RESEARCH ARTICLE JSLS

Preperitoneal Local Anesthesia Technique in Laparoscopic Peritoneal Dialysis Catheter Placement

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ABSTRACT

Background and Objectives: Peritoneal dialysis is an excellent treatment for end-stage renal disease. Peritoneal dialysis is more advantageous if the catheter is positioned laparoscopically with omentopexy. General anesthesia is required for laparoscopic peritoneal dialysis catheter placement. General anesthesia is associated with increased postoperative morbidity and mortality in high-risk patients. In this retrospective study, the results of laparoscopic placement of peritoneal dialysis catheter under preperitoneal local anesthesia technique and sedation are presented for end-stage renal disease patients not fit for general anesthesia.

Methods: We recruited 13 patients for laparoscopic placement of peritoneal dialysis catheter out of 99 end-stage renal disease patients who presented at a local tertiary hospital. The selection criteria were based on the American Society of Anesthesiologists classification III or above and patients unfit for general anesthesia.

Results: Laparoscopic placement of peritoneal dialysis catheter was performed on 99 patients, and 13 patients were unfit for general anesthesia. Laparoscopic placement of peritoneal dialysis catheter and omentopexy were performed on these 13 patients together with capnoperitoneum, under preperitoneal local anesthesia technique and sedation. Three catheters were removed due to exit-site infection. One patient died after 2 years due to cardiac disease. The remaining patients continued with peritoneal dialysis. No omental entrapment, catheter migration, or other complications were encountered.

Conclusion: Laparoscopic placement of peritoneal dialysis catheter under preperitoneal local anesthesia technique and sedation was successful for high-risk patients unfit for general anesthesia. This technique can be expanded for healthy patients to avoid general anesthesia complications, reduce costs, and speed recovery.

Key Words: Peritoneal dialysis catheter, Preperitoneal local anesthesia.

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Acknowledgment: I would like to express my special thanks of gratitude to SaudiLS for the support from the beginning of the research. The assistance provided by CF Manalo, CJD Rallonza, and SAl Haizan. Thank you.

Disclosure: none.

Funding sources: none.

Conflict of interests: none.

Informed consent: Dr. Abdullah Aldohayan declares that written informed consent was obtained from the patient/s for publication of this study/report and any accompanying images.

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DOI: 10.4293/JSLS.2021.00093

INTRODUCTION

Peritoneal dialysis (PD) proves to be an acceptable procedure for renal replacement therapy.[1] PD has been successfully used for continuous renal replacement therapy.[1–2] The proper placement of the catheter is paramount for its extended use.[3–4] A laparoscopic catheter placement technique is used instead of an open laparotomy technique, as it has proved to be the ideal technique in the placement of PD catheters.[4–8] Laparoscopic placement of peritoneal dialysis catheter (LPPDC) requires general anesthesia (GA) administration. Patients with end-stage renal disease (ESRD) usually have associated severe comorbidities, which makes administration of GA challenging. There have been successful reports using nitrous oxide and helium during the placement of the PD catheter, eliminating the need for

anesthesia.[6,9] However, nitrous oxide and helium are not available in most healthcare facilities.

The value of preperitoneal local anesthesia technique (PLAT) has been proven in the management of intraoperative and postoperative pain.[10] The technique has been utilized in LPPDC under sedation in severely ill patients. Carbon dioxide is used for pneumoperitoneum and is widely available in operating rooms.[10] In a previous report, the PLAT technique was introduced[11–12] with sedation as a method for LPPDC with capnoperitoneum and was performed in ESRD patients who were at a high risk for GA.[11] In the present study, the results of LPPDC under PLAT and sedation are presented for ESRD patient not fit for GA.

METHODOLOGY

This retrospective study was conducted at a local tertiary hospital. Ninety-nine patients were admitted for LPPDC between October 5, 2016 and Oct 1, 2021. All patients who were unfit for LPPDC under GA were included; thus, the sedation method was used. Furthermore, the Institutional Review Board of the hospital approved the use of PLAT. All the patients and their families were educated and instructed on the procedure of PD catheter placement. Each patient was examined to choose the catheter exit-site and tested for patient usage and convenience. The preparation for surgery included obtaining patient informed consent for omentopexy, fasting for six hours, and bladder evacuation before surgery.

