



Short postoperative hospital stay after pancreaticoduodenectomy: what is real minimally invasive surgery?

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Pancreaticoduodenectomy (PD) is performed for patients with tumors located in the region of the head of the pancreas, including cancer of the head of the pancreas, periampullary cancer, and distal bile duct cancer. PD is considered one of the most difficult and invasive surgeries in hepato-biliary-pancreatic surgeries because it requires meticulous techniques both in resection and reconstruction. Moreover, postoperative complications such as postoperative pancreatic fistula (POPF) and delayed gastric emptying (DGE) sometimes occur after PD, which leads to relatively higher mortality and longer postoperative hospital stay compared with other digestive surgeries. In PD, laparoscopic and robotic surgeries, called minimally invasive surgery (MIS), have recently been introduced. However, the incidence of postoperative complications and the length of the postoperative hospital stay have not decreased significantly after the introduction of such MIS (1-3).

In East Asia, the average postoperative hospital stay after PD is around 3 weeks. Despite the recent introduction of the enhanced recovery after surgery (ERAS) program to hepato-biliary-pancreatic surgeries, the postoperative hospital stay after PD is still longer than after other hepato-biliary-pancreatic surgeries such as hemihepatectomy and distal pancreatectomy.

Peter Drucker [1909–2005], known as the father of management, emphasized the importance of marketing and innovation in the business world. This idea definitely seems to be applicable to the medical field. If we focus on the long postoperative hospital stay after PD, we should consider the reasons why the postoperative hospital stay is long in PD. First, postoperative complications such as POPF and

DGE, which need drainage and sometimes fasting, prevent early discharge from hospital. Second, the application of the ERAS program to PD is still insufficient. Third, many patients for whom PD is planned are malnourished and have sarcopenia. We thought that if we could resolve these issues, the postoperative hospital stay would be naturally shortened. In this editorial, we would like to introduce our efforts to shorten the postoperative hospital stay after PD and our latest results. Moreover, we would like to discuss what real MIS is.

Our efforts to shorten postoperative hospital stay after PD can be divided into three parts: preoperative, intraoperative, and postoperative. We think that assessment and intervention are basic principles in every field, including perioperative management in PD. Preoperatively, we routinely assess patients' muscle strength and nutritional condition. We reported that preoperative sarcopenia was closely related to outcomes after hepato-biliary-pancreatic surgeries including hepatectomy and PD (4-9). Skeletal muscle mass (SMM) is usually evaluated by cross-sectional imaging such as computed tomography (CT) or magnetic resonance imaging (MRI) and a body composition analyzer, such as bioelectrical impedance analysis (BIA). Interestingly, both the European Working Group on Sarcopenia in Older People and the Asian Working Group for Sarcopenia most recently revised the sarcopenia diagnostic algorithm in 2019 and recommended to first measure muscle strength for early identification of people with, or at risk for, sarcopenia (10,11). In clinical settings, measurement of hand grip strength (HGS) is simpler, as well as more cost-effective, than evaluation of SMM using CT, MRI, and BIA. We also reported that there was a significant strong positive

correlation between SMM and HGS (12). Therefore, we consider that HGS can be a surrogate marker of SMM. Based on this idea, we started to assess HGS in patients planned for PD after April 2020. If HGS is less than 28.0 kg for men and less than 18.0 kg for women, patients undergo aggressive exercise intervention by rehabilitation staff in addition to a self-exercise training program at home. As for nutritional assessment, we focused on prealbumin (PA) and zinc among the various nutritional parameters. PA, or transthyretin, is one of the rapid turnover proteins with a short (1.9 days) half-life. We started a nutritional intervention using a nutritional formula for patients with a serum PA level less than 15 mg/dL. Zinc, an essential trace element, plays various pivotal roles in the human body and is needed for the activation of more than 300 enzymes. Serum zinc deficiency is known to induce impaired wound healing, appetite loss, and deterioration of immune function (13,14), which would prevent postoperative early recovery. Therefore, we give oral zinc tablets to patients with a serum zinc level less than 80 µg/dL.

Intraoperatively, we perform meticulous surgery to prevent postoperative complications with the idea that we can shorten postoperative hospital stay if major postoperative complications do not occur, especially in reconstruction. Our standard PD is open subtotal stomach-preserving PD. We prefer the modified Child reconstruction. For example, we clearly established our stent placement policy in pancreatico-jejunostomy (modified Blumgart's method): no stent for a hard pancreas with main pancreatic duct (MPD) diameter equal to or more than 7 mm; placement of a 4-Fr tube into the MPD for external incomplete pancreatic juice drainage for a soft pancreas with an MPD diameter equal to or less than 3 mm; and a lost stent for the other conditions. As for prevention of DGE, we perform gastro-jejunostomy using an automatic suture device to create an oblique anastomosis by elevating the afferent jejunal loop side. Moreover, we place the gastro-jejunostomy to the left abdomen to enable straight flow from the stomach to the efferent jejunal loop.

