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REVIEW

Systematic review of the role of thoracoscopic splanchnicectomy in palliating the pain of patients with chronic pancreatitis

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Abstract
Background The management of opiate-dependent intractable abdominal pain caused by chronic pancreatitis remains challenging. The published series on the role, safety, feasibility, and efficacy of thoracoscopic splanchnicectomy are reviewed.
Methods The MEDLINE, EMBASE, and PREMEDLINE databases were searched, and relevant English language publications were systematically retrieved. Data were pooled by two independent reviewers.
Results Between 1994 and 2006, 302 patients were featured in 16 reports. The reports described 202 procedures as bilateral and 100 as unilateral. These procedures were associated with rates of 16.6% for morbidity, 1.3% for conversion to thoracotomy, 1.3% for reoperation to manage complications, and 0% for mortality. The mean postoperative hospital stay was 2.7 days. The mean success rate was 90% up to 6 months of follow-up evaluation, 75% at >6 to 15 months of follow-up evaluation, and 49% at >15 months to 5.7 years of follow-up evaluation. Further intervention for pain relief was required for 12.9% of the patients.
Conclusion Splanchnicectomy reduces pain and improves quality of life for patients with chronic pancreatitis. Patient selection determines success rates, but the early good results achieved decline with time elapsed after thoracoscopic splanchnicectomy.

Keywords Chronic pancreatitis · Pain · Quality of life · Splanchnicectomy · Thoracoscopy

Relief of abdominal pain for patients with chronic pancreatitis (CP) poses a challenge for surgeons, gastroenterologists, and pain specialists. The pain of CP may initially mimic that of acute pancreatitis, but as the disease progresses, the painful attacks become more frequent with shorter pain-free intervals, culminating in a constant and often intractable abdominal pain.

Pain experienced by CP patients is the leading cause for hospitalization, loss of employment, early retirement, and addiction to opioids. The management options range from nonoperative to surgical approaches and may include pancreatic enzyme supplementation, nonopioid or opioid analgesia, celiac plexus block, thoracoscopic splanchnicectomy (TS), and operative procedures aimed at decompression of the pancreatic duct or pancreatic resection. Nonoperative methods may not be effective in achieving pain control for 20% to 50% of CP patients [1], whereas surgery carries the potential for long-term morbidity and a small risk of operative mortality. The wide variety of methods available for treating pain associated with CP reflects the multifactorial nature of this condition and shows that no single method produces superior results.

The greater, lesser, and least splanchnic nerves carry sympathetic "pain" innervation to the upper abdominal viscera, including the pancreas, from the 5th to 8th, 9th to 10th, and 11th thoracic ganglia, respectively. Although the greater and lesser splanchnic nerves appear to be constant, the least splanchnic nerve is not always present. At thoracoscopy, these nerves can be seen running superficial to the intercostal vessels and can be readily divided. This article aims to provide a systematic review of the current

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literature on TS experienced by patients with CP, and to evaluate the safety, feasibility, and efficacy of TS.

Patients and methods

This review used the MEDLINE, EMBASE, and PRE-MEDLINE databases and applied the search words "thoracoscopic," "splanchnicectomy," "pancreatitis," "transthoracic," "palliation," and "videoscopic" in various combinations. Relevant articles identified by cross-referencing also were retrieved and reviewed. The review included all the relevant publications in the English literature. For authors or institutions that republished their results with larger series, only the larger and most recent series was included. Results published in abstract form only were excluded.

Two reviewers independently pooled the data from each series, and any discrepancies were discussed between the authors until agreement was reached. Reviews were excluded unless new data were included. The denominator for any outcome measure was the total number of patients in each series that presented data in relation to that outcome. The success rate, postoperative hospital stay, rates of morbidity and mortality, duration of follow-up evaluation, recurrence rates, and need for reintervention after TS are presented.

