JEIMP
THE SCIENCE
Journal of
European Internal Medicine Professionals
J Eur Int Med Prof
2023, Volume 1(4)

10.5281/zenodo.10019799
Original Article

Comparison of Peritoneal Catheter Insertion Techniques: A Single-Center Experience Comparing Percutaneous and Laparoscopic Approaches

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Received: 27.08.2023 **Accepted**: 25.09.2023 **Published**: 20.10.2023

ABSTRACT

Background: There is still no consensus on the best approach for the insertion of the peritoneal dialysis catheter. We aimed to compare the results of the percutaneous Sildenger and laparoscopic surgical peritoneal dialysis catheter insertion approaches.

Materials and methods: The study examined the files of patients in the chronic PD program retrospectively. Demographic characteristics such as early and late complications, attacks of infection, time of use of the catheter, and number of hospitalizations were recorded to compare both methods. (Tablo 1). The results were evaluated through appropriate statistical analysis of the data.

Results: In our study, 32 (53.3%) out of 60 patients included were males. Patients were divided into two groups, the percutaneous PD catheter group (Group 1, n=36) and the Laparoscopic PD catheter group (Group 2, n = 24). The average age for group 1 was 65 years, while it was 57 years for group 2 (p = 0.197). The median follow-up time of the study population was 17 months (7-41). The average first usage time of the PD catheter was 13.5 (11-16.5) days in group 1 versus 21.5 (18.5-27.5) days (p 0.001) in group 2. The exit site leak was 11.1% (n = 4) versus 33.3% (n = 8) in groups 1 and 2, respectively (P = 0.039). No significant difference was observed between the two groups in terms of hospitalization, renal replacement treatment transition, and death.

Conclusion: The percutaneous approach for PD catheter insertion is more advantageous compared to surgical techniques with fewer complications. More importantly, there is no risk of anesthesia, in addition to shorter incisions and less hospitalization time.

Keywords: Peritoneal dialysis, percutaneous Seldinger technique, laparoscopic peritoneal catheter insertion, complications

INTRODUCTION

Peritoneal dialysis (PD) is one of the best options offered to patients with end-stage renal disease. We need a safe and long-lasting tool for this treatment option's successful and long-standing utilization. The success of PD as renal replacement therapy (RRT) depends on a well-functioning peritoneal catheter. Knowledge of best practices in catheter insertion can minimize the risk of catheter complications that lead to PD failure. Peritoneal catheter types and insertion techniques have evolved over time. Many techniques and insertion sites were tried for safe insertion and the least complications (1-7). The main aim is always to attain maximal duration with the least complications. Surgical complications and infections are the major concerns for peritoneal dialysis patients. Technical failure and recurrent peritonitis constitute major reasons for transfer to hemodialysis (8,9). Catheter insertion types include percutaneous with or without image guidance, open surgical dissection, peritoenoscopic, and surgical laparoscopy (10). The Tenckhoff trocar and the Seldinger approach are the two most popular percutaneous procedures (10-12). With the percutaneous approach, the peritoneal dialysis catheter is more easily tolerated, starting PD sooner and requiring

a smaller incision line. Open surgical procedures are replaced with laparoscopic techniques. The laparoscopic approach has fewer complications when compared to the oldest traditional surgical approaches (13). Blind insertion percutaneously was also found to have a comparable complication and safety profile when compared with laparoscopic insertion (14,15). Despite being more advantageous, the laparoscopic technique entails complicated equipment, an operation room, and general anesthesia. On the other hand, the Percutaneous Seldeinger technique is a bedside procedure performed with local anesthesia and does not necessitate complex, expensive equipment. There is no clear-cut consensus regarding the best peritoneal dialysis (PD) catheter placement approach. All procedures have their pros and cons. Previous studies and reports did not exclusively favor one specific technique over another (16). The advantage of the laparoscopic approach over the more traditional open approach has been well documented in many studies (17-19). We aimed to compare the outcomes of Sildenger percutaneous and laparoscopic peritoneal dialysis catheter placement approaches.

