The American Journal of Surgery xxx (2018) 1–5

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Original article

Effect of pre-firing compression on the prevention of pancreatic fistula in distal pancreatectomy

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ARTICLE INFO

Article history:
Received 19 June 2017
Received in revised form
12 February 2018
Accepted 23 March 2018

Keywords:
Distal pancreatectomy
Pancreatic fistula
Pre-firing compression
Stapler

ABSTRACT

Background: Postoperative pancreatic fistula (POPF) is a major complication of distal pancreatectomy (DP). Several procedures for resection and closure of the pancreas have been proposed; however, the rate of POPF remains high. The aims of this study were to investigate the relationship between perioperative factors and POPF and to clarify the advantages of pre-firing compression of the pancreas in the DP.
Patients and method: From 2008 to 2016, records of 75 patients who underwent DP were retrospectively reviewed. The relationship between the perioperative factors and clinically relevant POPF was investigated.
Results: Univariate analysis showed that body mass index, thickness of the pancreas, and pre-firing compression were significantly related with clinically relevant POPF. Multivariate analysis showed that the pre-firing compression was an independent factor of clinically relevant POPF (OR = 44.31, 95% CI = 3.394–578.3, $P = 0.004$).
Conclusions: Pre-firing compression of the pancreas can prevent clinically relevant POPF in DP.

1. Introduction

Distal pancreatectomy (DP) is a common operation in pancreatic surgery. Postoperative pancreatic fistula (POPF) is a major complication of DP, and its rate of occurrence remains high, ranging from 13% to 64%.[1–3] POPF leads to prolonged hospitalization, increased cost of treatment, and death as the worst possible outcome.

Several procedures for managing the pancreatic remnant stump, such as hand-sewn suture closure, stapler closure, pancreatoenteric anastomosis, and sealing with several materials including fibrin glue, have been proposed to reduce the rate of POPF in the DP. Some literature reported that stapler closure was superior to hand-sewn closure in preventing POPF,[2,4] but there is no crucial difference between hand-sewn and stapler closures.[3,5,6] We have performed stapler closure in DP and have used the technique of pre-firing compression of the pancreas since 2013 to decrease the rate of POPF.

The aim of this study was to investigate preoperative and operative factors including pre-firing compression of the pancreas and their influence on the risk of POPF following DP.

2. Patients and methods

2.1. Patients

Seventy-five patients who underwent DP in the Department of Gastroenterological and Pediatric Surgery, Oita University from 2008 to 2016 were enrolled in this study. Patient characteristics and surgical findings were examined retrospectively. The mean age was 64 ± 17 years. Of these 75 patients, 33 were women and 42 were men (Table 1). Diagnoses were pancreatic cancer in 27 patients and others in 48 (intraductal papillary mucinous neoplasms in 17, neuroendocrine neoplasms in 12, metastatic pancreas tumors in 4, mucinous cystic neoplasms in 3, solid pseudopapillary neoplasms in 2, serous cystic neoplasms in 2, epidermoid cysts in 2, and others in 6). All patients underwent blood tests and enhanced computed tomography. We measured the thickness of the pancreas which preoperative computed tomography showed at the transected line based on the operation record, previously described.[7] The mean thickness of the pancreas was found to be 11.3 ± 3.4 mm. We followed the ethical principles stated in the guidelines of the World Medical Association's Declaration of Helsinki in this study. This study was approved by the ethics committee of Oita University Faculty of Medicine.

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https://doi.org/10.1016/j.amjsurg.2018.03.023
0002-9610/

Table 1
Patient characteristics.

No. of patients	75
Patient characteristics	
Age (years)	64 ± 17
Sex (female/male)	33 (44.0%)/42 (66.0%)
Body mass index (kg/m2)	23.1 ± 3.7
Serum albumin (g/dl)	4.1 ± 0.5
Diagnosis (pancreatic cancer/others)	27 (36.0%)/48 (64.0%)
Thickness of the pancreas (mm)	11.3 ± 3.4

2.2. Distal pancreatectomy

DP was performed as previously reported.[8] The pancreatic parenchyma was divided with a linear stapler in all cases, and pre-firing compression of the pancreas was performed in open and laparoscopic DP from 2013. First, the pancreas was compressed with an intestinal clamp for 5 min (Fig. 1a) followed by compression with a linear stapler for 3 min (Fig. 1b). After the procedure, the pancreatic parenchyma was divided very slowly, and the linear stapler was released after waiting for 2 min. We called this compression procedure the "10-min method". We used Endo-GIA (Medtronic, Minneapolis, MN, USA) with blue or green cartridges until 2011, and with purple cartridges from 2012. When the purple cartridge could not be appropriately closed due to thick pancreas, a black cartridge was used. After the division, we visually checked no damage of the pancreatic capsule. Additional treatment or covering of the pancreatic remnant stump was not performed.