The reported results on hospital stay and follow-up evaluation were averaged by weighting for sample size in each study. Results pertaining to outcomes reached during the follow-up period such as success, recurrence, and reintervention rates were calculated by determining the number of patients achieving each outcome and relating that to the total number of patients attending for follow-up assessment.

Results

This review identified 16 reports between 1994 and 2006 that described the results of TS for patients with CP [1–16]. Five publications reported the results of unilateral TS [5, 7, 10, 13, 15], and eight publications reported the results of bilateral TS [2, 3, 8, 9, 11, 12, 14, 16]. The remainder described the results of unilateral and bilateral procedures [1, 4, 6]. No comparative studies of TS versus medical therapy or celiac plexus block were found.

The characteristics of patients and the nature of surgery in these 16 publications are listed in Table 1, whereas the main outcomes of TS are listed in Table 2. A summary of the data and outcomes is shown in Table 3.

Among 302 patients with CP who underwent TS, 202 (66.9%) had bilateral TS either simultaneously (n = 191) or in a staged manner (n = 11 patients), whereas 100 patients (33.1%) underwent unilateral TS (81 left, 10 right, and 9 side not reported). A total of 170 patients (56.3%) reportedly had a previous surgical (n = 129) or endoscopic (n = 41) intervention aimed at producing relief for symptoms of either pain or obstruction.

Four patients underwent conversion to open procedure (conversion rate, 1.3%), mainly because of dense and diffuse pleural adhesions (n = 4). Four technical failures (1.3%) were reported by Buscher et al. [11], who because of extensive pleural adhesions in patients with previous acute attacks of pancreatitis were not confident of complete transection of the splanchnic nerves. No operative deaths or complications occurred among 50 patients (16.6%).

The most common complications were intercostal neuralgia (n = 23, 7%), pulmonary atelectasis (n = 6, 1.9%), chylothorax (n = 4, 1.3%), and orthostatic hypotension (n = 4, 1.3%). The reoperation rate was 1.3% (3 thoracotomies and 1 thoracoscopy). The main reasons for reoperation were bleeding from port sites (n = 2) [9] and persistent chylothorax (n = 2) [12].

The mean postoperative hospital stay was 2.7 days, and the mean follow-up period was 24 months (Table 3). Figure 1 depicts the success rate for each of the published series in relation to the duration of the follow-up period. The mean rate of success (Table 3) declined with the time elapsed after TS. Success was defined by most as the percentage of patients who either remained free of opioid analgesia postoperatively at the time of follow-up assessment or had a reduction of 4 or more points on the visual analog scale (VAS) or numeric rating scale (NRS) regardless whether opioids were withdrawn or not.

Of the 16 reports, 13 (81%) used the VAS or NRS preoperatively and postoperatively as a method of objective pain measurement. The mean preoperative VAS scores ranged from 6.9 to 10, and the mean postoperative VAS scores ranged from 2 to 7 at the time of follow-up assessment. The rates of the opiate-dependent patients who remained opiate free after splanchnicectomy varied considerably between 7% [13] and 100% [5, 10]. Buscher et al. [16] used a somatic quantitative sensory testing method preoperatively and postoperatively to assess the effect of splanchnic denervation on pain processing for CP patients.

A total of 39 patients (12.9%) required further intervention for pain relief after TS [1, 2, 4, 6, 7, 10, 12]. Of the 111 patients who underwent unilateral TS, 15 (13.5%) required previously unplanned contralateral TS after their primary unilateral intervention [1, 4, 6, 7, 10].

