



Minimally invasive total pancreatectomy for treatment of pancreatic neoplasms: a narrative review

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Objective: The review aims to summarize and describe surgical techniques and outcomes of a minimally invasive total pancreatectomy (MITP).

Background: The minimally invasive approach has gained popularity in the last decades, even in complex abdominal surgery such as pancreatic resections. Currently, many meta-analyses focused on the benefit and advantages of the minimally invasive approach compared to open surgery, especially during distal pancreatectomy.

Methods: Literature research in PubMed was performed on 1st July 2021, using minimally invasive, laparoscopic, or robotic total pancreatectomy (TP) keywords. Case reports, case series on chronic pancreatitis, and no English language manuscripts were excluded. Considering the different MI approaches, laparoscopic or robotic, the literature research identified 416 and 221 manuscripts, respectively. After Authors' revision, 8 papers for each technique were included. The MITP is safe, feasible, and reproducible. The conversion rate was slightly higher in the laparoscopic approach (26% *vs.* 7%) than the robotic. Major postoperative complication, mortality, and length of hospital stay were higher in laparoscopic series compared to the robotic ones. However, the MI technique seems to offer better intraoperative and postoperative outcomes, reducing intraoperative blood loss, major postoperative complications, and length of hospital stay compared to an open approach.

Conclusions: Considering the widespread of the MI approach and the increased indication for TP, further studies, including randomized controlled trials, should be performed to assess the safety and feasibility of the MITP.

Keywords: Laparoscopy; robotic surgery; pancreatic surgery; minimally invasive pancreatic surgery; pancreatectomy

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Introduction

The minimally invasive approach has gained popularity in the last decades, even in complex abdominal surgery such as pancreatic resections (1). However, the minimally-invasive technique had a slower growth of interest if compared to other abdominal operations (2). The surgical

operation's technical problems due to the pancreatic gland's abdominal position, retroperitoneal and attached to the major abdominal vessels, the challenging training, and the concerns regarding the oncological outcomes could explain caution and prudence on its diffusion (3).

Currently, many meta-analyses focused on the benefit and advantages of the minimally invasive approach

compared to open surgery, especially during distal pancreatectomy (4). In contrast with partial pancreatic resections, the total pancreatectomy (TP) is still associated with significant morbidity and mortality (5). Recently, a systematic review reported that the overall morbidity after TP ranged from 36% to 69% and mortality from 0% to 27% (6). The high morbidity and mortality reported, the postoperative metabolic problems, and the complexity of surgical techniques could influence the adoption and diffusion of the minimally invasive TP (7). Furthermore, the indication to TP could be a limit to the choice of the minimally invasive approach (8).

The upfront TP is not a common resection, ranging from 8% to 17% of all pancreatectomies in the large series (9,10). This surgical procedure is reserved for extensive pancreatic cancer, multifocal parenchymal lesions, such as intraductal papillary mucinous neoplasm (IPMN), pancreatic neuroendocrine tumor (pNET), renal cell metastases, or diseases involving the entire pancreas, like the multiple endocrine neoplasia syndrome (MEN) (8). Additionally, TP can also be performed in selected patients with high-risk postoperative complications, such as frail patients or soft pancreatic parenchyma (11). The intraoperative decision to perform a TP is usually associated with a positive frozen section or an emergency setting to control vascular damage and bleeding. Clearly, this challenging surgical technique is only scheduled in selected patients, and the minimally invasive approach is limited to small series.

The review aimed to summarize and describe the surgical technique and outcomes of the minimally invasive total pancreatectomy (MITP).

We present the following article in accordance with the Narrative Review reporting checklist (available at <https://dx.doi.org/10.21037/dmr-21-70>).

Methods

Literature research of PubMed was performed on 1st July 2021, using the keywords of minimally invasive, laparoscopic, or robotic TP. The research was limited to English-language articles reporting the surgical outcomes of the MITP. The research focused on the treatment of pancreatic neoplasm. Chronic pancreatitis was excluded. Conference papers and case reports were excluded.

Selection criteria of the minimally invasive approach

The selection of the minimally invasive approach was

usually based on the absence of vascular involvement, BMI ≤ 35 kg/m², the absence of previous abdominal surgery, or preexisting diabetes or exocrine insufficiency. Less frequently, the surgeon evaluated the technical feasibility or the possibility to preserve the spleen (12).

