

Distal pancreatectomy with preservation of the spleen

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Abstract Distal pancreatectomy (resection of the pancreatic body and tail) can be performed with or without preservation of the spleen. Splenic preservation has the advantages of fewer postoperative complications such as abscesses in the resection bed, shorter length of hospitalization, and avoidance of the long-term risk of post-splenectomy sepsis related to encapsulated bacteria. Two techniques can be used to save the spleen: either by dissecting out the splenic artery and vein with division of the arterial and venous branches between the pancreas and the splenic artery and vein; or by resecting the splenic artery and vein along with the pancreas but with careful preservation of the vascular collaterals in the splenic hilum, which allows the spleen to survive on the short gastric vessels (Warshaw technique). The latter method has been shown to be associated with a shorter operation, less blood loss, and a shorter hospitalization. In general the Warshaw technique is easier, especially for laparoscopic pancreatectomy. The subsequent appearance of enlarged gastric veins (varices) is to be expected as a consequence of loss of the splenic vein but has not led to bleeding from these natural collaterals during long-term follow up.

Keywords Distal pancreatectomy · Splenic preservation · Splenectomy

Introduction

The most widely used technique for resecting the body and tail of the pancreas has included splenectomy. Because the spleen receives its principal arterial supply from the pancreas via the splenic artery and empties principally via the splenic vein, it is simplest to take the spleen with the distal pancreas rather than attempt to save it. Also, if cancer is the indication for resection, there is a perceived oncologic advantage to removing the lymphatics along the splenic vessels and the lymph nodes in the splenic hilum.

On the other hand, adverse consequences have been observed after splenectomy. These include a greater likelihood of postoperative abscesses [1–3], especially in obese patients [4], and most notably a long-term risk of serious post-splenectomy sepsis, often lethal, due to specific encapsulated bacteria [5]. The risk of overwhelming post-splenectomy infection (OPSI) has been estimated to be 1 per 400–500 patient years and fatal OPSI to be 1 per 800–1000 patient years [6]. While this risk is greatest in childhood, it persists to a lesser degree throughout life [7]. In addition, increases in later myocardial infarction [8], diabetes [9–11], and even cancer [12, 13] (especially when the splenectomy is related to a hematologic malignancy) are said to occur.

Preservation of the spleen with distal pancreatectomy can be accomplished in either of two ways: (1) meticulously separating the splenic artery and vein from the pancreas by isolating and dividing each of the many small branches between the pancreas and these vessels, or (2) taking the splenic artery and vein with the pancreas but carefully preserving the collateral blood supply of the spleen from the short gastric and left gastroepiploic vessels, first described by Warshaw et al. [14].

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Techniques

If the splenic artery and vein are to be preserved, it is expedient first to divide the pancreas proximally anterior to these vessels and to dissect from right to left in order to best visualize the short arterial and venous branches that must be taken. This dissection may be difficult, especially in the setting of chronic pancreatitis [15] or obesity, and may risk a positive resection margin of a malignant tumor [9]. Injury to the splenic vein is the most common cause for abandoning the attempt to conserve the spleen. Because the splenic vessels are more likely to be extra-pancreatic in children, the operation is technically easier in childhood.

If the Warshaw technique is utilized, the spleen should first be assessed for color (as a baseline) and size (an enlarged spleen is less likely to survive on the reduced blood supply after resection of the main splenic vessels). The lesser sac is entered by dividing the greater omentum outside the gastroepiploic vessels, and adhesions in the lesser sac are lysed. The left gastroepiploic vessels should be identified and preserved as they leave the greater curve of the stomach and course through the omentum to join the main splenic vessels in the splenic hilum: these are a significant collateral blood supply to the spleen [16]. The main collateral supply will, however, be the short gastric vessels. The peritoneum at the superior and inferior borders of the pancreas is incised to the left of the portal vein, and the pancreas and its vessels are encircled with a rubber drain for control and traction to the right. The retroperitoneal plane behind the pancreas is developed out to the spleen. It is important to keep the dissection right at the border of the pancreas, especially around the tail of the pancreas, in order not to disrupt the network of short gastric and gastroepiploic collateral vessels anastomosing with the main splenic artery and vein in the splenic hilum (Fig. 1). The splenic artery and vein are transected at the pancreatic tail. The pancreas is then mobilized to the right with its vessels to the point of proximal transection (Fig. 2).

Outcomes

Splenectomy versus spleen preservation

Carrère et al. [2] reported a series of distal pancreatectomies in 76 patients, half with splenectomy and half with splenic preservation. Intraoperative complications and postoperative infections occurred in 34 and 18%, respectively, in the splenectomy group, compared with 13 and 3% in the splenic preservation group. The spleen preservation in this study utilized the Warshaw technique successfully in 36 of 38 attempts and was judged to be “fast, safe, and effective” [2].

