Editorial

Blumgart pancreaticojejunostomy: does it reduce postoperative pancreatic fistula in comparison to other pancreatic anastomoses?

Marcello Di Martino, Ángela de la Hoz Rodríguez, Elena Martín-Pérez

Department of Surgery, HPB Unit, University Hospital La Princesa, Madrid, Spain

Correspondence to: Marcello Di Martino, MD, PhD. Calle de Diego de León, 62, 28006 Madrid, Spain. Email: marcellodima@gmail.com.

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The morbidity and mortality rates related to pancreaticoduodenectomy (PD) have significantly decreased during the last few decades. Centralisation of pancreatic malignancies, standardisation of surgical procedures and improvement in perioperative management have produced a significant drop in post-operative mortality, to less than 3–5% in high volume centres (1-3). However, pancreatic anastomosis still remains the Achilles' heel of this surgical procedure, with postoperative pancreatic fistula (POPF) rates ranging from about 10% to 30% (4-7).

Numerous pancreaticoenteric anastomoses have been used to decrease the incidence of POPF after PD. The duct-to-mucosa pancreatojejunostomy (PJ) as described by Cattel and Warren (CWA), with two separate anterior and posterior layers placed in addition to the duct-to-mucosa anastomosis, seems to be the most common technique. However, alternative pancreatic anastomoses have been proposed. The Blumgart pancreaticoenteric anastomosis (BA) (8) is a two-layer technique consisting of outer full-thickness mattress sutures through the pancreas and the jejunum and an inner duct-to-mucosal anastomosis. Other variations of the pancreatic anastomosis are the invaginating or 'dunking' PJ and the pancreaticogastrostomy (PG).

The results of the original BA, as described by Leslie H. Blumgart, were reported by some of his trainees from two US centres in a series published in 2010 (9). They assessed 187 unselected, consecutive patients with a variety of pancreatic textures and ductal sizes who underwent BA after PD. Overall mortality was 1.6%; 13.4% of patients presented a biochemical leak and only 6.7% presented a clinically relevant POPF (CR-POPF). There was no bleeding, reoperation, or mortality secondary to pancreatic anastomotic failure among patients in their series. The authors argued that the main advantage of BA consisted of avoiding disruption of the pancreatic gland, especially in cases with a soft pancreas, by using a single full-thickness mattress-type suture instead of separate anterior and posterior layers, as in CWA. Furthermore, the mild compression provided by 'sandwiching' the pancreas between the jejunum through the sutures may result in fewer leaks from accessory pancreatic ducts. Therefore, they concluded that BA is applicable to all patients in whom the pancreatic duct can be identified, and it is associated with very low rates of significant postoperative morbidity and mortality, supporting its routine use for pancreaticojejunal reconstruction after PD.

The favourable results from the US group were supported by Kleespies *et al.* in Germany (10). They introduced the BA in their practice in 2003 and compared the outcomes of CWA, which they used previously, with the outcomes of the novel technique. They included 182 patients: 90 with CWA and 92 with BA. The latter showed a decrease in duration of the operation, POPF (13% *vs.* 4%; P=0.032), postoperative haemorrhage, total surgical complications, and length of intensive care unit stay. However, one of the main limitations of their study is that

they included patients operated on over a period of 8 years, with a PD performed during the first 6 years included in the CWA group and patients operated on during the last 2 years in the BA group. Although they assert that surgical standards unrelated to the type of anastomosis remained mainly unchanged over the 8-year period, improvements in perioperative management may have affected their outcomes.

Modifications of BA have progressively been proposed over the years: the original BA technique assumed four to six full-thickness pancreas-to-seromuscular jejunal anastomoses with the knot tied on the pancreatic surface. The modifications have included utilising one to three wide, U-shaped sutures through the pancreas and the jejunum and knotting the suture on the jejunal surface. Fujii *et al.* (11) compared 120 patients whose pancreatic anastomosis was based on a variation of CWA, also known as Katita-PJ, with 120 patients with a modified BA (mBA). Again, the rate of CR-POPF was significantly lower in the mBA group (2.5% *vs.* 36%; P<0.001). A multivariate analysis assessing multiple variables related to CR-POPF showed that mBA was an independent predictor of non-formation of CR-POPF. Despite the mBA group showing a rate of POPF (2.5%) much lower than other reports in the literature, the high CR-POPF rate of the control group (36%) must be considered. One year later, Oda *et al.* (12) published a similar study comparing mBA with Kakita-PJ, which corroborated the decrease of CR-POPF: 20.5% in the former group in comparison with 37.2% in the latter. Further retrospective series supported these findings (13-15), and a recent single-centre propensity score matching analysis by Casadei *et al.* (16) assessed 187 patients divided in three groups: mBA, CWA and invagination PJ. The incidence of CR-POPF was not significantly different between the BA (21.6%) and the other pancreatic anastomoses (CWA =27.0% and PJ =35.1%). However, the mBA showed a significant decrease in POPF grade C, global severe complications, reoperations and 90-day mortality (0% *vs.* 12.2%; P=0.028) compared to other anastomoses.

