Original Article

Peritoneal Dialysis Catheter Insertion by Nephrologist Using Minilaparotomy: Do Survival and Complications Vary in Obese?

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Abstract

Introduction: Peritoneal dialysis catheter (PDC) placement for chronic kidney disease (CKD) amongst overweight and obese patients is difficult owing to deeper operating field. Literature being discordant on survival and complications in this patient subset, we attempted to analyse this research question in Indian population. **Materials and Methods:** We retrospectively analysed PDC inserted by nephrologist using surgical minilaparotomy for survivals and complications amongst 'overweight and obese' cohort ('O') at two tertiary care government hospitals in India, and compared results with normo-weight cohort ('N'), with 12−36 months follow-up. **Results:** 245 PDCs were inserted by surgical minilaparotomy and 'N' to 'O' ratio was 169:76. 'O' group were more rural residing (P = 0.003) and post-abdominal surgery (P = 0.008) patients. The 1, 2, and 3-year death censored catheter survival rate was 98.6%, 95.8%, and 88.2% respectively in 'O' group, and 97.6%, 94.5% and 91.8% in 'N' group respectively (P = 0.52). Patient survival (P = 0.63), mechanical complications (P = 0.09) and infective complications (P = 0.93) were comparable despite technically challenging surgery in 'O' group. Refractory peritonitis related PDC removal was comparable (P = 0.54). Prior haemodialysis or catheter related blood stream infections or diabetes were non-contributory to results. **Conclusions:** Catheter survival and patient survival amongst obese and overweight CAPD patients was non-inferior to normal weight patients. Mechanical, and infective complications were comparable despite technically challenging abdominal terrain in 'O' group. The overall CAPD performance was good amongst obese and overweight.

Keywords: *Catheter survival, minilaparotomy, obesity, patient survival, PD catheter, peritonitis rates*

Introduction

Clinicians face special challenges while managing overweight and obese chronic kidney disease (CKD) patients. The choice of modality of dialysis is entirely driven by the patients' will and the clinical parameters including the availability of superficial veins in upper limbs for autogenous arteriovenous fistula (AVF) creation and abdominal fat thickness during consideration of peritoneal dialysis. Continuous ambulatory peritoneal dialysis (CAPD) is fast getting popularity amongst overweight patients due to the ease of getting on daily living and freedom from dialysis units. Percutaneous insertion of peritoneal dialysis catheters (PDC) is popular amongst nephrologists owing to ease of procedure,[1,2] but overweight and obese patients pose special challenge in view of fatty anterior abdominal wall and increased preperitoneal fat. Laparoscopy and surgical minilaparotomy offered better view to the anatomy and fat layers, thus the success.

Outcomes in obese CKD patients on CAPD has been varied, with authors publishing poor[3,4] as well as good results,[5-10] though studies have been scanty in India.[11] To answer the research question of whether outcomes vary in higher weight group, we carried out a retrospective analysis comparing technical survival and complications of PDC insertion by nephrologist using surgical minilaparotomy amongst 'obese & overweight' cohort versus 'normal weight' adult dialysis requiring CKD patients in India.

Materials and Methods

We retrospectively analysed outcomes of CKD patients who underwent PDC insertion by surgical minilaparotomy between January 2014 and June 2018, at

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two tertiary-care government hospitals. The minimum and maximum follow-up period taken for this study was 12 months and 36 months, respectively. Standard ethical practices and standards of 1964 Helsinki declaration and later amendments were strictly followed. Institutional ethics committee approval was taken in both centres. Consent of patients was obtained before the procedure, including permission to publish data without divulging with their personal information.

Inclusion and exclusion criteria

All PDC insertions done by interventional nephrologists using surgical minilaparotomy in dialysis requiring CKD patients aged >18 years and BMI ≥19 kg/m^2 were included. Patients with history of abdominal surgery were also included. Exclusion subset was percutaneous and laparoscopic PDC insertions, BMI <19 kg/m^2, critically ill, and simultaneous abdominal herniorrhaphy patients. The data were maintained as electronic records and dialysis files in the department. It included the personal details of the patients, surgical details, mechanical complications, peritonitis episodes, patient status, catheter status and other records. Crosschecking of data with PD nurses log and patient dialysis log was done.

