

Outcome of Immediate Use of the Permanent Peritoneal Dialysis Catheter in Children with Acute and Chronic Renal Failure

Ahmad-Ali Nikibakhsh, MD; Hashem Mahmoodzadeh, MD; Mohamad Vali, MD; Ali Enashaei, MD;
Abdolreza Asem, MD; Zahra Yekta, MD

Nephrology-Urology and Transplantation Research Center, Urmia University of Medical Sciences, Iran

Received: Sep 16, 2012; Accepted: Nov 17, 2012; Online Available: Dec 29, 2012

Abstract

Objective: Peritoneal dialysis remains the only available option for patients which need immediate dialysis and it could be a bridge between end-stage renal failure (ESRD) and transplantation. There is a paucity of published experience of children with immediate use of permanent Tenckhoff Catheter for peritoneal dialysis from developing countries. In this study we report our experience on immediate use of permanent peritoneal access and continued peritoneal dialysis for a prolonged time.

Methods: Fifty six patients were studied including 30 males and 26 females within the age range of 1 month to 14 years with mean age of 6.5 years in Urmia, Northwest Iran.

Findings: No operative morbidity was seen. During a total of 499.5 continuous ambulatory peritoneal dialysis months, 16 patients had 28 episodes of peritonitis, which means a overall result of one episode per 17.8 months. There were 3 patients (5.35%) with catheter site leakage, 12 (21.4%) catheter obstructions (which led to omentectomy), 4 (7.2%) exit site infections (2 patients in the early postoperative period and 2 patients in during follow up). Death due to catheter related complications occurred in 1 per 56 patients and due to non-catheter related causes in 10 per 56 patients.

Conclusion: Present results indicate that catheter-related complications were not higher than those previously reported and peritoneal dialysis could be initiated immediately after catheter implantation and could be a safe bridge between end-stage renal failure (ESRD) and transplantation.

Iranian Journal of Pediatrics, Volume 23 (Number 2), April 2013, Pages: 171-176

Key Words: Peritoneal Dialysis; End-Stage Renal Failure; Complications; Peritonitis

Introduction

The choice of modality of renal replacement treatment in children with renal failure is a challenge. Although extracorporeal techniques such as continuous venovenous hemofiltration (CVVH) or continuous venovenous hemodiafiltration (CVVHDF) are used quite frequently in adult intensive care units (ICUs), but it is not a common modality of renal replacement treatment in many pediatric ICUs. Such techniques are very dependent on technology and are more costly than

acute peritoneal dialysis (PD)^[1]. However, in developing countries, acute PD remains a viable option for the treatment of children with renal failure, particularly in patients with hemodynamical compromise, severe coagulation abnormalities and difficulty in obtaining vascular access^[1,2-4].

Because of vascular access problem in children with acute renal failure (ARF) and those with ARF superimposed on chronic condition, especially when there is need for urgent dialysis which may last for more than a few days, it is important to

* Corresponding Author;

Address: Nephrology-Urology and Transplantation Reserch Center, Urmia University School of Medicine Iran

E-mail: anikibakhsh@yahoo.com

© 2013 by Pediatrics Center of Excellence, Children's Medical Center, Tehran University of Medical Sciences, All rights reserved.

www.SID.ir

start immediately and continue PD with a permanent peritoneal access. In most pediatric and adult PD centers because of catheter-related PD complications, dialysis begins after catheter has been implanted and sufficient time for healing has been allowed^[5-7]. However, catheter-related PD complications such as peritonitis, exit-site infection (ESI), tunnel infection, pericatheter leakage, and mechanical dysfunction are still major concerns^[6,8]. There is a paucity of published experience on children with immediate use of permanent Tenckhoff Catheter for PD from developing countries. In this article we report our experience on immediate use of permanent peritoneal access and continued PD for a prolonged time.