Results

Laparoscopic TP

Overall, the literature research identified 416 manuscripts. After the authors' revision, eight papers were included (Table 1) (7,12-18). Only a multicenter study was recorded. A total of 106 patients were available for the study. The indications to LTP consisted mainly of premalignant lesions. Almost half of the patients had IPMNs (43%), followed by pancreatic ductal adenocarcinoma (PDAC) (20%) and pNET (19%).

Regarding the surgical technique, all patients were placed in a supine position with their legs separated. Generally, five trocars were used. The 10 mm camera port was placed in the umbilicus. Another two trocars were put laterally in the rectus abdominis and at the midclavicular line bilaterally. Both techniques, *en-block* TP or two steps TP, were used. Typically, the "head approach" was applied first. For the patients with a preoperative suspicion of venous vascular involvement of the superior mesenteric vein or portal vein, the first distal approach to the pancreatic body-tail was suggested. This approach could reduce the splenic blood supply and total blood loss. Usually, the digestive reconstruction was fashioned by an end-to-side running suture hepaticojejunostomy and end-to-side single or double running sutures duodenojejunostomy.

Six papers reported complete data about the intraoperative parameters. The mean operative time and estimated blood loss were 418 minutes (range, 337–502 minutes) and 300 mL (range, 127–617 mL). The conversion rate reported was 26% (n=28). Eighteen patients (33%) had a complicated postoperative course. The mortality rate reported was 1.8% (n=2), and the mean length of stay was 14 days (range, 10–28 days).

Robotic TP

Overall, the literature research identified 221 manuscripts. After the authors' revision, eight papers were included (Table 2) (12,19-25). Again, only one multicenter study was recorded. A total of 94 patients were available for the review. Even for the RTP, the majority of the indications

Table 1 Laparoscopic total pancreatectomy studies

Authors	Year	No. of patients	Indication	Operative time	EBL	Conversion	Morbidity	Mortality	LOS
Choi <i>et al.</i> (13)	2012	3	IPMN [3]	423 [410–450]	483 [160–800]	0	1 (33%)	0	21 [17–46]
Dallemagne <i>et al.</i> (14)	2013	2	IPMN [1], pNET [1]	390 [360–420]	400 [200–600]	0	0	0	8 [8–8]
Dokmak <i>et al.</i> (15)	2013	2	IPMN [1], pNET [1]	315 [270–360]	250 [200–300]	0	1 (50%)	0	15 [12–18]
Zakaria (7)	2016	31	PDAC [5], pNET [6], IPMN [11], AC [1], CP [1]	534 [234–770]	200 [50–600]	7 (23%)	10 (42%)	1 (4%)	8 [4–52]
Wang <i>et al.</i> (16)	2017	3	IPMN [2], pNET [1]	490 [450–540]	266 [100–400]	0	2 (66%)	0	18 [8–24]
Goh <i>et al.</i> (17)	2019	2	–	–	–	0	–	0	–
Cai <i>et al.</i> (18)	2020	13	PDAC [6], IPMN [5], pNET [1], CP [1]	355 [300–470]	200 [50–1,000]	0	4 (30%)	0	17 [12–23]
Scholten <i>et al.</i> (12)	2021	50	–	–	–	21 (42%)	–	1 (2%)	–

IPMN, intraductal pancreatic mucinous neoplasm; pNET, pancreatic neuro-endocrine tumor; PDAC, pancreatic ductal adenocarcinoma; AC, ampullary carcinoma; CP, Chronic pancreatitis; EBL, estimated blood loss; LOS, length of stay.

Table 2 Robotic total pancreatectomy studies

Authors	Year	No. of patients	Indication	Operative time	EBL	Conversion	Morbidity	Mortality	LOS
Giulianotti <i>et al.</i> (19)	2011	5	PDAC [1], pNET [1], IPMN [1], SC [1], CP [1]	480 [300–560]	300 [50–650]	0	0	0	7 [5–10]
Zureikat <i>et al.</i> (20)	2013	10	IPMN [6], PDAC [1], CP [3]	560 [461–592]	650 [400–1,000]	1 (10%)	2 (20%)	0	10 [7–10]
de Mesquita Neto <i>et al.</i> (21)	2019	7	IPMN [4], pNET [2], CP [1]	480 [330–660]	240 [50–400]	1 (14%)	1 (14%)	0	10 [7–14]
Weng <i>et al.</i> (22)	2020	15	PDAC [4], IPMN [3], pNET [3], CP [3], RCC [2]	300[250–360]	400[200–700]	0	1 (7%)	0	18
Scholten <i>et al.</i> (12)	2021	15	–	–	–	2 (13%)	–	0	–
Wang <i>et al.</i> (23)	2021	14	–	307	200 [120–400]	3 (21%)	1 (7%)	0	9 [7–12]
Timmermann <i>et al.</i> (24)	2021	3	PDAC [2], RCC [1]	278 [258–302]	–	0	1 (33%)	0	11 [10–32]
Kauffmann <i>et al.</i> (25)	2021	25	IPMN [18], PDAC [5], RCC [1], CP [1]	585 [525–863]	500 [430–600]	0	6 (22%)	1 (4%)	22 [15–31]

