A novel minimally invasive approach for chronic pancreatitis: combination of Frey procedure and laparoscopic distal pancreatectomy

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Technical advance
Abstract

Background: The treatment of chronic pancreatitis requires a surgical approach in patients refractory to medical therapy. During surgical treatment, ductal decompression is required, but a pancreatectomy is necessary for some patients, such as those with severe stenosis of the pancreatic duct. Importantly, inadequate procedures lead to recurrent pancreatitis. We used a novel minimally invasive approach for patients with severe stenosis of the pancreatic duct. In this report, we aim to present the feasibility and outcomes of our approach.

Methods: We selected a laparoscopic approach for the distal pancreatectomy because these parts are relatively safe and the effect of reducing the length of the wound is substantial. We selected an open approach for parts of the Frey procedure because complete ductal compression has a high risk for injury to the vessels posterior to the pancreas. We examined operative outcomes, postoperative complications and recurrence of pancreatitis.

Results: Our approach was performed in three patients from January 2018 to December 2018. No intraoperative complications occurred and the postoperative course was uneventful in all patients. There were no recurrence of pancreatitis and no postoperative pain in all patients in the over two years follow-up.

Conclusion: Our hybrid method focusing on complete ductal compression with safety and minimal invasiveness is the optimal approach for the surgical treatment of chronic pancreatitis which requires a pancreatectomy with the Frey procedure.

Background

Chronic pancreatitis (CP) includes a wide range of progressive fibro-inflammatory diseases of the pancreas and leads to failure of exocrine and endocrine pancreatic function [1]. Currently, the treatment methods for CP have focused on the management of pain, complications (i.e., duodenal, biliary, and pancreatic obstruction, and pancreatic pseudocysts), and pancreatic insufficiency [2]. The initial treatment for CP is often medical therapy, but endoscopic therapy is often performed for patients refractory to medical therapy; however, randomized controlled studies have shown that surgery results in significantly greater and more durable pain relief than endoscopic therapy [3, 4]. Many different surgical strategies are used for the various manifestations of CP [5]. The Frey procedure and distal pancreatectomy is a tolerable and useful operation for CP with dilation of the main pancreatic duct and symptomatic lesions in the pancreatic head and tail (Fig. 1, 2) [6]. Our surgical procedure for CP, which is necessary for distal pancreatic resection, is a hybrid approach involving a laparoscopic distal pancreatectomy and an open Frey procedure. From the standpoint of minimal invasiveness, we perform mobilization of the distal pancreas and ligation of the splenic artery laparoscopically. We do not perform the Frey procedure laparoscopically because we think that the safest Frey procedure is a hand-assisted approach in which a hand is placed posterior to the head of the pancreas for coring out the head of the
pancreas. We herein report our surgical procedure for patients who have a need for a distal pancreatectomy and the Frey procedure.

**Methods**

**Surgical procedures**

The patient was placed in the lithotomy position. First, a 12-mm trocar was inserted in the umbilicus using an open method to accommodate a 10-mm rigid laparoscope. Another 12-mm trocar and three 5-mm trocars were then inserted. The abdominal cavity was explored with a pneumoperitoneum maintained at 10 mmHg with CO$_2$.

The first step was full mobilization of the spleen and ligation of the splenic vessels, if possible. After dissecting the greater omentum, the gastro-phrenic ligament was transected, including the short gastric vessels, until confirmation of the upper border of the spleen. The stomach was lifted through three tapes after dissecting the lesser omentum. Next, the distal portion of the pancreas was dissected at the lower edge of the pancreas and the splenic flexure of the left colon was mobilized. The dorsal aspect of pancreas was dissected at the layer of the fusion fascia, but recognition of that layer was often very difficult because of inflammation. Finally, we try to expose and ligation of the splenic vessels in principle. The vessels in patients with chronic pancreatitis are often atherosclerotic, so dissection of the splenic vessels sometimes seems risky. In such a case, it seems preferable to dissect these vessels after laparotomy to prevent unexpected bleeding in patients with inflammation. But in all our three cases, we could perform the ligation of the splenic vessels before laparotomy. I think that this was because the magnifying effect, and its effect made the ligation of the splenic vessels possible. The splenic artery was identified arising from the celiac artery and carefully divided at the roots. The splenic vein was isolated at the bifurcation of the portal vein and encircled by a vessel loop (Fig.3). Although pancreatic dissection has not been performed yet, most of the steps of distal pancreatectomy were finished by these procedures.

