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Original research

External pancreatic duct stent reduces pancreatic fistula: A meta-analysis and systematic review

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HIGHLIGHTS

- External pancreatic duct stenting reduces postoperative pancreatic fistula formation following pancreaticoduodenectomy.
- The use of an external stent was also found to significantly lessen length of hospital stay.
- There was no significant difference in operative time and intraoperative blood loss between stent and non-stent groups.

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ABSTRACT

Background: Postoperative pancreatic fistula formation (POPF) remains one of the most common and detrimental complications following pancreaticojejunostomy (PJ). The aim of this meta-analysis is to analyze the efficacy of external pancreatic duct stent placement in preventing POPF formation following PJ.

Methods: The primary end-point was the incidence of POPF formation following pancreaticoduodenectomy (PD) in the presence and absence of external stent placement. Secondary outcomes examined were the incidence of perioperative mortality, delayed gastric emptying, postoperative wound infection, operative time, blood loss, and length of hospital stay.

Results: Four trials were included comprising 416 patients. External pancreatic duct stenting was found to reduce the incidence of both any grade POPF formation (OR 0.37, 95% CI = 0.23 to 0.58, $p = 0.0001$) and clinically significant (grade B or C) POPF formation (OR 0.50, 95% CI = 0.30 to 0.84, $p = 0.0009$) following PD. The use of an external stent was also found to significantly lessen length of hospital stay (SMD −0.39, 95% CI = −0.63 to −0.15, $p = 0.001$).

Conclusions: This analysis has shown that external pancreatic duct stenting is indeed efficacious in the incidence of both any grade as well as clinically significant POPF formation following PD. Length of hospital stay was also found to be significantly less by external duct stenting.

1. Introduction

The National Cancer Institute has estimated that there will be as many as 45,220 new cases of pancreatic cancer in the U.S. in 2012 and that as many as 38,460 patients will die of the disease this year alone [1]. Pancreaticoduodenectomy (PD) remains the sole potentially curative intervention for several types of peri-ampullary and pancreatic carcinomas and pathologies. Postoperative pancreatic fistula formation (POPF) as a result of pancreaticojejunostomy (PJ) anastomotic failure remains one of the most serious and dreaded complications following PD. POPF is believed to be consequence of pancreatic exocrine secretion seepage across a compromised anastomotic site, with the most likely mechanism being autodigestion and destruction of the tissue surrounding the PJ anastomotic site leading to dehiscence and seepage into the abdominal cavity. The release of these activated pancreatic juices then cause peripancreatic collections, intra-abdominal abscesses, hemorrhage, and POPF [2].

Protection of this anastomotic site has therefore been the focus of many modifications to the original Whipple procedure. Stent placement across the PJ anastomosis has been proposed to protect

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the integrity of the site by diverting the potentially caustic exocrine secretions of the pancreatic remnant away from the delicate anastomotic site. In addition, such stents have been theorized to promote precise placement of anastomotic sutures, facilitate decompression of the pancreatic remnant, and maintain patency of the pancreatic duct postoperatively [3,4].

Two similar, though uniquely different, procedures have been integrated into the traditional PD procedure with varying reports of actual efficacy; an internal and an external pancreatic duct stent. The internal stent technique is generally performed by inserting a 6 cm stent into the pancreatic duct such that one-half of its length remains within the duct itself, bridges across the anastomotic site, and empties into the jejunal lumen. In contrast, the external stent utilizes a longer stent placed similarly within the pancreatic duct stump, bridges across the anastomotic site into the jejunal lumen, but the tail of which is exited through a small enterotomy site in the free end of the jejunal loop. This is then closed with a purse-string suture, externalized via a stab incision in the anterior abdominal wall, and closed by suturing the serosa of the jejunum to the peritoneum of the abdominal wall [6–9]. In both cases migration of the catheter is prevented with an absorbable suture attachment to the jejunal mucosal surface [4,5]. The final PJ reconstruction is then carried out with an end-to-side, duct-to-mucosa anastomosis using 1- or 2-layer interrupted fine sutures [6].

