Original Article

Endoscopic versus surgical treatment for pancreatic pseudocysts: Feasibility and short-term outcomes

Alhassan M. Hassan[a], Tarek M. Sehsah[a], Asem A. Elfert[b] and Hosam B. Barakat[a]

Department of [a]General Surgery, [b]Tropical Medicine, Faculty of Medicine, Tanta University, Tanta, Egypt.

ABSTRACT

Background: A pancreatic pseudocyst (PP) refers to a confined accumulation of fluid containing high levels of amylase and various enzymes. It is encased by either a fibrous wall or granulation tissue, typically stemming from acute or chronic pancreatitis, pancreatic injury, or obstruction of the pancreatic duct. Treatment options vary in effectiveness and include endoscopic, percutaneous, or surgical interventions.

Aim: The objective of this study was to conduct a retrospective analysis to contrast the outcomes of surgical and endoscopic interventions for PP. This analysis will focus on mortality rates, clinical success (defined as complete resolution within a 6-month follow-up period at intervals of 1, 3, and 6 months), recurrence rates, complications, associated costs, and duration of hospital stays.

Patients and Methods: Data were retrospectively collected from 50 patients from their medical records and files in the period from July 2018 to July 2021 in Tanta University Hospitals. These patients underwent surgical or endoscopic drainage of PP.

Results: No notable distinction was observed in the success rates of treatment, occurrences of adverse events related to drainage or general complications, and recurrence rates between surgical and endoscopic interventions. However, in terms of hospitalization duration, the endoscopic approach yielded superior results. Additionally, concerning treatment costs, the endoscopic method also demonstrated more favorable outcomes.

Conclusion: The success rates of surgical and endoscopic treatments for PP showed no significant difference, nor did the occurrence of adverse events or recurrence. However, the endoscopic group exhibited shorter hospitalization durations and lower treatment costs.

Key Words: Endoscopy, laparoscopy, pancreatic pseudocyst, surgery.

Received: 6 September 2024, **Accepted:** 27 September 2024, **Published:** 1 January 2025

Corresponding Author: Hosam B. Barakat, MD, Department of General Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt. **Tel.:** +20 100 284 1231, **E-mail:** elbohotyhossam2018@gmail.com

ISSN: 1110-1121, January 2025, Vol. 44, No. 1: 415-422, © The Egyptian Journal of Surgery

INTRODUCTION

Pancreatic fluid collections arise as complications of various pancreatic disorders, notably following acute biliary pancreatitis, chronic pancreatitis, trauma, or surgical procedures. Typically, these collections manifest ~4 weeks postinitial injury[1]. The 2012 Revised Atlanta classification categorizes inflammatory fluid collections of the pancreas. Pancreatic pseudocysts (PP) represent distinct fluid collections within the pancreas, often emerging several weeks following an acute pancreatitis episode. Walled-off necrosis arises from necrotizing pancreatitis, requiring a minimum of 4 weeks for development and containing necrotic tissue. PP incidence ranges up to 20% in acute pancreatitis cases and up to 40% in chronic pancreatitis cases[2]. Spontaneous resolution is dependent on size and time of evolution. Most PPs are asymptomatic and resolve spontaneously without intervention[3]. The main symptoms include abdominal pain (76–94%), early satiety, nausea, vomiting (50%), and weight loss (20–51%)[4]. Indications for PP drainage include persistent pain and/or nausea, vomiting regardless of size, large size (>6 cm), rapid growth, or complications such as infection and bleeding[4,5]. Drainage methods include endoscopic, surgical, or percutaneous procedures. Percutaneous drainage, while effective for certain cases, is associated with high recurrence rates and is not considered definitive treatment, often reserved for immature or infected cysts and patients with contraindications for definitive surgery[1]. Historically, open surgical approaches were considered the gold standard, but less invasive techniques like laparoscopic and endoscopic drainage have gained popularity. Depending on anatomical considerations, PP drainage can be safely achieved via the stomach, duodenum, or small intestine[6]. Endoscopic techniques encompass various approaches, such as transpapillary or transmural drainage, typically guided by endoscopic ultrasound (EUS) or transluminal endoscopic necrosectomy. Surgical options range from traditional open necrosectomy to minimally invasive surgical techniques, with hybrid interventions also feasible

DOI: 10.21608/EJSUR.2024.318848.1194

in certain cases[7]. Despite the increasing popularity of less invasive methods, comparative studies between surgical and endoscopic approaches for PP treatment are limited. Consequently, there is a need for systematic reviews and meta-analyses incorporating recent comparative studies to evaluate and compare these therapeutic modalities[1].