Patients were divided according to body mass index (BMI) and waist-hip ratio (WHR) into two major groups. [Table 1] The normal weight group ('N') cohort consisted of BMI 19.0−24.9 kg/m^2 and WHR <0.85 (female) or <0.9 (male). The 'O' cohort consisted of overweight, obese weighted and central obesity patients. Obese and overweight was defined as per the standard WHO criteria. We utilized WHR as an additional anthropometric marker to classify patients with central or abdominal obesity into the obese group. Finally, we classified obese as O-1, O-2, and O-3 as per BMI and WHR. Operating time was classified into 'brackets of time' ranging 20−30 min, 30−40 min, 40−50 min, 50−60 min and >60 min. Skin incision was classified into 'brackets of length' ranging 4−5 cm, 5−6 cm, 6−7 cm and >7 cm.

The survival outcomes were analysed by death censored catheter survival and patient survival. The complications analysis was divided into two subsets (a) Mechanical complications including procedure and catheter related, (b) Infective complications including peritonitis rates, exit site infection, tunnel infection and refractory peritonitis. Primary peritonitis was defined in our study as peritonitis within one month of PDC insertion whereas secondary peritonitis was taken as that beyond one month.

Catheter survival was assessed at regular designated intervals and at the end. It was estimated as, 'catheter survival, censored for patient death with a functioning catheter,' which estimated catheter loss only, and dwelt on actual catheter survival. If death occurred with a functioning catheter, the date of death was taken as last follow-up and this fatal event was taken as a case 'lost to follow-up' and not as catheter loss. Attribution of prior diabetes, catheter related blood stream infection (CRBSI) and prior haemodialysis (>1 month) on catheter survival was also assessed. Subgroup analysis between obese and overweight subgroups was also done.

Statistical analysis

The statistical technique applied was Chi square test with Yates correction or Fischer Exact test, for comparing two qualitative or categorical variables and Student's 't' test or Mann Whitney test wherever applicable for continuous data. Catheter and patient survival curves plotting used Kaplan Meier curves and compared using the Log rank test. The calculation of catheter survival was done from the day of insertion to the last day of follow-up or catheter removal or death. Peritonitis rates were calculated by dividing total catheter duration in months with number of peritonitis episodes and expressed as 'episodes per catheter months.' 'Episodes per catheter year' was calculated by dividing the number of episodes with catheter years' experience. Rates were compared using two tailed z tests with the assumption that there will be a probability of a given number of events occurring in a fixed time interval. Relative risk (RR) and odds ratio (OR) were used to decipher any relation between the adverse event and the exposed group. Statistical software used in our analysis was 'R' Development Core Team Software (R.3.3.0., Vienna, Austria). $P < 0.05$ was considered significant.

Results

During the study period, 245 PDCs inserted by surgical minilaparotomy qualified for analysis. Based on BMI and WHR, patients were divided into 'O' (n = 76) and 'N' (n = 169) groups [Table 1]. All PDC insertions were done by interventional nephrologists in minor operating room equipped with cardiovascular monitor, electrocautery, and emergency resuscitation equipment. During the said period, 129 percutaneous insertions, 20 laparoscopic insertions and 7 PDC insertions with simultaneous abdominal herniorrhaphy were excluded. There was no selection bias as both the groups included

Table 1: Weight groups classification as per weight and central obesity

Group	Classification	BMI (kg/m^2)	WHR (waist to hip ratio)	Male (*n*)	Female (*n*)
'N'	'N' (Normal weight)	19.0-24.9	<0.85 (F)/<0.9 (M)	113	56
'O'	'O-1' (Over weight)	25.0-29.9	<0.85 (F)/<0.9 (M)	23	8
	'O-2' (Obese)	≥25.0-29.9	>0.85 (F)/>0.9 (M)	12	16
	'O-3' (Obese)	≥ 30.0	Not required	8	9

patients with previous abdominal surgery, i.e., lower segment Caesarean Section (n = 2 in each group), renal transplant surgery with failed graft (3 in 'N' and 1 in 'O'), laparoscopic cholecystectomy (1 in 'N' and 5 in, 'O'), appendicectomy (1 in each group), and both cholecystectomy and appendicectomy (1 in, 'N' and 2 in 'O'). The major operative differences were requirement of two operating room assistants, longer duration bracket (40–50 min), longer skin incision (6–7 cm), use of abdominal compressive bandage and bed rest for 24–48 h among 'O' group, due to deeper operating field and more labour-intensive minilaparotomy. The decision of break-in was based on the patients' pain tolerability at suture line and tolerance of peritoneal fluid instillation during the planned PDC flushing. Mean break-in period was significantly shorter in 'N' group (8.26 ± 1.94 days vs. 10.12 ± 2.15 days in 'O', $P < 0.001$).