In addition to this, the utilisation of a reduced number of sutures in comparison with CWA has made the mBA a commonly used pancreatic anastomosis for groups performing laparoscopic PD. Poves *et al.* (17) and De Pastena *et al.* (18) recently published their mBA laparoscopic techniques, arguing that the laparoscopic CWA presents significant drawbacks: multiple small sutures are left untied in the surgical laparoscopic field, and it is difficult to create the posterior face of the duct-to-mucosa anastomosis when the capsular stitches on the posterior face have already been tied. These problems can be resolved with the mBA, externalising a reduced number of transpancreatic stitches through one of the ports.

Overall, these results seem to support the conclusion that use of the mBA is related to a decreased rate of POPF. However, the only unicentric randomised clinical trial (RCT) published so far comparing mBA with CWA did not confirm these outcomes. The trial included 103 patients with mBA and 107 patients with CW-PA who were analysed by intention-to-treat. CR-POPF occurred in 7 patients (6.8%) in the CWA group and 11 (10.3%) in the mBA group (P=0.367). There were no significant differences in postoperative complications between the interrupted suture group and the modified Blumgart mattress suture group. Therefore, the authors concluded that mBA did not reduce CR-POPF compared with CWA.

There is a paucity of data comparing mBA with other types of pancreatic anastomosis. We found only a retrospective series from Wang *et al.* (19) comparing mBA with PG in a group of 206 patients. The mBA showed a decreased rate of CR-POPF in comparison with PG (7% *vs.* 20%, P=0.007), especially for those in the intermediate and high fistula risk zone according to the Callery risk score (20) for CR-POPF. We did not find any RCT comparing BA/mBA with PG.

Some potential drawbacks of mBA could be related to the decrease in the blood flow of the pancreatic stump and the presence of a jejunal limb not large enough to cover the pancreatic stump completely. Some investigators have stressed the importance of blood flow at the anastomosis to optimise healing of the pancreaticojejunal reconstruction, and the mattress sutures could negatively affect this blood flow (21). Furthermore, in patients with a jejunum too thin in comparison with a bulky or thickened pancreatic stump, the bowel may not be large enough to cover the anastomosis completely (22). Kim *et al.* (22) tried to highlight this vulnerable point of mBA in their report; however, methodological limitations do not allow firm conclusions to be drawn. The authors included 50 patients operated on over a period of 9 years, which is a rather small number of cases per year. It is likely that a significant number of patients submitted to PD underwent other kinds of pancreatic reconstruction during this period. Selection criteria for mBA are not specified, and a comparison is not provided of the outcomes of patients who underwent other types of pancreatic anastomosis. Another interesting consideration would be when the grade B and C fistula

occurred and whether it was during the initial period of the study. It is not stated in the paper whether the only surgeon performing the mBA was had already completed his learning curve with this novel anastomosis technique or not; the surgeon's level of experience could have influenced outcomes and CR-POPF rate. Another factor to be taken into account is that Kim *et al.* described the use of an external pancreatic stent in the case of a pancreatic duct smaller than 2 to 3 mm. The use of an external pancreatic stent has proven to decrease the risk of CR-POPF in high-risk patients (5); however, stent use was not included in the original description of the BA and mBA technique. This additional modification could have influenced the CR-POPF rate as well. Overall, the conclusions of Kim *et al.* should be taken into account; nevertheless, additional experimental or clinical series could further assess the drawbacks of BA and mBA in detail.

In conclusion, BA and mBA provide favourable outcomes. Based on retrospective series, they seem to be easy to reproduce, they could shorten operative time and they could be comfortably used in laparoscopic PD. However, there is still a lack of level-1 evidence to support this technique in comparison with other types of pancreatic anastomosis. Further RCT are needed in order to provide solid data on this topic. An ongoing multicentric UK clinical trial, aiming to compare mBA and CWA, could provide this evidence (23).

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Footnote

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