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Role of Early Percutaneous Drainage in Improving Outcomes of Moderate to Severe Acute Pancreatitis: A Prospective Comparative Study

G Harsha Vardhan Reddy[1*], Venkata Sai Praneeth Muduru[2]

Abstract

Background and Objective:

To evaluate the clinical effectiveness of early percutaneous catheter drainage (PCD) in patients with moderately severe and severe acute pancreatitis with sterile acute inflammatory pancreatic fluid collections (AIPFCs).

Methods:

This prospective comparative study enrolled 32 adult patients with moderately severe or severe acute pancreatitis based on the 2012 Revised Atlanta Classification. Patients were randomized into two groups: Group 1 (n=16) underwent early ultrasound-guided PCD alongside standard care; Group 2 (n=16) received conservative management alone. Clinical parameters, severity scores, intra-abdominal pressure (IAP), enzyme levels, and outcomes were analyzed.

Results:

Baseline BISAP and SOFA scores were comparable between the groups. By Day 7, SOFA scores significantly improved in Group 1 (1.69 ± 1.55) compared to Group 2 (3.33 ± 1.35; p=0.013). IAP at Day 7 was also significantly lower in Group 1 (9.29 ± 1.82 vs. 13.81 ± 2.71; p=0.001). Serum amylase showed a greater reduction post-intervention in Group 1. No significant difference was observed in hospital stay duration or mortality, though Group 1 had a slightly higher mortality rate (31.2% vs. 18.8%; p=0.189). Fluid cultures were sterile in 75% of PCD patients.

Conclusion:

Early PCD in sterile AIPFCs may significantly reduce organ dysfunction and intra-abdominal pressure without increasing hospital stay. While not impacting overall mortality or discharge rate, PCD shows potential benefit in mitigating systemic effects of fluid collections in select patients with severe acute pancreatitis.

Keywords: Acute Pancreatitis, Percutaneous Catheter Drainage, Multiorgan Dysfunction.

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Introduction

Severe acute pancreatitis (SAP) is a life-threatening condition with a high risk of morbidity and mortality. Rapid systemic inflammation, driven by local pancreatic injury, can lead to multi-organ failure in a phenomenon described as the "two-hit" model. Minimally invasive strategies such as percutaneous catheter drainage (PCD), endoscopic drainage, and retroperitoneal necrosectomy have emerged as safer alternatives to early surgical intervention.

One of the debated issues in SAP management is the role and timing of drainage, especially in sterile acute inflammatory pancreatic fluid collections (AIPFCs). Some evidence suggests that these sterile collections, though non-infected, may perpetuate systemic inflammatory response through peritoneal absorption of cytokines, and potentially become secondarily infected.

Recent studies, including those by Wang et al.,(1) indicate that early drainage may lower intra-abdominal pressure (IAP) and improve organ function, even without confirmed infection. However, others caution that early intervention might introduce infection or be unnecessary in self-limiting cases. Given the individualized nature of pancreatitis management, especially under the updated 2012 Revised Atlanta Classification (RAC), the decision to intervene must be guided by evolving evidence.(2-4)

Acute pancreatitis management is highly individualized, and one-size-fits-all recommendations may not be appropriate. With the introduction of the 2012 Revised Atlanta Classification (2012 RAC), classification of AP now distinguishes between mild, moderately severe, and severe disease, based on the presence of local complications and the persistence or transience of organ failure.This updated framework replaces the older 1992 classification, which grouped patients more broadly and often misrepresented clinical severity. Notably, many cases previously classified as severe are now reclassified as moderately severe or mild. Persistent organ failure (lasting more than 48 hours) is now the key defining feature of SAP in the 2012 RAC.(5,6) Given these changes, it is important to reassess the timing and role of early PCD in patients with sterile AIPFCs, particularly across varying severities of acute pancreatitis as defined by the 2012RAC. This study aims to evaluate the clinical impact of early PCD in sterile AIPFCs among patients with moderately severe and severe acute pancreatitis.

