenic vessels for the treatment of solitary insulinoma of the pancreatic body.

Case

A 43-year-old woman was referred to our hospital for laparoscopic resection of a pancreatic tumor that had caused recurrent episodes of hypoglycemia, which was most often manifested as cold sweats on fasting. The patient had no family history of cancer and did not smoke or drink alcohol, and her medical history was unremarkable. The body mass index was 23.8 kg/m². There was no evidence of anemia or jaundice. Hematological examination on admission showed a low fasting blood glucose level of 42 mg/dL, an immunoreactive insulin (IRI) level of 15.2 μU/mL, and a Fajan's index (IRI/blood glucose) of 0.36 (normal, <0.30). No other abnormal values were detected in hormone levels or tumor markers.

Contrast-enhanced early-phase computed tomography (CT) of the abdomen showed a circular, densely stained 1.6-cm-diameter tumor in the pancreatic body. This tumor had developed within the pancreatic parenchyma, close to the main pancreatic duct (MPD) (Fig. 1).

Abdominal magnetic resonance imaging with moderate T1 and T2 weighting showed a signal of higher intensity than the surrounding parenchyma, indicating a single 1.6-cm-diameter lesion within the

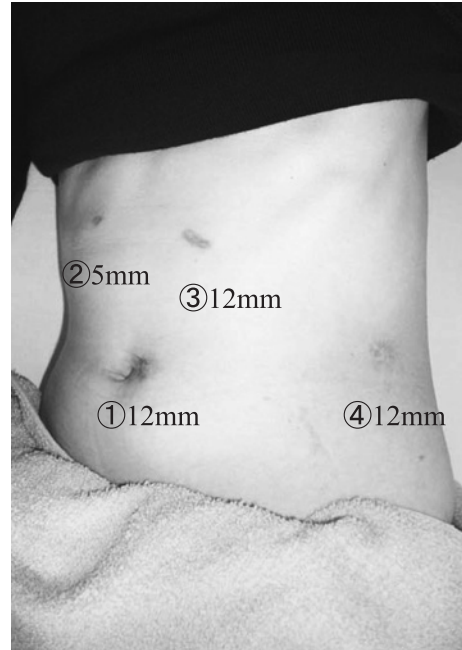


Fig. 2 Trocar placement for laparoscopic distal pancreatectomy and the postoperative wound.

Left umbilical trocar 12 mm in diameter (replaced with a 15-mm trocar for introduction of the endoscopic linear stapler), (2) a 5-mm trocar positioned 5 cm distal to the xiphoid process and slightly to the right of the midline, (3) a 12-mm trocar positioned below the left costal arch on the mammillary line, and (4) a 12-mm trocar positioned below the left costal arch on the anterior axillary line.

pancreatic body. No tumor masses were detected in other areas of the pancreas. Endoscopic ultrasonography showed a low-echoic lesion (15.8 × 7.6 mm) in the pancreatic body.

Hematologic studies and diagnostic imaging indicated a solitary insulinoma in the pancreatic body. Because the tumor was located close to the MPD, we elected to perform distal pancreatectomy preserving the spleen and splenic vessels, rather than enucleation.

Surgery: The patient was placed in the right semilateral position, and 4 trocars were inserted, as shown in Figure 2. The greater omentum was divided using laparoscopic coagulating shears. Dissection was started from the phrenicocolic ligament, and from the omental bursa toward the spleen, exposing the gastrosplenic ligament up to the