Surgical Technique

In the operating room, an intravenous prophylactic antibiotic was given to all patients. Bupivacaine (00.5%,), at a calculated dose of 20.5 mg/kg, was diluted in 300-mL normal saline.[10] The patient was placed in a supine position and an intravenous line was established, where all essential monitors, according to the Association of Anesthetists of Great Britain and Ireland, were placed. Sedation was achieved according to the Ramsay scale with intravenous 1% propofol at a dose of 50 – 100 μg/kg/minute and 5-mg remifentanil diluted in 50-mL normal saline (100 μg/mL) at a dose of 0.05–2 mic/kg/minute.[12]

The capnoperitoneum was established by a Veress needle through the palmer point. Fifty milliliters of diluted bupivacaine was injected peritoneally, maintaining 8 mm Hg of abdominal pressure. To allow the bupivacaine to distribute throughout the peritoneum, the patients' head was tilted downwards for 2 minutes and upwards for 2 minutes. A 5-mm trocar was introduced as described in **Figure 1** Following that, PLAT was done as described and reported.[10] The ABC sites (**Figure 1**) were injected from the skin into the peritoneum (**Figure 2**). Site D and the tunneling tract from D to C (**Figure 1**) were injected subcutaneously with diluted bupivacaine. Furthermore, sites 1 and 2 were injected with diluted bupivacaine in the preperitoneal space (**Figures 1 and 2**) under laparoscopic guidance with variable degrees of elevation of the peritoneum from the peritoneal fascia. The laparoscopic placement of the PD catheter was performed as sub-midline, a 1-cm subumbilical incision was made, a 5-mm trocar was passed through the linea alba, and the suture was passed through the edges of the defect using sutures and retrieved from another edge for proper closure of the inlet of the catheter (**Figure 3**). The distal end of the catheter was passed through and placed in the rectovesical pouch. The distal cough was placed in the tract of the linea alba and the proximal end was retrieved from different incisions 5 to 6 cm of the catheter entrance. The inflow and outflow were initiated, and the suture around the entrance of the catheter was tied, ensuring a smooth inflow and outflow of the dialysate.[13]

After positioning and securing the PDC catheter and inflow of 3 L of dialysate fluid, ensuring adequate inflow

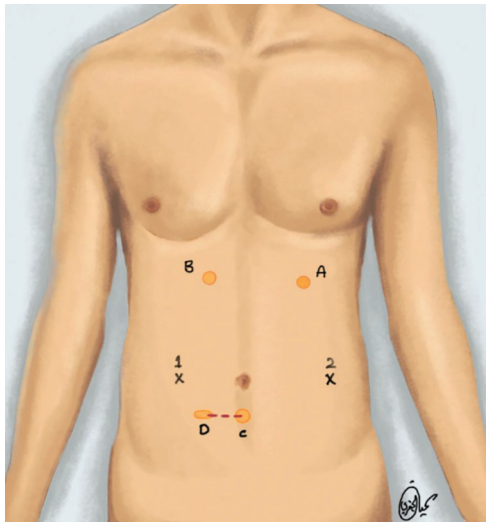

Figure 1. A) 5 Millimeter incision working port with preperitoneal local anesthesia technique; B) 5 Millimeter incision for camera port with preperitoneal local anesthesia technique; C) 1 Centimeter incision for the introduction of the catheter and closure of the linea alba around the cuff with preperitoneal local anesthesia technique; D) 5 Millimeter incision for catheter exit site with subcutaneous local anesthesia; C–D) Subcutaneous injection of marcaine; 1 – 2) Site of injection of preperitoneal local anesthesia technique.