2.3. Definition of postoperative pancreatic fistula

The grade of POPF was defined according to the International Study Group on Pancreatic Fistula (ISGPF).[9,10] Pancreatic fistula was classified into four categories: no fistula, biochemical evidence of fistula as defined by surgical drain amylase level greater than three times the serum level without clinical consequence (Biochemical leakage), biochemical evidence of fistula requiring persistent drainage over 3 weeks, percutaneous or endoscopic drainage, angiographic procedure for bleeding, or signs of infection without organ failure (grade B), and biochemical evidence of fistula with reoperation, organ failure, or death. (grade C). In this study, POPF grades B and C were defined as clinically relevant POPF.

Drainage tubes were removed within 5 days after surgery when the drain amylase level was less than three times of the serum level. Even if drain amylase level was greater than three times, drainage tubes were removed as soon as possible when the drainage fluid was not infected and the drain amylase level continued to be decreased.

2.4. Statistical analysis

We investigated the relationship between the perioperative factors and clinically relevant POPF using univariate and multivariate analyses. We included the following 14 perioperative factors in the analyses: patient characteristics, including age, sex, body mass index, serum albumin, diagnosis (pancreatic cancer/others), and thickness of the pancreas; and surgical procedures, including position of the pancreatic division (on the portal vein/left side of the portal vein), pre-firing compression (−/+), open/laparoscopic surgery, lymph node dissection (D1/D2), individual cutting of the splenic artery and vein (−/+), spleen preserving (−/+), combined resection of other organs (−/+), operation time, and blood loss. DP with preservation of spleen and splenic vessels was classified as a group of individual cutting of the splenic artery and vein (+) because of the technique of separation between the pancreas and vessels. All postoperative factors were excluded in this study.

All variables are expressed as the mean ± standard deviation for continuous data. Univariate analyses were performed using the Student *t*-test for continuous variables and chi-squared test for categorical variables. In the multivariate logistic regression analysis, the results were expressed as adjusted odds ratios with 95% confidence intervals. Statistical significance was defined as $P < 0.05$. All statistical analyses were performed using JMP 11 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1. Surgical procedures and outcomes

The position of the pancreatic division was above the portal vein in 44 patients (58.7%) and at the left side of the portal vein in 31

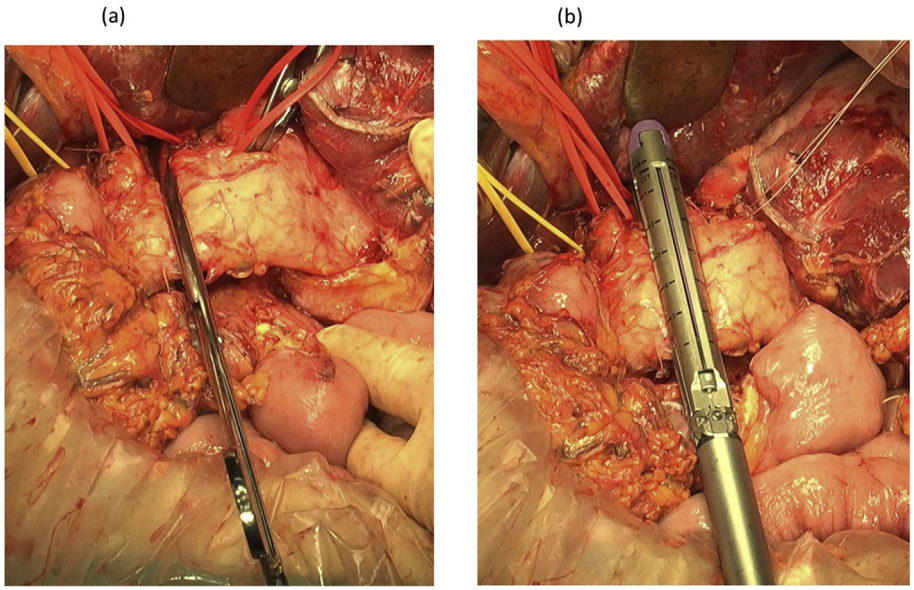

Fig. 1. Pre-firing compression of the pancreas by an intestinal clamp (a) and a stapler (b).

Please cite this article in press as: Hirashita T, et al., Effect of pre-firing compression on the prevention of pancreatic fistula in distal pancreatectomy, The American Journal of Surgery (2018), https://doi.org/10.1016/j.amjsurg.2018.03.023