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Original Article

A Retrospective Analytical Study to Compare Percutaneous and Surgical Placement of Peritoneal Dialysis Catheter

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ABSTRACT

Background and Aim: Peritoneal dialysis is an effective modality of renal replacement therapy in end-stage renal disease. The initial step in peritoneal dialysis management is securing the Peritoneal Dialysis Catheter (PDC). This study aims to compare the infective and mechanical complications of the surgical versus the percutaneous catheter insertion technique.

Methods: This retrospective analytical study was conducted on end-stage renal disease patients who attended the Department of Nephrology, ESIC Medical College, and Super Specialty Hospital. The study was conducted from January 2019 to June 2020. The records of 25 patients who underwent percutaneous PDC and 5 patients who underwent open surgical PDC technique were reviewed. The complications (mechanical and infective complications) at 3-, 6-, and 12-month intervals among the study groups were considered the primary outcome variables, and catheter and patient survival at 1-year interval were considered the secondary outcome variables. The student t test and the Chi-square test were used to compare the study groups. The data were analyzed via the coGuide software.

Results: No significant differences in baseline parameters were observed among the groups ($P>0.05$). The infective complications, namely the peritonitis rate and the exit site infection were reported more in the surgical technique of PDC placement compared to percutaneous placement (20% vs 16% and 20% vs 0%, respectively); however, the difference was not statistically significant. Catheter migration was higher in surgical technique compared to the percutaneous technique (20% vs 4%) but it was not statistically significant.

Conclusion: Both the percutaneous and surgical techniques reported similar rates of complications, technique survival, and patient survival. Further randomized control trials or prospective cohort studies are needed to analyze the effectiveness and complications of these techniques.

Keywords: Continuous ambulatory peritoneal dialysis, Catheters, Kidney failure, Chronic kidney diseases, Peritoneal dialysis, Peritonitis

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Introduction

Peritoneal Dialysis (PD) is an effective treatment modality for renal replacement therapy in patients with End-Stage Renal Disease (ESRD). Patients who are awaiting the restoration of diuresis, renal transplant, and so on are found to benefit more from PD, compared to hemodialysis as it offers a better quality of life for the patients [1, 2]. The fundamentals for the success of PD lie in its safe and permanent access to the peritoneal cavity [3]. A variety of factors, such as patient selection, mode of insertion, and catheter type affect the function and the longevity of Peritoneal Dialysis Catheters (PDCs) [4, 5].

Currently, there is no gold standard for the placement technique and the type of catheter being used as each type has its advantages and disadvantages [6, 7]. The methods for PDC insertion include percutaneous Seldinger, open surgical procedure, laparoscopic insertion, peritoneoscopic, and fluoroscopic placement techniques. The surgical technique requires General Anesthesia (GA) and is more invasive; however, it has the advantage of direct visualization, thereby ensuring the precise placement of the catheter in the peritoneal cavity [8, 9]. Percutaneous PDC placement provided favorable outcomes in recent studies and demonstrated safety and better efficacy [9, 10]. The percutaneous catheter placement technique could be performed using Local Anesthesia (LA) as an additional procedure. The advantages of percutaneous PDC insertion include the avoidance of GA and associated difficulties, such as long waiting for surgery and time allocation for theatre, faster recovery and ambulation, potentially less post-procedure pain, and efficient use of resources. While the main drawbacks are failure to advance the guide wire into the peritoneum as the Seldinger technique, it is a blind technique and may cause bowel perforation, cramp, or pain during the procedure; meanwhile, it brings limitations of use in obese patients and individuals who had undergone prior abdominal surgery [10]. Although many studies are comparing the surgical and percutaneous PDC techniques, Indian literature on the same topic is scarce. Accordingly, the present study aims to compare and evaluate the open surgical PDC technique with percutaneous PDC.

Objectives

Compare the infective and mechanical complications of open surgical PDC technique with percutaneous PDC.

Compare patient survival in patients with open surgical PDC technique and patients with percutaneous PDC placement.

Materials and Methods

Study site and population

The study population includes all the patients who had undergone continuous ambulatory PD in the Department of Nephrology, ESIC Medical College, and Super specialty Hospital from January 2019 to June 2020.