PATIENTS AND METHODS:

This study is a retrospective single-center study that was carried out on 50 patients diagnosed with PP at Tanta University Hospitals in the period between July 2018 and July 2021, after approval of our institutional ethical committee.

Inclusion criteria

All patients more than 18 years old are diagnosed with PP at our institute.

Exclusion criteria

(1) Patients with other combined diseases, such as pancreatic cystic tumors or pancreatic cancer.

(2) Patients with walled-off necrosis.

(3) Patients lost to follow-up.

Patients divided into two groups:

(1) Patients who underwent surgical intervention (open or laparoscopic) (30 patients).

(2) Patients who underwent endoscopic management (20 patients).

Patients where there is a blood vessel insinuated between the cyst and the stomach and patients where the cyst does not indentate through the posterior gastric wall, findings which are noted on the diagnostic images computed tomography (CT) and MRI, were subjected to surgical drainage.

Demographic information encompassed age, BMI, sex, and the etiology of PPs (acute, chronic, idiopathic, or traumatic pancreatitis). Clinical presentations such as pain, early satiety, jaundice, weight loss, and abdominal mass, along with laboratory data including hemoglobin, leukocyte count, C-reactive protein, serum amylase and lipase levels, and serum CEA and CA19.9 levels, were recorded. Radiological findings, including location, number (single or multiple), and size of PPs, were assessed through diagnostic abdominal enhanced CT (Fig. 1) or MRI. Surgical procedures were performed by a consistent team. Indications and types of interventions, including open or laparoscopic cystogastrostomy or cystojejunostomy for surgical interventions and endoscopic drainage, were documented. Details of interventions such as operative time, intraoperative blood loss, and the requirement for blood transfusion were recorded. Therapeutic success was defined as complete resolution or a significant decrease in pseudocyst size (<2 cm) on imaging accompanied by total symptom improvement following the initial intervention. Adverse events related to drainage (e.g. perforation, bleeding, infection, stent migration) and those not related to drainage (e.g. abdominal wall infection, postoperative fever, incisional hernia, deep venous thrombosis, and cardiopulmonary dysfunctions) were documented. Worsening exocrine functions, indicated by the need for oral digestive enzyme-assisted digestion in daily life, and worsening endocrine functions, indicated by the need for increased medication to control blood sugar or newly diagnosed diabetes, were recorded. The length of hospitalization was defined as the duration of stay from the day of intervention (surgical or endoscopic) to discharge. Recurrence was characterized by the appearance of a new pseudocyst observed through imaging methods during follow-up after previously reported resolution. Recurrence rate and mortality were evaluated during follow-up. The endoscopic management involved transmural approaches guided by EUS to drain the pseudocyst, often necessitating the use of multiple stents (Figs 2–5). Conventional open surgical procedures were conducted via a midline incision, providing extensive exposure to the stomach and duodenum. For laparoscopic approaches, patients were positioned supine, and four-port sites utilized. The surgeon positioned the patient's legs, with the camera port situated in the supraumbilical midline and two working ports in the left and right midclavicular lines. An additional epigastric port was used for assistance and liver retraction. Upon entering the abdomen, the PP was accessed anteriorly through the stomach's anterior wall, which was incised using a harmonic scalpel or electrocautery. Aspiration confirmed the pseudocyst's position, followed by drainage achieved through a laparoscopic stapler, creating a cystogastrostomy at least 4–5 cm long between the posterior stomach wall and the anterior pseudocyst wall. Bleeding from the stomach wall was managed accordingly. The pseudocyst was drained, and if necessary, pancreatic debridement was performed. In some cases, the cystogastrostomy walls were oversewn to prevent bleeding or stoma narrowing. Closure of the stomach's anterior wall was accomplished using a running suture (Figs 6–11).

