Original Research Paper

Volume - 14 | Issue - 07 | July - 2024 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Nephrology

COMPLICATIONS OF CAPD AND ITS IMPACT ON CATHETER SURVIVAL : A SINGLE-CENTRE STUDY

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ABSTRACT **Background :** CAPD is a common treatment modality of end stage renal disease and has gained popularity worldwide. **Aims and objectives:** 1. To evaluate the various complications associated with CAPD in our centre. 2. To study its impact on catheter and patient survival. 3. To identify any preventable measure for improving catheter outcome and long term results. **Methods :** This is a Retrospective study conducted in the Department of Nephrology, GMCH, Assam , from O1-10-2021 to 30-09- 2023. **Results:** A total of 55 patients who opted for CAPD as a RRT modality were included in the study.Mean age of the patients were 58.12± 16.34 years. 38 patients were male and 17 patients were female. Diabetic Nephropathy was the leading cause of ESRD seen in 40% of our study population followed by Glomerulonephritis (25.45%), Hypertensive Nephropathy (18.18%), CIN (10.91%) and Obstructive Uropathy (5.45 %). At the end of 1 month of CAPD insertion, there were 7 episodes (12.73%) of catheter migration followed by 5 episodes (9.09%) of poor outflow. At the end of 24 months, there were 11 episodes (20%) of peritonitis, 9 episodes (16.36%) of catheter malposition, 4 episodes (7.27%) of poor outflow, 2 episodes (3.6%) of exit site infection, 1 episode (1.82%) each of pericatheter leakage and hydrothorax. Rate of peritonitis in our study was 0.1 episode per patient year. Overall, CAPD catheter survival was found to be 92.73% and patient survival was 96.36% at the end of 24 months. **Conclusion :** CAPD is a safe and convenient modality of RRT. The complications associated with CAPD in our set up are mostly infections and catheter malposition which can be prevented if proper care and approach is undertaken.

KEYWORDS : CAPD, complication, catheter

INTRODUCTION

CAPD is a form of Renal Replacement therapy which entails manual exchanges during the day with a long dwell occurring overnight to provide continuous solute removal.

In 1959, Richard Ruben was the pioneer to use peritoneal dialysis (PD) successfully in a patient with end-stage renal disease (ESRD) for 6 months. Three years later, Fred Boen from the Netherlands described the first automatic cycling PD machine [1]. In 1968, Henry Tenckhoff was the first to develop the indwelling peritoneal catheter, which was inserted following an open surgical technique. [2]

In 1978, Popovich et al. described a novel sustainable PD technique, which became known as "continuous ambulatory peritoneal dialysis" (CAPD). [3]

The introduction of the percutaneous [4] and later the laparoscopic technique[5] was a major milestone towards the implantation of PD catheters.

Worldwide, Peritoneal dialysis accounts for 9% of all Renal Replacement therapy and 11% of all dialysis.[6,7,8] According to the 2018 International Society of Nephrology Global Kidney Health Atlas (ISN-GKHA) , the median global prevalence of PD was 38.1 per million population.[7]

Even after so many years, it still remains unclear whether peritoneal dialysis (PD) or hemodialysis (HD) is a better RRT modality.[9,10] HD has been preferred for its efficacy of rapid correction of metabolic and uremic abnormalities, whereas CAPD has gained popularity due to its better hemodynamic stability, greater lifestyle flexibility and independence, absence of need for vascular access,lack of need for anticoagulation. , its low cost, and the facility with which it could be performed by the patient at the comfort of his/her home.CAPD is preferred where vascular access is challenging or in patients with cardiovascular disease as it induces less cardiovascular stress .[11]

Catheter-related complications are the major causes of PD technique failure and account for approximately 20% of change to hemodialysis (HD).[12]

PD. related infections, including peritonitis, exit.site infections (ESI), and tunnel infections, are important complications, resulting in significant morbidity and a 3.5–10.0% risk of death.[13]

The introduction of CAPD Y system, 'flush before fill' technique however, have decreased the rate of peritonitis hence making CAPD a feasible alternative to hemodialysis.[14,15]

Aims and objectives of our study

1. To evaluate the various complications associated with CAPD in our centre.
2. To study its impact on catheter and patient survival.
3. To identify any preventable measure for improving catheter outcome and long term results.