Study Design and Setting:

This prospective comparative study was conducted from August 2022 to January 2024 in the Department of Department of HPB Surgery and Liver Transplantation at Institute of liver and biliary sciences ,New Delhi. Inclusion required a diagnosis of moderately severe or severe acute pancreatitis (MSAP/SAP) with sterile AIPFCs, based on the 2012 RAC.

Participants

Thirty-two patients (age ≤70 years) were included and randomized into two groups:

- **Group 1:** Early ultrasound-guided PCD + conservative care (n=16)
- **Group 2:** Conservative care only (n=16)

Exclusion criteria included traumatic or post-ERCP pancreatitis, chronic organ dysfunction, or delayed presentation (>7 days from onset). Diagnosis was confirmed via clinical features, elevated serum amylase/lipase, and contrast-enhanced CT.

Diagnosis was based on clinical presentation (epigastric pain radiating to the back, vomiting, abdominal distension), elevated pancreatic

enzymes (amylase/lipase ≥3x normal), and imaging findings on contrast-enhanced CT. Severity was assessed using BISAP and SOFA scoring systems. All patients underwent detailed clinical evaluation, laboratory investigations (CBC, LFT, KFT, electrolytes, ABG), imaging (USG abdomen, X-ray, CT), and assessment of intra-abdominal pressure (IAP) via Foley catheter.

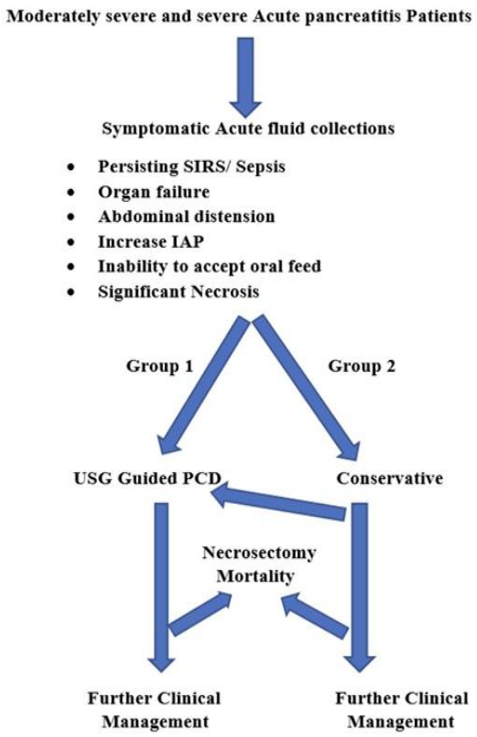
Acute pancreatitis was defined by the presence of abdominal pain, serum amylase or lipase levels three times above normal, and/or characteristic findings on contrast-enhanced CT. The most common etiology was gallstone disease, followed by alcohol use. Baseline characteristics were comparable between groups, except for age (Group 1: 32.88 ± 7.76 years; Group 2: 38.69 ± 7.59 years; p=0.028). The majority of patients were male and had BMI in the range of 18.5–22.9 kg/m².

Interventions and Assessments:

Group 1 underwent USG-guided PCD with a 16 Fr pigtail or 32 Fr abdominal drain. Drain fluid was analyzed for culture and amylase levels. Serial evaluations of SOFA scores and IAP were recorded on admission and on days 2, 7, 14, and 21. CTSI scores were assessed using CT imaging. Group 2 received fluid resuscitation, oxygen, analgesia, enteral nutrition, and antibiotics as required.

Statistical Analysis:

SPSS v27.0 was used for data analysis. Categorical variables were compared using Fisher's exact test and chi-square tests. Continuous variables were analyzed using Student's *t*-test or Mann–Whitney *U* test. A *p*-value <0.05 was considered significant.



Results

A total of 32 patients were analyzed (Group 1: PCD + conservative, n=16; Group 2: conservative only, n=16). The mean age was significantly lower in Group 1 (32.88 ± 7.76 years) than in Group 2 (38.69 ± 7.59 years, $p = 0.028$). Both groups were predominantly male, with comparable BMI values and similar etiological profiles, gallstones being the most common cause.