A previous meta-analysis performed by Markar et al. [10] examined the combined effect of placement of either stent type on clinical outcome following PJ. Based on the integrated data sets, these authors identified a non-statistically significant trend towards reduced pancreatic fistula with the use of either stent method, but the data was unable to definitively rule out the null hypothesis that stenting had no beneficial effect. Given the unique mechanism and distinctive risk and reward profiles of each individual technique, these results may have been affected by co-intervention bias as described by Kelly et al. [11].

The purpose of the present meta-analysis was to determine whether the technique of externalizing the pancreatic duct stent is indeed efficacious in minimizing the incidence of postoperative morbidity and mortality, including POPF formation, versus no stent placement following PJ.

2. Methods

An electronic literature search was conducted among all articles from January 1970 to March 2012. Medline, Cochrane Library, SCI, and EMBASE were searched using the following text and keywords in combination with both medical subject headings (MeSH) and text words: “Whipple procedure”, “pancreatoduodenectomy”, “pancreatic fistula”, and “pancreaticojejunostomy”. Further searches were extended to Oncology journals from Asian, American and European continents. In addition, bibliographies of included studies were screened for any additional literature. Prospective randomized control trials reporting primary outcomes on pancreatic fistula and mortality from stent versus non-stent during PJ were reviewed.

2.1. Inclusion criteria

Studies included in this analysis were those that were prospective randomized control in nature and that reported POPF formation or at least one of the secondary outcomes of interest in patients receiving an external pancreatic duct stent versus no stent following PD.

2.2. Exclusion criteria

Studies were excluded from this study if they included non-randomized control trials, utilized an internal pancreatic duct stent technique, those in which the outcomes of interest were impossible to calculate from the published results, or those in which the standard deviation of the mean for continuous outcomes of interest (operative time, blood loss, and length of hospitalization) were not reported.

2.3. Assessment of study quality

The quality of the randomized control trials included in this study was assessed using the Jadad scoring system [12], which was based upon three criteria; 1) randomization of cohorts, 2) double-blind assessment, and 3) accountability for patients either not included or withdrawn from the study (Table 1). Also quality guidelines were adherent to PRIMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statements in order to increase transparency of conclusions made by the authors [13]. Methodological qualities were independently assessed and any discrepancies were resolved with detailed discussion. A PRISMA flow chart was also obtained (Fig. 1).

2.4. Outcomes of interest

The primary outcome of interest was the incidence of POPF formation following PD in the presence versus absence of external

Table 1
Baseline and intraoperative demographics.

		Kuroki et al. (2011) [14]	Motoi et al. (2012) [7]	Pessaux et al. (2001) [9]	Poon et al. (2007) [6]
Number of patients	Stent	23	47	77	60
	No stent	22	46	81	60
Age	Stent	68.1 ± 11.2	66.0 (33–79)	60.8 ± 11.8	61 ± 12
	No stent	68.2 ± 8.4	65.5 (32–80)	60.6 ± 11.8	62 ± 13
Male/Female	Stent	13/10	26/21	39/38	31/29
	No stent	12/10	29/17	47/34	41/19
BMI	Stent	21.0 ± 3.0	21.7 (14.3–32.4)	24.6 ± 4	NR
	No stent	21.9 ± 3.0	21.5 (16.3–29.3)	25.2 ± 4.7	NR
Pancreatic duct size	Non-dilated (<3 mm)	35	41	158	60
	Dilated (>3 mm)	10	52	(excluded)	60
Pancreatic texture	Soft	45[a]	47	158	66
	Hard	22[a] (excluded)	46	(excluded)	54
Jadad's score [12]		3	3	3	3

NR: not reported.
[a] Kuroki et al. differentiated soft from hard pancreata utilizing a time-signal intensity curve (TIC) based upon dynamic contrast-enhanced magnetic resonance imaging (MRI).