The second step was a laparotomy with a small incision (about 10cm) and then the Frey procedure and pancreaticojejunostomy. After a mini-laparotomy was performed, kocherization was performed to create an adequate space for hand-assisted procedures posterior to the pancreas head. Next, transection of the pancreas and ligation of the splenic vessels were performed. The anterior aspect of the head of the pancreas was exposed for preparation of the Frey procedure and the main pancreatic duct was incised. The gastroduodenal artery was ligated and stitched to prevent bleeding while performing the Frey procedure. Coring out the pancreas and removal of the pancreatic calculus were performed completely with hand assistance posterior to the pancreas to avoid injury to the splenic vein. Finally, pancreaticojejunostomy was carefully performed while directing attention to cover the stump of the body of the pancreas. Surgical drains were placed at the cranial and caudal ends of the pancreaticojejunostomy (Fig. 4).
Results

We performed our procedures for three patients from January 2018 to December 2018. There were 35 years old woman, 59 years old man and 70 years old man. These causes of CP were alcoholic pancreatitis. The average of the disease period from onset was about 13 years. We considered Frey procedure to be indicated because of the presence of pancreatic head stones in all cases. And because of the findings in the pancreatic body and tail lesions, we thought that it was necessary to perform DP at the same time. Indeed, the indications of DP were that one case was the presence of pancreatic pseudocyst about 45mm diameter of the pancreatic tail and two cases were severe stenosis of main pancreatic duct of pancreatic body. Since we considered that the main pancreatic duct could not be fully opened in two cases of severe stenosis, we performed DP. The mean operative time was 503 min (Laparoscopic 232 min, open 271 min), the mean intraoperative bleeding was 474 ml and the mean postoperative hospital stay was 16 days. There were no morbidity and no mortality. With over 2 years follow-up, there were neither recurrence of pancreatitis nor postoperative pain. All three cases were released from the abdominal pain and successfully rehabilitated. As long-term outcomes, there was no new occurrence of diabetes and the serum albumin level was improved after surgery. The change of serum albumin level before and 1 year after surgery was 0.4 g/dl.

Discussion

The initial treatment for CP is often medical therapy, but for the patient refractory to medical therapy, endoscopic or surgical therapy is an alternative. One recent meta-analysis compared endoscopic and surgical interventions in patients with CP and concluded that surgery is a promising approach in the treatment of CP, with the obvious advantage of pain relief, which is difficult to achieve with medical treatment [7]. One study reported that earlier surgical drainage of the obstructed pancreatic duct led to better recovery of histologic changes and pancreatic exocrine dysfunction compared with late surgical drainage in an experimental model of obstructive pancreatitis [8].

A case of CP which has severe stenosis of the pancreatic duct is necessary not only for the Frey procedure, but also pancreatectomies (Figs.1-4). One study reported that Frey with DP can be a promising treatment for CP patients with pancreatic head and tail lesions[6]. We selected the hybrid approach in these cases. Minimal invasiveness is a very important point for the treatment of CP, which is a benign disease, even though the case is refractory to medical therapy. Benign pancreatic disease is a good indication for laparoscopic surgery[9]. There is one study which reported that laparoscopic distal pancreatectomy was associated with favorable perioperative outcomes compared with open distal pancreatectomy[10]. We selected a laparoscopic approach before performing the Frey procedure, attaching great importance to the minimal invasiveness. The new point of this procedure is hybrid approach. An incomplete Frey procedure must be avoided. It is essential that the Frey procedure (coring out of the pancreas and removal of the pancreatic calculus) be completed for treatment of CP. We do not perform these procedures laparoscopically for safety reasons and to ensure completion of the procedure.
Our hybrid procedure is the best approach from the viewpoint of safety and minimal invasiveness. We think that the procedure based on these concepts contains novelty.

The key points of our hybrid procedures are selecting two approaches for the appropriate situation. We selected the laparoscopic approach for situations which can be performed safely from the viewpoint of minimal invasiveness and selected an open approach for the situations which are high risk from the viewpoint of safety. For example, the former situation is the distal pancreatectomy and the latter situation is the coring out of the head of the pancreas. Our institute performed the hybrid approach for CP, which is necessary for resection of the pancreas with the Frey procedure. We have not experienced open approach for these cases, so we compared this new method with the open approach for only Frey and only DP. These results indicated that the perioperative results of our new method were relatively good (Table 1). In our hospital, we basically use a clinical path for pancreatic surgery, and if no complications is found, the diet will start on the 5th day after surgery, and the patient will be discharged in about two weeks in the case of DP. Since reported cases also used this clinical path, the mean postoperative hospital stay was 16 days.

