

Open distal pancreatectomy stump closure by linear stapling versus continuous suturing: a retrospective–prospective comparative study

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Background

Distal pancreatectomy (DP), performed for removing pancreatic lesions located to the left of the superior mesenteric vein, accounts for ~25% of all pancreatic resections. Most recently reported overall mortality rate of DP is less than 3%. However, albeit technically simpler to perform than pancreaticoduodenectomy, morbidity rate of DP remains substantial. Postoperative pancreatic fistulas (POPFs), which may result in numerous clinically significant and potentially life-threatening complications such as intraabdominal abscess, hemorrhage, and surgical site infection, is the leading cause of morbidity after DP, with an incidence of ~30–60%. Risk factors associated with POPFs after DP include decreased serum albumin levels, concurrent splenectomy, increased body weight, increased duration of surgery, higher American Society of Anesthesiologists score, and impaired renal function. Furthermore, POPFs often translate to significant increases in hospitalization costs.

Objective

To compare the technique of DP stump closure in two groups of patients; a group underwent stump closure with linear stapling technique and the other group underwent stump closure with continuous suturing technique.

Patients and methods

This was a retrospective–prospective clinical trial that was conducted at General Surgery Department, Ain Shams University Hospitals on 30 patients who were admitted to specialized hepatobiliary units in Cairo, Egypt for open DP. Between January 2020 and June 2022 with postoperative follow-up period of 2 months. In our study, there were 30 patients (15 in the continuous suturing technique group and 15 in the linear stapling technique group) with a mean age of 45.37 ± 10.662 years. Groups were similar in demographic and clinical characteristics ($P > 0.05$).

Results

In our study, 13.33% patients in continuous suturing technique group developed clinically relevant POPF (grade B and grade C POPF), whereas 33.33% patients in stapling technique group develop POPF ($P = 1.00$).

The amount of the blood loss which was found to be statistically significant as the P value was found less than 0.05 and the t test was found to be -2.396 which mean that the amount of the blood lost was more in the stapler group.

There was no statistically significant difference in the rate of clinically relevant POPF (grade B and grade C POPF) with suture closure compared with stapler closure (13.33 vs. 33.33%).

There was no statistically significant difference in the risk of intraabdominal abscess. There were three (20%) patients with a biochemical leak in continuous suturing technique group. In stapling technique group, three (20%) patients developed biochemical leaks. There was no significant in difference between groups in terms of biochemical leak.

In our study, mortality rates did not differ between stapler and suture closure techniques.

Conclusion

Our study showed no significant difference between suture and stapler closure of DP stump with respect to POPF or intraabdominal collection after DP.

The amount of the blood lost was more in the stapler group.

Keywords:

distal pancreatectomy, pancreatic stump, pancreatic surgery, postoperative pancreatic fistula

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Introduction

Trendelenburg carried out the first distal pancreatectomy (DP) for sarcoma on July 16, 1882 [1]. Pancreatology has changed significantly during the past several decades. This is due to the use of various surgical and interventional techniques for pancreatic diseases such as tumors and acute pancreatitis. Additionally, the indications for DP has increased [2].

The most commonly performed surgery for left-sided pancreatic lesions, such as cancer, solid tumors, pseudocysts, cystic neoplasms, and pancreatitis is now DP. Compared to pancreaticoduodenectomy, DP is a less complicated treatment since it does not necessitate the restoration of the digestive tract or pancreatobiliary system. However, following a DP, the majority of pancreatic surgeons deal with complications, particularly postoperative pancreatic fistula (POPF) [3–5].

Following DP, POPF is still the most frequent and clinically important complication, with serious clinical consequences such as intraabdominal abscess, sepsis, wound infection, delayed stomach emptying, ileus, or fatal bleeding [6].

To reduce this complication, a number of surgical methods for managing pancreatic remnants have been developed. These methods include continuous suturing, staple closure, combinations of staple devices, and some form of stump reinforcement, such as tissue sealants, pancreatico-enteric or gastric anastomosis, or sutures or a seromuscular patch [6–10]. The fact that so many different strategies have been proposed is itself an evidence that there is not a perfect choice.