Postoperatively, early mobilization, early oral intake, and early drain removal are essential. Patients start ambulation and drink clear water at 9 am on postoperative day (POD) 1. After confirmation of the absence of DGE by upper gastrography on POD 3, patients take their first meal with nutritional guidance by dietitians. As for drainage, we usually place two drains into the foramen of Winslow and the dorsal side of the pancreatico-jejunostomy. We daily check the color, amount, and pancreatic amylase level of the

drainage fluid from each drain. In principle, we remove each drain if the pancreatic amylase level of the drainage fluid of each one decreases to less than 1,000 U/L. We perform blood biochemical examinations on PODs 1, 3, and 5 and CT on POD 6. If there are no significant abnormal findings and patients can eat a moderate meal, the patients can be discharged from the hospital.

We have implemented the above policy since April 2020 and retrospectively examined its validity. The study protocol was approved by the Ethics Committee of St Luke's International Hospital (approval number 20-R104) and was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Twenty-one consecutive patients who underwent open PD with curative intent by July 2021 were enrolled. The patients' characteristics and intraoperative findings are shown in *Table 1*. Five of 21 patients (24%) were over 80 years old. The preoperative diagnosis was cancer of the head of the pancreas in 9, distal bile duct cancer in 6, periampullary cancer in 2, and so on. The median operative time was 496 min, and median operative blood loss was 380 mL.

Postoperative outcomes are shown in *Table 2*. Grade B POPF was found in 2 patients (10%). No DGE was found. The median day of drain removal was POD 3. The median postoperative hospital stay was 8 days, ranging from 6 to 26 days. All patients returned to their own homes. Only 1 patient was readmitted to our hospital within 2 weeks after surgery due to appetite loss. These findings show that our new protocol, which consists of appropriate preoperative intervention (exercise and nutritional intervention based on accurate assessment), perioperative management considering ERAS, and performance of meticulous surgery with less complications could definitely achieve early discharge from hospital after PD.

Today, laparoscopic and robotic surgeries are called MIS worldwide, because these surgeries are considered to be less invasive in terms of their short-wound length. Recently, such MIS is being enthusiastically performed in various kinds of surgeries including PD. We have also introduced these surgeries in our department. However, we should bear in mind that performance of MIS should not be the objective, but one of the modalities. If not safely performed, such MIS can cause severe postoperative complications leading to a long postoperative hospital stay or, if uncontrolled, death. As for PD, we have not yet introduced such "MIS". If the postoperative hospital stay is 3 weeks or longer after laparoscopic or robotic PD with or without major postoperative complications, should it really

Table 1 Characteristics of patients

Characteristic	Data
Age (y)	68 [46–84]
Sex	
Male/female	14/7
Original disease	
Pancreas head cancer	9 (43.0)
Distal bile duct cancer	6 (29.0)
Ampullary cancer	2 (10.0)
Pancreas body cancer	1 (5.0)
IPMN	1 (5.0)
Gastrinoma	1 (5.0)
Solitary fibrous tumor	1 (5.0)
Operative procedure	
SSPPD/PD	19/2
Operative time (min)	496 [429–719]
Blood loss (mL)	380 [70–1,155]
Pancreatic texture	
Soft/hard	10/11
Stent tube into MPD	
No/lost/incomplete	5/11/5

Data are presented as n (%) or median [range]. IPMN, intraductal papillary mucinous neoplasm; SSPPD, substomach preserving pancreaticoduodenectomy; PD, pancreaticoduodenectomy; MPD, main pancreatic duct.

Table 2 Postoperative outcomes

Outcome	Data
First ambulation (POD)	1 [1–2]
First meal (POD)	4 [3–4]
Drain removal (POD)	3 [2–25]
Postoperative complications	
POPF (grade B/C)	2/0
Delayed gastric emptying	0
Postoperative hospital stay (day)	8 [6–26]
Readmission within 2 weeks after discharge	1

Data are presented as n or median [range]. POD, postoperative hospital stay; POPF, postoperative pancreatic fistula.

be called MIS? Although all patients underwent PD by open surgery in this cohort, we can surely say that early discharge from hospital at around 8 days would be physically and economically less invasive for patients. We think that this is “real MIS”. In other words, whether a procedure is real MIS should be judged by outcomes, not by the surgical modality.

Once again, we should bear in mind that performance of MIS should not be the objective, but one of the modalities. We should select the appropriate surgical modality for each patient considering the conditions of the patient and the tumor. In conclusion, “real MIS” is not surgery performed by laparoscopic or robotic surgery, but surgery that provides good outcomes with early recovery for patients, irrespective of the surgical modality. To achieve such “real MIS”, adequate preoperative intervention, perioperative management, and meticulous surgery are mandatory.

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