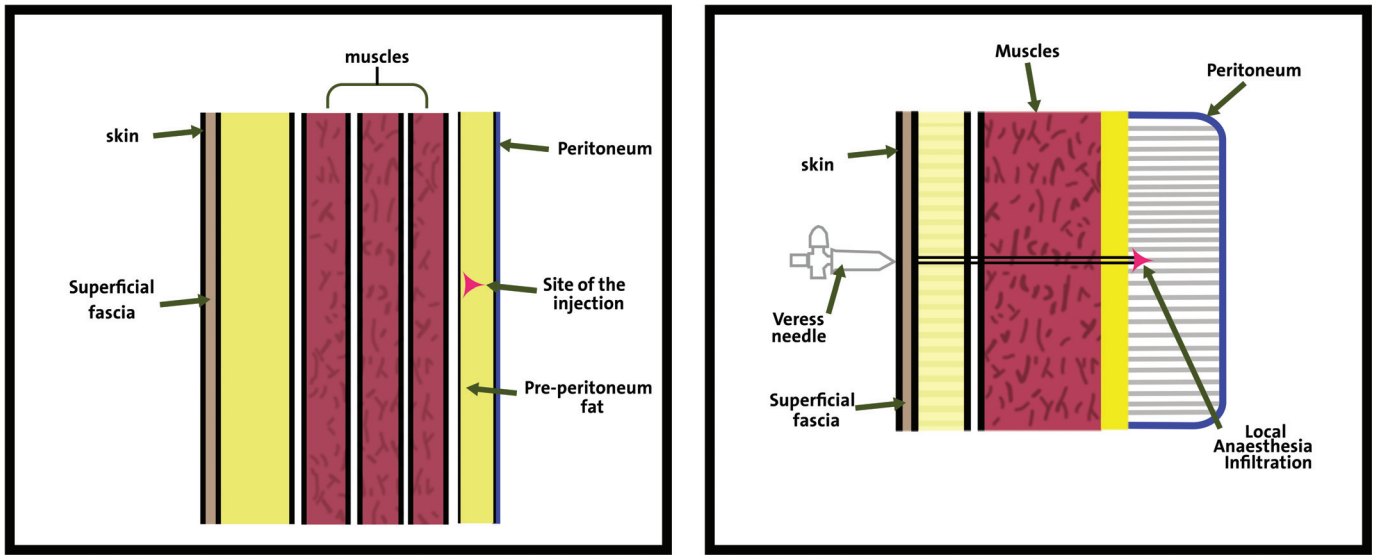

Figure 2. Injection site of peritoneal local anesthesia.

and outflow of the dialysate fluid, the greater omentum (GO) will float and, during the outflow, the omentum directed toward the pelvis and central part of the GO was grasped and sutured with nonabsorbable sutures to the falciform ligament percutaneously using a 2-mm stab incision fascia closure device mounted with nonabsorbable sutures though the falciform ligament and tip of GO and pulled back through the GO and falciform ligament and tied percutaneously. The CO_2 gas was evacuated, and the skin was covered with clips.[13] The cycle of inflow and outflow for 2 L of dialysis fluid was performed after wound closure, where the attending PD nurse ensured

