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Measure of pancreas transection and postoperative pancreatic fistula

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ABSTRACT

Background: In pancreaticoduodenectomy (PD), a standard protocol for pancreas transection has not been established although the method of pancreas transection might be involved in the occurrence of postoperative pancreatic fistula (POPF). This study aimed to compare whether pancreas transection by ultrasonically activated shears (UAS) or that by scalpel contributed more to POPF development.

Methods: A prospective database of 171 patients who underwent PD for periampullary tumor at National Cancer Center Hospital East between January 2010 and June 2013 was reviewed. Among the 171 patients, 93 patients with soft pancreas were specifically included in this study. Surgical results and background were compared between patients with pancreas transection by UAS and scalpel to evaluate the effectiveness of UAS on reducing POPF.

Results: Body mass index, main pancreatic duct diameter, or other clinicopathologic factors that have been reported as predictive factors for POPF were not significantly different between the two groups. The incidence of all grades of POPF and that of grade B were significantly lower in the scalpel group (52%, 4%) than in the UAS group (74%, 42%). Postoperative complications ≥ grade III were also significantly fewer in the scalpel group.

Conclusions: Scalpel transection was less associated with POPF than UAS transection in patients who underwent PD for soft pancreas. The method of pancreas transection plays an important role in the prevention of clinical POPF.

Introduction

Postoperative pancreatic fistula (POPF) is a serious complication of pancreaticoduodenectomy (PD), which results in prolonged hospital stay [1,2], increased cost [2,3], and a higher mortality rate that ranges from 3% to 15% [4,5]. Preventing POPF is crucial to performing safe PD [6,7]. To reduce the occurrence of POPF, several measures have been used, such as various types of pancreaticoenteric anastomosis [8–10], prophylactic use of perioperative somatostatin [11,12], and pancreatic duct stenting [13–15]. However, a standard procedure for minimizing the incidence of POPF has not been established.

Minor pancreatic fistula, which originates from pancreatic duct branch or parenchyma at the pancreas cut surface, is thought to be a trigger that provokes major POPF, involves duct-to-mucosa anastomosis, and result in more than POPF grade B, in most types of pancreatico-digestive tract anastomoses [16–18]. Pancreatic fluid from a minor fistula at the pancreatic surface might sometimes cause consequent

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disruption of the duct-to-mucosa anastomosis. Therefore, the method of pancreas transection, which affects the condition of the pancreas cut surface, is presumably associated with POPF.

Ultrasonically activated shears (UAS) is a surgical instrument to cut and coagulate tissues simultaneously, using energy generated from ultrasonic vibration. Frictional heat created by UAS with the property of lower maximum and slower increase in tissue temperature is beneficial to stronger thermal coagulation and less heat injury than that by electrocautery. UAS has been used in general surgeries, including laparoscopic surgeries and open surgeries of lung, liver, and so forth. Currently, several studies have reported that pancreas transection by ultrasonically activated scalpel and shears might have an advantage over the other transection methods in preventing minor pancreatic fistula by sealing small branches of the pancreatic duct at the cut surface [17,19,20]. On the other hand, transection by ultrasonically activated devices might have a disadvantageous effect on regional wound healing because of coagulation necrosis or thermal artifact at the cut surface [21].

Then, it is obscure whether UAS pancreas transection decreases POPF through effect on transection surface in comparison with scalpel-transection, which has been one of the community standards. Therefore, we assessed correlations between POPF and patient and operative factors in patients who underwent PD for soft pancreas to test the hypothesis that pancreas transection by ultrasonically activated shears (UAS) reduced POPF compared with scalpel.

Materials and methods

Patient population and data collection

This study comprised an analysis of data registered prospectively from patients undergoing PD at National Cancer Center Hospital East between January 2010 and June 2013. During the study period, at least one of the experienced surgeons who had performed more than 100 PDs (S.T., M.K., N.G., or Y.K.) took part in each PD operation. Pancreatic texture was assessed intraoperatively by one of the aforementioned surgeons and recorded routinely. As described subsequently, the operative procedure and perioperative management—except the method of pancreas transection—were standardized during the study period. The study was approved by the institutional review board of the National Cancer Center.

Operative procedure

Patients typically underwent subtotal stomach-preserving PD. Basically, a D2 lymphadenectomy, including the nodes along the common hepatic artery and superior mesenteric artery, and the regional lymph nodes around the pancreas and the hepatoduodenal ligament, was performed. Dissection of the para-aortic lymph nodes was not routinely performed. The operative procedure generally included resection of the nerve plexus around the superior mesenteric artery (half on the tumor side), the nerve plexus around the common hepatic artery, and the celiac plexus. When the portal vein (PV) or superior mesenteric vein (SMV) was involved, PV/SMV resection was performed if reconstructible.

For enteric reconstruction of the pancreatic stump, end-to-side pancreaticojejunostomy was performed using the modified technique first described by Kakita *et al.* [22]. In brief, for the outer layer, two to four interrupted sutures penetrating the pancreatic parenchyma and picking up the seromuscular layer of the jejunum were placed using 3-0 nonabsorbable monofilament sutures with a straightened needle (Figs. 1A, 2A). Next, the pancreatic duct and full-thickness jejunal wall were fixed as the inner layer with eight to 14 interrupted stitches using 5-0 or 6-0 absorbable monofilament sutures (Figs. 1B, 2A). A 6-Fr short internal drainage tube was placed through the pancreatic duct (Figs. 1C, 2B). Then, approximation of the jejunal wall and the pancreatic stump was accomplished with ligation of the outer layer stitches to fully cover the cut surface of the pancreas (Figs. 1D, 2B). No autologous grafts, artificial grafts, or sealing agents were applied for coverage of the anastomosis. Jackson–Pratt type closed suction drains were placed near the pancreaticojejunal and choledochojejunal anastomoses.

Pancreas transection

Transection by scalpel

After ligation of the pancreas on the right side of the planned transection line, the pancreas was transected by scalpel. The supratransverse pancreatic artery and the other observed thin arteries, which ran laterally near the transection line were suture-ligated before transection. Hemostasis of every bleeding point at the pancreatic stump was performed by suture-ligation with 5-0 nonabsorbable monofilament sutures. No blood flow control of the remnant pancreas such as by intestinal clamp was applied during the aforementioned procedures (Fig. 3A).

Transection by UA shears

The HARMONIC FOCUS curved shears and Ethicon G300 Gen 04 Ultracision Harmonic Scalpel Surgical Generator (Ethicon Endo-Surgery Inc, Cincinnati, OH) were used as the handpiece and generator. The power level was set at 3 (Fig. 3B).

The pancreas was transected using the UA shears except for the main pancreatic duct (MPD). The MPD was cut by scalpel to avoid damaging the portion to be sutured. Hemostasis of bleeding at the pancreatic stump was performed by electrocautery or suture-ligation.

Selection of pancreas transection method

Scalpel transection was adopted for all PDs between 2010/1/1 and 2010/9/30, whereas UAS transection was performed as the routine procedure between 2010/10/1 and 2012/6/30. After those periods, between 2012/7/1 and 2013/6/30, scalpel transection was always performed in the PDs, which the surgeon (S.T.) attended. UAS transection was always performed in the PDs, which one of the other surgeons (M.K., N.G., or Y.K.) attended, regardless of pancreas texture or the patient's condition.