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ORIGINAL ARTICLE

Comparison of the complications of open surgery versus laparoscopic technique in insertion of peritoneal dialysis catheter

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Background: Invention of peritoneal dialysis (PD) has opened new windows for patients under dialysis due to its fewer time requirement and being ambulatory in comparison to hemodialysis. Open surgery and laparoscopic technique have been utilized for peritoneal catheter embedding; however, data about the superior technique are controversial. This study aimed to assess the outcomes of open surgery versus laparoscopic technique and compare their complications in those with survival of over and less than a year in patients who need PD for the first time. **Materials and Methods:** This randomized clinical trial study was conducted on 121 cases admitted for PD. Patients were randomly divided into two groups undergoing either open or laparoscopic surgery for embedding PD catheter. Patients' demographics, as well as PD function and complications, were followed for a 12-month duration and compared between the two groups. **Results:** Catheter survival for over 12 months occurred in 39 patients (65%) underwent laparoscopic surgery, and 45 (73.8%) patients underwent open surgery ($P = 0.09$). Complications, including catheter obstruction, leak, abdominal hernia, and peritonitis, were not statistically different between the two techniques over 12 months of survival ($P > 0.05$). Complications among the catheters with less than a year survival, including obstruction, leak, catheter displacement, hernia, and peritonitis, were not significantly different comparing open surgery with laparoscopic technique ($P > 0.05$). **Conclusion:** Considering complications, PD catheter implantation through laparoscopic surgery was not statistically different from open surgery, neither for those with less than 12 months of survival nor for those with over a year.

Key words: Catheter obstruction, hernia, laparoscopic technique, peritoneal catheter, peritoneal dialysis, peritonitis

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INTRODUCTION

Peritoneal dialysis (PD) was first presented by Richard Ruben for about five decades ago.[1] Within a decade, other researchers developed it to ambulatory PD that opened new windows toward patients who were forced to spend many hours per week for hemodialysis.[2] The advantage of this technique in comparison to hemodialysis, other than saving time is its fewer costs, and also PD is an efficient means while patients would not respond to hemodialysis.[3] Malnutrition and protein loss are among usual complications of end-stage renal disease (ESRD) regardless of the dialysis type of these patients due to anorexia induced by renal dysfunction and the presence of inflammation and pro-inflammatory agents in the blood flow. The rate of this protein loss is considerably higher in PD as compared with hemodialysis. Since considerable protein aggravation would occur through this type of dialysis performed through peritoneum as compared with hemodialysis.[4]

Following mentioned events, various techniques of catheter embedding in the peritoneum, including open surgery, laparoscopic, percutaneous, and peritoneoscopic procedures are provided.[2,5,6] Novel techniques have been introduced to achieve less abdominal wall manipulation, better outcomes, more efficient dialysis, less infection, and least leakage.[7-9]

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Some experts prefer performing usual traditional technique of open surgery, in which they blindly insert a dialysis catheter into the peritoneal space;[9,10] while others claim that laparoscopic technique is accompanied with better outcomes, moreover, less leakage and catheter movement. In general, due to complications of each technique, specialists have not achieved unanimous opinion about the best way of PD implantation.[10,11]

This study aimed to assess the outcomes of open surgery versus laparoscopic technique and compare their complications in those with the survival of over and less than a year in patients who need PD for the first time.

METHODS

This was a randomized clinical trial study conducted on 121 cases admitted for PD at Alzahra university hospital affiliated to Isfahan University of Medical Sciences, Isfahan, Iran, during 2016–2017.

Inclusion criteria were patients' requirement of PD[12] for the first time and their willingness of participation in the study. In addition, those who did not have tolerance of spinal or general anesthesia were excluded from the study.

The study population was selected using the following formula:

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 \left[P_1\begin{pmatrix}1\\-P_1\end{pmatrix} + P_2\left(1-P_2\right)\right]}{(P_1 - P_2)^2}$$

Based on this formula, $P1$ was defined as the rate of catheter displacement in a laparoscopic technique that equaled 0%, and $P2$ was considered as the rate of catheter tip displacement in open surgical technique that equaled 12%. The estimated number of participants was achieved 53 per group that by consideration of probable withdrawn from the study, we selected 60 members for each of the groups.