Subjects and Methods

Data collection: Fifty six children with end stage renal failure and acute renal failure from 2005 to 2011 which needed PD, immediately after catheter insertion was included. Patients were included if there was a need for emergency dialysis (which was expected that it lasts for days and weeks) because of acute renal failure or acute condition on chronic renal failure. Exclusion criteria were children less than 1 month and more than 14 years old, patients who did not have an emergent dialysis, patients who were under PD less than 3 weeks. The information on patients was obtained from the files of the hospital's pediatrics ward – if they were hospitalized or in records available from follow up visits.

Catheter insertion method: Swan neck coil 2 cuff pediatric catheter was selected. After induction of general anesthesia and gastric decompression, the patient was placed in a supine position. A 10 mm incision was made left side 2 cm inferior to umbilicus, loop of the catheter was placed in the pelvic and after closing peritoneum and fascia a 10 cm subcutaneous tunnel was formed. The peritoneal cavity was flushed with 10 ml/Kg of PD solution to check for gross bleeding or leakage. PD started immediately after finishing the operation. The patients were kept at bed rest for 72 hours.

Dialysis method: We used 10 cc/Kg dialysis fluid with dwell time of 15-30 min for 3 days; during

next days volume of the fluid gradually increased up to 40cc/kg. After two weeks, dialysis was performed with 40cc/kg with dwell time of about 3 hours, 5–6 times a day.

Antibiotics and medication: Antibiotics were applied for 72 hours after operation. The regular use of Mupirocin ointment at the exit site, intraperitoneal prophylactic antibiotics (cephalexin 125mg/l of dialysis fluid) and intraperitoneal heparin (500 IU/l of dialysis fluid) was practiced in all patients.

Follow up: Peritoneal fluid analyzes and microbial cultures were applied and patients were observed for complications during hospitalization. After discharge patients were visited every other week for 1 month and every month later on. All patients were operated by the same surgeon and the biochemical tests and analyses carried out in the same laboratory.

Data analysis: Outcomes were analyzed in terms of peritonitis, ESI, tunnel infection (TI), pericatheter leakage, mechanical dysfunction, renal transplantation and mortality and changing to hemodialysis. ESI, TI and peritonitis were defined according to the International Society for PD guidelines/recommendations^[9]. Peritonitis was defined as positive peritoneal fluid culture or if two of four of the following signs were present: abdominal pain, fever, cloudy peritoneal effluent, white blood cell count (at least 50% polymorphonuclear leukocytes) greater than 100/ml in dialysis fluid. ESI was diagnosed in the presence of purulent discharge from the sinus tract, or marked pericatheter swelling, redness, and/or tenderness with or without a pathogenic organism cultured from the exit site; TI was defined as presence of pain and signs of inflammation along the subcutaneous tunnel.

Findings

Fifty six patients were studied including 30 males (53.6%) and 26 females (46.4%) within the age range of 1 month to 14 years with mean age of 6.5 years. The body mass index (BMI) of patients were calculated with WHO BMI charts for pediatrics^[10]. BMI less than 3 percentile found in 30.2% patients, 53.2% had BMI between 3 and 9

Table 1: Incidence of early and late catheter related complications in patients on CAPD (n=56)

Complication	Early onset <1 month	Late onset >1 month	Overall
Obstruction	11 (19.6%)	1 (1.8%)	12 (21.4%)
Leak	2 (3.57%)	1 (1.78%)	3 (5.35%)
Exit site infection	2 (3.6%)	2 (3.6%)	4 (7.2%)
Tunnel infection	1 (1.8%)	0	1 (1.8%)
Peritonitis*	3 (5%)	13 (23%)	16 (28%)

* The incidence of peritonitis is one episodes/17.8 months. CAPD: continuous ambulatory peritoneal dialysis

percentile and 16.3% had BMI more than 97 percentile.