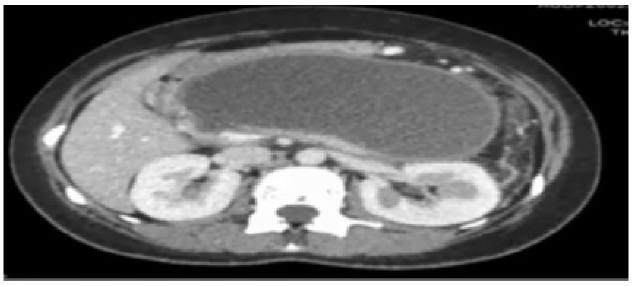

Fig. 1: CT abdomen of large pancreatic pseudocyst. CT, computed tomography.

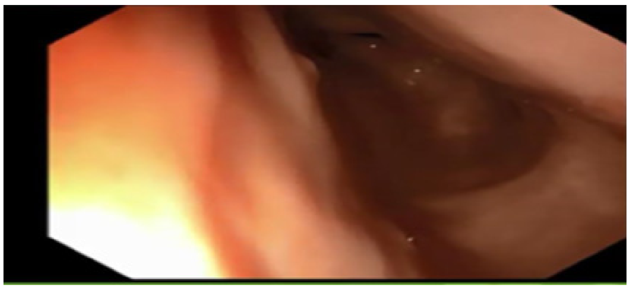

Fig. 2: Endoscopic view of the large bulge into lesser curvature of the stomach.

Fig. 3: EUS-guided FNA of pancreatic pseudocyst.EUS, endoscopic ultrasound.

Fig. 4: Endoscopic view of a pancreatic pseudocyst with a guide wire into the bulging lesser curve.

Fig. 5: Endoscopic view of pancreatic pseudocyst with two double pigtail plastic stents.

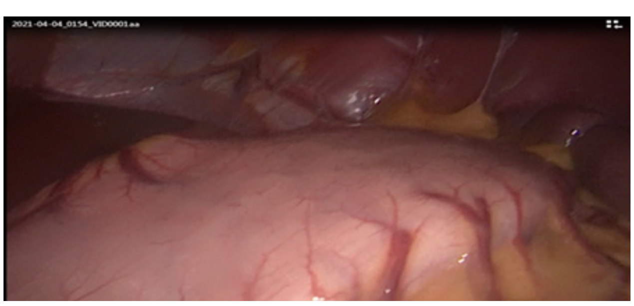

Fig. 6: Laparoscopic view of large PPC bulging through the stomach.

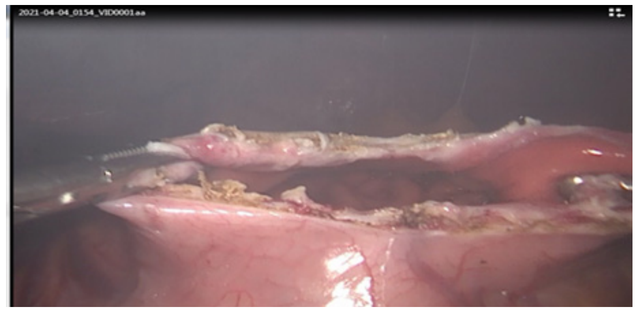

Fig. 7: Creating stoma through the anterior abdominal wall through electrocautery.

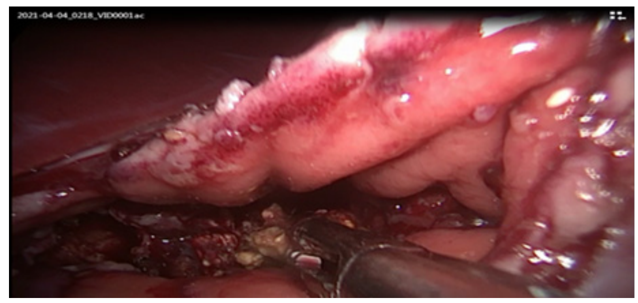

Fig. 8: Necrosectomy through laparoscopic cystogastrostomy.

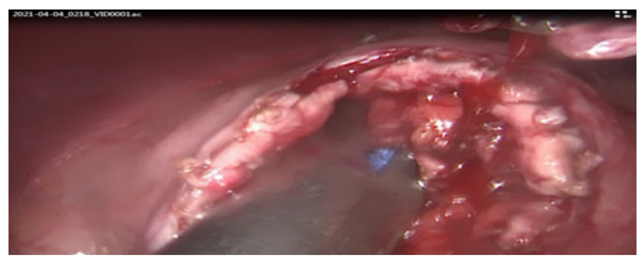

Fig. 9: Stapler cystogastorostomy.