Discussion

The safety of TS is well demonstrated, with no reported operative mortality and low morbidity. The need for conversion to open surgery arose for approximately 1% of

Table 1 Patient characteristics, indications, and types of thoracoscopic splanchnicectomy (TS) procedures

No.	Author	No. of patients	Age (yr)[a]	M/F	Preoperative intervention	Approach	Operative time (min)[a]	Reason for conversion
1	Cuschieri, et al. (1994) [2]	5	31–54	NR	CPB ($n = 2$)	5 BTS	NR	0
2	Strickland, et al. (1996) [3]	1	33	M	Endoscopic sphincterotomy ($n = 1$), cholecystectomy, open sphincteroplasty ($n = 1$)	1 BTS	NR	0
3	Kusano, et al. (1997) [4]	9	42.3	7/2	CPB ($n = 2$), Whipple's procedure ($n = 1$)	5 UTS (3 right, 2 left) 4 BTS (1 staged)	98[a]	0
4	Lönroth, et al. (1997) [5]	3	45	1/2	NR	3 L	Fewer than 60	0
5	Bradley, et al. (1998) [6]	16	42.9	11/5	Cyst-enteric drainage ($n = 12$), pancreatic resection ($n = 4$), pancreaticojejunostomy ($n = 2$), unknown ($n = 2$)	4 UTS (1 right, 3 left) 10 BTS (4 staged, 6 synchronous)	NR	2 (adhesions)
6	Noppen, et al. (1998) [7]	7	49.1	5/2	None	5 UTS (left) 2 BTS (staged)	20[a] (±8)	0
7	Moodley, et al. (1999) [8]	17	47	17/0	CPB ($n = 1$), pancreatic resection ($n = 1$)	17B	16.6[a] (left) 11.4[a] (right)	0
8	Ihse, et al. (1999) [9]	21	48	14/7	Exploratory laparotomy ($n = 3$), cholecystectomy ($n = 2$), gastric resection ($n = 1$), cystgastrostomy ($n = 2$), percutaneous cyst drainage ($n = 1$), pancreaticojejunostomy ($n = 6$), Frey procedure ($n = 1$), distal pancreatectomy ($n = 4$), CPB ($n = 1$)	21 BTS	NR (range, 30–40)	0
9	Leksowski (2001) [10]	20	36.4	16/4	Pancreaticojejunostomy ($n = 2$), cystgastrostomy ($n = 2$), CPB ($n = 2$), gastroenterostomy ($n = 1$), choledochojejunostomy ($n = 1$), truncal vagotomy ($n = 1$)	16 UTS (12 left, 4 right) 4 BTS staged	46[a]	0
10	Maher, et al. (2001) [1]	15	41	4/11	CPB ($n = 15$)	9 UTS 6 staged BTS	NR	0
11	Buscher, et al. (2002) [11]	44	41	26/18	Beger procedure ($n = 5$), Partington-Rochelle procedure ($n = 3$), pancreatic resection ($n = 9$), pancreatic duct stenting ($n = 8$), CPB ($n = 2$), papilloplasty ($n = 3$), biliodigestive bypass ($n = 2$), pseudocyst drainage ($n = 3$)	40 BTS	NR	0
12	Howard, et al. (2002) [12]	17	37	6/11	None	17 BTS	NR	0

Table 1 continued

No.	Author	No. of patients	Age (yr)[a]	M/F	Preoperative intervention	Approach	Operative time (min)[a]	Reason for conversion
		38	40	13/25	Distal pancreatectomy (n = 2), Whipple's procedure (n = 2), Frey procedure (n = 2), endoscopic sphincterotomy ± pancreatic duct stenting (n = 32)	38 BTS		
13	Makarewicz, et al. (2003) [13]	32	51.5	21/11	NR	32 UTS (left)	55	1 (adhesions)
14	Hammond, et al. (2004) [14]	20	43	8/12	CPB (n = 4), cholecystectomy (n = 13), subtotal pancreatectomy (n = 5), vagotomy and pyloroplasty (n = 1)	20 BTS	40 (20 each side)	0
15	Basinski, et al. (2005) [15]	18	47.3	14/4	NR	18 UTS (left)	NR	1 (adhesions)
16	Buscher, et al. (2006) [16]	19	51	11/8	NR	19 BTS	NR	0

