

Laparoscopic Enucleation and Distal Pancreatectomy for Pancreatic Insulinomas

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Pancreatic insulinomas, albeit rare, are the commonest functioning neuroendocrine tumors of the pancreas. They are frequently solitary, typically small, and invariably benign and are evenly distributed in the pancreas. Surgical treatment usually requires a relatively large incision to reach the pancreas deep-seated in the retroperitoneum and to perform a thorough exploration of the whole pancreas to look for occult tumor not localized by preoperative localization or multiple tumors.¹⁻⁴ New technology has facilitated the application of various open surgical procedures to their equivalents in a minimally invasive fashion. Laparoscopic pancreatic resection has been shown to be feasible, safe and effective for benign conditions of the pancreas with enhanced postoperative recovery.⁵⁻¹⁵ Pancreatic insulinoma is one of the most commonly reported pancreatic pathology in which laparoscopic resection can be adopted with good outcome.⁵⁻⁷

PREOPERATIVE LOCALIZATION

The cost-effectiveness of preoperative tumor localization has been challenged because of the accurate intraoperative localization by bimanual palpation and intraoperative ultrasound during conventional open procedures.¹⁻³ In fact, many occult insulinomas can be identified by intraoperative localization.³ However, laparoscopy provides only visual examination of the pancreatic surface. On the other hand, modern imaging has improved the accuracy of preoperative localization.⁴ Preoperative localization with conventional imagings including computed tomography scan and magnetic resonance imaging, endoscopic ultrasound and arterial-stimulated venous sampling is preferred to localize or regionalize the insulinomas and to facilitate a focused exploration (Fig. 1).

In addition, experience with intraoperative laparoscopic ultrasound (LUSG) has shown its accuracy in locating pancreatic insulinoma in similarity to its open counterpart.¹³⁻¹⁵ It can enhance intraoperative identification of tumors



Fig. 1: Preoperative localization with contrast computed tomography localized an insulinoma located at the posterior aspect of the proximal tail of the pancreas (arrow). A focused exploration with aim of enucleation was planned

localized or regionalized by preoperative localization and facilitate the decision of resection vs enucleation by providing information on the location of the tumors in relationship to the pancreatic duct. LUSG is considered as a promising adjunct to the procedure, even when the tumors can be identified by preoperative localization.¹³⁻¹⁵ With increasing experience of this intraoperative localization tool, occult insulinoma or tumors without positive preoperative localization can be located during laparoscopy by a skilfully performed LUSG.¹⁵

TECHNIQUE OF LAPAROSCOPIC RESECTION OF INSULINOMAS

Both open and laparoscopic resection of pancreatic insulinomas shares similar operative strategy. Either enucleation or distal pancreatectomy can be considered for tumors at body/tail of the pancreas based on their anatomical

position and proximity to the pancreatic duct while enucleation is preferred for pancreatic head tumors to preserve pancreatic function and to avoid a major resection requiring multiple anastomoses.

INSULINOMAS LOCATED AT THE BODY/TAIL OF PANCREAS

The patient is put in a supine position with a nasogastric tube and an indwelling urinary catheter inserted. A 30° angled 10 mm laparoscope is inserted through the subumbilical 11 mm port for laparoscopy while a 5 mm port and two 11 mm ports are inserted to the epigastrium and left upper quadrant respectively for dissection. An additional port 5 or 10 mm can be inserted if retraction is necessary (Fig. 2). By lifting the greater curvature of the stomach by a Babcock forceps through the epigastric trocar, the neck, body and tail of pancreas was exposed and examined through a window in the gastrocolic ligament. The window is created by dividing branches of gastroepiploic arcade between clips or, more conveniently, by an ultrasonic dissector (Olympus Sonosurg, Olympus Optical Company Limited, Tokyo, Japan) inserted to the ports of the left upper quadrant of the abdomen. Exposure and subsequent dissection of the body and tail of the pancreas can be accessed through enlarging this window by dividing the short gastric vessels. An ultrasound probe 10 mm in diameter with 8 MHz frequency (Sharplan, Honeyclave Medical Ltd., NJ) is then employed for intraoperative LUSG. It is applied directly in contact with the anterior surface of the pancreatic neck, body and tail. Once the tumor has been located and the relationship to the pancreatic duct has been defined, decision for