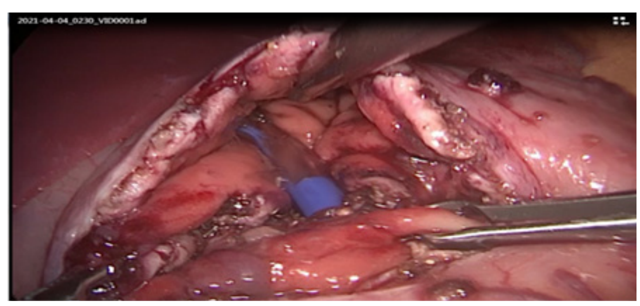

Fig. 10: Drainage of pancreatic pseudocyst.

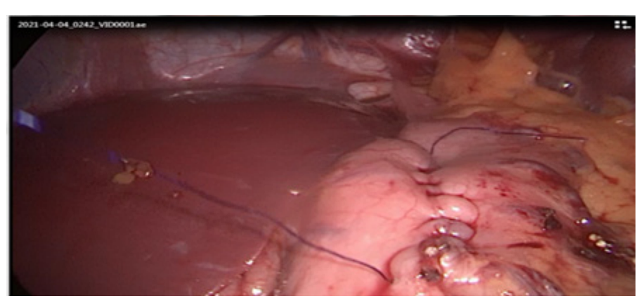

Fig. 11: Closure of anterior gastrotomy.

RESULTS:

Patient demographics and disease characteristics

From July 2017 to July 2021, 50 patients with PP at our institute underwent surgical (n=30) (22 laparoscopic and eight open surgery) or endoscopic (n=20) management. The patients were followed up for an average of 30 months. Baseline demographic information and disease characteristics were analyzed and compared as depicted in (Table 1). No statistically significant differences were observed in age, sex, BMI, and time of disease onset among the various groups. However, gallstone pancreatitis exhibited statistical significance (*P=0.02*) compared to other causes of pancreatitis, also there was no statistical difference between the groups regarding cyst size (9.95±1.36 in the endoscopic group, 10.59±2.54 in the laparoscopic group, and 11.25±2.49 in the open group with *P=0.322*) and location whether head and neck or body and tail (*P=0.141*).

Perioperative characteristics

The choice of surgical procedure is determined by the surgeon preoperatively and confirmed intraoperatively, and all procedures are performed by the same surgical team. Comparing the characteristics of endoscopic and surgical management (Table 2), there was a shorter operative time in the endoscopic group with statistical significance (39.40±5.36, *P=0.001*) compared to the laparoscopic group (104.09±12.02) and open group (115.63±9.04), and significantly decreased intraoperative blood loss in endoscopic group (38.75±9.98, *P=0.001*) compared to laparoscopic group (240.45±109.39) and open surgical group (312.50±87.63).

Postoperative complications

Postoperative complications and long-term follow up was recorded (Table 2), 11 patients developed postoperative wound infection seven in laparoscopic and four in open surgery with no infection in endoscopic group with statistical significance (*P=0.005*), eight patients in endoscopic group and 17 patients in surgical group developed fever which was mild (<38.5) and managed by antipyretics, with no statistical significance (*P=0.247*), four patients in endoscopic group and six patents in surgical group worsening of their exocrine functions proved by fecal elastase level and continued on exogenous pancreatic enzyme supplementation with no statistical difference in all groups (*P=0.918*), also four patients in endoscopic group and 11 patients developed diabetes postoperative and all managed by insulin with no statistical significance(*P=0.451*), four patients required reoperation, two in endoscopic group, one in laparoscopic group, and one in open group, all were due to bleeding, in endoscopic group bleeding was controlled endoscopically with no need to surgically explore the patient, the other two patients were controlled one by suture and the other by electrocautery with no statistical difference (*P=0.710*).