Baseline characteristics

Baseline characteristics were comparable between the two groups except for higher rural cohort ($P = 0.003$) and those with previous abdominal surgery ($P = 0.008$) in 'O' group. [Table 2] The PDCs inserted were 2-cuffed and were either 43-cm swan neck or 57-cm 'curl' (coiled) PDC. The proportion of 43 cm length PDC between 'N' and 'O' groups was 8:1 as compared to 1.54:1 for 57 cm length coiled PDC. The type of PDC inserted was entirely dependent on its availability in hospitals' medical stores department on day of surgery. Assessment of peritoneal membrane transport status (Peritoneal equilibration test) and dialysis adequacy (weekly peritoneal dialysate clearance) was done at 4-6 weeks after initiation of CAPD.

Survival functions

The mean catheter duration was comparable (27.9 ± 7.9 months, 'N' and 26.5 ± 9.1 months, 'O', $P = 0.22$). There was no primary catheter non-function in either group. The death censored catheter survival [Figure 1] and patient survival [Figure 2] were comparable. Among all 245 patients, there was no cumulative attributive relation seen between poor catheter survival and prior haemodialysis (OR = 0.88, 95% CI 0.43–1.46, $P = 0.47$) or CRBSI (OR = 1.7, 95% CI 0.90-3.37, $P = 0.09$) or diabetes (RR = 0.84, 95% CI 0.45–1.57, $P = 0.6$). Subgroup analysis in 'O' group did not reveal any attribution of poor catheter survival to prior haemodialysis (OR = 0.37, 95% CI 0.10–1.31, $P = 0.12$) or CRBSI (OR = 1.50, 95% CI 0.39–5.64, $P = 0.54$) or diabetes (RR = 1.16, 95% CI 0.33–4.04, $P = 0.81$). However, the odds of poor catheter survival were high in the obese cohort than in overweight cohort (OR = 0.17, 95% CI 0.03–0.76, $P = 0.02$). Similarly, subgroup analysis in 'N' group did not reveal any attribution of poor catheter survival to prior haemodialysis (OR = 1.08, 95% CI 0.54–2.18, $P = 0.82$) or CRBSI (OR = 1.92, 95% CI 0.88–4.16, $P = 0.09$) or diabetes (RR = 0.79, 95% CI 0.38–1.67, $P = 0.5$). There was no attributive relation of patient deaths in 'O' group to prior haemodialysis (RR = 0.80, 95% CI 0.48–1.32, $P = 0.39$) or prior CRBSI (RR = 0.67, 95% CI 0.36–1.23, $P = 0.19$) or diabetes (RR = 0.78, 95% CI 0.44–1.38, $P = 0.39$).

Mechanical and infective complications

Mechanical complications were comparable between both groups [Table 3]. 'O' group had numerically more yet statistically insignificant peri-catheter leaks which responded to peritoneal rest, all cases being with BMI >30 kg/m^2. Catheter migrations were comparable between groups, and all migrated PDCs were salvaged with laparoscopic repositioning. We detected four rectus hematomas, due to our protocol of doing anterior abdominal wall ultrasound scan on Day-2. All these were managed conservatively with compression bandage and did not require re-exploration or blood transfusion. Peritonitis rates were also comparable between both groups ($P = 0.93$). The cumulative period until first episode of peritonitis was longer in 'N' group ($P < 0.0001$). Primary peritonitis incidence was nil in either group. Ten patients suffered more than one episode of peritonitis (3.5%, group 'N' vs. 5.2%, group 'O'). PDC removal due to refractory peritonitis was also comparable ($P = 0.54$).

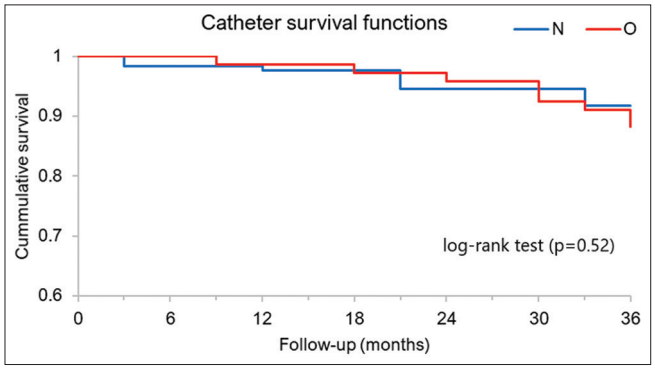

Figure 1: Kaplan Meier plot of catheter survival censored to patient death and log-rank test for significance