METHODS

The present study was conducted on 109 patients followed retrospectively in our peritoneal dialysis outpatient clinic. The study was conducted in accordance with the Declaration of Helsinki and after approval of the ethics committee of our university faculty of medicine (E-71522473-050.01.04-241662-327). The percutaneous PD catheter was inserted by a nephrologist under local anesthesia and prophylactic antibiotics in the intervention room, while the laparoscopic PD catheter was inserted by the same nephrologist with the help of a general surgeon under general anesthesia and prophylactic antibiotics in the operating room. Prior to the procedure, all patients had intestinal cleaning with a fleet enema the day before and 2 hours before the procedure. All received pre-operative prophylactic 1 gram cefazoline antibiotic therapy. Laparoscopic insertion was performed primarily by surgeons with the assistance of a nephrologist in the operating room. Under general anesthesia, a median of 2-3 cm in the sub-abdominal region, with additional holes for laparoscopy, was performed. To prevent organ trauma at this level, 1000 ml of 1.36% glucose dialysis solution (supplemented with 500U/L heparin) was administered through the peritoneal membrane through the 16G intracath. After the PD solution injection, a guide wire was sent, and then the rectal muscle and peritoneal membrane were dilated with a dilatator, and a catheter was inserted in the abdominal cavity. The catheter was placed with direct vision into the Douglas space. For the percutaneous Sildenger method, the same preoperative measures were conducted. After local anesthesia, a left paramedian superficial cut below the umbilicus was performed (1-maximum of 1.5 cm) to allow dilatation using the fifth digit of the right hand of the operating nephrologist. like the surgical method, the peritoneal cavity was rinsed with heparinized dialytic solution (1000 ml of 1.36% solution). All patients had a direct abdominal X-ray (in a standing position). As shown in **Figure 1** (Flowchart), we included 60 patients who were actively followed for the last 5 years (**Table 1**). 3 out of 24 patients in group 2 had an obligatory laparoscopic approach. One because of morbid obesity and the other two because of incompliance. Our inclusion criteria were age over 18, catheter insertion in our institution, and the least follow-up duration of 6 months. We excluded patients with missing data, open surgical techniques, those with short follow-up, and those not performed primarily in our center. Baseline demographic, biochemical parameters, and other items, including primary disease, duration of PD period, residual urine, complications resulting from PD catheter insertion, the time between catheter insertion and first use, discontinuation of the PD program for any reason, and switching to another renal replacement therapy modality. We concluded the study by performing an appropriate statistical analysis of all recorded data.

STATISTICAL ANALYSIS

A descriptive analysis was performed to provide information on the general characteristics of the study population. We used Visual (probability plots, histograms) and analytical methods (Kolmogorov-Smirnov and Shapiro-Wilk's test) to evaluate the normality of the distribution. The descriptive analyses were presented using the median (IQR, 25th–75th percentile) to compare our non-normally distributed variables. We used the Mann-Whitney U test for nonparametric parameters. The categorical variables were presented as frequency (% percentage). Categorical variables between the two groups were evaluated using the Chi-square test. Automated analyses were performed by SPSS statistics

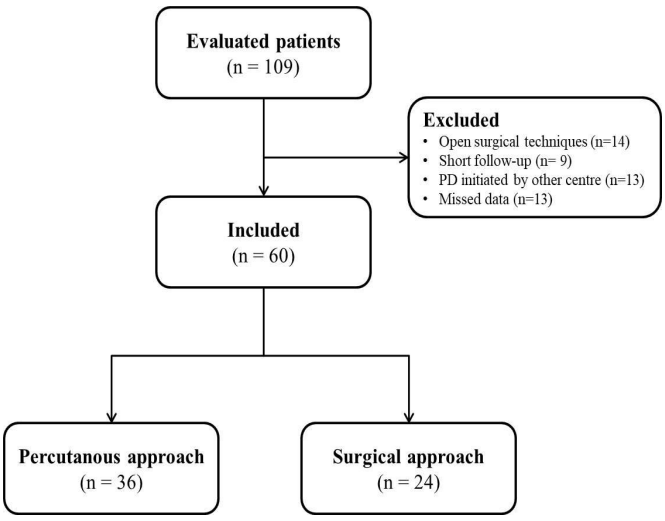

Figure 1. Study flowchart

Table 1. Comparison of demographic and basal characteristics of the study population

	Percutaneous Approach (No= 36) Group 1	Laparoscopic approach (No=24) Group 2	All patients (n=60)	p value
Age, year*	65.0 (17.5)	57 (19)	63.0 (53.0-69.5)	0.197
Sex, (Male), n (%)	20 (55)	12 (50)	32 (53.3)	0.433
BMI, kg/m2*	27.8 (8.5)	30.1 (7.5)	29.0 (8)	0.077
Diyabetes Mellitus, no (%)	8 (22.2)	6 (25)	14 (23.3)	0.520
Hipertansiyon, no (%)	36 (100)	24 (100)	60 (100)	NA
Bazal hemoglobin (g/dl)*	9.3 (1.6)	9.4 (2.6)	9.3 (2.2)	0.651
Basal urea, (mg/dl)*	148.8 (54)	169.7 (38.6)	160.0 (55.3)	0.069
Basal serum creatinine, (mg/dl)*	4.0 (3.3)	4.7 (3.6)	4.1 (4.5)	0.963
Basal sodium, (mmol/L)*	136.0 (7)	137.5 (7)	137.0 (7)	0.639
Bazal potassium, (mmol/L)*	4.2 (1.3)	4.6 (1.1)	4.3 (1.2)	0.141
Assisted PD, n (%)	18 (50)	7 (29.2)	25 (41.7)	0.09
HIV positive, n (%)	0	0	1 (1.17)	1
HBV positive, n (%)	0	0	0	NA
HCV positive, n (%)	0	0	0	NA