Risk factors for recurrence and complications

Two patients had a recurrence in the endoscopic group (10%), and five n the laparoscopic group (22.7%), and no patients had a recurrence in the open group with no statistical difference between the two groups (*P=0.227*), the median recurrence time was 12 months which was discovered during follow up, three were discovered accidentally during follow-up and four had abdominal pain, mean size of the recurrent cyst was 4±1.3 and all managed conservatively. Univariate analysis of the factors affecting recurrence, including age, etiology, time of initial onset of pancreatitis, cyst size, and location, intraoperative blood loss, etc., the logistic regression analysis found a high incidence of recurrence associated with gallbladder stones etiology (*P=0.008*), the increase in cyst size (*P=0.012*) and shorter time of initial onset of symptoms after pancreatitis (*P=0.001*) (Table 3).

Table 1: Patient demographics and disease characteristics

	Endoscope	Laparoscopic surgery	Open surgery	χ^2	*P* value
Age					
Range	32–65	25–60	25–56	*F*: 0.773	0.467
Mean±SD	43.60±10.03	47.41±10.15	44.38±11.01		
*P*1: 0.235, *P*2: 0.857, *P*3: 0.476					
Sex [*n* (%)]					
Male	8 (40.0)	9 (40.9)	3 (37.5)	0.028	0.986
Female	12 (60.0)	13 (59.1)	5 (62.5)		
Etiology [*n* (%)]					
Gallbladder stone	16 (80.0)	10 (45.5)	8 (100.0)	15.001	0.020*
Alcohol	0	2 (9.1)	0		
Trauma	0	6 (27.3)	0		

Ch panc	4 (20.0)	4 (18.2)	0		
BMI					
Range	25–40	25–44	27–42	*F*: 3.098	0.081
Mean±SD	31.00±5.13	35.64±6.49	34.75±6.02		
*P*1: 0.062, *P*2: 0.136, *P*3: 0.718					
Initial onset					
Range	1–15	1–13	1–4	*F*: 0.682	0.511
Mean±SD	4.90±4.55	4.36±3.82	3.00±1.20		
*P*1: 0.657, *P*2: 0.249, *P*3: 0.400					
Cyst location [*n* (%)]					
Head & neck	6 (30.0)	8 (36.4)	0	3.914	0.141
Body and tail	14 (70.0)	14 (63.6)	8 (100.0)		
Cyst size					
Range	8–12	7–15	9–15	*F*: 1.160	0.322
Mean±SD	9.95±1.36	10.59±2.54	11.25±2.49		
*P*1: 0.336, *P*2: 0.152, *P*3: 0.458					

*: significant as *P value* less than or equal to 0.05.

Table 2: Perioperative data and postoperative complications

	Endoscope	Laparoscopic surgery	Open surgery	χ^2	*P* value
Operative time					
Range	30–50	80–130	100–130	*F*: 316.438	0.001*
Mean±SD	39.40±5.36	104.09±12.02	115.63±9.04		
*P*1: 0.001*, *P*2: 0.001*, *P*3: 0.005*					
Blood loss					
Range	25–55	90–500	200–500	*F*: 47.170	0.001*
Mean±SD	38.75±9.98	240.45±109.39	312.50±87.63		
*P*1: 0.001*, *P*2: 0.001*, *P*3: 0.036*					
Hospital stay					
Range	2–4	3–37	7–8	*F*: 4.046	0.024*
Mean±SD	2.40±0.68	5.82±7.03	7.13±0.35		
*P*1: 0.023*, *P*2: 0.021*, *P*3: 0.047*					
Fever [*n* (%)]					
No	12 (60.0)	11 (50.0)	2 (25.0)	2.800	0.247
Yes	8 (40.0)	11 (50.0)	6 (75.0)		
Wound infection [*n* (%)]					
No	20 (100.0)	15 (68.2)	4 (50.0)	10.532	0.005*
Yes	0	7 (31.8)	4 (50.0)		
Worsen endocrine [*n* (%)]					
No	16 (80.0)	14 (63.6)	5 (62.5)	1.591	0.451
Yes	4 (20.0)	8 (36.4)	3 (37.5)		
Worsening exocrine [*n* (%)]					
No	16 (80.0)	18 (81.8)	6 (75.0)	0.170	0.918
Yes	4 (20.0)	4 (18.2)	2 (25.0)		
Reparation [*n* (%)]					
No	18 (90.0)	21 (95.5)	7 (87.5)	0.686	0.710
Yes	2 (10.0)	1 (4.5)	1 (12.5)		