PDAC, pancreatic ductal adenocarcinoma; pNET, pancreatic neuro-endocrine tumor; IPMN, intraductal pancreatic mucinous neoplasm; CP, Chronic pancreatitis; RCC, renal cell carcinoma; SC, serous cystoadenoma; EBL, estimated blood loss; LOS, length of stay.

to surgery consisted of premalignant lesions. Half of the patients had IPMNs (49%), followed by PDAC (20%) and pNET (9%).

Regarding the surgical technique, the most common device used was the da Vinci Si Surgical System (Intuitive Surgical, Sunnyvale, CA, USA). All patients were placed in a supine position with the legs split in the French position. Generally, five trocars were used. The camera port was placed lower below the umbilicus. Another two trocars were put laterally on the right rectus abdominis and at the right midclavicular line. The fourth robotic trocar was placed above the transverse umbilical line crossing with the left midclavicular line. Another 12-mm trocar was placed on the left side of the umbilicus for the assistant surgeon. Even for the robotic procedures, both techniques, *en-block* TP or two steps TP, were described.

Seven papers reported complete data about the intraoperative parameters. The mean operative time and estimated blood loss were 427 minutes (range, 354–556 minutes) and 382 mL (range, 208–625 mL). The conversion rate reported was 7% (n=7). Twelve patients (15%) had a major postoperative complication. The mortality rate reported was 0.1% (n=1), and the mean length of stay was 12 days (range, 9–18 days).

Discussion

The present review described the current status of the minimally invasive approach to the TP, summarizing the current literature. Excluding case reports and case series on chronic pancreatitis, to date, only fifteen studies reported the feasibility of the MITP. Actually, the minimally invasive approach to TP is safe, feasible, and reproducible. Furthermore, this surgical technique seems to offer better intraoperative and postoperative outcomes, reducing blood loss, major complications, and length of stay compared to the open approach (12).

Comparing the data, the laparoscopic approach to TP seems to have still higher performance than the robotic ones, especially analyzing the intraoperative outcomes. However, the postoperative course seems to be better in the robotic series. During the resection, the robotic platform has several benefits, such as 3D vision, muscle tremor filters, improved stability, six axes of freedom, and a 360-degree range of articulation. These benefits could be relevant during accurate dissections, such as spleen-preserving pancreatectomies (26). Indeed, the minimally invasive TP

spleen-preserving rate varied from 25% to 50% (12,22). The main indication to TP was a malignancy. However, the preservation of the spleen should continuously be taken into account. In this context, the diffusion of the MITP could certainly improve the resection and results. Indeed, the spleen's immunological role and the significant reports of postoperative infectious complications related to its resection have led the surgeons to be more conservative in the surgical approach during TP, when feasible.

Another hot topic correlated to the minimally invasive approach is the economic aspect. An intense debate is ongoing, especially regarding the use of the robotic platform, on the cost-efficacy of the minimally invasive pancreatic procedures, with still controversial results (27,28). Improving the quality of life and cosmetic satisfaction is often described as a major benefit of minimally invasive surgery. However, these TP parameters have been recognized as inferior compared to the other pancreatic resections, reducing its indications (10).

There are a few limitations to this study. The included studies are mostly case series with a small sample size from single centers. Furthermore, well-designed studies with or without randomization are lacking. Surgeon experience, training, and available resources should be considered to determine which approach can be adopted.

Conclusions

The present review reported the current status of the minimally invasive approach to the TP. The MITP is safe, feasible, and reproducible. The use of the minimally invasive approach is associated with better intraoperative and postoperative outcomes. Considering the widespread of the minimally invasive approach and the increased indication to TP, further studies, such as a randomized controlled trial, should be performed to assess the safety and feasibility of the MITP definitively.

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Footnote

Reporting Checklist: The authors have completed the Narrative Review reporting checklist. Available at <https://dx.doi.org/10.21037/dmr-21-70>

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Ethical Statement: The authors are 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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