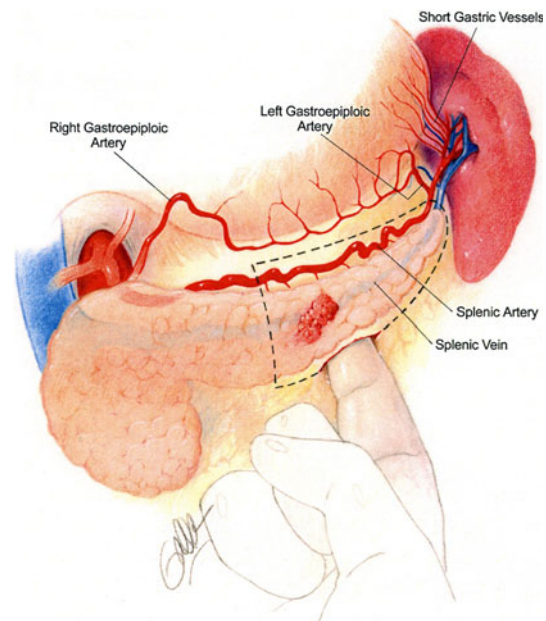


Fig. 1 Technique of mobilization of the left pancreas by incising the retroperitoneum along the pancreatic margins (from Rodriguez et al. [17] with permission)

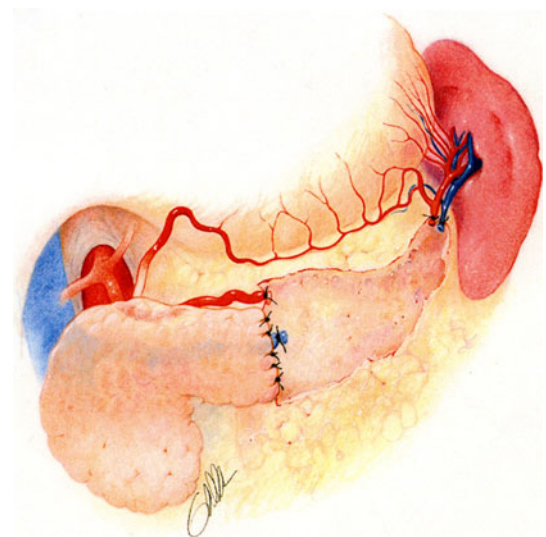


Fig. 2 The splenic vessels are then ligated as close as possible to the pancreas and also at the point of pancreatic transection. The collateral circulation to the spleen via short gastric vessels is preserved (from Rodriguez et al. [17] with permission)

Similarly, Shoup et al. [1] reported the outcomes in 46 patient with splenic preservation and 79 with splenectomy. The splenectomy group had postoperative infections in 28%, severe complications in 11%, and an average postoperative length of hospital stay of 9 days. The spleen-preserved group had only 9% postoperative infections, 2% severe complications, and a length of stay of 7 days. All of these differences are significant.

Table 1 Operative factors and postoperative complications of patients who underwent distal pancreatectomy with splenic conservation vs. traditional splenectomy

	SP <i>n</i> = 74 (29%)	DPS <i>n</i> = 185 (71%)	<i>P</i> value
Median OR time (h)	2.5	3.1	<0.001 ^a
Additional procedures	24.4%	39.7%	0.02 ^b
Blood loss (ml)	300	500	<0.001 ^a
Locally advanced	6.4%	32.6%	<0.001 ^b
Median LOS (days)	6 (IQR, 5–7)	7 (IQR, 5–8)	0.001 ^a
Pancreatic leak	36%	33%	0.67 ^b
Fistula	27%	17%	0.09 ^b
Collection	8%	9%	1.00 ^b
Abscess	8%	14%	0.21 ^b
Wound disruption	8%	10%	0.65 ^b
Other (complication not related to leak)	18%	25%	0.20 ^b
Reoperation	2.7%	1.1%	0.70 ^b
Mortality	0	1.1%	0.90 ^b

SP splenic preservation, DPS distal pancreatectomy with splenectomy, OR operating room, LOS length of stay, IQR Interquartile range

^a Fisher exact test

^b Wilcoxon rank sum test (from Rodriguez et al. [17])

Rodriguez et al. [17] reported a series of 259 patients undergoing distal pancreatectomy. Seventy-four were judged to be candidates for spleen preservation by the Warshaw technique (93% had benign diseases), and 185 had the spleen removed. The operative outcomes are listed in Table 1 and demonstrate highly significant advantages with regard to length of operation, blood loss, and hospital length of stay for the patients with spleen preservation. There was no difference between the two groups in the incidence of postoperative complications including collections, abscesses, pancreatic fistulas, or wound healing problems.

Splenic vessel preservation versus splenic vessel resection

There is relatively little data with which to compare these two techniques directly, principally because the failure rates based on intention to treat are largely unknown. The attempt to save the spleen with its artery and vein is particularly difficult with a chronically inflamed pancreas [12] or with an obese body habitus, and intraoperative bleeding and loss of the spleen are significant risks [18].