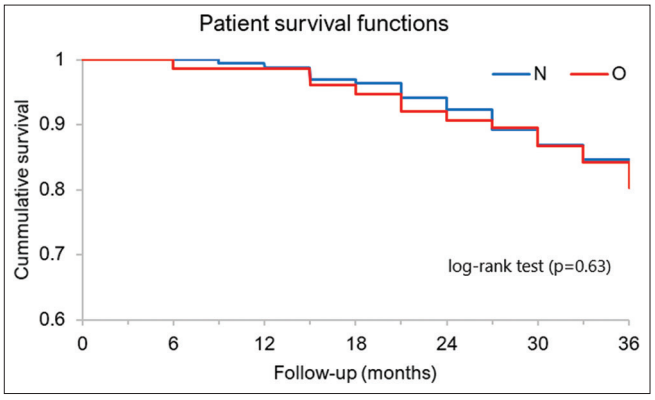

Figure 2: Kaplan Meier plot of patient survival and log-rank test for significance

Table 2: Baseline characteristics of patients

Variable	Group 'N' (*n*=169)	Group 'O' (*n*=76)	*P*
Age in years (Mean±SD)	51.04±9.2	52.31±10.1	0.33
Females, (%)	33.1	43.4	0.12
Rural population, (%)	70.4	88.1	0.003
Abdominal surgery, (%)	4.7	14.5	0.008
BMI in kg/m^2 (Mean±SD)	22.1±1.81	28.3±2.57	<0.0001
Diabetes, (%)	34.9	44.7	0.14
Prior hemodialysis, (%)	50.9	56.6	0.41
CRBSI, (%)	22.5	25	0.67
57 cm coiled catheters, (%)	62.1	89.5	<0.0001
Swan neck catheters (%)	37.9	10.5	<0.0001
D/P Creatinine	0.70±0.12	0.72±0.09	0.22
High Transporter	11.3	8.3	0.47
High average transporter	45.2	48.6	0.62
Low Average Transporter	37.9	40.2	0.73
Low transporter	5.6	2.8	0.34
Peritoneal dialysate clearance (weekly Kt/V urea)	1.89±0.45	1.94±0.33	0.41

CRBSI: catheter related blood stream infection; D/P Creatinine: Dialysate/Plasma Creatinine

Table 3: Mechanical and infectious complications

Variable	'N' group (*n*=169)	'O' group (*n*=76)	*P*
1. Mechanical complications (Total) (%)	6.5	13.1	0.09
Rectus muscle hematoma (%)	1.18	2.63	
Haemorrhagic outflow (%)	1.18	2.63	
Vascular injury (%)	0	1.31	
Bowel injury (%)	0	0	
Peri-catheter leak (%)	0.59	3.94	
Incision hernia (%)	0	0	
Scrotal swelling (%)	0.59	0	
Catheter migration (%)	2.95	2.63	
2. Infectious complications			
Peritonitis episodes (*n*)	37	17	0.93
Exit site infection (*n*)	5	2	0.89
Peritonitis rate (episode/catheter months)	1/127.6	1/118.1	
Peritonitis rate (Episodes/catheter year)	0.09	0.1	0.98
3. Catheter removal (mechanical/infective causes)			
Refractory peritonitis (%)	11.8	9.2	0.54
Ultrafiltration failure (%)	0.59	1.31	0.56

Discussion

Gone are the days when obesity was considered a poor outcome marker for CAPD.[5] Many a success stories have been written in this subset.[6-10] Surgical minilaparotomy for PDC insertion was usually done by surgeons/urologists and very rarely by nephrologists. The data addressing the use of surgical minilaparotomy by interventional nephrologists for PDC insertion is scarce[12-15] and is further lacking for obese and overweight subset. Though percutaneous technique has been used for obese patients, elaborate studies are absent.[16] Our PDC insertion practice conformed to those formulated under the best practices for PDC insertion, getting updated over time.[2,17,18]