* Expressed as median (IQR), BMI; body mass index, IQR; interquartile range PD; peritoneal dialysis

software (IBM SPSS Statistics, Version 21.0). P-value <0.05 was considered significant.

RESULTS

Our study included 60 patients with a mean age of 63 years (53-69.5). 53.3% (n=32) of patients were males. Patients were divided into two groups based on the PD catheter insertion approach. The percutaneous PD catheter group (Group 1) included 36 (60%), and the laparoscopic PD catheter group (Group 2) included 24 (40%). The average age for group 1 was 65 years (53.5-71), while it was 57 years (49-68) for group 2 (p=0.197). As shown in **Table 2**, the median follow-up time of the study population was 17 months (7-41) (**Figure 2** & **Figure 3**). The average first usage time of the PD catheter was 13.5 (11-16.5) days in group 1 versus 21.5 (18.5-27.5) days in group 2 (p<0.001). The exit site leak was 11.1% (n=4) versus 33.3% (n=8) in groups 1 and 2, respectively (P=0.039). No significant difference was observed between the two groups regarding hospitalization, renal replacement treatment transition, and death. As shown in Table 2, while late (> three months), subcutaneous edema was 11.1% (n=4) in group 1, it was 33.3% (n=8) in group 2 (p=0.039). Two patients (8.3%) developed exit-site infection in group 2, while none were in group 1.

DISCUSSION

In the present study, we compared the outcomes of Sildenger percutaneous and laparoscopic peritoneal dialysis catheter insertion approaches, and we found no significant differences between the two modalities in terms of primary endpoints like morbidity, hospitalization, and death ratio. However, we demonstrated some important advantages in favor of the percutaneous PD catheter insertion method, like shorter time to start PD

Table 2. Comparison of outcomes of percutaneous and laparoscopic peritoneal catheter insertion approaches

	Group 1 Percutanous sildenger approach (No= 36)	Group 2 Laparoscopic Approach (No=24)	TOTAL (n=60)	p
Time lapsing untill first use (days), median (IQR)	13.5 (5.5)	21.5 (9)	16 (8.5)	P <0.001
Total followup duration (month), median (IQR)	11 (29.5)	29 (46)	17 (34)	0.006
Subcutaneous edema (first 3 months), n (%)	2 (5.6)	1 (4.3)	3(5.1)	0.665
Exit-site leak (first 3 months), n (%)	4 (11.1)	8 (33.3)	12 (20.0)	0.039
Hemoperitonium, n (%)	7 (19.4)	6 (25)	13 (21.7)	0.420
Hernia, n (%)	5 (13.9)	3(12.5)	8 (13.3)	1
Exit-site infection, n (%)	0 (0.0)	2(8.3)	2 (3.3)	0.079
Catheter malposition, n (%)	7 (19.4)	6 (25.0)	13 (21.7)	0.420
Catheter removal for any cause, n (%)	10 (28.6)	4 (16.7)	14(23.7)	0.230
Hospitalizations, n (%)	14 (40.0)	14 (58.3)	28 (46)	0.309
Transfer to hemodialysis, n (%)	2 (5.6)	2 (8.3)	4 (6.7)	0.528
Transfer to renal transplantation, n (%)	3 (8.3)	1 (4.2)	4 (6.7)	0.472