Table 1: Baseline characteristics of patients in group 1 and group 2

	Group		
Parameters	Conservative (n = 16)	Drain (n = 16)	p value
Age (Years)***	38.69 ± 7.59	32.88 ± 7.76	0.028
Age			0.227
21-30 Years	2 (12.5%)	7(43.8%)	
31-40 Years	9 (56.2%)	5(31.2%)	
41-50 Years	5 (31.2%)	4(25.0%)	
Gender			0.446
Male	10 (62.5%)	12(75.0%)	

Female	**6 (37.5%)**	**4(25.0%)**	
BMI (Kg/m²)	**21.52 ± 1.66**	**21.62 ± 2.08**	**0.836**
BMI			**1**
18.5-22.9 Kg/m2	**13 (81.2%)**	**13 (81.2%)**	
23.0-24.9 Kg/m2	**2 (12.5%)**	**1 (6.2%)**	
25.0-29.9 Kg/m2	**1 (6.2%)**	**2 (12.5%)**	
Etiology			**0.212**
Gallstone	**13 (81.2%)**	**9 (56.2%)**	
Alcohol	**3 (18.8%)**	**4 (25.0%)**	
Trauma	**0 (0.0%)**	**3 (18.8%)**	

Clinical Features:

All patients presented with abdominal pain and distension. Other symptoms such as fever, obstipation, vomiting, respiratory distress, and inability to tolerate oral feeds were more frequent in Group 2, but not statistically significant.

Table 2: Symptoms and Signs on admission in group 1 and group2

Parameters	**Group**		
	Conservative (n = 16)	**Drain (n = 16)**	**p value**
Symptoms: Pain Abdomen (Yes)	16 (100.0%)	16 (100.0%)	1
Symptoms: Fever (Yes)	5 (31.2%)	5 (31.2%)	1
Symptoms: Abdominal Distension (Yes)	16 (100.0%)	16 (100.0%)	1
Symptoms: Obstipation (Yes)	8 (50.0%)	6 (37.5%)	0.476
Symptoms: Vomiting (Yes)	12 (75.0%)	11 (68.8%)	1
Symptoms: Respiratory Distress(Yes)	5 (31.2%)	4 (25.0%)	1
Symptoms: Inability To Accept Oral Feed (Yes)	10 (62.5%)	8 (50.0%)	0.476
Signs: Febrile (Yes)	2 (12.5%)	3 (18.8%)	1
Signs: Tachycardia (Yes)	14 (87.5%)	12 (75.0%)	0.654
Signs: Hypotension (Yes)	4 (25.0%)	3 (18.8%)	1
Signs: Tachypnea (Yes)	5 (31.2%)	5 (31.2%)	1
Signs: Crepts In Chest/Dec Air Entry			0.433
0	1 (6.2%)	0 (0.0%)	
No	10 (62.5%)	13 (81.2%)	
Yes	5 (31.2%)	3 (18.8%)	
Signs: Lump / Phlegmon (Yes)	5 (31.2%)	4 (25.0%)	1
Signs: Decrease U/O (Yes)	1 (6.2%)	2 (12.5%)	1

Severity Scores and Enzymes:

Baseline BISAP and SOFA scores were comparable (BISAP $p = 0.301$; SOFA $p = 0.568$). However, SOFA scores on Day 7 were significantly lower in Group 1 (1.69 ± 1.55) vs. Group 2 (3.33 ± 1.35, $p = 0.013$). Peak SOFA and CTSI scores were similar between groups. Serum amylase/lipase levels on admission were comparable, but post-procedure Day 2 amylase was notably reduced in the PCD group.