| Table 1. Perioperative data of three procedures |
|-----------------------------------------------|
| Frey+LapDP (n=3) | Frey (n=13) | OpenDP (n=1) |
| Operative time, median (range), min | 503 (358-637) | 496 (284-708) | 368 (300-40) |
| Blood loss, median (range), mL | 474 (405-601) | 644 (191-3124) | 1416 (435-406) |
| Pancreatic fistula (Grade B,C), n (%), | 0 | 1 (7.7) | 3 (50) |
| Intraabdominal abscess, n (%), | 0 | 1 (7.7) | 2 (33) |
| Postoperative bleeding, n (%), | 0 | 0 | 0 |
| Morbidity (Clavien-Dindo Grade III, IV), n (%), | 0 | 2 (15.4) | 2 (33) |
| Mortality, n, | 0 | 0 | 0 |
| Postoperative hospital stay, median (range), day | 16 (14-19) | 23 (11-33) | 30 (19-4) |

An incomplete Frey procedure is associated with a risk of CP recurrence. Sometimes operation time became long because of the severe inflammation and the needs of a reliable coring out of the head of pancreas under such situations. To perform a complete Frey procedure safely, hand assistance is very useful to prevent injury to the splenic vein. We placed our hand posterior to the head of the pancreas to confirm the depth of coring out and the distance to the splenic vein. We are of the opinion that mini-laparotomy does not add a large incision because a 5-cm wound is needed for extraction of the distal pancreas in any case. We performed the Frey procedure completely to raise the success rate in achieving long-term pain relief.
Conclusion

Our hybrid approach, with a focus on safety and minimal invasiveness, is best for the surgical treatment of CP, which is necessary for pancreatotomy and the Frey procedure.

Abbreviations

CP: chronic pancreatitis

Declarations

Ethics approval and consent to participate: All the procedures performed in this study were carried out in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments.

Consent for publication: Written informed consent was obtained from all patients.

Availability of date and materials: The datasets used during the current study are available from the corresponding author on reasonable request.

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Authors’ Contributions:

- Study conception and design: KS, YM
- Acquisition of data: GU, KO, HI
- Analysis and interpretation of data: YH, KT, MM
- Drafting of manuscript: KS, RO, HT
- Critical revision of manuscript: IN, KH, HK, ST

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References

1. Majumder S, Chari ST: Chronic pancreatitis. Lancet (London, England) 2016, 387(10031):1957-1966.
2. Issa Y, Bruno MJ, Bakker OJ, Besselink MG, Schepers NJ, van Santvoort HC, Gooszen HG, Boermeester MA: Treatment options for chronic pancreatitis. Nature reviews Gastroenterology & hepatology 2014, 11(9):556-564.
3. Dite P, Ruzicka M, Zboril V, Novotny I: A prospective, randomized trial comparing endoscopic and surgical therapy for chronic pancreatitis. *Endoscopy* 2003, 35(7):553-558.

4. Cahen DL, Gouma DJ, Nio Y, Rauws EA, Boermeester MA, Busch OR, Stoker J, Lameris JS, Dijkgraaf MG, Huibregtse K et al: Endoscopic versus surgical drainage of the pancreatic duct in chronic pancreatitis. *The New England journal of medicine* 2007, 356(7):676-684.

5. Zhao X, Cui N, Wang X, Cui Y: Surgical strategies in the treatment of chronic pancreatitis: An updated systematic review and meta-analysis of randomized controlled trials. *Medicine* 2017, 96(9):e6220.

6. Sato H, Ishida M, Motoi F, Sakata N, Aoki T, Suzuki H, Yamamura A, Karasawa H, Hata T, Ohtsuka H et al: Combination of longitudinal pancreaticojejunostomy with coring-out of the pancreatic head (Frey procedure) and distal pancreatectomy for chronic pancreatitis. *Surgery today* 2019, 49(2):137-142.

7. Ahmed Ali U, Pahlplatz JM, Nealon WH, van Goor H, Gooszen HG, Boermeester MA: Endoscopic or surgical intervention for painful obstructive chronic pancreatitis. *The Cochrane database of systematic reviews* 2015(3):Cd007884.

8. Lamme B, Boermeester MA, Straatsburg IH, van Buijtenen JM, Boerma D, Offerhaus GJ, Gouma DJ, van Gulik TM: Early versus late surgical drainage for obstructive pancreatitis in an experimental model. *The British journal of surgery* 2007, 94(7):849-854.

9. Inomata M, Shiroshita H, Uchida H, Bandoh T, Akira S, Yamaguchi S, Kurokawa Y, Seki Y, Eguchi S, Wada N et al: Current status of endoscopic surgery in Japan: The 14th National Survey of Endoscopic Surgery by the Japan Society for Endoscopic Surgery. *Asian journal of endoscopic surgery* 2020, 13(1):7-18.

10. Nakamura M, Wakabayashi G, Miyasaka Y, Tanaka M, Morikawa T, Unno M, Tajima H, Kumamoto Y, Satoi S, Kwon M et al: Multicenter comparative study of laparoscopic and open distal pancreatectomy using propensity score-matching. *Journal of hepato-biliary-pancreatic sciences* 2015, 22(10):731-736.