IQR; interquartile range

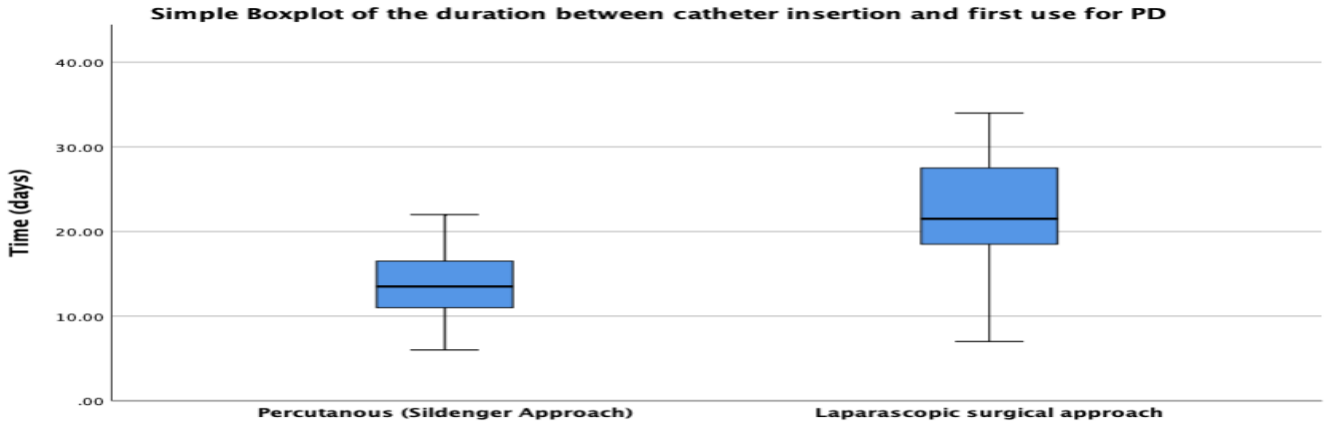

Figure 2. The time between PD catheter insertion and first peritoneal dialysis in days.
The duration between catheter placement and peritoneal dialysis (PD) initiation was shorter in group 1 (Sildenger technique) than in the Laparoscopic surgical approach. Time until the first PD session was 13.5 (11-16.5) days Versus 21.5 (18.5-27.5) days in groups 1 and 2 respectively (P <0.001).

dialysis, lower rates of leakage, and less exit-site or tunnel infection. The absence of need for general anesthesia and operating room are other crucial benefits. The time between PD catheter insertion and PD initiation was significantly shorter in favor of the percutaneous insertion method. ISPD guidelines recommend a break-in period of at least two weeks before elective start on PD (16,20). In our study, despite the mean waiting time of three weeks in the laparoscopic PD catheter insertion group, technical complications were more common.

In terms of exit-site infection and peritonitis, we noted that there was no difference between comparable groups. In the literature, controversial results have been reported in this field (14,15,21-24). In one study, two weeks after catheter placement, catheter-related infection episodes occurred in 13.6% of patients with percutaneous approach versus 14.3% of patients in the laparoscopic insertion group (15). However, in another study, percutaneous PD catheter insertion had a lower relative risk concerning exit-site infection and early peritonitis compared with the surgical approach [64% (95% CI = 47%-76%) vs 48% (95% CI = 23%-64%); respectively] (21). In another study including 121 patients, there was no statistically significant difference regarding complications either in catehteres with survival of more than 12 months as those with survival of less than 12 months (25). Unplanned urgent peritoneal dialysis initiation is a problem in late referred patients and may be a reason for PD catheter-related complications in the early period (26).

Initiation of dialysis following catheter placement should be delayed for two weeks when possible to minimize the risk of leaks. The incidence of exit-site

