

ORIGINAL ARTICLE

The Efficacy of Percutaneous Catheter Drainage in the Management of Acute Pancreatitis and the Factors /Affecting the Outcome of the Therapy

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ABSTRACT

Background The efficacy of percutaneous catheter drainage in the management of acute pancreatitis and the factors affecting the outcome of the therapy were studied. **Methods** It is prospective and retrospective observational analysis. Patients of acute interstitial edematous and acute necrotising pancreatitis with acute peri-pancreatic fluid collections and walled off necrosis were referred for image guided percutaneous drainage. Success rate of percutaneous drainage and the variables that affect its outcome were assessed. CT diagnosed cases of acute pancreatitis with peri-pancreatic collection (APFC and WON) referred for image guided percutaneous drainage were included in the study. **Results** Successful resolution on PCD was seen in 60% of the cases (n=60) where there was improvement in clinical outcome with control in sepsis and temperature, in our study surgical necrosectomy was performed in 35% of the cases (n=35). Successful resolution on PCD in patients with severe necrotising pancreatitis was 41.94% as compared to moderate and mild group which was 88.57% and 100% respectively. Homogenous peri-pancreatic collection (APFC and WON) was observed in 36 patients where the outcome was successful in 31(86.11%) of the patients. In the patients with heterogenous peri-pancreatic collection (APFC and WON), out of 64 patients successful outcome was seen in (n=29; 45.31%) of the patients. Presence of MODS (Marshals criteria was considered before defining MODS) (n -29) was a negative predictor of success. In our study statistical significance of MODS and negative outcome of success was noted. Successful outcome was seen in only (n=2; 6.9%) of the cases. Presence of more than 30% necrotic tissue was seen in (n=59) cases where successful resolution was seen in (n=26; 44.07%) of the cases. (n=33) cases had less than 30% necrosis and success rate was in (n=26; 78.79%) of the cases. Age, comorbidities, cause of pancreatitis and gender had no significant correlation statistically in predicting successful resolution on PCD. **Conclusion** Percutaneous Catheter drainage is an efficacious method in the management of complicated acute pancreatitis. So PCD is efficacious technique in walled off pancreatic necrosis. Heterogeneity of collection, severity of pancreatitis, multiple organ dysfunction syndrome and increased percentage of pancreatic necrosis have negative predictive values in its management.

INTRODUCTION

Acute pancreatitis is an acute inflammation of the pancreas with involvement of peri-pancreatic region and organ systems [1]. Acute pancreatitis is divided into mild disease that lacks organ failure with no local or systemic complications and associated with low mortality; moderately severe disease that has organ failure of less than 48 hrs and severe disease which has organ failure of more than 48 hours [2].

The complications of acute pancreatitis include acute peri-pancreatic fluid collection, necrotizing pancreatitis, walled off necrosis, pseudocysts and infected pancreatic necrosis [2]. The overall mortality of acute pancreatitis is 3.8%-5 % while that of severe acute pancreatitis is 13-16% [3].

Management of acute pancreatitis includes medical and surgical interventions. Surgical intervention carries a mortality of 15-25% [4]. Percutaneous catheter drainage is preferred treatment in necrotizing pancreatitis as it can delay the surgical necrosectomy or can be the primary treatment [5].

Image guided PCD can be treatment option in critically ill or hemodynamically unstable patients who cannot undergo surgical drainage [6] and The rate of success of different percutaneous approaches depends upon the anatomical position of collection and amount of liquefied component within the collection [7].

The purpose of our study is to estimate the success rate of percutaneous catheter drainage in the management of complicated acute pancreatitis and the factors affecting its outcome especially for the Indian population.

MATERIALS AND METHODS

Sample Size included 100 cases (50 cases prospectively and 50 cases retrospectively). Prospective cases included at least 50 consecutive cases of acute interstitial edematous and acute necrotizing pancreatitis that underwent percutaneous catheter drainage at our institute from January 2017 to Sep 2018. Retrospective cases included

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Keywords Pancreatitis; Surgery

Abbreviations APFC acute peri-pancreatic fluid collections; WON walled off necrosis

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50 cases of acute interstitial edematous and necrotizing pancreatitis that underwent per cutaneous catheter drainage at our institute 2 years back.