No operative morbidity was seen. During a total of 499.5 continuous ambulatory PD (CAPD) months, 16 patients had 28 episodes of peritonitis; which means one episode per 17.8 months. There were 3 (5.35%) cases of catheter site leakage, 12 (21.4%) catheter obstructions (which led to omentectomy), 4 (7.2%) ESI (2 in the early postoperative period and 2 during follow up (Table 1). The rate of ESI and pericatheter leakage was relatively low. Leakage stopped in all of patients with decreasing the number and volume of dialysis fluid. The rate of early onset obstruction in patients without omentectomy at the time of insertion of catheter was high. None of the patients with omentectomy had at the time of insertion of catheter obstruction.

The death due to catheter related complications were 1 per 56 patients and death due to non-catheter related causes was 10 per 56 patients (Table 2). Four deaths occurred among 21 children with acute renal failure and 7 among 35 children with chronic renal failure (Table 3, 4).

Table 2: Outcome of the immediate use of the permanent peritoneal dialysis catheter in children with end stage renal disease

Outcome	Frequency (%)
Expired	11 (19.6)
Transplanted	15 (26.8)
Cured	15 (26.8)
Under peritoneal dialysis	12 (21.4)
Transfer to hemodialysis	3 (5.4)
Total	56 (100)

Table 3: Dialysis duration (month) and causes of acute renal failure

Patients' ID	Age (year)	Condition	Sex	Dialysis duration (months)	Causes of acute renal failure (ARF)
1	8	cured	Male	1	Rhabdomyolysis
2	9	cured	Male	1	HUS
3	11	cured	Female	1	HUS
4	13	cured	Male	1	HUS
5	10	cured	Female	2.5	RPGN
6	8	cured	Female	2	HUS
7	1	cured	Female	1	HUS
8	<1	cured	Male	1	Renal Vein Thrombosis
9	6	cured	Female	1	HUS
10	<1	expire	Male	1	HUS
11	2	cured	Female	2	HUS
12	3	cured	Female	2	HUS
13	13	cured	Male	1.5	HUS
14	<1	cured	Male	2	HUS
15	<1	expire	Male	<1	sepsis
16	3	cured	Female	1	HUS
17	5	expire	Male	<1	HUS
18	4	cured	Male	1	HUS
19	8	cured	Female	2	HUS
20	14	cured	Male	1	Unknown
21	3	expire	Male	2	HUS

RPGN: Rapid progressive glomerulonephritis / HUS: Hemolytic uremic syndrome

Table 4: Dialysis duration (month) and causes of chronic renal failure

Patients' ID	Age (year)	Condition	Sex	Dialysis duration (months)	Causes of chronic renal failure (CRF)
1	7	Transplantation	Female	13	Neurologic bladder
2	11	Change to HD	Female	5	Reflux nephropathy
3	3	Under CAPD	Female	15	Neurologic bladder
4	1	expired	Male	<1	Posterior urethral valve
5	10	expired	Male	13	Cystinosis
6	4	Transplantation	Male	6	Unknown
7	<1	expired	Male	1	Nephrocalcinosis
8	14	Under CAPD	Male	48	Neurologic bladder
9	5	Transplantation	Female	14	Glomerulonephritis
10	11	expired	Female	24	Reflux nephropathy
11	7	Under CAPD	Male	27	Neurologic bladder
12	5	Under CAPD	Male	24	Glomerulonephritis
13	5	Transplantation	Male	5	Reflux nephropathy
14	11	Under CAPD	Female	20	Unknown
15	9	Transplantation	Male	12	Nephrocalcinosis
16	7	Transplantation	Male	12	Glomerulonephritis
17	1	expired	Female	10	Glomerulonephritis
18	9	Under CAPD	Male	10	Reflux nephropathy
19	8	Transplantation	Female	6	Reflux nephropathy
20	14	Under CAPD	Female	7	Glomerulonephritis
21	9	Transplantation	Male	6	Nephrolitiasis
22	10	Under CAPD	Male	6	Hemolytic Uremic Syndrome
23	14	Transplantation	Female	20	Glomerulonephritis
24	5	Under CAPD	Male	4	Cystinosis
25	8	Transplantation	Female	3	Urogenital anomaly
26	4	Change to HD	Female	1	Reflux nephropathy
27	7	Transplantation	Female	12	Hemolytic Uremic Syndrome
28	7	Transplantation	Female	38	Glomerulonephritis
29	4	expired	Male	15	Cystinosis
30	12	Transplantation	Female	24	Glomerulonephritis
31	8	Under CAPD	Female	24	Alport syndrome
32	8	expired	Male	24	Alport syndrome
33	7	Transplantation	Male	6	Reflux nephropathy
34	7	Transplantation	Male	11	Unknown
35	9	Change to HD	Female	5	Neurologic bladder