Inclusion criteria

The inclusion criteria comprised the following items:

All patients who had undergone Continuous Ambulatory Peritoneal Dialysis (CAPD); Patients who had placed catheters either by percutaneous technique or the surgical technique during the study period; Patients with available follow-up data greater than 3 months; Patients aged above 15 years.

Exclusion criteria

The exclusion criteria were patients with incomplete medical records or missing data and patients with immediate catheter removal in less than 1 month.

Study design

The study design is a retrospective analytical record-based study.

Sample size and sampling method

All 30 patients' records that passed the inclusion and exclusion criteria (25 in percutaneous and 5 in surgical; the difference in the sample size was because of the higher number of patients who underwent the percutaneous procedure during the study period) attended the department via the convenient sampling method.

Ethical considerations

The study was approved by the Institutional Review Board and the Ethics Committee of the hospital.

Percutaneous peritoneal dialysis catheter placement

Percutaneous catheter insertion was carried out as a side-room procedure in the renal ward. A curled 2-cuffed Tenckhoff catheter was placed using the

Seldinger technique under aseptic conditions. The premedication as a part of the PDC insertion protocol included intravenous piperacillin-tazobactam 4.5 g. A consultant nephrologist performed the percutaneous insertions on all the patients.

Surgical peritoneal dialysis catheter placement

Surgical insertion of the same 2-cuffed coiled Tenckhoff catheters was carried out under GA by consultant surgeons in a theater room using the standard open surgical technique.

Data collection

The demographic data, type of PDC placement, infective and mechanical complications, and survival outcomes were collected from the inpatient and outpatient medical records. Peritonitis was identified by physical findings, the clinical history documented in the medical notes (fever, nausea, abdominal pain, abdominal tenderness, and diarrhea), and laboratory data (a positive affluent culture or dialysate white cell count exceeding 100/mm^3, or both). From the laboratory database, positive swab cultures of suspected exit site infection were collected and identified. Poor initial drainage was defined as significant drainage failure within 48 h of commencing PD exchanges, necessitating either catheter manipulation or replacement or discontinuation of PD. We defined secondary drainage failure as catheter blockage or dysfunction occurring more than 48 h after successful initial drainage and resulting in catheter manipulation or replacement or discontinuation of PD. True ultrafiltration failure is defined by the rule of fours: failure to achieve at least 400 mL of net ultrafiltration during a 4-hour dwell using 4.25% dextrose [11]. Primary and secondary outcome variables were collected from the records at 3-month and 12-month intervals.

Statistical methods

The primary outcome variables included infective and mechanical complications, peritonitis, poor initial drainage, primary failure, exit site infection, exit site leak, catheter migration, and ultrafiltration failure. Catheter survival or patient survival were considered the secondary outcome variables at the end of 12 months. The procedure type (percutaneous vs surgical) was considered a primary explanatory variable. The mean and standard deviations were calculated for the continuous parametric data while medians and interquartile ranges were obtained for the nonparametric data. We reported frequencies for the categorical data. For group comparisons, we used the student t test, the Mann–Whitney test, or the Chi-square test (the Pearson or Fisher exact test). The $P<0.05$ was considered statistically significant. The data were analyzed via the coGuide software, version 1.03 [12].

Results

A total of 30 subjects underwent CAPD during the study period, of which 25 (83.33%) participants underwent percutaneous PDC insertion and 5 (16.67%) participants underwent open surgical technique. There was no difference in the baseline characteristics between the two study groups (Table 1).

In the percutaneous group, 5 (20%) participants had exit site leak, followed by PD peritonitis in 4 (16%) participants. Two participants (8%) had poor initial drainages and ultrafiltration failure. Each participant out of 5 in the surgical technique group had exit site infection, PD peritonitis, exit site leak, catheter migration, and ultrafiltration failure. Infective and mechanical complications between the groups showed no statistical significance (Table 2).

In the percutaneous group, the majority (19 participants [76%]) had catheters still in use and 6 (24%) participants were reported dead. No significant differences in catheters were observed between the two groups (Table 3).

