

Spleen-preserving laparoscopic distal pancreatectomy: is it worthwhile?

Luigi Bonavina

Division of General Surgery, Department of Biomedical Sciences for Health, IRCCS Policlinico San Donato, University of Milano, Milano, Italy
Correspondence to: Prof. Luigi Bonavina, MD, PhD. Policlinico San Donato, Via Morandi 30, 20097 San Donato Milanese, Milano, Italy.
Email: Luigi.bonavina@unimi.it.

Comment on: Nakata K, Shikata S, Ohtsuka T, *et al.* Minimally invasive preservation versus splenectomy during distal pancreatectomy: a systematic review and meta-analysis. J Hepatobiliary Pancreat Sci 2018;25:476-88.

Received: 08 July 2019; Accepted: 28 July 2019; published: 30 July 2019.
doi: 10.21037/ls.2019.07.06

View this article at: <http://dx.doi.org/10.21037/ls.2019.07.06>

Distal pancreatic resection has been standardized in the 1990s, and since then favourable short-term results have been reported in high-volume centers (1). Later on, with the advent of minimally invasive surgery, the issue of spleen preservation has become more and more important given the implications of this organ in the regulation of body immunocompetency. Laparoscopic distal pancreatectomy is generally indicated for benign or pre-malignant solid or cystic pancreatic lesions. More recently, indications to laparoscopic distal pancreatectomy have been expanded to include patients with adenocarcinoma (2), and robotic-assisted procedures have gained acceptance in some centers. Although splenic salvage may be possible in up to 75% of the procedures initiated with this intent, the long-term benefit of splenic preservation has not been clearly demonstrated. In spite of that, splenectomies are expected to decline in the era of minimally invasive surgery as underlined in the paper by Nakata and coworkers (3).

Laparoscopic versus open distal pancreatectomy

The first laparoscopic distal pancreatectomy was simultaneously reported in 1996 by Cuschieri *et al.* (4) for chronic pancreatitis and Gagner *et al.* (5) for benign tumors. Compared to the open surgical approach, the laparoscopic procedure allows better visualization and exposure of the distal pancreas and splenic hilum. Laparoscopic distal pancreatectomy has been associated with lower blood loss, decreased morbidity, and shorter length of hospital stay.

These favorable outcomes, along with a 6% conversion rate to open procedure even in more complex patients, have been confirmed in larger series (6).

Robotic versus laparoscopic/open distal pancreatectomy

At the beginning of the new millennium, the robotic platform was introduced in surgery to overcome the limitations of laparoscopy, such as the two-dimensional view, the reduced degree of freedom, and the fulcrum effect of the instruments. A few series have compared the outcomes of laparoscopic/open and robotic distal pancreatectomy. Kang *et al.* (7) reported no significant differences in terms of morbidity, mortality, and length of stay. However, operative time and related costs were significantly greater for the robotic procedure. Last but not least, a spleen-preserving pancreatectomy was more common in patients undergoing a robotic operation. In the study of Waters *et al.* (8), the greater intraoperative costs related to longer operative time were compensated by a shorter length of stay, but once again the robotic procedure allowed splenic salvage in a significant number of patients. In the study of Daouadi *et al.* (9), the advantage of robotics consisted of shorter operative time and no conversions to an open procedure. Two recent meta-analyses comparing laparoscopic and robotic distal pancreatectomy have shown that the robotic procedure is associated to higher spleen-preservation rate, reduced risk of conversion to open surgery, and shorter length of hospital stay (10,11).

Spleen preservation: why and how?

Before the era of minimally invasive surgery, it was suggested that *en bloc* splenectomy was superior to spleen-preserving distal pancreatectomy and associated to a better postoperative course and shorter hospital stay (12,13). Over the past two decades, there has been a growing interest in the immunological function of the spleen. This has influenced surgeons to preserve the spleen during operations for trauma, benign lesions, and, whenever possible, even in malignant tumors of the stomach and distal pancreas. Concomitant splenectomy may in fact increase the incidence of postoperative infectious complications (14,15) and is associated with the feared overwhelming post-splenectomy sepsis (OPSS). The peak of incidence of OPSS is 10–19 years after splenectomy, with an overall mortality reaching 50% (16).

Splenic salvage implies that the tumor should not be adherent to the splenic artery or vein, nor in contact with the splenic hilum. Also, portal hypertension and an intense inflammatory change surrounding the splenic vessels may contraindicate splenic salvage. Mallet-Guy and Vachon first described the technique of splenic preservation during distal pancreatectomy for chronic pancreatitis (17). Splenic preservation can be performed using a lateral to medial or a medial to lateral approach. The main issue is whether the splenic vessels should be preserved or not. In 1988, Andrew Warshaw (18) first described a “...rapid, easy, and safe means of saving the spleen while resecting or fully mobilizing the pancreatic tail. ...The spleen survives on the short gastric vessels, which are carefully preserved”. However, a relevant risk of left-side portal hypertension with development of perigastric varices has been attributed to the Warshaw procedure (19,20). Kimura *et al.* (21) advocated and popularized the conservation of splenic vessels during spleen-preserving distal pancreatectomy. A retrospective study comparing the Warshaw and Kimura techniques in 140 patients showed a significantly higher rate of spleen-related complications after the Warshaw procedure, with half of these individuals requiring subsequent splenectomy (22). Furthermore, an interesting systematic review showed that, despite a longer operative time, the Kimura technique carries a significantly lower risk of subsequent splenectomy, splenic infarction, and chronic left-side abdominal pain compared to the Warshaw technique. It is likely that patients with splenomegaly or paucity of short gastric vessels, and those who can tolerate

a longer surgical procedure, may benefit from the Kimura procedure (23). Today, despite the increasing awareness that spleen preservation may play a significant role in preventing postoperative infectious complications and improve patient-reported outcomes (24), no randomized clinical trials are available to resolve the controversy about the role of splenic salvage and the choice of the most appropriate surgical technique for spleen preservation.

The systematic review and meta-analysis by Nakata and co-workers (3) are properly focused on spleen preservation versus splenectomy during minimally invasive distal pancreatectomy. The robust data provided by this multi-institutional study confirm that splenic preservation is associated to less operative time and blood loss, and reduced infectious complications and pancreatic fistula rates. In addition, splenic vessel preservation appears superior to the Warshaw technique due to a reduced incidence of splenic infarction and the need for subsequent splenectomy.

Conclusions

Scientific evidence regarding the choice of the minimally invasive approach (laparoscopy *vs.* robotic) and the technique of splenic salvage (splenic vessel ligation *vs.* preservation) is still lacking. Indeed, laparoscopic surgery remains the gold-standard treatment in high-volume centers. At present, there is no conclusive evidence that the robotic approach is superior to standard laparoscopy, although it is common perception that the potential of robotics extends far beyond its current applications. If a properly conducted clinical study will show that robotic-assisted distal pancreatectomy can improve the rate of splenic preservation, we should expect a pendulum shift away from conventional laparoscopy in the next future.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Laparoscopic Surgery*. The article did not undergo external peer review.

Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/ls.2019.07.06>).

[org/10.21037/ls.2019.07.06](https://doi.org/10.21037/ls.2019.07.06)). The author has no conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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doi: 10.21037/ls.2019.07.06

Cite this article as: Bonavina L. Spleen-preserving laparoscopic distal pancreatectomy: is it worthwhile? *Laparosc Surg* 2019;3:28.