Numerous investigations found that there was no statistically significant difference in POPF and death rates between different pancreatic stump closure approaches, despite the availability of data on diverse closure techniques [6,11,12].

Aim

The aim of this study was to compare the technique of DP stump closure in two groups of patients; a group underwent stump closure with linear stapling technique and the other group underwent stump closure with continuous suturing technique.

Patients and methods

Type of study: a retrospective–prospective comparative study.

Study setting: this study was conducted at General Surgery Department, Ain Shams University Hospitals. Approval of the Ethical Committee and written informed consent from all participants was obtained.

Study period: between January 2020 and June 2022 with postoperative follow-up period of 2 months.

Study population

Inclusion criteria of the study were male and female patients with distal pancreatic lesions including cancer, cystic neoplasms, solid tumors and pseudocysts, fit for surgery, and willing to attend follow-up visits. While exclusion criteria of the study were high-risk patients unfit for surgery (ASA V–VI), old age (over 75 years old), previous pancreatic surgery, patient's refusal, pancreatic lesions that are not able to be fully removed with a DP or achieve an R0 resection, inoperable pancreatic malignancy, pancreatic multifocal lesions, and chronic pancreatitis proven by final pathology.

Study procedures

Preoperative assessment

- (1) Full clinical history and full clinical examination.
- (2) Routine preoperative investigations.
- (3) Preoperative comorbid factors were controlled when possible before surgery.
- (4) Patients undergoing cancer resections should have preoperative Ca19-9.
- (5) A pancreatic computed tomography protocol is done.
- (6) Any signs of preoperative malnutrition should be addressed and managed accordingly.
- (7) Preoperative immunization with splenectomy vaccines at least 2 weeks before surgery for elective patients otherwise patients' group underwent emergency or urgent procedure with splenectomy should receive splenectomy vaccines within 2 weeks postoperatively.

Operative procedure

- (1) Open DP with splenectomy.

Study intervention

DP stump closure with either linear stapling or continuous suturing by isolated ductal ligation with continuous parenchymatous suturing.

Statistical analysis

- (1) Data was collected, revised, coded, and entered to the Statistical Package for Social Science (IBM SPSS, Version 23.0. Armonk, NY: IBM Corp).

- (2) Quantitative data is presented as mean, SDs, and ranges when their distribution is found parametric.
- (3) Qualitative data is presented as numbers and percentages.

Results and comparative statistics

Our study included 30 patients divided into two groups each group 15 patients the first group is the patients

Table 1 Comparison between the two groups with regard to operative time

Operative time (h)	Group		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
2-3 h						
Count	3	1	4			
% within group	20.0	6.7	13.3			
3-4 h						
Count	4	5	9			
% within group	26.7	33.3	30.0			
4-5 h						
Count	6	8	14	1.730	0.685	NS
% within group	40.0	53.3	46.7			
>5 h						
Count	2	1	3			
% within group	13.3	6.7	10.0			
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value more than 0.01: highly significant. χ^2 test.

Table 2 Representing the comparison between the two groups with regard to drain amylase

Drain amylase	Group		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
>10 folds serum amylase						
Count	4	5	9			
% within group	26.7	33.3	30.0			
Negative						
Count	11	10	21			
% within group	73.3	66.7	70.0	0.159	0.690	NS
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value more than 0.01: highly significant. χ^2 test.

Table 3 Representing the comparison between the two groups with regard to wound infection

Wound infection	Groups		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
Yes						
Count	5	2	7			
% within group	33.3	13.3	23.3			
No						
Count	10	13	23			
% within group	66.7	86.7	76.7	1.677	0.390	NS
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value more than 0.01: highly significant. χ^2 test.

who had DP with suturing and the second group with stapling.

In our study the number of the male patients are 11 (36.7%) and the female patients are 19 (63%) of the total populations included in our study.

The next tables will represent the comparison between the two groups (Tables 1–9).

By comparing the two groups with regard to these different variables it was found to be there is no correlation between the two groups with regard to these variables as it was found to be statistically insignificant *P* value more than 0.05 using χ^2 test for the categorical data except for the drain color as it was found to be more correlated to the suturing group than stapler group.

The next table will compare the numerical values of the different variables for the two groups using independent *t* test (Table 10).