Study evaluated the efficacy of percutaneous catheter drainage and also the factors affecting the outcome in complicated cases of acute interstitial edematous and acute necrotising pancreatitis.

Revised Atlanta Classification of Acute pancreatitis

Acute pancreatitis according to the Revised Atlanta Classification is divided into interstitial edematous pancreatitis and necrotising pancreatitis based on the finding of necrosis within. Four different subtypes of collection are described on the basis of presence or absence of necrosis and time between onset of pancreatitis and the collection [8].

Interstitial Edematous Pancreatitis associated fluid collections are acute peri-pancreatic fluid collection (APFC) and pseudocyst.

Acute Necrotic Collection (ANC) and walled off necrosis (WON) are associated with acute necrotising pancreatitis.

APFC and ANCs are seen to occur within 4 weeks of the onset of disease. After this time they may either persist or resolve. If they persist a mature wall develops around them and then they are called pseudocyst and walled off necrosis respectively [9] (Table 1).

A majority of patients with necrotising pancreatitis develop acute necrotising collection. More than half of these ANC develop walled off necrosis.

Inclusion criteria; CT diagnosed cases of acute interstitial edematous and acute necrotising pancreatitis with peri-pancreatic collection (APFC and WON) referred for image guided percutaneous drainage Exclusion criteria; Inaccessible pancreatic collections (APFC and WON) [10].

STATISTICAL ANALYSIS

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non parametric test was used.

Statistical tests were applied as follows-

1. Quantitative variables were compared using Independent T test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups.

2. Qualitative variables were correlated using Chi-Square test/Fisher’s Exact test.

3. Univariate and multivariate logistic regression was used to assess the significant factors affecting successful resolution on PCD [11].

A p Value of <0.05 was Considered Statistically Significant.

Patients were classified according to Modified CT Severity Index. 0-3: mild acute pancreatitis, 4-6: moderate acute pancreatitis, 7-10: severe acute pancreatitis. Patient outcome will be defined as successful resolution on percutaneous catheter drainage. Clinical improvement will be based on temperature charting and WBC count.

PCDs were carried out under CT or Ultrasound guidance using seldingers technique and catheters of size ranging from 14 to 32 F were used [12]. Drain selection was done keeping in mind the ease, site and feasibility of the procedure. Quality of fluid determined the different size of drains that were used. Drained fluid was sent for bacteriological analysis. Upsizing of catheter drain was done if previous drain was insufficient to drain the thick collections. Multiple drains can be inserted if required. Irrigation of drains were done if any blockage of drain was suspected. There was relatively lesser complications associated with percutaneous drainage. Complications observed were bleeding, bowel injury, and pancreatic fistula [13].

Patients Outcome

Follow up was done on 1st day, 3rd day, 5th day, 7th day, 14th day, 1 month, 3 month and 6 months and patients were categorized as:

- A) Successful resolution on PCD
- B) Successful resolution on PCD and later surgery
- C) Treatment failure on PCD then surgery
- D) Treatment failure on PCD and surgery then death

RESULTS

Etiology of Pancreatitis

Most common cause of pancreatitis was idiopathic (56%) followed by Gall Stone induced pancreatitis (39%). Distribution of patients according to etiology is shown in Table 2.

Table 1. Definitions of Organ Failure [9].

Criteria	Definition
Single organ failure	
Renal	Creatinine level more than 177 micromol per litre After rehydration or new need of hemofiltration or hemodialysis
Pulmonary	PaO ₂ less than 60 mm of Hg despite FiO ₂ of 0.30 or requirement of mechanical Ventilation.
Cardiovascular	Circulatory systolic blood pressure less than 90mm of Hg irrespective of adequate fluid resuscitation or need of ionotropic catecholamines.
Multiple Organ Failure	
	Failure of two or more organ systems.

Culture of Drain output - Gram Negative Cocci were isolated in 84%. Gram positive Cocci were found in 4% of the cases and 12% of the cases showed sterile drain output [14].

Requirement of Surgery- Surgery was performed in 30% of the prospective cases and 40% of the retrospective cases while it was avoided in 70% of the prospective cases and 60% of the retrospective cases.