Recurrence [*n* (%)]					
No	18 (90.0)	17 (77.3)	8 (100.0)	2.960	0.228
Yes	2 (10.0)	5 (22.7)	0		

Table 3: Univariate analysis of the factors affecting recurrence

	OR (95% CI)	*P* value
Cyst size	0.532 (0.174–0.863)	0.012*
Initial onset	2.325 (1.385–5.521)	0.001*
Blood loss	0.359 (0.176–2.631)	0.137
Hospital stay	0.674 (0.286–1.754)	0.230
Etiology	0.635 (0.276–0.967)	0.008*

DISCUSSION

Multiple factors can contribute to pancreatic duct discontinuity and subsequent leakage of pancreatic juice into the abdominal cavity, which is considered a primary pathogenesis of PP[8]. While the clinical presentations of PP vary, the fundamental treatment principle primarily involves managing abnormal pancreatic juice drainage. In over two-thirds of patients, pseudocysts can resolve spontaneously, making conservative treatment based on observation and follow-up the initial approach[6]. However, in cases where fistulas fail to close or are accompanied by complications such as bleeding, infection, digestive tract obstruction, or pancreatic portal hypertension after prolonged conservative treatment, endoscopic or surgical interventions may be required[6]. Percutaneous puncture drainage, commonly guided by ultrasound or computed tomography, is a frequently utilized method due to its simplicity, minimal trauma, and cost-effectiveness[9]. However, percutaneous drainage can lead to complications, such as secondary infection, bleeding, catheter blockage, and pancreatic cutaneous fistula, necessitating careful consideration in clinical practice[10]. In our study, no patients underwent percutaneous drainage. Endoscopic drainage for PP has significantly advanced in recent years, although indications for endoscopic treatment remain varied and targeted toward specific populations. For mature pseudocysts with a diameter exceeding 6 cm causing gastrointestinal wall compression, endoscopic drainage is generally considered appropriate[3]. Studies have reported success rates exceeding 75% for stent implantation via endoscopic retrograde cholangiopancreatography and over 90% for transgastric or duodenal drainage guided by EUS[11]. In our study, the success rate of endoscopic management was 90%. However, endoscopic therapy may be associated with complication rates ranging from 5 to 19%, primarily hemorrhage and recurrence[12]. In our study, few complications were observed following the endoscopic intervention, mainly postoperative fever, and worsening endocrine and exocrine functions. Most studies suggest that endoscopic internal drainage must ensure that the distance between the cyst and the intestinal or stomach wall is less than 1 cm[13]. In our study, 10% of patients developed recurrence after endoscopic drainage. Our results were similar to those recorded by Kruger *et al*.[14] and Baron *et al*.[15], who recorded recurrence in 12% of cases following endoscopic drainage. On the other hand, Bhasin *et al*.[16] reported no recurrence while Cremer *et al*.[17] reported a very high recurrence rate (91%) in their cases subjected to endoscopic drainage. This wide variation in recurrence rate between different studies may be attributed to different operator experiences and whether endoscopic intervention was conventional or EUS-guided endoscopic drainage. Laparoscopy offers an innovative approach without additional wounds. Complication incidence and therapeutic efficacy can be comparable to endoscopic treatment[4,18]. Compared to conventional open surgery, laparoscopic drainage reduces surgical mortality and cyst recurrence rates while causing less trauma and enabling faster recovery[2]. Furthermore, laparoscopic drainage can remove more necrotic tissue from the cyst wall than endoscopic drainage. However, limitations of the laparoscopic approach include abdominal contamination, incomplete anastomosis, and gastric perforation, which may restrict its application[4]. In 2008, Melman and colleagues, 13 conducted a retrospective comparative study evaluating laparoscopic, endoscopic, and open cystogastrostomies for PP treatment. The study, including 16 laparoscopic, 22 open, and 45 endoscopic patients, reported no difference in complication rates (31.5 vs. 22.7 vs. 15.6%, respectively) but noted a higher primary success rate with the surgical approach compared to endoscopy (87.5 vs. 81.2 vs. 51.1%, respectively)[19]. Our study results indicate no difference in treatment success rates or recurrence between endoscopic and laparoscopic treatments. However, adverse events, except for wound infection, were significantly higher in the surgical group (*P=0.005*) compared to the endoscopic group, with no significant difference observed in other adverse effects. Additionally, operation time, intraoperative blood loss, and hospital stay were significantly shorter in endoscopic treatment compared to laparoscopic treatment. These findings are comparable to other published studies[19–21]. The shorter operation time in endoscopic treatment may be attributed to the absence of sewing operations, resulting in a shorter hospital stay. Improved hemostatic equipment utilization and increased suturing experience may enhance the operative time of laparoscopic drainage. EUS guidance may contribute to less blood loss during endoscopic drainage[22,23]. In our study, recurrent cases were observed in patients who underwent early intervention shortly after the onset of pancreatitis symptoms. This finding corresponds with other studies indicating that draining PP within a short timeframe may lead to recurrence or complications, possibly due to immature pancreatic necrosis, pancreatic fistula, and cyst wall instability[1]. Internal surgical drainage can be performed via communication between the pseudocyst and the stomach, jejunum, or duodenum, with the technique determined by pseudocyst location, adjacent structures, and surgeon preference. In the current study, cystogastrostomy was the primary drainage method, either open or laparoscopic. Compared to Roux-en-Y cystojejunostomy, cystogastrostomy offers a wider gastric drainage opening, facilitating better necrotic tissue removal and placement of a gastric tube in the cyst for improved drainage. Additionally, gastric acid action on the capsule wall aids in hemostasis and inhibits pancreatic secretion. However, Roux-en-Y cystojejunostomy involves two anastomoses, increasing the risk of associated complications[6].

