5 Stomach-Preserving Pancreaticoduodenectomy

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5.1 Introduction

Whipple first reported pancreaticoduodenectomy with resection of the distal stomach in 1941 [1]. Soon afterwards, the first pylorus-preserving pancreaticoduodenectomy (PPPD) (Fig. 5.1) was performed in 1944 [2]. Classic Whipple's and PPPD are now the most widely used surgical procedures for pancreatic head and periampullary tumors [3]. Whereas the classic Whipple's procedure includes resection of the pancreatic head, duodenum, gallbladder, distal common bile duct, partial jejunum, and distal stomach, in PPPD, the proximal duodenum is transected 3–4 cm distal to the pyloric ring [3]. Delayed gastric emptying (DGE) is one of the most common postoperative complications following PD. The mechanisms underlying DGE remain unclear but may result from the extent of gastric resection, loss of the pylorus, interrupted gastrointestinal neural connections, diabetes, local ischemia, or loss of gastrointestinal hormonal production causing gastroparesis [4]. DGE after PPPD has been attributed to devascularization and denervation of the pylorus with subsequent pylorospasm. Although DGE is not life-threatening, it leads to prolonged hospital stays, which increases hospital costs and decreases patients' quality of life. Decreasing the occurrence of DGE is important in patients undergoing any type of PD [5].

Subtotal stomach-preserving pancreaticoduodenectomy (SSPPD) (Fig. 5.1) was developed to prevent DGE, and several clinical studies have demonstrated that the procedure leads to a reduction in DGE. SSPPD was initially described during the 1990s in Japan [6] and involves dividing the stomach 2–3 cm proximal to the pyloric ring and resecting the entire duodenum distal to the site of transection, thereby removing the pylorus but retaining much of the body of the stomach, which differs from the classic Whipple's procedure [7]. Two different gastrojejunostomies can

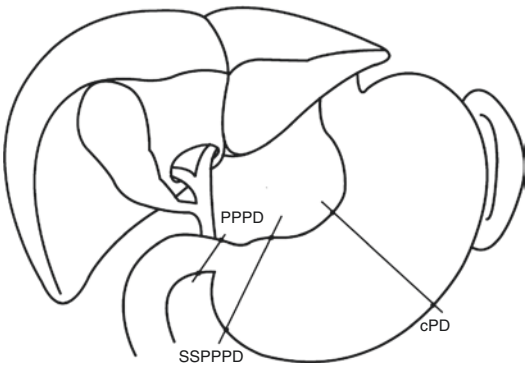

Fig. 5.1 Schematic illustration of the three types of pancreaticoduodenectomy (PD): conventional PD (cPD), SSPPD, and PPPD. In SSPPD, the stomach is resected 2–3 cm proximal to the pyloric ring. cPD, subtotal stomach-preserving pancreaticoduodenectomy; PPPD, pylorus-preserving pancreaticoduodenectomy

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then be performed: end-to-side and side-to-side. The gastric stump is anastomosed to the jejunal loop end-to-side, whereas with side-to-side, the jejunal loop is anastomosed to the greater curvature of the stomach 5–10 cm proximal to the closed gastric stump, and the anastomosis involves only the greater curvature and not the anterior or posterior stomach wall [8].

Several studies have compared SSPPD with PPPD. Kawai et al. in a prospective, randomized, controlled trial of pylorus-resecting versus pylorus-preserving pancreaticoduodenectomy showed that pyloric ring resection decreased the incidence of DGE in patients undergoing pancreaticoduodenectomy [9]. However, another randomized, controlled trial showed that SSPPD was equally effective in decreasing the incidence of DGE and preserving long-term nutritional status compared with PPPD [10]. Huang et al. performed a meta-analysis and reported that patients undergoing SSPPD had a lower incidence of DGE compared with those undergoing PPPD, and that the duration of nasogastric intubation was shorter with SSPPD. Furthermore, there was a tendency towards shorter times to liquid and solid diets, as well as shorter hospital stays, although this tendency did not reach statistical significance [11].

Because SSPPD is a recent development, it is not yet widely used. SSPPD has the theoretical advantage of reducing the incidence of DGE by retaining most of the gastric body but resecting the pyloric complex [11]. Several studies suggested that SSPPD is as safe as PPPD and may be superior to PPPD regarding DGE. However, there is still a need for well-designed randomized, controlled trials comparing SSPPD and PPPD with regard to patients' quality of life and survival outcomes [5].

5.2 Case

The patient was a 55-year-old man admitted to our hospital because of upper abdominal pain for more than 3 months. His skin and sclera had been colored yellow for 2 weeks. Laboratory examinations showed increased liver function tests: total bilirubin: 192.2 μmol/L, direct bilirubin: 153.6 μmol/L, aspartate aminotransferase: 321 U/L, alanine aminotransferase: 754 U/L, alkaline phosphatase: 1093 U/L, and r-glutamyl transpeptidase: 3328 U/L. Levels of the tumor marker CA19-9 were increased at 572 kU/L; CA125 levels were also increased at 83 kU/L, and all other tumor marker levels were within normal reference limits.