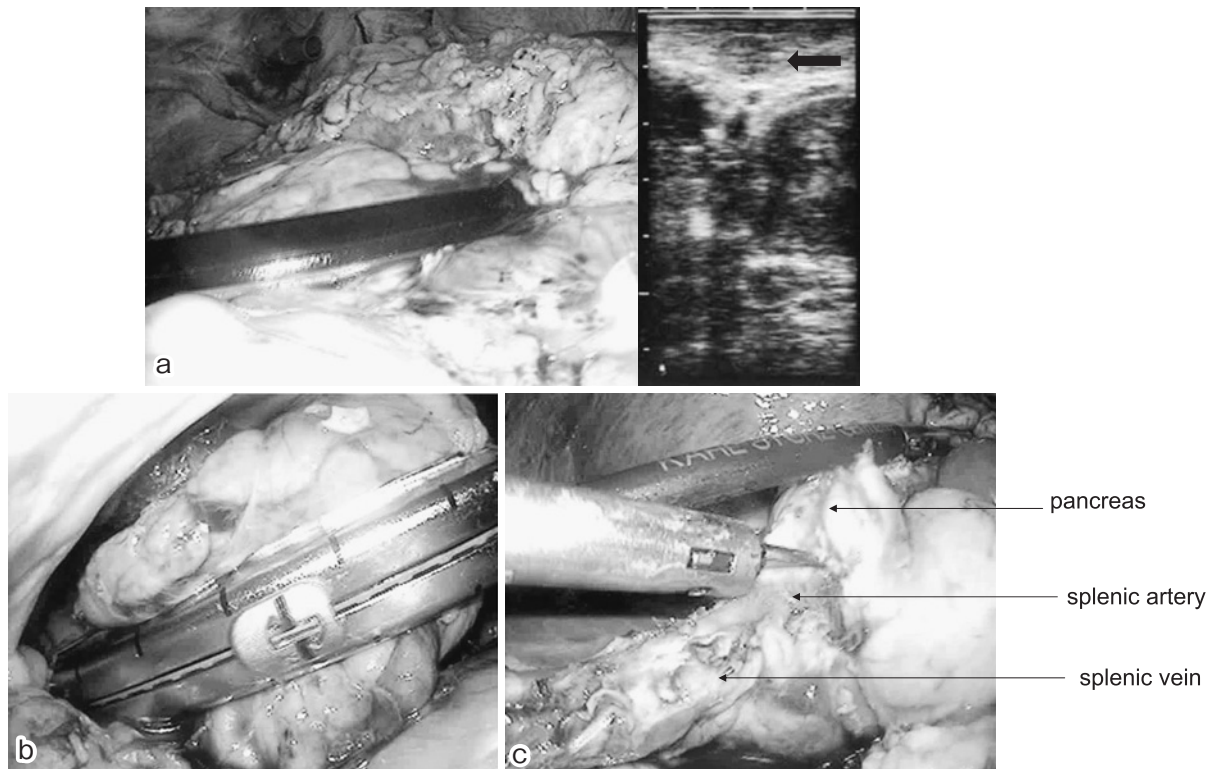


Fig. 3 **a:** Intraoperative photograph. Laparoscopic ultrasound was used to identify the tumor within the pancreas. **b:** Intraoperative photograph. The pancreas has been resected with an endoscopic linear stapler. **c:** Intraoperative photograph. After lifting the stump of the resected pancreas anteriorly, we used both laparoscopic coagulating shears and a vessel sealing system to separate the splenic artery and vein from the right side of the pancreas up to the splenic hilum.

splenic hilum. Laparoscopic ultrasonography was performed to locate the insulinoma and to determine the pancreatic resection line (**Fig. 3a**). We separated the splenic artery and vein from the pancreas at that point and resected the pancreas with an endoscopic linear stapler (EndoGIA 60-4.8, Tyco Japan, Tokyo, Japan) (**Fig. 3b**). After lifting the stump of the resected pancreas anteriorly, we used both laparoscopic coagulating shears and a vessel sealing system to separate the splenic artery and vein from the right side of the pancreas up to the splenic hilum (**Fig. 3c**). No clips were used, and little bleeding was observed. The resected pancreas was inserted into a surgical bag for removal through the trocar incision. The surgical procedure was completed by placing a closed drain in the left subphrenic cavity.

Intraoperative monitoring: Insulin and blood glucose levels were monitored during surgery. Before removal of the tumor, insulin levels remained consistently high, never decreasing to less than 10

$\mu\text{U}/\text{mL}$. After tumor excision, insulin levels decreased rapidly to less than $5 \mu\text{U}/\text{mL}$ within 30 minutes and subsequently remained at the new low level, indicating complete resection of the insulinoma (**Fig. 4**).

Operating time was 277 minutes, and blood loss was 50 mL.

Macroscopic examination of the resected specimen revealed an unencapsulated round tumor 1.6 cm in diameter, yellowish-brown with clear margins and regular borders within the pancreatic parenchyma (**Fig. 5**).

Histologic examination of the tumor showed tumor cells with uniform granular cytoplasm and a funicular or ribbon-like architecture (**Fig. 6**). On immunohistochemical staining the tumor cells were positive for insulin, consistent with the diagnosis of insulinoma.

The postoperative course was uneventful. The patient resumed oral feeding on postoperative day 2, passed flatus on day 3, and was discharged without



Fig. 4 Changes in blood glucose and insulin levels

Before removal of the tumor, insulin levels remained consistently high, never decreasing to less than 10 μU/mL. After tumor excision, insulin levels decreasing rapidly, to less than 5 μU/mL within 30 minutes, and subsequently remaining at the new low level.

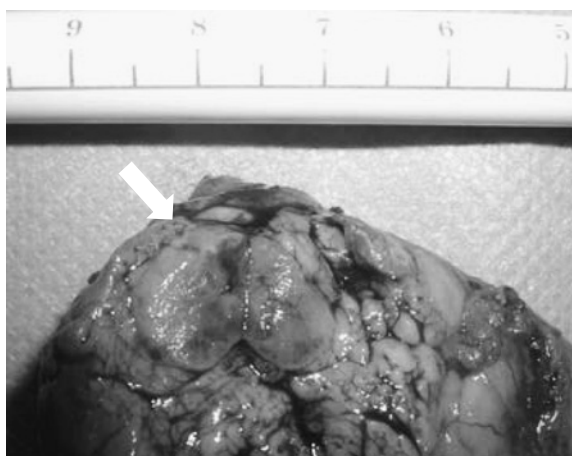


Fig. 5 Macroscopic findings on resection. Macroscopic examination of the resected specimen revealed an unencapsulated round tumor 1.6 cm in diameter, yellowish-brown with clear margins and regular borders within the pancreatic parenchyma.