Inclusion criteria

1. All patients of end stage renal disease undergoing CAPD were included.
2. Patients of either gender and varied age groups.

Exclusion criteria

1. Patients of ESRD on hemodialysis.
2. Patients who were lost to follow up.

METHODS AND MATERIALS

It is a single- centre retrospective study conducted in the Department of Nephrology, Gauhati Medical College and Hospital, Assam, from 1-10-2021 to 30-09- 2023. Double-cuffed swan neck catheter was inserted in all patients using the surgical technique by the Urology Department. Flushing was done on Day 5 and Day 10, and CAPD was started on the 15 th day of catheter insertion. Detailed history, clinical examination and relevant laboratory investigations of all patients were taken into account. Both infectious and non-infectious complications occurring during the study period and its outcome in terms of technique survival was noted. The study was approved by the Ethical Committee. Informed Consent was waived off because the study is of a retrospective design.

Statistical analysis

All statistical calculations were performed with the SPSS 22 software.

The level of statistical significance was set at p value of ≤ 0.05. The data were expressed as mean ± SD or percentages. Peritonitis rate was calculated in terms of episode per patient-year.

RESULTS

Table 1: Baseline characteristics of the study population

Characteristics	Values
Total number of CAPD Patients (n)	55
Age [mean SD]	58.01± 16.34 years
Males(n/%)	38 (69%)
Females (n/%)	17 (31%)
S. Creatinine [mean± SD]	14±4 mg/dl
S. Albumin [mean± SD]	3.12 ± 0.42 g/dl
Random blood sugar [mean± SD]	146 ±37.12 mg/dl
Haemoglobin [mean± SD]	8.46 ±2.17 g/dl
S. Calcium [mean± SD]	7.82 ±1.08 mg/dl
S. Phosphorus [mean± SD]	6.51 ± 2.26 mg/dl
Uric acid [mean ± SD]	7.63 ±2.52 mg/dl
Alkaline phosphatase [mean ± SD]	126 ± 32.12 U/L
Sodium [mean ± SD]	141.8 ± 5.43 mmol/L
Potassium [mean ± SD]	4.27±0.59 mmol/L
iPTH [mean ± SD]	187 ± 64 pg/dl
Total cholesterol[mean ± SD]	165.1 ±33 mg/dl
Triglycerides [mean ± SD]	171.4±27.8 mg/dl
LDL cholesterol [mean ± SD]	148.7± 23.7 mg/dl
HDL cholesterol [mean ± SD]	48.7 ± 14.3 mg/dl

Table 2: Etiology of ESRD in the study population

Etiology	Number of patients	Percentage (%)
Diabetic Nephropathy	22	40
Chronic Glomerulonephritis	14	25.4
Hypertensive Nephropathy	10	18.2
Chronic Interstitial Nephritis	6	10.9
Obstructive Uropathy	3	5.45

Table 3: Duration of CAPD in our study population

Duration of CAPD (months)	Total number of patients
5-10	8
11-15	30
16-20	13
21-24	4
Total follow up	553 patient-months

Table 4: Complications at the end of 1 month

Complications	Number of episodes	Percentage(%)
Catheter migration	7	12.73
Poor outflow	5	9.09
Pericatheter leak	2	3.64
Exit site infection	1	1.82

Table 5: Complications at the end of 24 months

Complications	Number of episodes	Percentage(%)	Episode per patient-year
Peritonitis	11	20	0.1
Catheter migration/malposition	9	16.36	
Poor outflow	4	7.27	
Exit site infections	2	3.6	
Peri-catheter leak	1	1.82	
Hydrothorax	1	1.82	

Table 6: Organism responsible for peritonitis in our study

Pathogen	Number of episodes	% of total episodes
Coagulase Neg Staph Aureus	5	45.45
Staphylococcus Aureus	3	27.27
Culture negative	1	9.09
Pseudomonas	1	9.09
Fungal	1	9.09