Several limitations of this study should be noted. First, there is no clear standard for selecting the surgical approach for patients, and this decision is ultimately made by the surgeon, leading to potential variability in treatment approaches. Additionally, being a single-center study, there may be inherent selection bias in patient inclusion. The surgeon's experience also plays a significant role in determining the surgical approach, which could introduce bias. As a retrospective study, certain factors may be subjective, affecting the interpretation of results. Further research is warranted to explore whether additional clinical or imaging predictive features can help identify specific subsets of patients who may benefit more from one treatment approach over the other. High-quality prospective randomized controlled trials are needed in the future to provide more definitive evidence regarding the optimal treatment approach for PP.

CONCLUSION

Endoscopic treatment may be a favorable approach for managing PPs, considering the improvements seen in operative time, intraoperative blood loss, and hospital stay with endoscopic treatment compared to laparoscopic treatment. Based on the findings of this study, there is no conclusive evidence suggesting that endoscopic treatment is superior to laparoscopic treatment in terms of treatment success rates, adverse events, and recurrence rates for patients with PPs. It is recommended that treatment decisions be made collaboratively by a multidisciplinary team consisting of therapeutic endoscopists, interventional radiologists, and pancreatic surgeons.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Farias G, Bernardo W, De Moura D, Guedes H, Brunaldi V, de C Visconti T *et al*. Endoscopic versus surgical treatment for pancreatic pseudocysts Systematic review and meta-analysis. Medicine 2019; 98: (8)e14255.

2. Szako L, Matrai P, Hegyi P,Pécsi D, Gyöngyi Z, Csupor D, *et al* . Endoscopic and surgical drainage for pancreatic fluid collections are better than percutaneous drainage: Meta-analysis. Pancreatology 2020; 20:132–141.

3. Vargas R, Sepulveda-Copete M, Zuleta J, Hani A . Case report: Treatment of pancreatic pseudocysts with endoscopic transpapillary drainage. Rev Col Gastroenterol 2010; 2:203–206.

4. Hao W, Chen Y, Jiang Y, Yang A . Endoscopic versus laparoscopic treatment for pancreatic pseudocysts: a systematic review and meta-analysis. Pancreas 2021; 50:788–795.

5. Brugge W, Lewandrowski K, Lee-Lewandrowski E, Centeno B, Szydlo T, Regan S *et al*. Diagnosis of pancreatic cystic neoplasms: a report of the cooperative pancreatic cyst study. Gastroenterology 2004; 126:1330–1336.

6. Ye J, Wang L, Lu S, Yang D , Hu W , Lu H , Zhang Y. Clinical study on cystogastrostomy and Roux-en-Y-type cystojejunostomy in the treatment of pancreatic pseudocyst: a single-center experience. Medicine 2021; 100:10.