Table 3: Severity scores and enzyme levels in group1 and 2

	Group		
Parameters	**Conservative (n = 16)**	**Drain (n = 16)**	**p value**
BISAP (Day 0)	1.00 ± 0.73	1.19 ± 0.75	0.476
CTSI	6.88 ± 1.93	7.62 ± 2.33	0.301
SOFA (Day 0)	1.25 ± 1.06	1.62 ± 1.45	0.568
SOFA (Day 2)	2.94 ± 1.12	3.19 ± 1.80	0.575
SOFA (Day 7)* **	3.33 ± 1.35	1.69 ± 1.55	0.013

SOFA (Day 14)	2.40 ± 1.88	1.89 ± 1.76	0.647
SOFA (Day 21)	2.00 ± 2.32	1.43 ± 2.15	0.56
Peak SOFA	3.56 ± 1.50	3.25 ± 1.84	0.66
>2 Organ failure (Yes)	10 (62.5%)	7 (43.8%)	0.288
S.Amylase (Admission)	1018.31 ± 1008.24	1342.12 ± 971.47	0.341
S.Amylase (Day 2)	-	640.00 ± 658.40	-
S.Lipase (Admisison)	970.94 ± 1396.27	649.00 ± 630.58	0.925

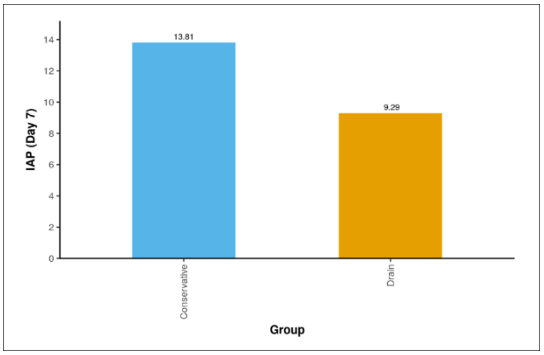
Intra-abdominal Pressure (IAP):

Initial IAP values were similar (Group 1: 12.75 ± 2.46 mmHg; Group 2: 12.56 ± 2.39 mmHg). However, Day 7 IAP was significantly lower in Group 1 (9.29 ± 1.82) than Group 2 (13.81 ± 2.71, $p = 0.001$). Peak IAP was lower in Group 1 but not statistically significant.

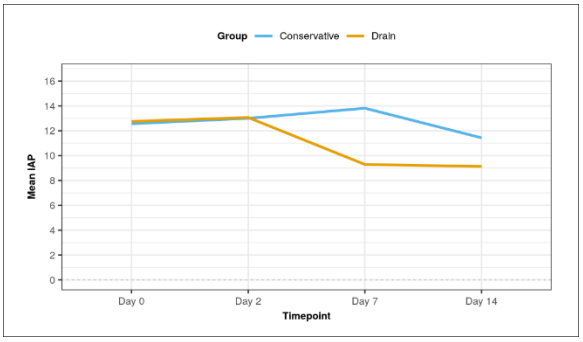
Table 4: Serial IAP measurements in group 1 and 2

	Group		
Parameters	**Conservative (n = 16)**	**Drain (n = 16)**	**p value**
IAP (Day 0)	12.56 ± 2.39	12.75 ± 2.46	0.829
IAP (Day 2)	13.00 ± 2.00	13.06 ± 2.26	0.954
IAP (Day 7)* **	13.81 ± 2.71	9.29 ± 1.82	<0.001
IAP (Day 14)	11.43 ± 3.46	9.12 ± 2.10	0.066
Peak IAP	14.50 ± 2.19	13.19 ± 2.23	0.191

Association Between Group and IAP (Day 7) (Student t-test)



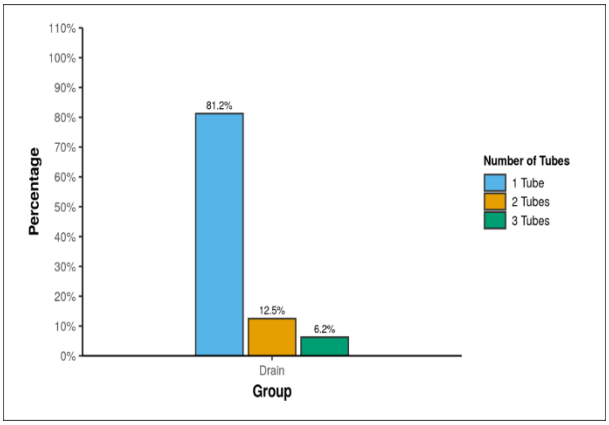
Change in IAP Over Time



Drain Fluid Analysis (Group 1):

Mean fluid amylase was 287.81 ± 502.23 U/L. Cultures were sterile in 75%, while 12.5% showed *Klebsiella*, and 12.5% showed mixed growth.