Only 2 patients showed resolution of collection, the presence of multi-organ dysfunction syndrome had significant impact on resolution of collection, thereby significantly affecting the outcome and efficacy of PCD [15].

Age and sex has got no significant affect on resolution of collection and outcome. 35 patients underwent surgery, out of which 24 underwent open necrosectomy and 11 underwent VARD with a mortality of 17% (Table 3).

DISCUSSION

Acute pancreatitis is a common clinical entity and the main causes are Gall stone and Alcohol [16]. The course of necrotising pancreatitis is associated with liquefaction of the phlegmonous collection which can get absorbed or can get complicated by superinfection. Management of acute necrotising pancreatitis includes prolongation of intervention for at least for 3-4 weeks to allow for encapsulation and liquefaction of the collection inside which reduces the risk of bleeding [17] PCD has superseded the role of surgery as primary treatment modality in majority of the patients and sometimes to stabilize critically ill patients before surgery.

In our study, the most common cause of pancreatitis was idiopathic followed by gall stone related pancreatitis which also corroborated with the study of Freeney *et al.* [10]; Successful resolution on PCD was seen in (n=60, 60%) of the cases where there was improvement in clinical outcome with control in sepsis and temperature. This finding is close to the efficacy rates of various other studies.

In the study done by Rau *et al.* [18] the efficacy of conventional surgery by resection with open necrosectomy and drainage was 57.9%, In our study additional surgical intervention (24 open necrosectomy and 11 cases of VARD) was performed in 35% of the cases with overall mortality of 17%, however in the step up approach done by Zerem *et al.* [15] surgical necrosectomy was necessary in only 12.8% and had overall mortality of 9.3%.

Univariate analysis (Table 4, 5 and 6) showed that *the higher the degree of necrotising pancreatitis, the less favourable was the outcome.* Successful resolution on PCD in patients with severe necrotising pancreatitis was 41.94% as compared to moderate and mild group which was 88.57% and 100% respectively. This finding was statistically significant (p value < 0.0001), it is corroborating with the study done by Sahu *et al* [19].

Type of peri-pancreatic collection on CT and successful resolution of PCD was statistically significant (p value < 0.0001). Homogenous peri-pancreatic collection was observed in 36 patients where the outcome was successful in (n=31, 86.11%) of the patients (Table 7). In the patients with heterogenous peripancreatic collection, out of 64 patients successful outcome was seen in (n=29, 45.31%) of the patients. Catheter drainage cannot remove the solid debris. The success rate of drainage is less likely in collections with a large amount of debris [13] i.e, more heterogenous collection, which is similar to the study done by Gou Quiang *et al.* [20] where the successful outcome was 57.14% cases, whereas in the failed PCD group outcome was 31.25% (Table 8, 9).

Presence of MODS is a negative predictor of success [21], In our study statistical significance of MODS and negative outcome of success was noted (p value < 0.0001). Successful outcome was seen in only (n=2, 6.9%) of the cases (Table 10, 11). In rest of the cases with MODS patients were either surgically managed or death occurred, similar results were also observed in study by Holleman *et al.* [13] (Table 12, 13).

Percentage of necrosis of pancreas with outcome was analysed. We found out that higher percentage of necrosis is associated with less favourable outcome. Central necrosis of the pancreas is associated with less favourable outcome. This is because there is disruption of the midsection of the main pancreatic duct and thus isolates the body and tail of the pancreas from its head [10]. Presence of more than 30% necrotic tissue was seen in (n=59) cases where successful resolution was seen in (n=26; 44.07%) of the cases. (n=33) cases had less than 30% necrosis and success rate was in (n=26; 78.79%) of the cases. This finding was statistically significant (p value=

Table 2. Distribution of patients according to etiology of pancreatitis.

Cause of pancreatitis	Percentage
Alcoholic pancreatitis	3.00%
Ercp induced	2.00%
Gall stone pancreatitis	39.00%
Idiopathic	56.00%
Total	100.00%

Table 3. Distribution of patients.