7. Khan M, Hammad T, Khan Z, Lee W, Gaidhane M, Tyberg A, Kahaleh M. Endoscopic versus percutaneous management for symptomatic pancreatic fluid collections: a systematic review and meta-analysis. Endosc Int Open 2018; 6:E474e83.

8. Banks-Peter A, Bollen-Thomas L, Dervenis C, Gooszen H, Johnson C, Sarr M, Tsiotos GVege S. Classification of acute pancreatitis 2012: revision of the Atlanta classification and definitions by international consensus. Gut 2013; 62:102–111.

9. Zerem E, Hauser G, Loga-Zec S, Kunosić S, Jovanović P, Crnkić D. Minimally invasive treatment of pancreatic pseudocysts. World J Gastroenterol 2015; 21:6850–6860.

10. Morton-J, Brown A, Galanko J, Norton J, Grimm I, Behrns K. A national comparison of surgical versus percutaneous drainage of pancreatic pseudocysts: 1997–2001. J Gastrointest Surg 2005; 9:15–21.

11. Li Q and Qin M. Endoscopy and laparoscopy co-therapies for pancreatic pseudocyst: an analysis of 38 cases. World Chin J Dig 2008; 16:3913–3918.

12. Ma Q. [A retrospective study on the diagnosis and treatment of pancreatic cyst lesion]. [In Chinese] [Master's Thesis]. Lanzhou, China: Lanzhou University Second Hospital; 2017. Available at: http://cdmd.cnki.com.cn/Article/CDMD-10730-1017716490.htm. [Accessed January 26, 2020].

13. Smits M, Rauws E, Tytgat G, Huibregtse K. The efficacy of endoscopic treatment of pancreatic pseudocysts. Gastrointest Endosc 1995; 42:202–207.

14. Kruger M, Schneider AS, Manns MP, Meier PN. Endoscopic management of pancreatic pseudocysts or abscesses after an EUS-guided 1-step procedure for initial access. Gastrointest Endosc 2006; 63:409–416.

15. Baron TH, Harewood GC, Morgan DE, Yates M. Outcome differences after endoscopic drainage of pancreatic necrosis, acute pancreatic pseudocysts, and chronic pancreatic pseudocysts. Gastrointest Endosc 2002; 56:7–17.

16. Bhasin DK, Rana SS, Udawat HP, Thapa BR, Sinha SK, Nagi B. Management of multiple and large pancreatic pseudocysts by endoscopic transpapillary nasopancreatic drainage alone. Am J Gastroenterol 2006; 101:1780–1786.

17. Cremer M, Deviere J, Engelholm L. Endoscopic management of cysts and pseudocysts in chronic pancreatitis: long-term follow-up after 7 years of experience. Gastrointest Endosc 1989; 35:1–9.

18. Bang J, Wilcox C, Trevino J, Ramesh J, Hasan M,Hawes R,Varadarajulu S. Relationship between stent characteristics and treatment outcomes in endoscopic transmural drainage of uncomplicated pancreatic pseudocysts. Surg Endosc 2014; 28: 2877–2883.

19. Melman L, Azar R, Beddow K, Brunt LM, Halpin VJ, Eagon JC, , *et al*. Primary and overall success rates for clinical outcomes after laparoscopic, endoscopic, and open pancreatic cystgastrostomy for pancreatic pseudocysts. Surg Endosc 2009; 23:267–271.

20. 20 Varadarajulu S, Lopes TL, Wilcox CM, Drelichman ER, Kilgore ML, Christein JD. EUS versus surgical cyst-gastrostomy for management of pancreatic pseudocysts. Gastrointest Endosc 2008; 68:649e55.

21. Saluja S, Srivastava S, Govind H, Dahale A, Sharma B, Mishra P. Endoscopic vs surgical cystogastrostomy in patients with pancreatic pseudocyst: a comparative study. HPB 2016; 18:e338.

22. Fabbri C, Luigiano C, Maimone A, Polifemo AM, Tarantino I, Cennamo V. Endoscopic ultrasound-guided drainage of pancreatic fluid collections. World J Gastrointest Endosc 2012; 4:479–488.

23. Braden B, Dietrich CF. Endoscopic ultrasonography-guided endoscopic treatment of pancreatic pseudocysts and walled-off necrosis: new technical developments. World J Gastroenterol 2014; 20:16191–16196.