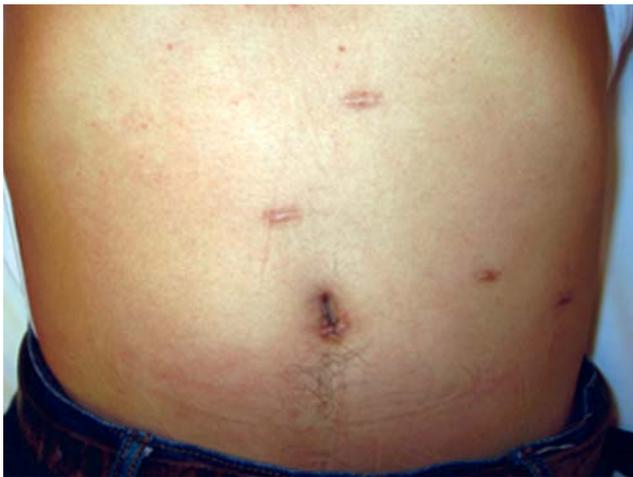


Fig. 2: Postoperative clinical picture of the abdomen showing the port sites in a patient after laparoscopic splenic-preserving distal pancreatectomy

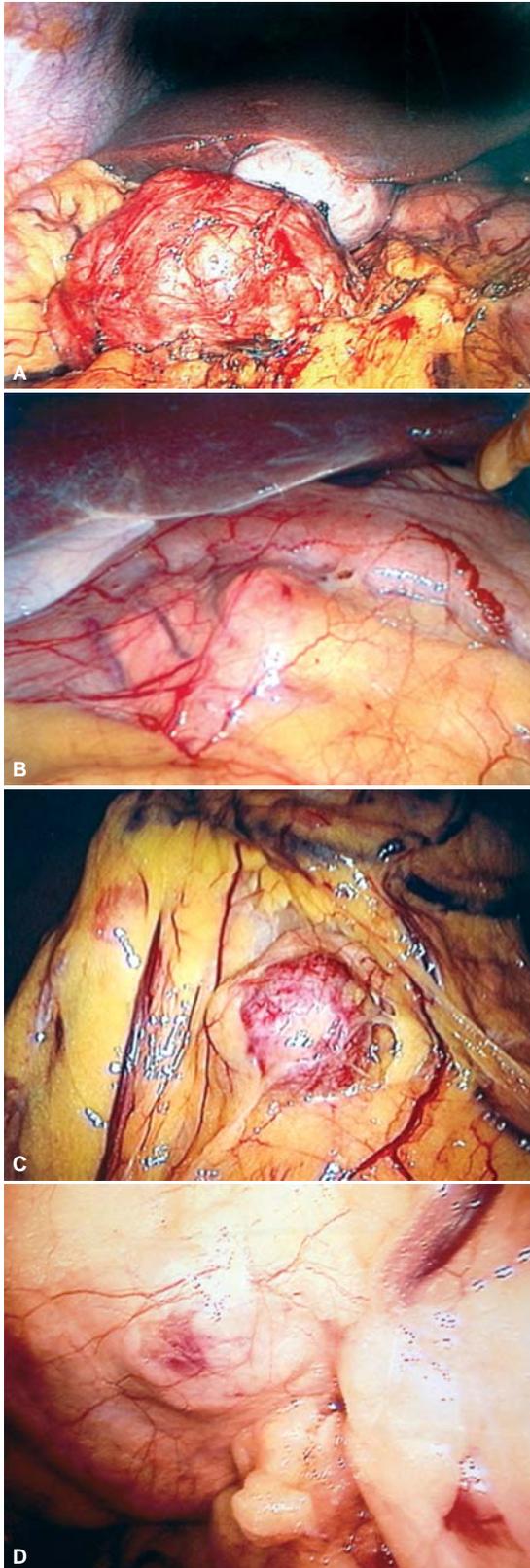
laparoscopic enucleation or distal resection should be made. Alternatively, the inferior border of the body and tail of the pancreas can be incised and mobilized and LUSG can be performed on the posterior surface of the pancreas.