NR, not reported; CPB, celiac plexus block; BTS, bilateral thoracoscopic splanchnicectomy; UTS, unilateral thoracoscopic splanchnicectomy

[a] Data shown represent mean

patients, largely because of dense pleural adhesions, whereas reoperations were required by approximately 1% for port-site bleeding [9] or persistent chylothorax [12]. Local damage to the intercostal nerves by retractors (during open splanchnicectomy) or trocars may be responsible for the postprocedure intercostal neuralgia [17]. In some situations, electrocautery of the splanchnic nerves may cause thermal injury to the adjacent intercostal nerves. The introduction of smaller trocars (5 mm) and instruments and use of the ultrasonic dissector (Harmonic Scalpel) for dissection of the splanchnic tissues have been proposed as measures that may potentially diminish the occurrence of postoperative intercostal neuralgia [18].

The palliation of pain after TS has been associated with weight gain [8, 19], return to gainful employment [8], and improvement in quality of life [8, 10, 12, 14]. Furthermore, bilateral TS for CP pain appeared to reduce the number of subsequent hospital admissions among responders and prescriptions for analgesia [14].

Although the overall success rate for TS in the published 16 series was 90% for the first 6 months, the rates diminished with the length of follow-up evaluation. The high success rates reported by some authors came either from a short follow-up period (89% at 2 months [15], 88% at 3 months [4], 100% at 6 months [10], and 94% at 12 months [8]) or from application of stringent criteria for patient selection. Moodley et al. [8] intentionally denied their patients narcotic prescriptions preoperatively and reported that 94% of the patients remained opiate free during a mean follow-up period of 12 months. For 5 years of follow-up evaluation, Maher et al. [1] reported a rather disappointing success rate of 20%. Similarly, the rates of postoperative opioid withdrawal were good at short-term follow-up evaluation (100% at 3 months [5], 88% at 3 months [4], and 100% at 6 months [10]), but markedly declined with time. Ihse et al. [9] reported a success rate of 90% and an opioid-free rate of 62%, but only 7 of their 21 CP patients were followed up to 48 months.

Whether TS should be performed bilaterally or unilaterally remains controversial. Lönroth et al. [5] performed left-sided TS and divided the sympathetic chain from T4 to T10–11 in nine patients, three of whom had CP, and reported consistent pain relief with freedom from opiates in CP patients at 3 months of follow-up evaluation. Noppen et al. [7] found that the initial symptomatic response to unilateral (left-sided) TS was brief and modest, necessitating contralateral procedures. Leksowski [10] reported recurrence of pain within 4 months of left-sided TS in 25% of CP patients. A contralateral procedure relieved their symptoms. Makarewicz et al. [13] evaluated the effects of left-sided TS for 32 patients with CP and reported noticeable improvements in the emotional status and everyday life functioning at 3 months postoperatively that