1. CTSI Score	Percentage
Mild	3
Moderate	35
Severe	62
2. Peripancreatic Collections	
Homogenous	36
Heterogenous	64
3. Necrosis	
<30%	33
>30%	59
4. Successful Resolution Of PCD	
Yes	60
No	40

Table 4. Univariate analysis of Modified CT Severity Index on successful resolution of PCD.

		Successful resolution on PCD(Y/N)		Total	P value
		No	Yes		
Modified CT severity index	Mild	0 (0.00%)	3 (100.00%)	3 (100.00%)	<.0001
	Moderate	4 (11.43%)	31 (88.57%)	35 (100.00%)	
	Severe	36 (58.06%)	26 (41.94%)	62 (100.00%)	
Total		40 (40.00%)	60 (60.00%)	100 (100.00%)	

More severe the pancreatitis (higher the CTSI score) lesser the resolution of collections and there by poorer the outcome

Table 5. Univariate analysis of type of peripancreatic collection on successful resolution of PCD.

		Successful resolution on PCD(Y/N)		Total	P value
		No	Yes		
Type of collection on CT	Heterogenous	35 (54.69%)	29 (45.31%)	64 (100.00%)	<.0001
	Homogenous	5 (13.89%)	31 (86.11%)	36 (100.00%)	
Total		40 (40.00%)	60 (60.00%)	100 (100.00%)	

Heterogeneity of collection (presence of significant of solid component) is significantly affecting the drainage and thereby affecting the resolution and outcome

Table 6. Univariate analysis of percent necrosis of pancreas on successful resolution of PCD.

		Successful resolution on PCD(Y/N)		Total	P value
		No	Yes		
Percentage of necrosis of pancreas	<30%	7 (21.21%)	26 (78.79%)	33 (100.00%)	0.0003
	>30%	33 (55.93%)	26 (44.07%)	59 (100.00%)	
	None	0 (0.00%)	8 (100.00%)	8 (100.00%)	
Total		40 (40.00%)	60 (60.00%)	100 (100.00%)	

More the area of necrosis involving the pancreatic parenchyma ,lesser the resolution of pancreatic collections and thereby affecting the outcome

Table 7. Distribution of cases according to the culture isolated from the drain output.

Culture of drain output	Percentage
Gram negative	84.00%
Gram positive cocci	4.00%
STERILE	12.00%
Total	100.00%

Table 8. Distribution of patients according to requirement of surgery.

Surgery done (y/n)	Percentage
NO	65.00%
YES	35.00%
	24%- open necrosectomy
	11%- VARD (Step up approach)
Total	100.00%

Table 9. Univariate analysis of Multi Organ Dysfunction Syndrome before PCD on successful resolution of PCD.

		Successful resolution on PCD(Y/N)		Total	P value
		No	Yes		
Mods	No	13 (18.31%)	58 (81.69%)	71 (100.00%)	<.0001
	Yes	27 (93.10%)	2 (6.90%)	29 (100.00%)	
Total		40 (40.00%)	60 (60.00%)	100 (100.00%)	

Only 2 patients showed resolution of collection, The presence of multi-organ dysfunction syndrome had significant impact on resolution of collection, thereby significantly affecting the outcome and efficacy of PCD

0.0003) and is similar to the study done by Solanki R *et al.* [22] which says that >50% intrapancreatic necrosis is associated with more chance of PCD failure (**Table 14**).

Comorbidities and cause of pancreatitis had no significant correlation statistically in predicting successful resolution on PCD.

Table 10. Successful resolution with PCD in different categories of patients.

	Successful Resolution Of PCD		Total	P Value
	YES	NO		
CTSI	60	40	100	<.0001
Peripancreatic Collections	60	40	100	<.0001
Necrosis	60	40	100	<.0001
Mods	60	40	100	<.0001

Table 11. Type of complications of PCD in our study.

Complications	YES
Hemorrhagic drain output	6
Pancreatic fistula	1
Drain block	2

Table 12. Type of pancreatic collections in whom PCD was done.

Type of Pancreatic Collections	No. of Patients
APFC	8
WOPN	92

Table 13. Success rate of percutaneous catheter drainage in various other studies.