This study was conducted based on a proposal approved by the Ethical Committee of Isfahan School of Medicine (code: 396,183). Moreover, the study was approved by the Iranian Registry of Clinical Trials (code: IRCT20190525043691N1). Thereafter, information about the surgical procedures, randomization, and study design was provided to all the patients. Then, they all signed written consent form.

The study population was enrolled based on the inclusion criteria. They were divided into two groups randomly in simple method using Random Allocation software (version 1.0, developed by Mahmood Saghaei, Iran). In this method, all patients were provided a number by the software, and those with even number were supposed as members of open surgery, and those with odd numbers were members of the other group.

Patients of the laparoscopic group underwent surgical procedure using the Argyle™ Swan Neck Curl Catheter. In this order, patients were positioned in the Trendelenburg position and anesthetized. Within 2–3 cm under naval, an incision with 11-mm length was performed, and the staple-containing camera on its end was inserted through this port. Then, another paramedian port was incised within 5 cm on the right side of the first port, and the grasper was inserted through it. Thereafter, PD catheter was inserted through the first port after camera removal, and its place was checked following camera insertion again. Thus, the catheter was placed in the pelvic space using grasper under camera vision. By this action, catheter distal parts found by its double-terminal cuffs with grasper were removed from the abdominal space through the second port. Thus, the first catheter's cuff was exactly placed under/in fascia thickness. Then, by the aid of tunneler that was placed at the end of the catheter, a 10 cm tunnel was embedded to the left paramedian side, and finally, the catheter was extracted from the left paramedian side, and the second cuff was embedded under the skin. Thereafter, catheter function was tested using normal saline and in case of functioning, the camera assessed the abdominal space and portal place. Finally, grasper and camera were removed, and the incisions were sutured.

The second group underwent the open surgical procedure as done by van Laanen *et al*.[2]

Following surgeries, all patients were trained about the use of PD, its caring recommendations, and its probable complications. PD was started within 2 weeks after surgery.

Patients' demographics, including age, gender, duration of hospitalization for this surgical procedure, and history of abdominal surgery, were recorded. All patients' PD function and complications were followed for a 12-month duration.

Data were analyzed using the SPSS software (version 20, IBM Corp., USA). Descriptive information was reported in mean and percentages. For analytics, *t*-test, Chi-square, and Fisher's exact test were used. P <0.05 was considered as statistically significant.

RESULTS

In this study, a total number of 135 patients were assessed regarding the eligibility of participation in

the study. Among them, nine patients were excluded as they could not undergo spinal or general anesthesia based on anesthesiologist consultant. The remaining 126 patients were randomly divided into two subgroups, and only a member of laparoscopic group did not receive intervention because of hemodynamic instability during anesthesia. Remaining participants underwent surgical procedure. Eventually, two members of each group did not participate in follow-up visits and were excluded. Therefore, this study was conducted on 121 patients and they were divided into two groups. The first group consisted of 60 members underwent laparoscopic PD implantation, and the second one included 61 patients who underwent open surgery technique of PD implantation [Figure 1].

Table 1 presents demographic information of two groups. Based on this table, members of the two groups were not significantly different considering age, gender distribution, duration of hospitalization for this surgical procedure, history of abdominal surgery, and death ($P > 0.05$ for all).

According to the findings of this study, complications associated with laparoscopic surgery, including catheter obstruction ($P = 0.96$), leak ($P = 0.98$), movement ($P = 0.06$), abdominal hernia ($P = 0.98$), and early and late peritonitis ($P = 0.80$), were not statistically different with open surgery [Table 2].