Table 2 Results

No.	Author	Complications	Re-operation	Success rate (%)	LOS	Follow-up (mos)	Patients free of opioids at time of follow-up (%)	No. of patients requiring further intervention for pain relief	Pain scores before/after surgery[a]
1	Cuschieri, et al. (1994) [2]	0	0	60	NR	NR (range, NR-8)	60	Pancreatic resection (n = 2)	NR
2	Strickland, et al. (1996) [3]	Right hypochondrial dysaesthesia (n = 1)	0	100	NR	25	100	0	NR/0
3	Kusano, et al. (1997) [4]	Intercostal neuralgia (n = 3)		88	NR	13.7[b]	88	RTS (n = 1) required LTS	10/2.3[b]
4	Lönroth, et al. (1997) [5]	0	0	100	NR	3[b]	100	NR	7/1[b]
5	Bradley, et al. (1998) [6]	Intercostal neuralgia (n = 1), hyperaesthesia (n = 1), minimal atelectasis (n = 6)		50		23.3[b]	20	NR	8.25/4.1[b]
6	Noppen, et al. (1998) [7]	Intercostal neuralgia (n = 1)	0	62.5	2[b] days	23.2[b]	28	LTS (n = 2) required contralateral TS, and further 2 LTS failed but patients refused further procedure	NR
7	Moodley, et al. (1999) [8]	Pneumothorax (n = 1)	0	94	<24 h[c]	12[b]	94	NR	8.2/2.1[b]
8	Ihse, et al. (1999) [9]	Bleeding from port's incision site (n = 2)	Thoracotomy (n = 2)	90	NR	43[b]	62 (at 12 mos)	NR	7/2[b]
9	Leksowski (2001) [10]	Intercostal neuralgia (n = 5)	0	100	24 h	6[b]	100	LTS (n = 4) required contralateral TS	8.5/2[b]
10	Maher, et al. (2001) [1]	Chylothorax (n = 1), orthostatic hypotension in first 4 mos (n = 3)	0	20	NR	69[c]	27	UTS (n = 6) required contralateral TS procedure in a later stage	7.2/2.9[b] at 18 mos follow-up, 7.2/4.5 at 5 years
11	Buscher, et al. (2002) [11]	Intercostal neuralgia (n = 3), respiratory failure (n = 1), pneumothorax (n = 2), wound infection (n = 1), pneumonia (n = 1)	0	46	4 days[c]	36[c]	12	NR	8.5/2[c] (at 2 yr)
12	Howard, et al. (2002) [12]	Chylothorax (n = 3), wound infection (n = 2), pneumonia (n = 1), intercostal neuralgia (n = 6)	Persistent chylothorax (n = 2)	41	3.6 days[b]	32[c]	78 (at 24 mos follow up)	Wallstent of pancreatic duct dilation and Peustow drainage (n = 1), insertion of intrathecal morphine pump (n = 1)	6.9/3.8[b] (at 36 mos, for patients with no prior intervention)

Table 2 continued

No.	Author	Complications	Re-operation	Success rate (%)	LOS	Follow-up (mos)	Patients free of opioids at time of follow-up (%)	No. of patients requiring further intervention for pain relief	Pain scores before/after surgery[a]
				18			28 (at 24 mos follow- up)	Intrathecal morphine pump insertion ($n = 6$), total pancreatectomy and islet cell transplantation ($n = 4$), pancreatic resection ($n = 2$), enteral feeding ($n = 2$).	7.6/7[b] (at 36 mos, for patients with prior intervention)
13	Makarewicz, et al. (2003) [13]	0	0	94 (at 3 mos follow- up)	7[b]	12[b]	7 (at 3 mos)	NR	8.3/3.9[b]
14	Hammond, et al. (2004) [14]	NR	NR	60	35 h[b]	15[c]	17	NR	9/6[b]
15	Basinski, et al. (2005) [15]	Orthostatic hypotension ($n = 1$), intercostal neuralgia ($n = 4$)	0	89	NR	2[b]	36	NR	8.5/3[b]
16	Buscher, et al. (2006) [16]	NR	NR	47	NR	1.5[b]	47	NR	5/3[c]

LOS, Length of postoperative hospital stay; NR, not reported; RTS, right thoracoscopic splanchnicectomy; LTS, left thoracoscopic splanchnicectomy; TS, thoracoscopic splanchnicectomy; UTS, unilateral thoracoscopic splanchnicectomy

[a] Visual analog scale score (VAS) or numeric rating scale score (NRS)

[b] Data shown represent the mean

[c] Data shown represent the median

Table 3 Summary of patients' characteristics, procedures, and their outcomes in 16 series of thoracoscopic splanchnicectomy (TS) for chronic pancreatitis