Fernández-Cruz et al. [19], using a laparoscopic approach, tried to save the splenic vessels but had to convert to the Warshaw technique in 5/11 cases because of bleeding. They found a shorter operative time (165 vs. 222 min) and lower blood loss (225 vs. 495 ml) with the Warshaw technique.

Levard's group at the Université René Descartes Paris V compared 18 patients who had splenic vessel preservation with 17 whose splenic vessels were resected with the pancreatic tail. In the vessels-preserved group there was one postoperative splenic infarct due to splenic vein thrombosis, two patients who required reoperation for bleeding from the splenic vessels, and three reoperations resulting in splenectomy. Among the 17 with splenic vessel resection, seven patients were noted to have "transient splenic ischemia" and several were said to have lateral "segmental portal hypertension", but there was no spleen loss or variceal bleeding (A. Fingerhut, personal communication, 2009).

Laparoscopic distal pancreatectomy and spleen preservation

Laparoscopic distal pancreatectomy is becoming favored for many neuroendocrine tumors, cystic neoplasms, and some inflammatory disorders. Its use for malignant tumors is debatable. The largest series of laparoscopic distal pancreatectomies, 127 patients, has been reported from a multicenter European trial [18]. Maintaining the spleen by either vascular preservation or vascular resection with collateral preservation can be accomplished laparoscopically [19], but in the experience from Barcelona, and in our experience to date, the Warshaw technique is easier, faster, and most likely to have a successful outcome.

Late outcomes of splenic preservation

Obviously the desired outcome of saving the spleen is protection against infection and reduction of the other potential health risks of splenectomy which have been cited previously. Both techniques for spleen preservation presumably accomplish these goals. However, concerns have been expressed about both the early and late consequences of the Warshaw technique.

Unquestionably reliance on the collateral circulation to keep the spleen alive has limitations. We have learned through experience that the collaterals are insufficient to maintain the increased volume of an enlarged spleen. It is thus important to assess the size of the spleen early in the operation. When we ignored this caveat, the spleen infarcted postoperatively in two cases (one in our original series [14] and one in our recent update [17]—about 2% of the combined series). Also, the number of short gastric vessels is somewhat variable and their sufficiency should be evaluated before a final intraoperative decision.

After the pancreatic resection is completed, the spleen is re-examined. Invariably its color is darker than before the

vascular interruption, but a burgundy or dark red color indicating perfusion and viability should still be discernible. A disproportionately dark gray or black, sharply demarcated area indicates a zone of probable necrosis requiring a decision to remove the spleen or not, depending on the volume of critical ischemia.

It is undisputed that there is reduced perfusion of the spleen after division of the splenic artery and vein. In our earlier experience we used radionuclide spleen scans [14] and contrast-enhanced computed tomography (CT) scans to evaluate splenic perfusion postoperatively. However, despite the routine demonstration of hypoperfusion, we saw no adverse clinical consequences. Even small areas of apparent infarction, perhaps less than one-third of the spleen, are well tolerated and do not require intervention. Sato et al. [20] and Aldridge and Williamson [21] have shown that the blood supply to the spleen recovers in a short time through accommodation by collateral flow. Levard et al. also have noted “transient splenic ischemia” without clinical consequences (A. Fingerhut, personal communication, 2009).

Of potentially greater concern is the development of gastric varices after interruption of the splenic vein. Miura et al. [22] followed 10 patients for more than 52 months and found perigastric varices by CT in 7/10, two of which were seen endoscopically. However, enlargement of the short gastric and gastroepiploic veins is to be expected after splenic vein ligation, and these varices are merely the visible result. We have not had a single case of bleeding from gastric varices in more than 100 patients followed for up to 24 years. Similarly, while Levard et al. reported “segmental portal hypertension” in their 17 patients after splenic vein ligation, none bled (A. Fingerhut, personal communication, 2009). (The only report known to me of variceal bleeding after spleen-preservation with splenic vein ligation was in a patient who had a middle segment pancreatectomy with resection of the splenic vessels 6 years previously [23]. In this case the added burden of blood flow from the preserved pancreatic tail, as well as the spleen, may have caused intolerable flow through the short gastric veins.)

Conclusions

Preservation of the spleen with distal pancreatectomy is generally feasible, particularly for benign lesions, and is desirable for long-term benefits. The early outcomes are also better than if the spleen is removed, including intraoperative complications, postoperative collections and infections, and length of hospital stay [1, 17]. The spleen may be saved by dissecting out the splenic artery and vein or by taking the artery and vein but carefully preserving the

short gastric and gastroepiploic collaterals to the splenic hilum. The latter (Warshaw) technique is faster, easier, and perhaps safer [1, 18, 19]. Both can be performed laparoscopically, but the Warshaw technique is more likely to be completed successfully [18, 19]. Transient splenic hypoperfusion (but not clinically significant ischemic injury) is to be expected with splenic vessel resection [17, 20], as is enlargement of perigastric veins (but not gastric hemorrhage from ruptured varices).

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