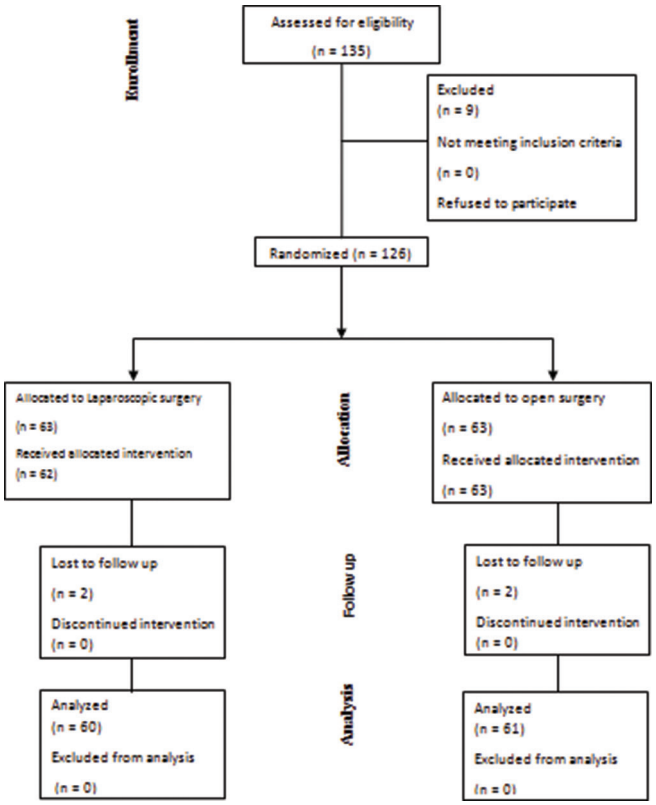

Figure 1: Consort diagram of the study population

Comparison of two surgical techniques regarding complications, including catheter obstruction, leak, movement, abdominal hernia, peritonitis, patients' death, and patients' kidney transplantation, presented no statistical differences among catheters with over a year survival ($P > 0.05$ for all). Mentioned factors are demonstrated in Table 3.

Eventually, six patients died in this study. Four of them were among those underwent laparoscopic surgery and two of them underwent open surgery. Three patients died during the study assessment period due to diabetes mellitus (two in

Table 1: Comparing demographic information of laparoscopic versus open surgery

Demographic variables	Laparoscopic surgery (*n*=60)	Open surgery (*n*=61)	*P*
Age (years), mean±SD	56.95±17.21	55.54±18.13	0.66
Gender (male), *n* (%)	40 (66.7)	38 (62.3)	0.61
Duration of hospitalization (days)	1.99±1.36	2.25±1.48	0.75
History of previous abdominal surgery, *n* (%)	7 (11.7)	2 (3.3)	0.09

SD=Standard deviation

Table 2: Comparison of complications following laparoscopic versus open surgery for embedding peritoneal dialysis catheter with over a year survival

Complications	Laparoscopic surgery (*n*=60), *n* (%)	Open surgery (*n*=61), *n* (%)	*P*
Catheter obstruction	10 (16.7)	10 (16.4)	0.96
Catheter leak	4 (6.7)	4 (6.6)	0.98
Catheter movement	7 (11.7)	15 (24.6)	0.06
Abdominal hernia	3 (5.0)	3 (4.9)	0.98
Peritonitis	9 (15.0)	14 (23.0)	0.26
Early peritonitis (<1 month postsurgery)	6 (66.7)	10 (71.4)	0.80
Late peritonitis (>1 month postsurgery)	3 (33.3)	4 (28.6)	
12 months catheter survival	39 (65.0)	45 (73.8)	0.09

The amounts are considered as *n* (%)

Table 3: Comparison of complications following laparoscopic surgery versus open surgery with catheter failure within 12 months

Complications	Laparoscopic surgery (*n*=21), *n* (%)	Open surgery (*n*=16), *n* (%)	*P*
Catheter obstruction	7 (33.3)	6 (37.5)	0.79
Catheter leak	1 (4.8)	1 (6.3)	0.84
Catheter displacement	5 (23.8)	6 (37.5)	0.36
Abdominal hernia	1 (4.8)	1 (6.3)	0.84
Peritonitis	5 (23.8)	6 (37.5)	0.36
Early peritonitis (<1 month postsurgery)	3 (60.0)	4 (66.7)	0.81
Late peritonitis (>1 month postsurgery)	2 (40.0)	2 (33.3)	
Death	4 (19)	2 (12.5)	0.68

The amounts are considered as *n* (%)

the laparoscopic group and one in open surgery), one died because of chronic obstructive pulmonary disease (open surgery), and two others died following acute coronary syndrome (laparoscopic group).

DISCUSSION

In the current study, we tried to compare the outcomes of laparoscopic procedure of PD catheter embedding with open surgery. Based on our research in literature, this was the first study assessing complications and outcomes of implanted PD catheters considering the type of implantation (surgical procedure) regarding their survival either less or more than 12 months.