Association between Group and Number of Tubes (Chi-squared test)



Outcomes

Discharge rates were slightly lower in Group 1 (68.7%) vs. Group 2 (81.2%). One patient in Group 1 developed a conservatively managed pancreatic fistula. Mean hospital stay was similar in both groups (Group 1: 16.27 ± 10.66 days; Group 2: 16.08 ± 5.31 days; $p = 0.662$). Mortality was higher in Group 1 (31.2%) than Group 2 (18.8%), though not statistically significant ($p = 0.189$). Time to mortality was longer in Group 2.

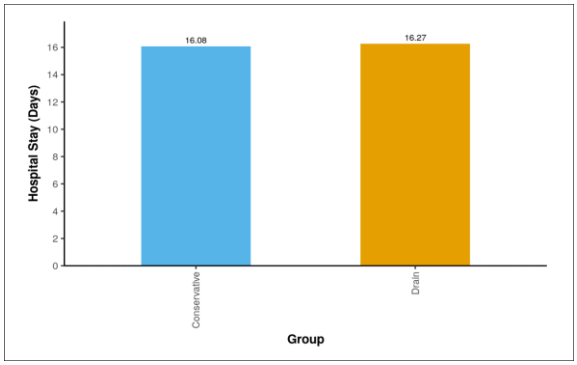


Figure : Association Between Groups and Time to mortality (Days)

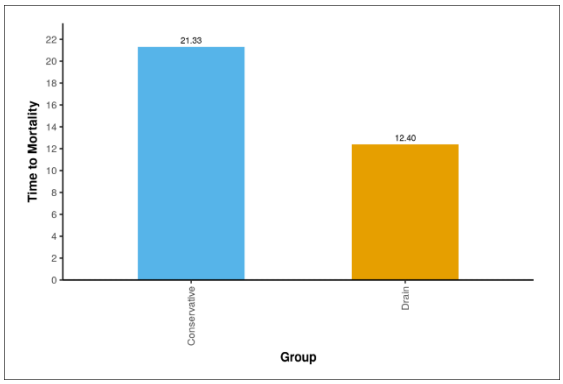
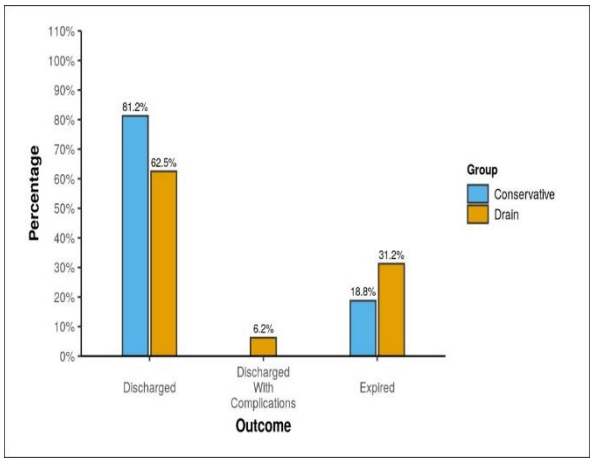


Figure: Association between Group and Time to mortality

Association between Group and Outcome



Discussion

Percutaneous catheter drainage (PCD) is gaining recognition as a minimally invasive alternative for managing pancreatic fluid collections in acute pancreatitis. In cases of severe acute pancreatitis (SAP), fluid accumulation can exacerbate systemic inflammation, making early, ultrasound-guided PCD a strategic intervention with potential to reduce inflammatory responses, alleviate pain, and shorten hospitalization. Recent literature has increasingly supported the efficacy and safety of early PCD.