Table 7: Metabolic complications of the study population

Complications	At 6 months (n/%)	At 24 months (n/%)
Hyperuricemia	8 (14.54%)	21 (38.18%)
Hyperglycemia	5 (9.09%)	12 (21.81%)
Hypertriglyceridemia	1 (1.81%)	3 (5.45%)
Hypercholesterolemia	1 (1.81%)	2 (3.63%)

Table 8: Removal of CAPD Catheter

Cause of removal	Number of patients	Time of removal (months)
Recurrent peritonitis	2	8 and 15
Fungal peritonitis	1	5
Hydrothorax	1	7

Table 9: Outcome of CAPD in our study

Outcome	Number of patients	Percentage (%)
Catheter removal	4	7.27
Shift to hemodialysis	4	7.27
Deaths	2	3.64

Table 10: Common predisposing factors for CAPD complications in our study

Complication	Predisposing factors	Treatment
Peritonitis/Exit site infection	Poor aseptic measures	Antibiotics
Catheter migration	Constipation	Laxatives
Poor outflow	Fibrin deposition	Intra-peritoneal heparin
Pericatheter leak	Wound infection	Antibiotics PD rest for 2 weeks
Hydrothorax	?Pleuro peritoneal fistula	Catheter removal Shift to HD

RESULTS

A total of 55 patients who opted for CAPD as a RRT modality were included in the study. Mean age of the patients were 58.12± 16.34 years. 38 patients (69%) were male and 17 patients (31%) were female. Mean serum creatinine of the patients were 14± 4 mg/dl. The total follow up was 553 patient- months.

Diabetic Nephropathy was the leading cause of ESRD seen in 40% of our study population followed by Glomerulonephritis (25.4%), Hypertensive Nephropathy (18.2%), CIN (10.9%) and Obstructive Uropathy (5.45 %).

Early complications of CAPD at the completion of 1 month were noted. There were 7 episodes (12.73%) of catheter malposition, 5 episodes (9.09%) of poor outflow, 2 episodes (3.64%) of pericatheter leak and one episode (1.82%) of exit site infections.

At the end of 24 months, there were 11 episodes (20%) of peritonitis, 9 episodes (16.36%) of catheter malposition, 4 episodes (7.27%) of poor outflow, 2 episodes (3.6%) of exit site infection, 1 episode (1.82%) each of pericatheter leakage and hydrothorax. Rate of peritonitis was 0.1 episode per patient year.

In our study, peritonitis was caused by Coagulase negative Staphylococcus aureus in 5 (45.45%) episodes, staphylococcus aureus in 3 (27.27%) episodes, Culture negative in 1 (9.09%) episodes, Pseudomonas spp in 1 (9.09%) episode and fungal growth in 1 (9.09%) episode .

Metabolic complications of the study population was assessed at the end of 6 and 24 months. At 24 months , it was seen that hyperuricemia was present in 21 (38.18%) patients, hyperglycemia in 12 (21.81%), hypertriglyceridemia in 3(5.45%) and hypercholesterolemia in 2 (3.63%) patients.

CAPD catheter was removed in 4 patients in our study and they were shifted to hemodialysis . The reason for catheter removal was recurrent peritonitis in 2 patients (at 8 months and 15 months post catheter insertion), fungal peritonitis in 1 patient (at 5 months post catheter insertion) and hydrothorax in 1 patient (at 7 months post catheter insertion). Deaths occurred in 2 of the patients during the study period.

DISCUSSION

The baseline characteristics of our study population was comparable to other studies. Diabetic nephropathy was the leading cause of ESRD in our study (40%) which was similar to the study conducted by Raina et al. (2017)[17] where the most common cause of ESRD was also Diabetic Nephropathy (38.8%).

In our study, catheter malposition was the most common early complication (12.73%) at the end of one month followed by poor catheter outflow (9.09%). This was similar to a study conducted by

Kim K et al.(2018) [18], where the most common early complication was catheter malposition. In another study by Abdulla et al. (2014) [19], exit site leak (19%) was the most common early complication.