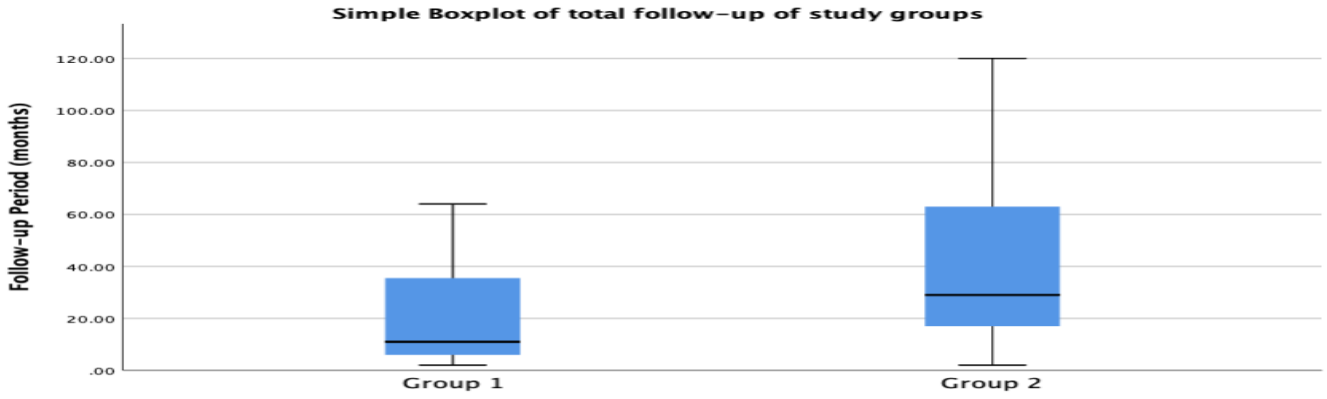

Figure 3. The total time follow-up of the study population.
The total follow-up period was higher in group 2 (surgical method) than in group 1 (Sildenger technique). The median follow-up in group 1 was 11 (6-35.5) months versus 29 (17-63) months in group 2 (P = 0.006). The preferred insertion method is the percutaneous method unless an obligatory reason is indicated. Only 3 patients from group 1 had obligatory laparoscopic insertion. The total follow-up period was higher in group 2 (surgical method) than in group 1 (Sildenger technique). The median follow-up in group 1 was 11 (6-35.5) months versus 29 (17-63) months in group 2 (P = 0.006). The preferred insertion method is the percutaneous method unless an obligatory reason is indicated. Only 3 patients from group 1 had obligatory laparoscopic insertion.

leak rates was higher in the surgical group (%33.3 vs. %11.1). Our results are consistent with other studies (15,21,27). However, according to the results of meta-analyses, there were no significant differences between the percutaneous and surgical methods in terms of excite-side leak (21,28). The main reasons for our leak results in favor of the percutaneous method may be that the team has years of experience, we used the catheter in accordance with the literature (at least two weeks), and we performed the catheter exit site without incision (20). No statistically significant difference was observed in other outcomes, including catheter survival and mechanical complications. These results were consistent with the literature (15,28,29). In another study comparing three different techniques (open surgery, Sildenger, and modified Sildenger), the complication rate of catheter malposition was higher than either procedure (39.1% for sildenger compared to 27.3 % and 9.1 % in open surgical and modified sildenger, respectively) (30). In our study, the rate was 19.4%, which is lower, but the gap is not very high. This may be due to the small sample size, which is 23 in the Ma et al. study compared to 36 in our study (30).

Due to the inherent nature of percutaneous techniques as blind procedures, there exists a minor potential for inadvertent perforation of the abdominal organs. Previous investigations utilizing the percutaneous approach have demonstrated an exceedingly low incidence of perforation, ranging from 0% to 1.3% (31-33). Efforts are made to mitigate the occurrence of this problem by instilling fluid into the abdominal cavity either during or immediately prior to the insertion. This complication has not been observed during any of the catheter procedures performed in our clinic. Y. Koc et al. reported more exit site bleeding complications in the Seldinger technique than in the surgical technique (34). In our study, the exit site bleeding was comparable, and no major problem was documented. This may be due to planned procedures and paying attention to the complete stopping of antiaggregants at least 5 days before the procedure. It is important to note that the use of antiaggregants should always be carefully considered and managed in order to minimize bleeding complications during catheter procedures. Additionally, our study found that both the Sildenger and laparoscopic techniques had a lower incidence of post-procedure bleeding complications compared to the open surgical technique reported in the Y. Koc et al. study (34). This could be attributed to the direct visualization and control of bleeding during the surgical approach. Rather, the incision is smaller in laparoscopic technique and even shorter in our clinical practice. Further research is needed to evaluate this point.

Limitations of the Study

Sample Size: The study's sample size may be relatively small, limiting the generalizability of the findings to a broader population of individuals with CKD observing Ramadan fasting.

Retrospective Data: The study's retrospective nature may introduce inherent biases and limitations in data collection and analysis, potentially affecting the accuracy and completeness of the information obtained. Prospective studies comparing the outcomes, burden of hospitalizations, and costs are needed to clarify superiority.

Single-Center Study: Conducting the study at a single center may limit the diversity of the study population and restrict the representation of individuals treated with peritoneal dialysis from different geographic regions or healthcare settings.

Costs: We did not have accurate calculations to compare the costs of the two methods.

CONCLUSION

These findings suggest that insertion of the peritoneal catheter via the Sildenger percutaneous technique is safer with a lower frequency of long-term complications. Rather, it has the advantage of no general anesthesia and a shorter cutaneous incision.

ACKNOWLEDGMENT

The authors would like to thank our nurses, Peruze Yuksel and Esen Ulker, for their assistance in collecting data and preparing the pre-evaluation spreadsheet.

DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of the local ethics committee (Decision number: E-71522473-050.01.04-241662-327).

Informed Consent: All patients included in the study signed informed consent.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The author has no conflicts of interest to declare.

Financial Disclosure: The author declares that this study has received no financial support.

Author Contributions: All authors contributed to conceptualization and data collection. MI and HD wrote the first draft. All authors contributed to the revision and approval of the last draft.

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