First Author	Year	Total number of cases	Success Rate
Freeny <i>et al.</i> [10]	1998	34	n=16(47%)
Zerem E <i>et al.</i> [11]	2011	69	n=58(85%)
Babu RY <i>et al.</i> [12]	2013	56	n=26(46.4%)
Holleman <i>et al.</i> [13]	2016	130	n=45(35%)
Li A <i>et al.</i> [14]	2016	54	n=18(33.3%)
Our study		100	n=60(60%)

Table 14. Table showing the rate of complication in various studies.

Author	Year	Number of cases	Successful PCD	Need for additional surgery	Complication
Freeney [10]	1998	34	n=16(47%)	n=18(52.94%)	n=24(70.5%)
Fotoohi <i>et al.</i> [11]	1999	44	n=41(93%)	n=3(6.8%)	n=6(13.6%)
Zerem <i>et al.</i> [15]	2011	69	n=58(84%)	n=11(15.94%)	n=5(7.24%)
Our study		100	n=60(60%)	n=35(35%)	n=10(10%)

We have studied the drain output culture and found out that the most common group of organism to be isolated was from the gram negative group, which is same as study done by Noor T *et al.* [23].

In our study mortality after PCD insertion was seen in (n=5, 7.69%) cases. In all the PCD only cases where death occurred, the cause of death was septicemia.

In (n=10; 10%) cases complications were noted. The most common complication was hemorrhagic drain output in (n=6) cases. (n=1) case showed fistula formation, (n=1) case showed hollow viscus perforation and (n=2) cases showed drain block which is similar to study done by Fotoohi *et al.* [11].

The median time between onset of pancreatitis and insertion of PCD in the successful and unsuccessful group was 37 days each. In the study done by Cao Xi *et al.* [24] the median time between onset of acute necrotising pancreatitis and insertion of PCD was 28 days.

The step-up approach includes primary percutaneous catheter drainage, followed, if needed, by minimally

invasive necrosectomy. The step-up approach significantly reduced the major complications and death.

CONCLUSION

Percutaneous Catheter drainage is an efficacious method in the management of complicated acute pancreatitis. So PCD is efficacious technique in walled off pancreatic necrosis. Heterogeneity of collection, high grading of pancreatitis, multiple organ dysfunction syndrome and increased percentage of pancreatic necrosis have negative predictive values in its management.

Conflict of Interest

The authors declare that there are no conflicts of interest.

References

1. Glasbrenner B, Adler G. Pathophysiology of acute pancreatitis. *Hepatogastroenterology* 1993; 40:517-21. [PMID: 8119636]