Peritonitis was the most common complication in our study at the end of 24 months (20%) and the most common organism responsible was coagulase negative Staphylococcus Aureus (36.36%). The number of culture negative organism responsible for peritonitis was 9.09% . The rate of peritonitis in our study was 0.1 episode per patient year which is also fulfilling the ISPD recommendation. Our findings were similar to the study conducted by Abhisekh et al.(2016)[16] and Raina AF et al. (2017) [17] where the most common complication of CAPD was peritonitis. However, in the study by Abhisekh et al., Staphylococcus Aureus (22%) was the most common organism causing peritonitis and in the study by Raina et al.(2017) , Staphyloccocus Epidermidis was the most common organism.

Bacterial infections causing peritonitis are the commonest occurring complication, with a reported frequency of one episode every 20–30 months per patient [20] and are the commonest cause of catheter replacement.[21]

The likeliest route of infection is via the dialysis catheter but can occur secondary to other intra-abdominal infective or inflammatory pathologies.[22]

It was seen that the commonest predisposing factor for peritonitis in our study population was poor aseptic measures and contamination during PD exchange. Patients and the caregivers were counselled regarding proper hygiene during the procedure and were treated with IP and systemic antibiotics. 2 patients did not respond adequately to antibiotics and subsequently catheter had to be removed due to recurrent peritonitis. One patient had fungal peritonitis and was treated with prompt removal of CAPD catheter and antifungals.

Mechanical complication like pericatheter leak was seen in 3 patients in our study .They were managed conservatively with PD rest for 2 weeks and antibiotics . The incidence of dialysate leak is 5-20% in CAPD patients.[23-27] An association has been found between early leaks (≤30 days) and immediate CAPD initiation and midline catheter insertion.[23] Such leaks can lead to some infectious complications, either peritonitis or an exit site infection requiring antibiotic therapy.Rarely, the leak may require the removal of the catheter.[24-26] Late leaks may present more subtly with subcutaneous swelling and edema, weight gain, peripheral or genital swelling (24-56%).[25]

In our study, poor catheter outflow was mostly due to fibrin deposition and was treated with heparin flushes.Catheter malposition /migration was surgically repositioned in most of the cases in our study.

There was one case of hydrothorax in our study ,most likely due to pleuro-peritoneal fistula and the CAPD catheter was removed in the patient and was put on hemodialysis.

One study reported a 5% incidence of hydrothorax in the CAPD population.[28] Early-onset hydrothorax mostly occurs within 24h following the initiation of PD session and disappears rapidly on discontinuation of PD. Delayed-onset large hydrothorax is also reported. Hydrothorax most commonly affects older females, is rare in children and is predominantly right-sided. Dyspnea is the first clinical clue. Obese patients and those on steroids are more likely to have leaks. Diaphragmatic leaks present with pleural effusion, almost always right-sided in the first few weeks of PD and made worse by use of more hypertonic fluids.[29] Massive hydrothorax is an indication for temporary transfer to hemodialysis which may permit a spontaneous closure of a diaphragmatic defect. The correction of a pleuroperitoneal communication or diaphragmatic defect can also be achieved by pleurodesis.[28]

In our study , overall CAPD catheter survival was found to be 92.73% and patient survival was 96.36% at the end of 24 months. The limitations of our study are that its a single -centre study with a relatively small sample size conducted over a short duration of 2 years.

CONCLUSION

CAPD is a commonly and increasingly used method of renal replacement therapy in patients with end-stage renal disease. From the insertion of the peritoneal catheter through to the actual treatment, there are pitfalls and complications that may adversely affect the patient and compromise the success of the dialysis. Complications can be either immediate or delayed, and can also be categorised into infectious and non-infectious aetiologies.

Early recognition of complications is crucial in the management of CAPD in order to reduce treatment failure and limit patient morbidity and mortality. In our set up, the complications associated with CAPD are mostly infections and catheter malposition which can be preventable if proper care and approach is undertaken.

Conflict of Interest- None.
Funding -None
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