In this prospective comparative study, we analyzed 32 patients with moderately severe or severe acute pancreatitis and sterile fluid collections, randomized equally into PCD plus conservative care versus conservative therapy alone.

Our cohort primarily comprised men aged 31–40 years, with gallstones being the predominant etiology. Baseline demographics and clinical signs—including BMI, symptoms, and organ function scores—were well balanced between the groups.

Primary Outcome - Length of Hospital Stay

We found no significant difference in length of stay between groups (16.27 days vs. 16.06 days; p=0.662), contrasting with studies by Li et al. (7) and Formanchuk et al. (6), which reported 4-day reductions in the PCD cohort. Our lack of observed benefit may reflect the limited sample size and prolonged management of complications like pancreatic fistulas.

Secondary Outcomes - Organ Function, Enzymes, IAP

Although admission SOFA and BISAP scores were similar, the PCD group showed significantly lower SOFA scores by day 7—a finding aligned with Gao et al. (2018), who also reported improved organ dysfunction with early ultrasound-guided PCD. Post-procedure serum amylase declined more rapidly in the PCD arm, and intra-abdominal pressure dropped significantly by day 7 (9.3 vs. 13.8 mmHg; p=0.001).(8-10).

These observations corroborate earlier reports by Wang et al. (11), Bellam et al. (12), and Liu et al. (2011), who found that reductions in IAP,

collections, and inflammatory mediators are key predictors of successful outcomes and reduced infection risk.

Microbiological Findings

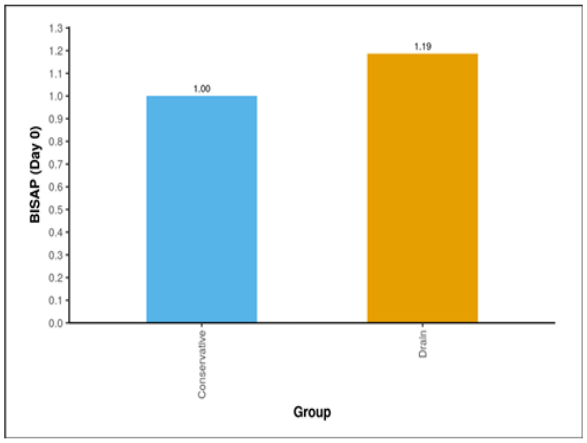
Fluid analysis showed an average amylase level of 287 U/L, with sterile cultures in 75% of cases; *Klebsiella* and mixed flora were isolated in 12.5% each. This contrasts with studies on infected collections reporting high rates of gram-negative infections, notably *E. coli* (Baal et al. 2014). Our data suggest that early intervention in sterile collections does not increase infection risk.(13,14).

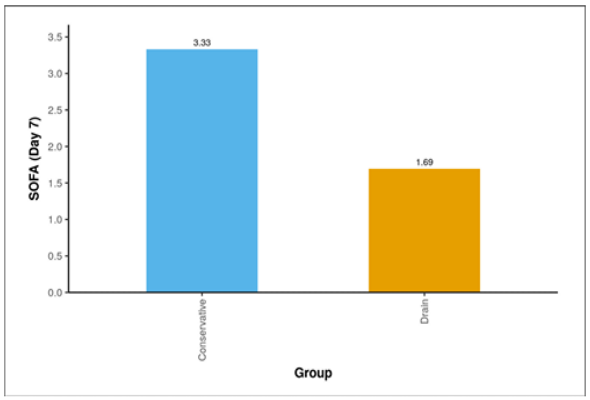
Clinical Outcomes

Most PCD patients had a single drain (81%); others required multiple drains or chest tubes. The discharge rate in this group was 68.7%, with one patient managing a pancreatic fistula conservatively. Mortality was higher in the PCD group (31% vs. 19%), though this did not reach statistical significance. This differs from pooled data (mortality ~17%) and outcomes in Formanchuk's study, perhaps due to variations in patient acuity and procedural timing.

