Intraoperative pancreatography and gastric-wall-covering method for the prevention of pancreatic leakage after enucleation of insulinoma in the pancreas

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Abstract
Pancreatic leakage is one of the most common complications following pancreatic surgery. Although several surgical techniques and several devices for the management of pancreatic ducts have been advocated to prevent pancreatic leakage, its incidence is still not acceptable. We report our new surgical technique, a gastric-wall-covering method, for the prevention of pancreatic leakage in the enucleation of insulinoma in the pancreas, along with intraoperative pancreatography for navigation surgery of the pancreatic duct. Our novel techniques help to prevent pancreatic leakage following pancreatic surgery, including partial resection of the pancreas.

Key words Gastric-wall-covering method · Intraoperative pancreatography · Pancreatic leakage

Introduction
Pancreatic insulinoma is one of the most common functioning islet cell tumors. Most insulinomas are benign and solitary tumors. Insulinomas cause hypoglycemic episodes, including sweating, tremor, nausea, and aberrant behavior. Usually, treatment of solitary pancreatic insulinomas needs surgically complete excision.1 Although the mortality rate of pancreatic surgery has been reduced in recent years, postoperative morbidity still shows a high incidence. Pancreatic leakage is one of the most common complications following pancreatic surgery.2,3 Therefore, several surgical techniques, such as intraoperative pancreatography, ultrasonography, and several devices for the management of pancreatic ducts have been advocated to prevent pancreatic leakage. We report here in our new surgical technique, a gastric-wall-covering method, for the prevention of pancreatic leakage in pancreatic resection, along with intraoperative pancreatography for navigation surgery of the pancreatic duct.

Patient and technique
A 63-year-old Japanese woman with an 8-year history of hypoglycemic episodes, with dizziness, fatigue, and nausea, was admitted to our hospital in March 2005. With an increase in the frequency and intensity of the episodes in the most recent 4 years, she had had an episode of aberrant behavior. Hypoglycemia, with a serum glucose level of 24 mg/dl (normal range, 70–110 mg/dl) was detected, in the presence of a concomitant high insulin level, of 32.8 µU/ml (normal range, 3.0–15.0 µU/ml). Abdominal ultrasonography (US) showed a 2-cm diameter hypoechoic lesion in the head of the pancreas. Abdominal computed tomography (CT) revealed a low-density mass of the same size in the pancreas, and it showed strong staining in the early phase on the contrast-enhanced CT image. Consequently, the tumor was diagnosed as insulinoma of the pancreas, and the patient underwent laparotomy.

Under general anesthesia, we placed an endoscopic nasopancreatic drainage (ENPD) tube (7F; Olympus, Tokyo, Japan) for intraoperative pancreatography prior to laparotomy. The main pancreatic duct was normal in size. After midline laparotomy, the gastrocolic ligament was divided and the pancreas was exposed. The duodenum was mobilized to facilitate access to the head of the pancreas. A hard tumor, approximately 2 cm in diameter, was detected in the head of the pancreas. Detection of the ENPD tube with intraoperative US was quite useful for identifying the direction and position of the main pancreatic duct and the relationship between the tumor and the main pancreatic duct. We performed enucleation of the pancreatic tumor under the guidance of repeated pancreatic US and intraoperative
pancreatography. Intraoperative pancreatography, performed after enucleation of the tumor, clearly demonstrated the main pancreatic duct and the pancreatic branch ducts, and then we detected the leakage of contrast medium from a small branch duct communicating with the main pancreatic duct (Fig. 1). We used indigocarmine mixed with contrast medium for the intraoperative pancreatography to identify the leakage from the pancreatic duct. Thus, we were able to close the pancreatic leakage point appropriately with 4-0 absorbable monofilament sutures. Intraoperative US was also useful to obtain a clear surgical margin. After confirmation of the absence of pancreatic leakage, the ENPD tube was removed. The cut surface after enucleation of the tumor was fixed to the posterior wall of the gastric body to prevent pancreatic leakage from the pancreatic duct, including small pancreatic branch ducts. The fixation was constructed by suturing between the pancreatic parenchyma and the seromuscular layer of the stomach with a 4-0 absorbable monofilament (Fig. 2a). For this anastomosis, we used four sutures. Finally, the cut surface of the pancreas was completely covered by the gastric wall (Fig. 2b). We called this new method for the prevention of pancreatic leakage the “gastric-wall-covering method”.

The operating time was 4 h, and blood loss was 630 ml. Her postoperative course was uneventful. Although there were no signs of pancreatic leakage, such as abdominal symptoms, fever, or skin inflammation around the drain, the amylase level of the fluid in the peritoneal cavity, taken through the drain, was slightly elevated (2415 IU/l) on the third postoperative day. We used a somatostatin analogue to combat this and the amylase level of the discharge rapidly became negligible. The drain was withdrawn on the fourteenth postoperative day and she was discharged home on the twenty-second postoperative day, with a normal glucose level.

Discussion

Pancreatic leakage is one of the most frequent complications and is still responsible for most mortality after pancreatic surgery. Therefore, several surgical techniques for the prevention of pancreatic leakage have been reported. Yamaguchi et al. have reported ductal branch-oriented minimal pancreatostomy for patients with intraductal papillary-mucinous adenoma, using intraoperative pancreatography. They concluded that the intraoperative pancreatography was quite helpful to identify the pancreatic duct for the prevention of injury to the main pancreatic duct. In addition, they used...