No. of patients	302
Age (yr): mean (range)[a]	43.7 (31–51)
Sex: male, female, NR: *n* (%)	175 (57.9), 122 (40.4), 5 (1.7)
Bilateral TS, unilateral TS: *n* (%)	202 (66.9), 100 (33.1)
Conversion to open surgery: *n* (%)	4 (1.3)
Complications: *n* (%)	50 (16.6)
Reoperation rate: *n* (%)	4 (1.3)
Mortality	0
Postoperative hospital stay (days): mean (range)[a]	2.7 (<24 h–7)
Follow-up: mean (range)[a]	24 mos (1.5 mos–5.7 yr)
Success rate (%): mean (range)	90 (47–100) at 6 mos
	75 (60–94) at >6–15 mos
	49 (20–90) at >15 mos to 5.7 years
Further intervention for pain relief: *n* (%)	39 (12.9)

NR, bot reported

[a] Range of mean/median reported in each series (Table 2)

persisted to the end of the 12-month follow-up period. The overall rate for the need to undergo previously unplanned contralateral TS among the 111 patients of the current review who underwent unilateral TS was 13.5%, although some series have reported higher rates (28%, 30%, and 40%) during longer follow-up periods (2 years or longer) [1, 6, 7].

There is evidence to suggest that CP patients with a dilated pancreatic duct experience rather inferior results

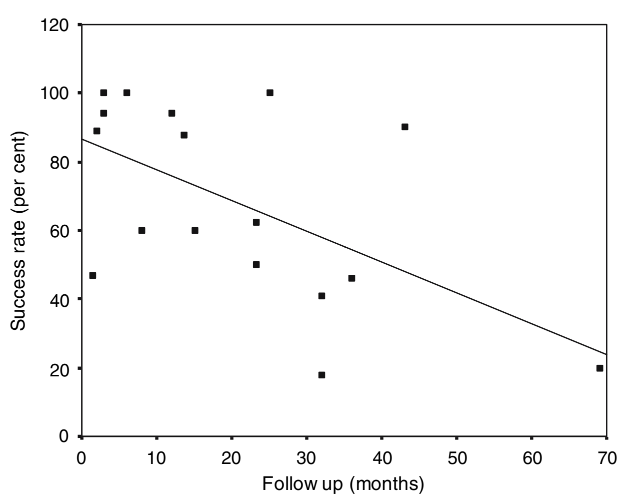

Fig. 1 A linear regression plot depicting the success rate for reported series against the duration of follow-up evaluation (numeric data displayed in Table 2)

from TS than those with nondilated ducts, and that continued alcohol abuse equates with a poor response [4]. However, Buscher et al. [11] found no difference in failure rate (approximately 50% at a median follow-up period of 36 months) between the 9 patients with a dilated duct or an inflammatory mass and the 21 patients without these features.

The long-term outcome after TS appears to be determined by whether the patient has undergone prior direct pancreatic intervention or not. In a study published by Howard et al. [12] patients with small-duct CP who had not undergone prior endoscopic or surgical interventions ($n = 17$) fared markedly better than those who did ($n = 38$) (Fig. 1). The initial benefits of splanchnicectomy were quickly lost at 12 months for 31 (82%) of 38 patients who had prior intervention, and their pain scores returned to their preoperative levels. In contrast, 7 patients (41%) who had no prior intervention maintained significantly lower pain scores during a 36-month follow-up period (mean VAS pain score, 3.5). Furthermore, patients with no prior intervention were less likely to require additional procedures directed at pain control after TS than those with prior interventions (12 vs 37%) [12].

Although TS results in significantly reduced pain and narcotic usage for patients with CP, it appears that one-fifth [1] to less than one-half [11] of the patients maintain pain relief in the long term. Maher et al. [1] reported the longest follow-up evaluation after TS for CP patients. Whereas the short-term results were quite favorable (at approximately 18 months follow-up evaluation, 46% of patients became narcotics free and a further third reduced their narcotic intake by more than 75% and took less potent drugs), these results were not durable (at a median follow-up period of 5 years, only 20% of patients appear to have obtained long-term reductions in their pain and disability scores) [1].

