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Falciform ligament wrap for prevention of gastroduodenal artery bleed after pancreatoduodenectomy

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ABSTRACT

Background: The present study aims to assess the effectiveness and current evidence of a pedicled falciform ligament wrap around the gastroduodenal artery stump for prevention of erosion hemorrhage after pancreatoduodenectomy (PD).

Methods: Retrospective data were pooled for meta-analysis. At the own center, patients who underwent PD between 2012 and 2015 were retrospectively analyzed based on the intraoperative performance of the wrap. A systematic literature review and meta-analysis was performed that combined the published and the obtained original data. The following databases were searched: Medline, Embase, Web of Science, and the Cochrane Library.

Results: At the own center, a falciform ligament wrap was performed in 39 of 196 PDs (20%). The wrap group contained more ampullary neoplasms, but the pancreatic fistula rate was not significantly different from the nonwrap group (28% *versus* 32%). In median, erosion hemorrhage occurred after 21.5 d, and it was lethal in 39% of the patients. Its incidence was not significantly lower in the wrap group (incidence: 7.7% *versus* 9.6% in the nonwrap group). The systematic literature search yielded four retrospective studies with a high risk of bias; only one study was controlled. When the five data sets of published and own cases with a falciform ligament wrap were pooled, the incidence of erosion hemorrhage was 5 of 533 cases (0.9%) compared with 24 of 297 cases (8.1%) without the wrap.

Conclusions: The reported incidence of erosion hemorrhage after the falciform ligament wrap is low, but there are still insufficient controlled data to support its general use.

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Introduction

Pancreatoduodenectomy (PD) is the standard operation for malignant tumors of the pancreatic head and neck, and it is also indicated for some benign or borderline tumors (e.g., intraductal papillary mucinous neoplasms), patients with chronic pancreatitis or rare emergency settings. The operation is increasingly centralized at high-volume hospitals but still associated with a substantial morbidity between 40% and 60%.[1] The most common surgical postoperative complications are delayed gastric emptying (DGE), postoperative pancreatic fistula (POPF), or postpancreatectomy hemorrhage (PPH). When the international consensus classification is applied, POPF develop in approximately 25% of

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the patients after PD, and clinical relevant grades B and C are reported in 12%.[2] These data were primarily obtained from retrospective studies, and recent prospective randomized trials suggest an incidence of grade B and C fistulas as high as 22%.[3] A critical complication of an established POPF is the erosion of the gastroduodenal artery (GDA) stump or hepatic artery (HA) by pancreatic enzymes or local inflammation, leading to delayed and potentially fatal PPH. Erosion hemorrhage frequently occurs after a median interval of 7-13 d but can manifest much later.[4-6] Erosion of the GDA or HA accounts for a large portion of late PPH (>24 h after the index operation), which is encountered in 3%-5% in single-center studies, and associated with a significantly increased mortality of 16%-22%.[4,6-8]

In recent years, multiple surgical attempts have been made to lower the incidence of erosion hemorrhage and/or POPF. The common surgical techniques are the coverage of either the visceral arteries or the pancreatic anastomosis with the round or falciform ligament, or an omental flap.[9] One of the most promising surgical approaches is the protection of the skeletonized HA and the stump of the GDA by a pedicled falciform ligament wrap.[10] Although this technique is established in some Asian centers, its routine performance lacks solid evidence and is uncommon in Europe or the United States.[9] The aim of the present study was to analyze a single-center experience with the pedicled falciform ligament wrap and to systematically review and meta-analyze the available data on this technique for prevention of visceral artery erosion hemorrhage after PD.

Methods

Patients and morbidity

All patients who underwent PD for malignant or benign diseases between September 2012 and December 2015 at the Department of Visceral, Thoracic and Vascular Surgery, University Hospital Carl Gustav Carus, TU Dresden, were included in this retrospective, observational study. The study was approved by the local ethics committee (decision no. 225062016). All clinical, biochemical, and radiological data were retrospectively collected from a prospective database.

Surgical morbidity included intra-abdominal abscess, postoperative bile leak, DGE, POPF, PPH, and surgical site infection. The complications DGE, POPF, and PPH were defined and graded according to the international consensus definitions of the International Study Group of Pancreatic Surgery.[11-13] Briefly, POPF was defined as any abdominal fluid secretion with amylase levels greater than three times compared with the normal serum levels on or after the third postoperative day. Erosion hemorrhage was diagnosed using computed tomography or conventional angiography studies and were all classified as PPH grades B or C. Immediate computed tomography and/or conventional angiography studies were routinely indicated for patients with late mild (sentinel bleeding) and late severe PPH. Nonsurgical morbidity included pneumonia, pleural effusion, deep vein thrombosis, pulmonary embolism, and urinary tract infection. Morbidity rates combined surgical and nonsurgical morbidity. Any further reoperations, postoperative hospital stay duration, or 30-d and 60-d mortality rates were also recorded.

Surgical technique

Pylorus-preserving and classic PD was performed as described recently.[14-16] Briefly, the lymphadenectomy included the standard lymph node stations[17] plus the HA and interaortocaval lymph nodes (12a and 16b1). The GDA was dissected to ensure a stump length of >1 cm if possible and routinely divided using a suture stitch (Prolene 4-0 or 5-0, Johnson & Johnson Medical GmbH, Norderstedt, Germany) and two additional titanium clips. Reconstruction was achieved by end-to-side pancreatojejunostomy, end-to-side hepaticojejunostomy, and end-to-side duodenojejunostomy or gastrojejunostomy. The pancreatojejunostomy was standard accomplished with a double-layer single-stitch technique using polydioxanone (PDS) 5-0.[14] A pedicled falciform ligament wrap was performed at the discretion of the surgeon who performed the operation. There were no standard indications for the wrap, and some pancreatic surgeons generally did not perform the wrap. However, if the falciform ligament was available and the surgeon decided to create a wrap, it was performed in a standardized fashion. The pedicled falciform ligament wrap was mobilized after division of the round ligament close to the umbilicus. The resection line then followed the ventral abdominal wall cephalad along the ventral attachment of the falciform ligament. At the junction to the coronary ligament, the falciform ligament is freed from the ventral hepatic surface until the round ligament is reached (Fig. 1A). The pedicled falciform ligament flap was then carefully tunneled below the common HA and wrapped around the GDA stump in a tension-free fashion using only one turn (Fig. 1B). Fixation was performed with 2-3 stitches using PDS 5-0. At the end of the surgical procedure, one drain was placed near the pancreatic and bile duct anastomoses, respectively. Subcutaneous octreotide was administered perioperatively only in case of a soft pancreatic texture, at the discretion of the surgeon.

Systematic literature search

The systematic literature search was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[18] A systematic literature search was performed on December 2, 2015, using a detailed search algorithm, which was adapted for each database (Table 1). The following databases were searched: Medline, Embase, Web of Science, and the Cochrane Library. The retrieved articles were imported into an electronic library and duplicates removed. The reference lists of all included articles were cross checked for further relevant articles.

Eligibility criteria, data collection, and quality assessment

There were no language or publication date restrictions. Three reviewers (A.W., B.M., and T.W.) independently assessed the eligibility of the retrieved abstracts, and a full article was investigated if one of the reviewers considered it potentially relevant. Articles were eligible if they reported original data on

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