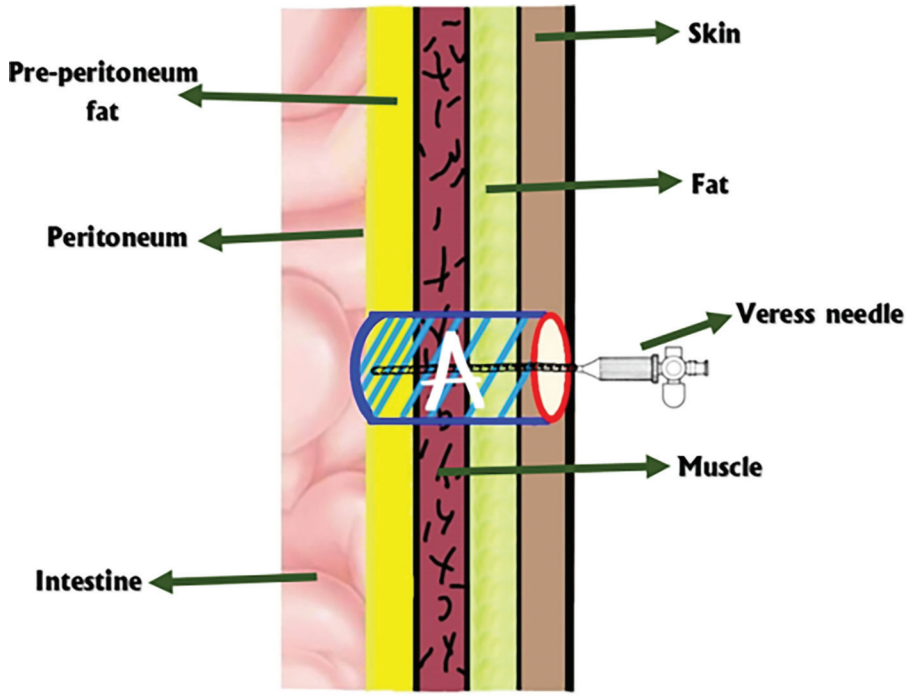

Figure 3. Local anesthesia is injected into the whole trocar pathway from the skin to the peritoneum.

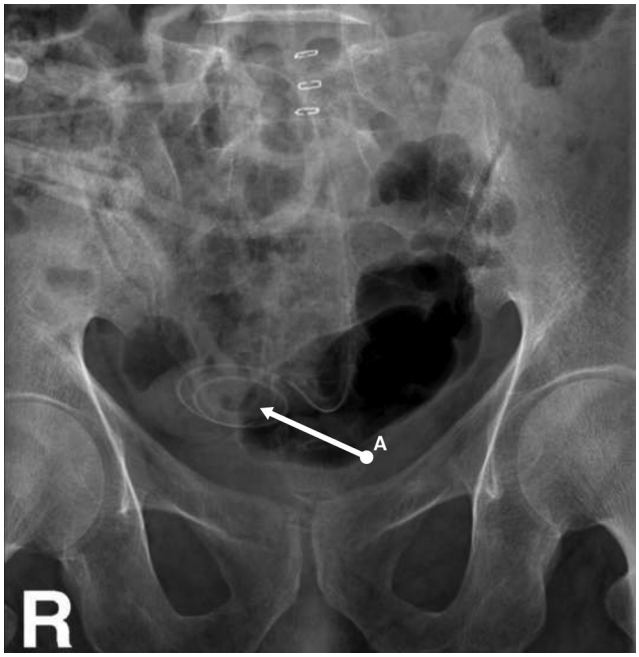

Figure 4. The frontal pelvic radiograph showing that the tip of peritoneal dialysis catheter is within the lower pelvic cavity. Few surgical clips are seen projecting over the lower abdomen.

that the inflow and outflow were satisfactory and that there were no leaks. Furthermore, the catheter position was confirmed radiologically; however, in case of constipation and bowel gas distension, it may lead to catheter coiling (**Figure 4**).

RESULTS

Thirteen of these patients were unfit for LPPDC under GA. The demographic data and outcomes are shown in **Table 1**. Five male and eight female patients underwent successful LPPDC under PLAT and sedation. The mean age was 69 years (range: 38 – 86 years). Three catheters were removed due to exit-site infection. The catheter was functional for the rest of the patients without complications at an average follow-up of 22.3 months. One patient died from cardiac disease after 2 years. Moreover, no side effects or complications secondary to bupivacaine usage were observed.

Table 1.
Patient Demographics and Outcomes

	Number = 13 (*Mean)	Percentage (%)
Gender		
Male	5	38.46
Female	8	61.54
Age*	(69)	-
BMI*	(28.55)	-
ASA score		
3	8	61.54
4	5	38.46
Primary Cause of End Stage Renal Disease		
Hypertension	3	23.08
Diabetes mellitus	7	53.85
Polycystic kidney disease	1	7.7
FSGS	1	7.7
Lupus nephritis	1	7.7
Medical Comorbidities		
Hypertension	11	84.62
Diabetes mellitus	7	53.85
Atrial fibrillation	2	15.38
Myocardial infarction	4	30.77
Stroke	2	15.38
COPD	1	7.7
Pulmonary hypertension	2	15.38
Sever aortic valve stenosis	1	7.7
Bronchial asthma	1	7.7
SLE	1	7.7
Hypothyroidism	3	23.08
Outcomes		
PDC exit site infection	3	23.08
PDC removal	3	23.08
Mortality	1	7.7
Follow up* in months	(22.3)	-

* Mean was used instead of the number patient.
BMI, Body Mass Index; ASA, American Society of Anesthesiology; FSGS, Focal segmental glomerulosclerosis; COPD, Chronic obstructive pulmonary disease; SLE, Systemic Lupus Erythematosus; PDC, Peritoneal Dialysis Catheter.