Despite these discouraging results, two-thirds of the patients replied that they would have the surgery again and thought that the pain relief they experienced, albeit short term, was worthwhile [1]. In another study of 44 patients with CP who underwent bilateral TS, Buscher et al. [11] reported a cumulative probability of 46% for pain relief 4 years after the procedure. Therefore, clinicians counseling prospective patients ought to explain that for most patients, the relief of pain and disability will be short lived.

The criteria for selecting patients to undergo TS have a considerable impact on short- and long-term results, and have varied from one investigator to another. Cuschieri et al. [2] reported that the worst results were observed for patients with the most severe disease and concluded that splanchnicectomy would be most appropriate for CP patients with "minimal" disease. Similarly, Maher et al. [20] reported that the failures of TS occurred for patients with more extensive disease, as reflected by their history of previous pancreatic surgery. However, exclusion of patients with advanced CP and previous pancreatic surgery may not be appropriate. Bradley et al. [6] reported good results for patients with severe CP and those with previous pancreatic procedures.

To enhance selection of patients for TS, it is important to differentiate actual pancreatic pain from that of drug-seekers or psychogenic diseases, or pain caused by various somatically innervated conditions. In a case report, Strickland et al. [3] suggested that a good response to preoperative paravertebral sympathetic (splanchnic) nerve block with local anesthetic predicted a good response to TS.

Adopting this principle, Bradley et al. [6] preevaluated 22 patients with CP using epidural infusion of placebo as well as low-dose (sympathetic) and high-dose (somatic) analgesia, assessing patients' responses with VAS as a guide to selection for TS. Six of the patients (27%) experienced more than a 50% reduction in VAS score after placebo injection and were denied TS. The 13 patients who had a good response to low-dose sympathetic epidural blockade experienced more than a 50% reduction in VAS score after splanchnicectomy, whereas none of the three patients who responded only to high-dose somatic epidural blockade benefited from the procedure. The majority of patients who benefited from splanchnicectomy using this selection method continued to do so at a follow-up evaluation after approximately 2 years.

Although we focus on the results of TS, it is helpful to comment briefly on the potential pathophysiologic factors involved in recurrence of abdominal pain after splanchnotomy. Technical failure to divide all the relevant branches of the splanchnic nerves known to vary in location and number may account for the varied response to TS, but it is possible that somatic nerve pathways may play a role, particularly with acute exacerbations of CP. Involvement of the posterior abdominal wall by the inflammatory process may explain why some patients undergoing preoperative selective epidural anesthesia respond only to full somatic blockade and not to sympathetic blockade [6]. It also is possible that some pancreatic pain afferents may be carried by the parasympathetic nerve fibers of the vagus, which is why some advocate a vagotomy in addition to splanchnicectomy [19, 21]. However, the benefits of additional vagotomy remain to be confirmed.

Opioid abuse also may contribute to the recurrence of pain for some patients with CP, and this addiction may interfere with clinicians' ability to evaluate adequately the response to TS. Finally, splanchnicectomy may have a placebo effect for some patients, which may explain the relatively large number of patients who experience pain recurrence within 1 year.

Bilateral TS has long-term efficacy and is more effective for patients with small-duct CP and abdominal pain who have failed medical treatment, have not had a previous surgical interventions, and have responded appropriately to preoperative epidural analgesia. Nonetheless, the use of splanchnicectomy for patients with prior surgical or endoscopic interventions may provide short-term symptomatic relief.

Unilateral TS may fail for approximately 30% of patients, necessitating a contralateral procedure. The varied follow-up periods and preoperative patient selection criteria explain the wide variations in the success rate and the number of patients who remained opioid free postoperatively. For patients with CP, TS offers a minimally invasive intervention aimed at reducing pain and possibly opioid dosage, with inherent improvement in quality of life. The expectations for a opioid-free and durable outcome should, however, be guarded.

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