Members of two groups were not statistically different considering demographics. Thus, probable confounding variables could affect the outcomes of surgical procedures were similar. Complications that patients' with 12-month functional PD catheter were struggling with including catheter obstruction, leak and movement, abdominal hernia, peritonitis, and 12-month survival showed no difference between the two groups. Assessment of complications incidence, including catheter obstruction, leak and movement, abdominal hernia, peritonitis, abdominal surgery requirement, death, and kidney transplantation among those catheters survived for more than a year, revealed no statistical difference between those who underwent laparoscopic PD implantation with those under open surgery procedure.

In the study conducted by van Laanen *et al*., the rate of success functioning was somewhat similar to ours while they assessed their catheters functioning within 2 weeks following procedures.[2] These rates were better in Gajjar *et al*. study, as they presented success rate of 97% in laparoscopic technique and 80% in open surgery.[9] Other studies assessed success rate of laparoscopic surgery even presented better outcomes of up to 100%. These rates were presented by Oğünç *et al*.[7] and in Crabtree and Fishman.[13] Mentioned differences can be attributed to facilities provided for surgeons, underlying etiology of ESRD as cases with diabetes mellitus may have poor outcomes and also surgeons' experience and proficiency.

These rates about open surgery are consistent with other studies in which they have presented failure rate of 16%–33% for PD catheter embedding through open surgery.[6,10,14] However, it seems that laparoscopic failure detected in the current study is somewhat higher than literature, although this rate is approximately near to what was mentioned by Wright *et al*., as they mentioned 30% failure in their studied population under laparoscopic surgery.[6] These rates are considerably higher than what was mentioned by Tsimoyiannis *et al*.[14] with 0% failure and Jwo *et al*. with 0%.[10] These differences among the studies can be attributed to surgeon techniques or equipment used by them.

PD is usually accompanied by complications such as obstruction, infection, leakage, and movement. These complications have been presented by previous studies in which whether laparoscopic or open surgery was performed as well.[9,13] In a study conducted by Jwo *et al*., performing laparoscopic technique caused higher bleeding (7.5% vs. 21.6%) and also higher rate of catheter movement (15% vs. 2.7%); but in general complications, the two techniques did not differ in significant manner.[10] About catheter survival, they presented similar outcomes of ours.

Another study conducted by Cox *et al*. strongly recommended laparoscopic technique as they found significantly higher rate of both minor and major complications following PD catheter embedding. Furthermore, they presented no difference between the two groups regarding catheter survival.[11] The latter study conducted by Soontrapornchai and Simapatanapong found a significant difference between the two surgical techniques regarding catheter displacement as those underwent open surgery presented 12% versus 0% of laparoscopic ones; these differences are while other complications, including obstruction, leak, bleeding, infection, and hernia, were not different.[8]

Oğünç *et al*. presented that considerable fewer rate of obstruction would occur following laparoscopic surgery. Moreover, this technique would provide an appropriate view for operating further incidental pathologies found during the surgical procedure. Therefore, they presented significant superiority of laparoscopic techniques to open surgery.[7] A study meta-analysis conducted by Xie *et al*. found that laparoscopic procedure posed longer duration of surgery; while minor and major complications and duration of hospitalization were not statistically different. Contrary to their presentations that showed the superiority of open surgery, they concluded that further studies for eventual unanimous technique acceptation for PD catheter embedding are required.[15]

Contrary to the mentioned study, Hagen *et al*. in their meta-analysis presented advantages of laparoscopic technique regarding two technique-associated complications that made open surgery inferior to laparoscopic one.[16] These presentations of Chen *et al*. were consistent with Chen *et al*. that showed significant less infection, displacement, and reoperation requirement among those who underwent the laparoscopic procedure.[17] Another study conducted by Qiao *et al*. presented the superiority of laparoscopic technique regarding less complication occurrence except for bleeding. They eventually claimed the laparoscopic procedure as their preference instead of traditional open surgery.[18]

CONCLUSION

We have to confess that laparoscopic procedure in comparison to open surgery was not accompanied with significant superiority considering complications. These findings were consistent with both catheters survived for less than or over 12 months. Comparison of catheter-associated complications regarding their survival duration was done for the first time in this presentation.

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Conflicts of interest

There are no conflicts of interest.

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