DISCUSSION

Laparoscopy is an ideal minimally invasive surgery.[1] However, this technique cannot be used in severely ill patients who are at a high risk for GA.[6] ESRD is usually associated with other severe medical illnesses. PLAT and sedation can be used for high-risk patients requiring laparoscopic PD catheter placement.[9] In this report, we

observed a good outcome of LPPDC under PLAT and sedation. LPPDC under local anesthesia using nitric oxide and helium has been previously reported.[6–9] However, nitrous oxide and helium are not commonly available in most healthcare facilities. In contrast, CO_2 is available in most healthcare facilities. The only disadvantage of CO_2 is that it causes peritoneal irritation, which can be minimized by PLAT blocking using bupivacaine, which was well-tolerated by the patients in this study.

The association between ESRD and cardiopulmonary disease is an obstacle to consider with LPPDC performed under GA. Urgent hemodialysis in such high-risk patients is a common risk factor; thus, PD is a safe alternative that can be immediately administered. Another advantage of the LPPDC technique is its utilization as day-case surgery. In this study, the techniques were successfully coupled with sedation and low CO_2 administration. The sedation technique involved a local anesthetic injection in the whole tract of the trocar and catheter passage into the bilateral preperitoneal space, along with administration of 8 mm Hg of CO_2 pressure. The two incisions were subcostal and 5 mm in size, which could heal quickly. The laparoscopic technique eliminates fluid leakage and allows the surgeon to place the catheter in the pelvis. The PLAT of the whole trocar pathway is important for the comfort of the patients. Moreover, the patient will not feel the movement of the trocars during the procedure. The tip of the floating omentum over the dialysis fluid was grasped and fixed to the falciform ligament.

The procedure was done without complications, such as catheter tip migration, omental entrapment, intestinal entrapment, catheter leak, and superficial cuff extrusion. The incidence rate of these complications varies.[1–3,7,8,14] Position C, the linea alba catheter exit (**Figure 1**), was closed by suture to ensure a continuous flow of the dialysis fluid; no gas or pericatheter leaks were reported. The novel technique of simultaneous exit wound closure around the proximal coup with continuous inflow and outflow of the dialysate in the presence of capnoperitoneum ensures a free flow of the dialysate with no leaking. Although the leak rate for PD is approximately 7.4%,[1–3] no pericatheter leaks were encountered in this study. Omental entrapment occurs between 3% and 10%;[7–8] however, no omental entrapment was encountered when using the described technique.

The omentopexy procedure eliminates omental entrapment and has been previously reported.[4,9] The alternative procedure involving tack fixation has many disadvantages: the procedure is more costly as additional machinery is required, the length of the 7-mm tack is not sufficient for proper fixation, the weight of the GO exceeds the capacity of the tacks used, and there is a high-risk of adhesion and bowel herniation. Selective omentopexy is therefore recommended.[15–16]

The average rate of peritonitis is 14%.[16,17] However, the infection rate, which required catheter removal, is 25%. Indeed, old age, multiple comorbidities, and presence of diabetes were the main contributing factors for catheter infection, which resulted in catheter removal. Moreover, the death rate of this study is less than that of a previous study.[19] In addition, the patients in this study were older than those described in the literature.[17–18] The type of anesthesia is not the main factor for occurrence of catheter infection. Hence, old age and multiple comorbidities were the main contributing factors of catheter infection.

There were limitations to this work. This retrospective study involved a small sample size, and it did not compare different insufflation gases and other anesthetic techniques.

CONCLUSION

This study demonstrated LPPDC as a safe technique. Using PLAT in combination with sedation proved to be a good alternative for high-risk patients unfit for GA. The technique used CO_2, a gas that is more readily available in operating rooms compared to other gases. This technique can be performed more regularly and can be applied to all patients undergoing laparoscopic surgery.

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