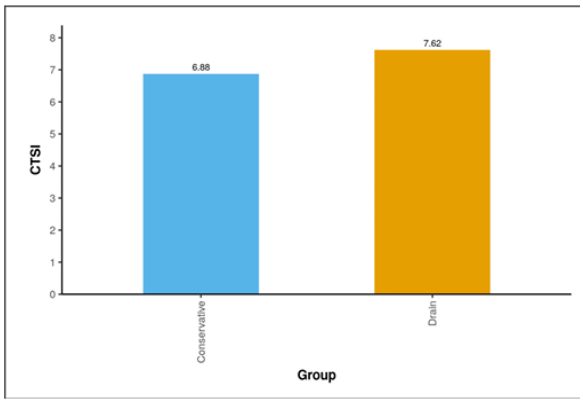
In this prospective comparative study , 32 patients with moderately severe and severe acute pancreatitis and sterile acute inflammatory fluid collections were evaluated to compare outcomes between early percutaneous catheter drainage (PCD) and conservative management. The majority of patients were male and aged between 31–40 years, with gallstones being the predominant etiology. The study found that while baseline BISAP and SOFA scores were comparable, by Day 7, SOFA scores were significantly lower in the PCD group, indicating better control of organ dysfunction (p = 0.0131). Serum amylase levels dropped significantly post-drainage in the PCD group, and intra-abdominal pressure (IAP) was markedly reduced by Day 7 (p = 0.001), highlighting effective pressure management. Although mortality was higher in the PCD group (31.2% vs. 18.8%), the difference was not statistically significant. Mean hospital stay was comparable between the two groups. Fluid cultures were sterile in most cases, suggesting that early drainage of sterile collections did not increase infection risk. Two patients in the control group required crossover to PCD due to worsening clinical status and subsequently improved. One patient in the PCD group could not be drained due to lack of a safe window and later died due to MODS. Overall, the study suggests that early PCD may contribute to improved organ function and pressure control, although it did not significantly affect hospital stay or mortality in this small cohort.

Association Between Group and SOFA (Day 0 & Day 7) (Wilcoxon-Mann Whitney U Test)

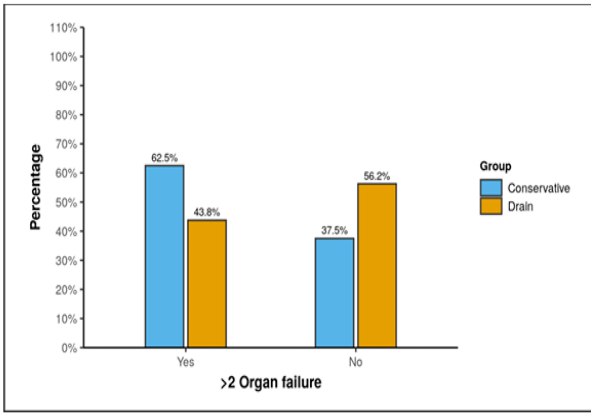




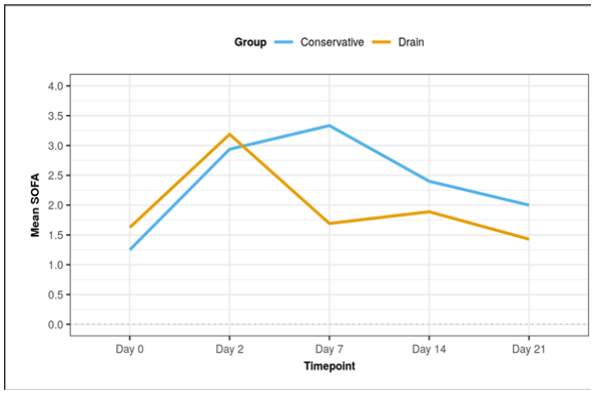
Association Between Group and CTSI (Wilcoxon-Mann-Whitney U Test)



Association between Group and >2 Organ failure (Chi-squared test)



Change in SOFA Over Time



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