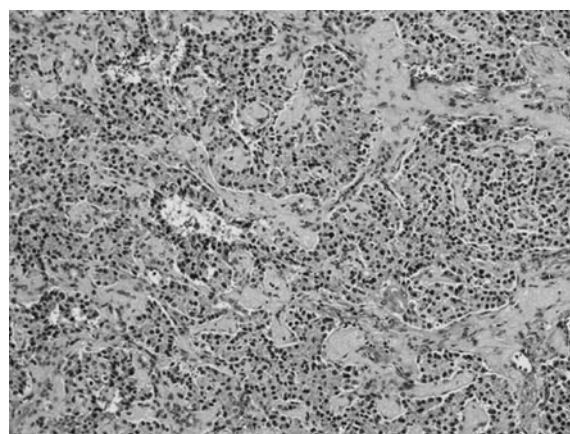


Fig. 6 Histological examination of the tumor (hematoxylin and eosin, 40×) showed tumor cells with uniform granular cytoplasm and a funicular or ribbon-like architecture. On immunohistochemical staining the tumor cells were positive for insulin, consistent with the diagnosis of insulinoma.

complications on day 7.

Discussion

The primary treatment for insulinoma is surgical resection. Pancreatic endocrine tumors grow slowly

and 70% to 80% are benign. Most insulinomas are located in the body and tail of the pancreas and rarely invade other organs or recur in the pancreas, making them well-suited to laparoscopic surgical intervention^{10,11,13}. Cunha and colleagues⁵ have reported that the laparoscopic treatment of

insulinoma is as safe as open surgery and that the laparoscopic approach is associated with significantly shorter hospital stay and significantly reduced incidence of postoperative pancreatic fistula.

When the tumor is near the surface of the pancreas and an adequate distance from the MPD, enucleation of the tumor is indicated. In such cases we use laparoscopic ultrasonography during surgery to locate the tumor, MPD, and splenic vessels and carefully enucleate the tumor. However, when the tumor is deep within the pancreatic parenchyma and close to the MPD, enucleation procedures might damage the MPD. In such cases we choose either distal pancreatectomy or pancreatoduodenectomy^{10,11,13}. Distal spleen-preserving pancreatectomy protects against infections, such as sepsis, and other serious postoperative complications and reduces the incidence of postoperative cerebral infarction by preventing hematologic abnormalities, such as thrombocytosis^{4,12,14}. Warshaw and colleagues have reported the successful ligation of the splenic artery and vein with preservation of the short gastric and left gastroepiploic arteries and veins for splenic blood supply¹⁵. However, this procedure is associated with a risk of postoperative splenic necrosis, necessitating splenectomy^{12,14,16}. Because we perform laparoscopic surgery as a minimally invasive treatment and because Warshaw's procedure can result in splenic necrosis, we chose to preserve the splenic vessels. If the insulinoma were deep within the pancreatic parenchyma and close to the MPD, enucleation, we would have performed laparoscopic distal pancreatectomy with preservation of the spleen and splenic vessels instead of enucleation.

When preserving the spleen and splenic vessels, it is important to first resect the pancreas and then to separate the splenic vessels from the tail of the pancreas, starting from the right and working toward the splenic hilum^{9,17}. The endoscopic linear stapler must be used within a narrower working space for this procedure than for distal pancreatectomy with splenectomy, and extremely careful resection is required to prevent injury to surrounding tissues and organs.

Successful resection of the insulinoma requires diagnostic determination of the tumor location and

confirmation that complete resection has been achieved¹⁸⁻²⁰. Laparoscopic ultrasonography for multiple lesions and serial measurement of blood sugar are continued throughout the duration of the surgery. Serial monitoring of IRI (both intraoperative and postoperative) in the portal vein and peripheral arteries has been reported to be useful for confirming tumor excision¹⁹⁻²¹. In the present case, we confirmed complete tumor excision both through laparoscopic ultrasonography and through serial measurement of peripheral IRI during surgery. This procedure is simpler and easier than measuring portal IRI during laparoscopy, and we anticipate future opportunities for serial measurement of IRI from peripheral arteries. Additional research in a larger patient population is needed, with the accumulation of more data on intraoperative IRI monitoring from peripheral arteries during insulinoma resection.

Conclusion

We have reported a case of laparoscopic distal pancreatectomy, with preservation of the spleen and splenic vessels, for a solitary insulinoma of the pancreatic body. We were able to locate the insulinoma and to complete the resection as successfully as if the procedure had been done by open surgery rather than laparoscopically. There was no major intraoperative bleeding other than at the resected surface. The patient was ambulatory soon after the procedure, and her hospital stay was short; therefore, the surgery was judged to have been highly useful.

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