Enucleation

Depending on the anatomical position of the tumor, a different degree of mobilization of the pancreas is essential. For tumor located at the anterior or inferior surface of the pancreas, minimal mobilization of the pancreas is required. For tumors located at the posterior and superior aspect of the pancreas, an adequate mobilization of the body and tail of the pancreas is essential. The inferior border of the pancreas is dissected from the retroperitoneal fat until the gland can be turned anterosuperiorly and the posterior aspect can be accessed from below. Enucleation can be performed once the tumor is located either by visualization or LUSG. For tumors not visualized, the overlying rim of normal pancreatic tissue is incised to identify the tumor before dissection can be performed expeditiously. Dissection was performed using a combination of hook electrocautery, ligaclips and/or ultrasonic dissector (Figs 3A and D).

Distal Pancreatectomy with or without Splenectomy

When the tumor is in close proximity to the pancreatic duct or in a more central position of the pancreas and a safe enucleation is considered difficult without jeopardizing the main pancreatic duct, a distal resection should be considered. It is also preferable to preserve the spleen during a distal pancreatectomy by preserving the splenic vessel rather than by based on the short gastric vessels only (Warshaw procedure).¹⁶⁻¹⁸ The splenic vein can be identified posteriorly at the superior border of the pancreas while the splenic artery can be visualized anteriorly at a more superior position from the vein. Once the line of transection is proposed, the splenic vein should be meticulously dissected from the pancreatic surface at the proposed line of transection with small branches taken care by ligaclips or ultrasonic dissector. A window can be made and a sling with a cotton tape can be inserted after separating the splenic vein from the superior border of the pancreas. An endoscopic linear stapler (45 mm in length and 18 mm in diameter, Ethicon, Johnson & Johnson, Cincinnati, Ohio) can be carefully inserted to transect the pancreas proximal to the insulinoma. Once the pancreatic body/tail has been



Figs 3A to D: Different intraoperative laparoscopic view of tumors located at the head (A and B) and body/tail of pancreas (C and D). Some tumors (B and D) might not be easily identify by visualization because of their location but could be readily confirmed by laparoscopic ultrasound

transected, the distal end of the pancreas can be grasped and traction applied downwards as well as laterally to expose the small branches of splenic tributaries for clipping or division by ultrasonic dissector. Laparoscopic approach may enhance splenic preservation because of the magnified view to deal with the small branches of the splenic veins and the positioning of the surgical instruments (Fig. 4A).

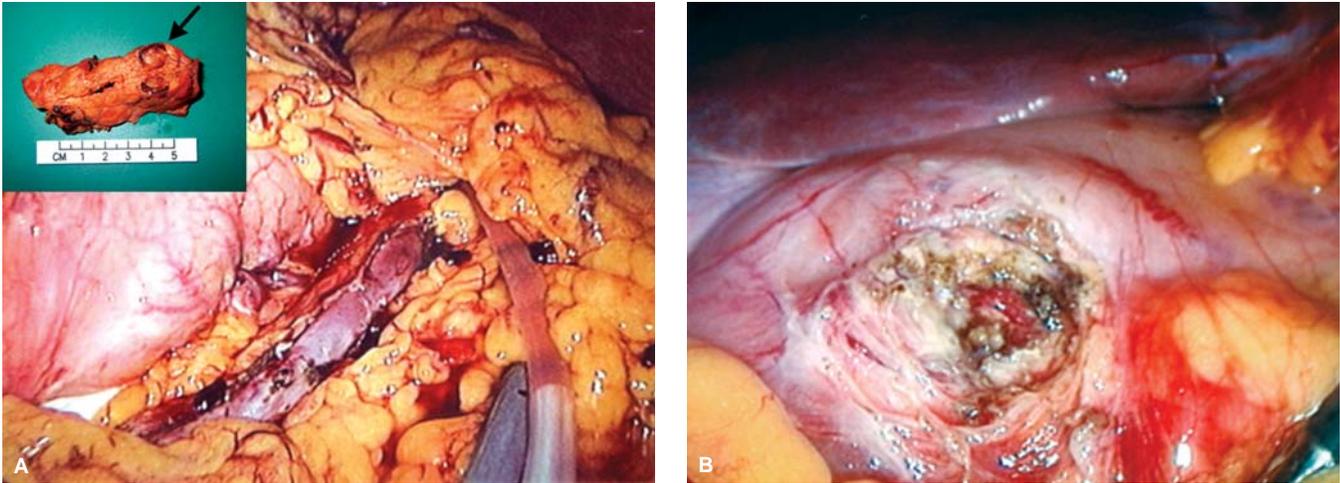
When splenectomy is considered necessary, the splenic artery is identified superior to the gland before it is doubly clipped and ligated proximal to the proposed line of transection. The ligation at proximal stump is reinforced with a pre-form suture loop. The pancreas can be transected proximal to the tumor together with the splenic vein by an endoscopic linear stapler. Resection can be completed with the division of splenorenal ligament and rest of short gastric vessels.