All of the variables were found to statistically insignificant by the comparison between the two groups using *t* test as the *P* value was found more than 0.05 except for the amount of the blood loss which was found to be statistically significant as the *P* value was found less than 0.05 and the *t* test was found to be -2.396 which mean that the amount of the blood lost was more in the staplers group (Table 11).

Discussion

Surgeons have attempted a multitude of procedures to seal the stump of the remaining pancreas in an effort to decrease the amount of postoperative fistulas. The

Table 4 Representing the comparison between the two groups with regard to delayed gastric emptying

	Groups		Total	χ^2 test	<i>P</i> value	Significance
	Suturing	Staplers				
Delayed gastric emptying						
Yes						
Count	4	2	6			
% within group	26.7	13.3	20.0			
No						
Count	11	13	24			
% within group	73.3	86.7	80.0	0.833	0.651	NS
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; *P* value less than 0.05: significant; *P* value more than 0.01: highly significant. χ^2 test.

Table 5 Representing the comparison between the two groups with regard to postoperative pancreatic fistula (ISGPF grade)

	Groups		Total	χ^2 test	<i>P</i> value	Significance
	Suturing	Staplers				
Postoperative pancreatic fistula (ISGPF grade)						
No						
Count	10	7	17			
% within group	66.7	46.7	56.7			
Grade A						
Count	3	3	6			
% within group	20.0	20.0	20.0			
Grade B						
Count	1	3	4			
% within group	6.7	20.0	13.3	1.863	0.652	NS
Grade C						
Count	1	2	3			
% within group	6.7	13.3	10.0			
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; *P* value less than 0.05: significant; *P* value more than 0.01: highly significant. χ^2 test.

Table 6 Representing the comparison between the two groups with regard to intraabdominal collection by ultrasound

	Groups		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
Intraabdominal collection (ml) by ultrasound						
0–100						
Count	11	10	21			
% within group	73.3	66.7	70.0			
100–200						
Count	3	2	5			
% within group	20.0	13.3	16.7			
200–300						
Count	1	2	3			
% within group	6.7	13.3	10.0	1.581	1.000	NS
>400						
Count	0	1	1			
% within group	0.0	6.7	3.3			
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value more than 0.01: highly significant. χ^2 test.

Table 7 Representing the comparison between the two groups with regard to related hospital readmission

	Groups		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
Related hospital readmission (times)						
0						
Count	13	11	24			
% within group	86.7	73.3	80.0			
1						
Count	2	2	4			
% within group	13.3	13.3	13.3			
2						
Count	0	2	2	2.167	0.531	NS
% within group	0.0	13.3	6.7			
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value more than 0.01: highly significant. χ^2 test.

Table 8 Representing the comparison between the two groups with regard to element of acute pancreatitis by final pathology

	Groups		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
Element of acute pancreatitis by final pathology						
Yes						
Count	8	11	19			
% within group	53.3	73.3	63.3			
No						
Count	7	4	11			
% within group	46.7	26.7	36.7	1.292	0.450	NS
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

Table 9 Representing the comparison between the two groups with regard to drain color

Drain color	Group		Total	χ^2 test	P value	Significance
	Suturing	Staplers				
Serous						
Count	8	4	12			
% within group	53.3	26.7	40.0			
Serosanguinous						
Count	3	8	11			
% within group	20.0	53.3	36.7			
Blood						
Count	4	0	4			
% within group	26.7	0.0	13.3	10.606	0.008	S
Pancreatic						
Count	0	3	3			
% within group	0.0	20.0	10.0			
Total						
Count	15	15	30			
% within group	100.0	100.0	100.0			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value more than 0.01: highly significant. χ^2 test.