Abdominal ultrasonography and abdominal computed tomography showed a mass in the ampullary region, and dilation of the common bile duct and pancreatic duct (Fig. 5.2 a, b). The same findings were found in abdominal magnetic resonance images (Fig. 5.3). Ampullary adenocarcinoma was confirmed by duodenal endoscopy and biopsy.

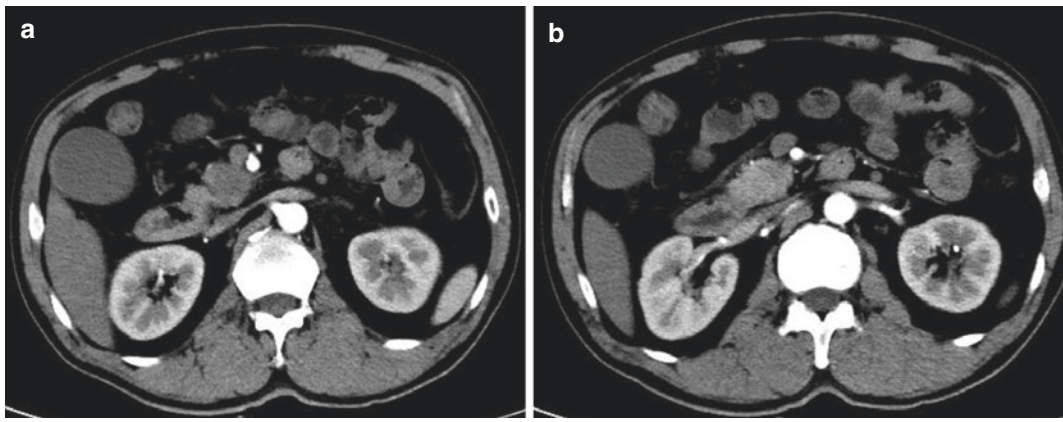

Fig. 5.2 (**a**, **b**) CT image showed a mass in the ampullar region

Fig. 5.3 MRI image also showed a mass in the ampullar region

Based on these findings, a diagnosis of ampullary adenocarcinoma was made, and SSPPD was performed.

Informed consent was obtained from all participating patients, and the ethics committee of Tongji Hospital, Huazhong University of Science and Technology, approved this study.

5.3 Details of the Surgical Procedure

The key steps in the surgery included the approach, lymphadenectomy, transecting the pancreas and jejunum, dividing the uncinate process, and pancreaticojejunal anastomosis, hepaticojejunostomy, or cholecystojejunostomy as described in the classic Whipple's and PPPD procedures.

SSPPD involved dividing the stomach 2 cm proximal to the pyloric ring and resecting the entire duodenum distal to the transection site, as well as excising the gallbladder, distal common bile duct, and pancreatic head. The pyloric ring was carefully identified and clearly isolated. Then, a dividing line was marked using an electrotome. All of the blood vessels to the stomach were carefully preserved. Following the marked line, the gastric antrum was divided using a surgical stapler and cutter.

We chose side-to-side gastrojejunostomy for this patient. The stomach stump was closed, and the jejunal loop was anastomosed to the greater curvature 5–10 cm proximal to the closed gastric stump. The anastomosis involved only the greater curvature and not the anterior or posterior stomach wall. The gastrojejunostomy was performed with a two-layer anastomosis using the Gambee technique with 4-0 monofilament absorbable sutures followed by antecolic reconstruction. The opening of the anastomosis was approximately 5 cm in length, and a nasogastric tube was maintained, intraoperatively. The nasogastric tube was removed when the drainage volume decreased to <400 mL on postoperative day 1. A clear liquid diet was introduced on postoperative day 1, and solid food intake was introduced on postoperative day 3. Octreotide (Sandostatin®, Novartis Pharmaceuticals Corp., East Hanover, NJ) and proton-pump inhibitors were used perioperatively.

5.4 Pathology and Prognosis

The patient's pathological diagnosis was well to moderately differentiated duodenal papillary adenocarcinoma. The mass measured 2 cm in diameter and had not invaded the plexus, portal, or venous systems. Neither did the tumor involve the pancreatic head, cut margin of the common bile duct, pancreatic margin, stomach, or duodenum. Twelve lymph nodes, including three peripancreatic lymph nodes, three superior mesenteric artery lymph nodes, one No.16 lymph node, and five No.12 lymph nodes were totally excised, and none were positive.

The patient recovered uneventfully, was discharged 12 days after the operation, and experienced no DGE. Six months after surgery, follow-up computed tomography and tumor marker examinations revealed no recurrence.

5.5 Comment

DGE is one of the most common complications after pancreaticoduodenectomy and has been reported to occur in 1–6% of patients [4]. SSPPD was introduced more recently as an alternative to PPPD to maintain the pooling ability of the stomach and to reduce the incidence of DGE by

retaining most of the gastric body but resecting the pyloric complex [11]. Most studies report that SSPPD is associated with a lower incidence of DGE compared with PPPD. However, considering the studies' designs, the results might not have completely elucidated the correlation between DGE and other perioperative complications. Therefore, standardized, randomized, prospective studies would help determine whether DGE is associated with other risk factors and postoperative complications, or whether this complication results from a specific surgical technique [5].

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