INSULINOMAS LOCATED AT PANCREATIC HEAD

Enucleation of insulinoma located at the head of the pancreas is technically more demanding because of the lack of tactile sensation and difficult retraction. One 5 mm ports should be inserted to the epigastrium while 1-2 additional 5 or 11 mm ports is required in the right lower quadrant of the abdomen depending the position of the tumors. For tumors located at the posterior surface, a full Kocherization of the duodenum is required and additional retraction is necessary. For anteriorly located tumor, the overlying omentum is freed or divided by the ultrasonic dissector and the tumor should be either seen or located by the LUSG before enucleation with a hook cautery or ultrasonic dissector can be performed. The anatomical location of the tumor also determines the ease of resection and surgical success (Fig. 4B).

PERIOPERATIVE MANEUVERS

Patients routinely receive one dose of intramuscular injection of pneumococcal vaccine before the operation for tumor located at the body or tail of the pancreas in case splenectomy needs to be performed. Prophylactic antibiotics and perioperative sandostatin analogues (octreotide) injections are routinely given to avoid postoperative complications.²⁰ Several surgical techniques and devices, such as the use of fibrin-glue sealing, an ultrasonic dissector or closure of the pancreatic remnant have been advocated to prevent pancreatic fistula but none has been consistently demonstrated to be reliable.²¹⁻²² Fibrin glue (Tissel/Tissucol F4 TM, Immuno AG, Vienna) can be sprayed to the



Figs 4A and B: Intraoperative view by the laparoscope showing the preserved splenic vein after splenic-preserving distal pancreatectomy (A) with small diagram showing the resected specimen (arrow on insulinoma located deep inside the body of pancreas) and the enucleated site at the head of the pancreas (B)

enucleated surface of the pancreas, and an omental patch is used to reinforce the enucleated site to avoid leakage.²³ It is also possible to close the pancreatic stump with interrupted sutures. However, since these methods have no convincing evidence to reduce leakage, the adoption of these strategies is not absolutely essential but is up to the discretion of individual operator.

The specimen is placed inside a sterile plastic bag and is retrieved through the subumbilical port, which is enlarged slightly. When splenectomy is performed, the spleen can be morcellated in the specimen bag before retrieval. A silicone closed suction drain is placed next to the enucleated pancreatic site or the transected pancreatic stump. Intraoperative glucose monitoring is routinely employed to confirm surgical success or alert the presence of multiple tumors. A rebound hyperglycemia (1 to 1.5 mmol/L) within 15 to 20 minutes postexcision confirms the complete removal of tumor and surgical success.

CONCLUSIONS

Laparoscopic pancreatic resection is feasible and safe in selected patients with presumed benign pancreatic tumors including insulinomas. The application of this surgical strategy seems to be more favorable for tumor located at the body and tail or left side of the pancreas and should be associated with enhanced patient recovery as well as improved chance of splenic preservation. Laparoscopic pancreatic resection should be ideal for pancreatic insulinomas, where technical advance can be translated into patient benefit associated with minimally invasive surgery.

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