Table 10 Representing the comparison of the two groups with regard to different variables using t test

	Groups	Mean	SD	t test	P value	Significance
Amount of blood loss (ml)	Suturing	496.67	±117.210	-2.396	0.027	S
	Staplers	673.33	±260.403			
Hospital stay (days)	Suturing	8.27	±3.453	-0.880	0.386	NS
	Staplers	9.40	±3.602			
ICU stay (days)	Suturing	1.13	±1.125	-0.879	0.387	NS
	Staplers	1.53	±1.356			
Peak TLC	Suturing	20.67	±5.602	0.452	0.655	NS
	Staplers	19.73	±5.700			
Day 1 drain amount (ml)	Suturing	280.67	±172.273	-0.090	0.929	NS
	Staplers	286.67	±191.299			
Day 2 drain amount (ml)	Suturing	343.33	±398.935	0.594	0.557	NS
	Staplers	276.67	±172.033			
Day 3 drain amount (ml)	Suturing	232.00	±197.274	0.824	0.417	NS
	Staplers	183.33	±115.984			
After day 7 drain amount (ml)	Suturing	60.00	±145.406	-0.519	0.608	NS
	Staplers	93.33	±201.660			

P value more than 0.05: nonsignificant; P value less than 0.05: significant; P value less than 0.01: highly significant. Dependent t test.

Table 11 Represent a summary of some important variables

Statistics	Age	Amount of blood loss (ml)	Day 1 drain amount (ml)	Day 2 drain amount (ml)	Day 3 drain amount (ml)	Day 4 drain amount (ml)	Day 5 drain amount (ml)	Day 6 drain amount (ml)	Day 7 drain amount (ml)	After day 7 drain amount (ml)
Mean	45.37	585.00	283.67	310.00	207.67	146.67	118.33	96.67	90.00	76.67
SD	10.662	217.806	178.895	303.755	160.917	205.499	180.270	201.688	202.740	173.570
Minimum	22	300	100	50	20	0	0	0	0	0
Maximum	61	1200	860	1700	700	1000	800	700	700	600

methods most frequently employed are stapler closure and suture closure of the pancreatic remnant. Because there are so many contradicting findings in the

literature, the debate concerning the effect of stapler closure and suture closure of the pancreatic stump on the PF rate is far from being resolved [13].

A 2005 meta-analysis by Knaebel *et al.* [14] failed to come to a definitive conclusion about the best technique for stump closure, however stapled closure was a trend favored by many surgeons.

In our study, there were 30 patients (15 in continuous suturing technique group and 15 in stapling technique group) with a mean age of 45.37 ± 10.662 years. Groups were similar in demographic and clinical characteristics ($P > 0.05$).

This thesis agrees with Okuyan [15], who aimed to determine rates of POPF after DP and evaluate impact of two closure methods on development of POPF. Patients were grouped as groups hand-sewn and stapled closure. They reported no significant difference between both groups as regard demographic and clinical characteristics.

In our study, patients who had continuous suturing method developed POPF at a rate of 33.3%, while patients who underwent stapling technique developed POPF at a rate of 53.3% ($P = 0.652$). The mandatory closure of the primary pancreatic duct, which is thought to be the most important part of this procedure, may be a significant factor in the decreased POPF rate with continuous suturing approach compared with stapling technique.

According to Bilimoria and colleagues, patients who had their pancreatic duct sutured had an incidence rate of 9.6%, whereas those who did not have sutured closure had a rate of 34%.

A multivariate analysis indicated that failure to ligate the major pancreatic duct at the stump was a significant risk factor for pancreatic leakage with an odds ratio of 5.0 (95% confidence interval=2.0–10.0; $P = 0.001$) [16].

The notion that stapling induces localized necrotizing pancreatitis was raised by Diener *et al.* [11] when they found a greater morbidity rate following stapler closure.

Reeh *et al.* [17] observed a considerably increased POPF rate following stapler closure in their 283 consecutive DP cases, which is similar to the current study. According to Sheehan *et al.* [18], the POPF in the stapler group was 25% while it was 14% in the suture group.

According to several comprehensive studies, the risks associated with stapler closure and suture closure are the same [11,19].

Zhou *et al.* [13] found that the incidence of PF in the surgical literature ranges significantly from 0 to 45.7% in their meta-analysis.

In contrast to the earlier reported incidence of POPF (19.7–35.5%), the rate of POPF in the stapler closure group in our study was greater [20,21].

Between 20 and 44% of hand-sewn items have been documented to have POPF [21,22].

Conclusion

In conclusion, our study showed no significant difference between suture and stapler closure of DP stump closure with respect to POPF or intraabdominal collection after DP.

The amount of the blood lost was more in the stapler group.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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