2. Zhao K, Adam SZ, Keshwani RN, Horowitz JM, Miller FH. Acute pancreatitis: revised Atlanta classification and the role of cross sectional imaging. *AJR Am J Roentgenol* 2015; 205:32-41. [PMID: 26102416]
3. Fu CY, Yeh CN, Hsu JT, Jan YY, Hwang TL. Timing of mortality in severe acute pancreatitis: experience from 643 patients. *World J Gastroenterol* 2007; 13:1966. [PMID: 17461498]
4. Werner J, Feuerbach S, Uhl W, Buchler MW. Management of acute pancreatitis: from surgery to interventional intensive care. *Gut* 2005; 54:426-36. [PMID: 15710995]
5. Torres W, Evert M, Baumgartner B, Bernardino M. Percutaneous aspiration and drainage of pancreatic pseudocysts. *AJR Am J Roentgenol* 1986; 147:1007-9. [PMID: 3490139]
6. Carter R. Percutaneous management of necrotizing pancreatitis. *HPB* 2007; 9:235-9. [PMID: 18333229]
7. Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, et al. Classification of acute pancreatitis—2012: revision of the Atlanta classification and definitions by international consensus. *Gut* 2013; 62:102–111. [PMID: 23100216]
8. Solanki R, Thumma V, Sastry RA, Bheerappa N. The role of image guided percutaneous drainage in multidisciplinary management of necrotizing pancreatitis. *Trop Gastroenterol* 2013; 34:25-30. [PMID: 23923371]
9. Freeny P, Hauptmann E, Althaus S, Traverso L, Sinanan M. Percutaneous CT-guided catheter drainage of infected acute necrotizing pancreatitis: techniques and results. *AJR Am J Roentgenol* 1998; 170:969-75. [PMID: 9530046]
10. Fotoohi M, D'Agostino HB, Wollman B, Chon K, Shahrokni S, VanSonnenberg E. Persistent pancreatocutaneous fistula after percutaneous drainage of pancreatic fluid collections: role of cause and severity of pancreatitis. *Radiology* 1999; 213:573–578. [PMID: 10551244]
11. Babu RY, Gupta R, Kang M, Bhasin DK, Rana SS, Singh R. Predictors of surgery in patients with severe acute pancreatitis managed by the step-up approach. *Ann Surg* 2013; 257:737-50. [PMID: 22968079]
12. Hollemans RA, Bollen TL, van Brunschot S, Bakker OJ, Ali UA, van Goor H. Predicting success of catheter drainage in infected necrotizing pancreatitis. *Ann Surg* 2016; 263:787-92. [PMID: 25775071]
13. Li A, Cao F, Li J, Fang Y, Wang X, Liu DG, et al. Step-up mini-invasive surgery for infected pancreatic necrosis: Results from prospective cohort study. *Pancreatol* 2016; 16:508-1. [PMID: 27083075]
14. Zerem E, Imamovic G, Susic A, Haracic B. Step-up approach to infected necrotizing pancreatitis: A 20-year experience of percutaneous drainage in a single centre. *Dig Liver Dis* 2011; 43:478-83. [PMID: 21478061]
15. Lowenfels AB, Maisonneuve P, Sullivan T. The changing character of acute pancreatitis: epidemiology, etiology, and prognosis. *Current gastroenterology reports*. 2009; 11:97-103. [PMID: 19281696]
16. Freeman ML, Werner J, van Santvoort HC, Baron TH, Besselink MG, Windsor JA, et al. International Multidisciplinary Panel of Speakers and Moderators. Interventions for necrotizing pancreatitis: summary of a multidisciplinary consensus conference. *Pancreas* 2012; 41:1176–1194. [PMID: 23086243]
17. Rau B, Uhl W, Buchler MW, Beger HG. Surgical treatment of infected necrosis. *World J Surg* 1997; 21:155-61. [PMID: 8995071]
18. Sahu B, Abbey P, Anand R, Kumar A, Tomer S, Malik E. Severity assessment of acute pancreatitis using CT severity index and modified CT severity index: Correlation with clinical outcomes and severity grading as per the Revised Atlanta Classification. *Indian J Radiol Imaging* 2017; 27:152. [PMID: 28744075]
19. Guo Q, Li A, Hu W. Predictive factors for successful ultrasound-guided percutaneous drainage in necrotizing pancreatitis. *Surg Endosc* 2016; 30:2929-34. [PMID: 26487212]
20. Johnson CD, Abu-Hilal M. Persistent organ failure during the first week as a marker of fatal outcome in acute pancreatitis. *Gut* 2004; 53:1340-4. [PMID: 15306596]
21. Solanki R, Thumma V, Sastry RA, Bheerappa N. The role of image guided percutaneous drainage in multidisciplinary management of necrotizing pancreatitis. *Trop Gastroenterol* 2013; 34:25-30. [PMID: 23923371]
22. Noor MT, Radhakrishna Y, Kochhar R, Ray P, Wig JD, Sinha SK, et al. Bacteriology of infection in severe acute pancreatitis. *JOP* 2011; 12:19-25. [PMID: 21206096]
23. Cao X, Cao F, Li A, Gao X, Wang XH, Liu DG, et al. Predictive factors of pancreatic necrosectomy following percutaneous catheter drainage as a primary treatment of patients with infected necrotizing pancreatitis. *Exp Ther Med* 2017; 14:4397-404. [PMID: 29104650]
24. Hollemans RA, Bakker OJ, Boermeester MA, Bollen TL, Bosscha K, Bruno MJ, et al. Superiority of Step-up Approach Vs Open Necrosectomy in Long-term Follow-up of Patients With Necrotizing Pancreatitis. *Gastroenterology* 2019; 156: 1016-26. [PMID: 30391468]