In the percutaneous group, out of 22 participants in the third month, the majority (36.36%) reported mechanical complications and 22.7% reported exit site leak. Meanwhile, 13.6% of participants had PD peritonitis and infective complications. At the 12-month follow-up, 9.09% had PD peritonitis and infective complications out of the 11 participants. In the surgical technique group, out of 5 participants at the 3-month follow-up, the majority (40%) of the participants had a mechanical complication and 20% reported PD peritonitis, exit site leak, and catheter migration. Out of 3 participants at the 12-month follow-up, the majority (66.66%) of participants had a mechanical complication and only one (33.33%) participant had exit site infection (abscess) and ultrafiltration failure (Table 4).

Discussion

The study included 30 subjects, of which 25 participants underwent percutaneous PDC insertion and 5 underwent open surgical technique. In the percu-

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Table 1. Comparison of demographic and baseline parameters between the procedure type (n=30)

Parameters		Mean±SD / No. (%)		P
		Percutaneous (n=25)	Surgical Technique (n=5)	
Age (y)		45.44±16.	49.8±8.61	0.570*
Gender	Male	15(60)	1(20)	0.157**
	Female	10(40)	4(80)	
Therapy modality	Automated PD	4(16)	2(40)	0.254**
	CAPD	21(84)	3(60)	
Reasons for PD initiation	Access failure	5(20)	1(20)	***
	Cardiac failure	1(4)	0(0)	
	patient choice	19(76)	4(80)	
	Diabetes (%)	12(48)	2(40)	1.000**
	Hypertension (%)	19(76)	4(80)	1.000**
	Previous abdominal surgeries (%)	2(8)	0(0)	***

* Independent sample t-test, ** Fisher exact test, *** No statistical test was applied- due to 0 subjects in the cells.
PD: Peritoneal Dialysis; CAPD:Continuous Ambulatory Peritoneal Dialysis.

taneous group, the majority had exit site leaks followed by PD peritonitis, while in the surgical technique group, PD peritonitis and exit site leaks were the main complications.

Similar to the present study, earlier research reported exit site leak as the main complication of the percutaneous group, while secondary drainage was the common complication observed in the open surgical group as the primary failure and poor initial drainage, PD-

Table 2. Comparison of complications between the procedure type (n=30)

Parameters	No. (%)		P
	Percutaneous (n=25)	Surgical Technique (n=5)	
Primary failure	0(0)	0(0)	**
Poor initial drainages	2(8)	0(0)	**
PD peritonitis	4(16)	1(20)	1.000*
Exit site infection	0(0)	1(20)	**
Exit site leak	5(20)	1(20)	1.000*
Catheter migration	1(4)	1(20)	0.310*
Secondary drainage failure	1(4)	0(0)	**
Ultrafiltration failure	2(8)	1(20)	0.430*
Infective complications	4(16)	1(20)	1.000*
Mechanical complications	11(44)	4(80)	0.330*

* Fisher exact test, ** No statistical test was applied- due to 0 subjects in the cells. PD: Peritoneal Dialysis.

Table 3. Comparison of outcome parameters between the procedure type (n=30)

Parameters	No. (%)		P
	Percutaneous (n=25)	Surgical Technique (n=5)	
12 months catheter survival	19(76)	4(80)	1.000*
Death with functioning catheter	2(8)	0(0)	**
Death	6(24)	1(20)	1.000*

* Fisher exact test, ** No statistical test was applied because 0 subjects were in the cells.

related peritonitis, exit site leak, scrotal leak, pleural leak, and secondary drainage were the other observed complications [13]. At the same time, Eklund et al. reported PD-related peritonitis as the main complication followed by the pleural leak [14]. Dialysate leakage or exit site leak was frequently reported in the percutaneous groups in some studies [15, 16], while other studies did not find any difference between both groups [9, 10]. The higher incidence of leakage in the percutaneous group might be because of a shorter break-in period (time from insertion to the use of a catheter) [14, 15]. The majority of the exit site leaks were observed early and showed conservative settlement by holding PD exchanges for a few days [17]. Previous studies have reported a rate of early exit site infections ranging from 0% to 6.5% in the percutaneous method. This is while in the present study, none of the patients had exit site infection in the percutaneous group [17-19].