The largest data of surgically inserted PDCs by nephrologists has been published by Chow *et al*.[13] including 8.8% of patients with BMI >30 kg/m^2. They reported an overall primary PDC failure rate of 2.8%, intra-operative bowel injury as 0.8%, omental wrap as 1.6%, and catheter occlusion with intraluminal clots as 0.4%. As compared, our study cohort consisted of 6.5% patients with BMI >30 kg/m^2, and 24.4% with BMI 25−29.9 kg/m^2 and central obesity. We had primary PDC failure as 0%, intra-operative bowel injury as 0%, omental wrap as 0%, and catheter occlusion with intraluminal clots as 0%. The 1-year and 2-year catheter survival rates censored to death in our 'N' cohort was 97.6% and 94.5% respectively and 'O' cohort as 98.6% and 95.8% as compared to 92.7% and 87.2% by Chow *et al.*

PDC survival in overweight and obese patients on CAPD was always a cause of concern. In a large data published from ANZDATA registry on renal replacement therapy initiation, obesity was associated with increased risk of death, had worse technique survival and had more clearance problems as the cause of CAPD discontinuation, than normal weight patients,[3] whereas another study showed a comparable mortality risk to normal weight ESRD patients on CAPD over 3 years period[5] Overall, the technique survival and patient survival in obese PD patients was comparable to non-obese.[7-9,19,20] Our results showed comparable catheter survival and patient survival functions in 'O' subset and 'N' subset.

In a retrospective study of 178 PDC insertions by Xie *et al.*, subgroup analyses of BMI >28 kg/m^2 showed a superior one-year infection-free catheter survival of percutaneous technique compared to surgical minilaparotomy[16] though the overall catheter survival was comparable across BMI groups. Our study too demonstrated that PDC survival and infection rates were comparable across BMI groups.

Prasad et al. from northern India analyzed 328 PD patients for effects of different BMI groups on PD outcomes, with 33.6% being overweight and obese[11] and demonstrated a 1, 2 and 3 year death censored catheter survival among obese subset as 97%, 91% and 84.5% respectively. Compared to this, our study had 31% patients in 'O' cohort, with 1-, 2- and 3-year death-censored catheter survival as 98.6%, 95.8% and 88.2%, respectively. Similarly, the 1-, 2- and 3-year patient survival by Prasad *et al.* was 94.1%, 74.5% and 69% respectively, compared to 98.6%, 90.7% and 80.3% respectively in our 'O' cohort. The better catheter and patient survival in our study was due to intensive PD technique counselling and repeated counselling about the infective complications, given that our cohort was predominantly rural as well as those living in mountainous terrain, with distant immediate emergent medical facilities (Himachal Pradesh and Jammu & Kashmir). Another study from India analysed catheter and patient survival over 9 years follow up amongst 60 CAPD patients in hilly region; patient and technique survival at 1-, 2-, and 3-years was 77%, 53% and 25%, respectively, though there was no comparison across different weight groups.[21]

Mechanical complications were comparable, with both groups having their share of rectus muscle hematoma and haemorrhagic outflow. Our study cohort had low mechanical complication rate as compared to the varied rates reported during PDC insertion by surgical minilaparotomy in past,[22-26] though nil surgical complications have been published too.[27-29] There was no bowel injury despite inclusion of post-abdominal surgery cases, as has been reported in surgical minilaparotomy in past.[13] Though 'O' group had a comparatively difficult abdominal terrain, meticulous operative steps and avoidance of hurrying the procedure was the key behind minimal complications experienced in our study. We followed best practices for PDC insertion, [18,19] though certain specific procedural manoeuvres were used by us to ensure lesser catheter migration and peri-catheter leak. These were (a) small peritoneal entry and placement of purse-string suture, (b) use of straightening style to guide PDCs in true pelvis, and (c) sub-rectus aponeurotic tunnel to make PDC exit through the anterior rectus sheath approximately 25 mm craniolaterally (angled at 30-45 degrees from vertical axis of peritoneal entry).[12,15]

The limitation of this study was that it was a retrospective study. The strengths of our study were (a) high number of central obesity, overweight and obese patients, (b) robust patient follow-up and (c) obviating selection bias by inclusion of post-abdominal surgery patients in both groups. To date, we are the first team of interventional nephrologists in India to analyse technical survival, and complications analysis of PDC insertions with surgical minilaparotomy technique in overweight and obese cohort ('O').

Conclusion

The catheter and patient survivals of central obesity, overweight and obese population on CAPD was non-inferior to normo-weight counterparts. Additionally, the mechanical and infective complications in this subset were comparable despite technically challenging abdominal terrain. CAPD performance was incredibly good amongst dialysis requiring obese and overweight patients.

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Conflicts of interest

There are no conflicts of interest.

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