Catheter tip migration was observed in one participant in percutaneous and surgical PDC insertion groups. The peristaltic movement of the bowel was thought to be the cause of the migration of the catheter tip in the percutaneous group in an earlier study. They noted that catheter placement on the right side of the abdomen with its tip toward the left iliac fossa aids in reducing catheter migration [20]. In addition, catheter insertion through a paramedian location and the inner cuff burial beneath the anterior rectus sheath has been advocated as procedures to reduce catheter migration, cuff extrusion, and leaks [21]. With a functioning catheter in place, 2 participants of the percutaneous group died. Similar results were observed in previous studies in which the percutaneous group showed a higher death rate compared to the surgical group; however, there was no statistically significant difference [14, 16].

Percutaneous PDC placement was found to be a safe procedure compared to surgical placement and causes fewer complications [22]. Recent meta-analyses did not find any significant differences in outcome or complications between both techniques, except for the laparoscopic method. The percutaneous catheter placement was considered a safe and effective surgical technique

Table 4. Complication between the third and the twelfth month among percutaneous and surgical group

Parameters	No. (%)			
	Percutaneous		Surgical Technique	
	Third Month (n=22)	Twelfth Month (n=11)	Third Month (n=5)	Twelfth Month (n=3)
PD peritonitis	3(13.6)	10(90.90)	1(20)	0(0)
Exit site infection (abscess)	0(0)	0(0)	0(0)	1(33.33)
Exit site leak	5(22.7)	0(0)	1(20)	0(0)
Catheter migration	1(4.5)	0(0)	1(20)	0(0)
Secondary drainage failure	1(4.5)	0(0)	0(0)	0(0)
Ultrafiltration failure	1(4.5)	0(0)	0(0)	1(33.33)
Infective complications	3(13.6)	1(9.09)	1(20)	0(0)
Mechanical complications	8(36.36)	0(0)	2(40)	2(66.66)

PD: Peritoneal Dialysis.

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[23-25]. The guideline by the International Society for Peritoneal Dialysis recommends that the choice for insertion of PDC should be based on patient factors, operator expertise, and facility resources. It also suggests that patients who had not undergone previous major surgery or had peritonitis are suitable for any of the operator-friendly techniques for catheter insertion [26].

Conclusion

Our study showed that both the infectious and mechanical complications were almost the same in surgical and percutaneous techniques. Also, given the limitations regarding the small sample size in one group and the retrospective design, the survival rate of patients in the surgical and the percutaneous technique did not show significant differences. The percutaneous method is a simple, safe, and immediately available technique and compares favorably with other methods. The percutaneous PDC insertion technique maintains an advantage of applicability in patients who cannot undergo GA or invasive surgery. Further randomized control trials or prospective cohort studies are needed to analyze the effectiveness and complications of the techniques.

Limitations

The limitations of this study are related to its retrospective design and the single-center study. Secondly, the small sample size in one study group may affect the results.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by the institutional human Ethics Committee and the Institutional Review Board (reference number: 799/U/IEC/ESICMC/F0254/01/2021). Data confidentiality was maintained and a written informed consent letter was obtained from each participant.

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Authors' contributions

Conceptualized the study and played primary role in compiling, analysis and interpretation of the data: Deepthi Ayanavelli; All the drafts were prepared, reviewed and final draft was approved: Dhanalakshmi Gorakanti, Imran Ahmed Siddiqui, Raichur Vijay Kumar, Deepthi Ayanavelli; Contributed in fine tuning of the proposal, contributed in data collection and entry: Dhanalakshmi Gorakanti, Imran Ahmed Siddiqui, Raichur Vijay Kumar, Deepthi Ayanavelli. Reviewed the results and contributed to preparation and review of drafts: All authors; Read and approved final version of the manuscript: All authors. Take complete responsibility for the content of the manuscript: All authors.

Conflict of interest

The authors declared no conflict of interest.

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