CAPD: continuous ambulatory peritoneal dialysis / HD: hemodialysis

Discussion

CAPD is a viable option for ESRD in children in developing countries and can be used as a bridge between ESRD and renal transplantation. It is particularly very useful where there are no pediatric hemodialysis facilities within easy reach^[4,11]. There are no pediatric data available on how to best initiate PD. Current recommendation in this regard is a waiting period of 14–21 days between catheter insertion and PD initiation^[12-14]. This period of delay in starting PD results in the need for bridging hemodialysis in patients who require immediate dialysis.

Bridging hemodialysis usually requires temporary hemodialysis catheters with vascular access problems and risk of hemodialysis catheter complications. It has been shown that hemodialysis catheters are associated with high rates of infection, thrombosis, central venous stenosis, inflammatory stress and lead to increased morbidity^[15,16].

In some developing countries, pediatric haemodialysis facilities are unavailable, and there is no maintenance hemodialysis program in most of the nephrology centers. Thus, PD remains the only available option for patients who need

immediate dialysis and it could be a bridge between end-stage renal failure and transplantation.

So in acute situations, when the need for dialysis lasts for more than a few days, and with acute on chronic condition in end-stage renal failure, it is important that a permanent peritoneal access is implanted and PD begins immediately. Concern for early use of catheters derives mainly from the perceived risk of both dialysate leaks and the subsequent risk of peritonitis and poor survival rate of peritoneal access. It has been reported that the risk of leakage is increased in patients with little or no break-in period^[17,18] and may increase the risk of other catheter-related complications like infection and catheter malfunction^[6].

However, there are only a few reports about risks and benefits of immediate use of PD for prolonged time and there is no clear consensus about the starting time of PD after catheter insertion. In a recent report by Ghaffari, 18 patients who presented urgently with chronic kidney disease stage 5 were offered PD as the initial and urgent modality of dialysis. Concurrently, 9 patients with delaying use of PD catheters were included as the comparative group. In this study peritonitis, ESI, catheter-related complications, and other complications were similar between the two groups, although the number of minor leaks was higher in the urgent-start group^[19]. In other study by Jo et al the rate of pericatheter leakage and other catheter-related complications were relatively low in CAPD patients with using urgently PD catheters^[20]. Pericatheter leakage, catheter tip migration, ESI, and peritonitis developed in only 1.9%, 1.9%, 3.9%, and 3.9% of patients, respectively.

Some reports indicate that the standard survival of patients on PD has been improved to 90% at first year in developed societies^[21-23]. Reviewing the reports of patients on CAPD from developing countries indicate that the mortality is still high and varying between 50% in Iran, 26.6% in India and 33% in Saudi Arabia^[11,24,25]. In our study the overall mortality rate was 19.6% and the most of them coexisted with multiorgan involvement (Table 3 and 4). In this study, total follow up duration was 499.5 months and 16 patients had 28 episodes of peritonitis (5% were early onset and 23% late onset), which is one

episode per 17.8 months. The reported peritonitis rate by other studies vary from one episode per 19.9 patient-months to one episode per 13.2 patient-months^[24,26-28]. Over the past several decades, there has been a steady decline in the rate of peritonitis in both children and adults that is largely due to improvements in connection technology and a decreased incidence of touch contamination.

Conclusion

Present study indicated that catheter-related complications were not higher than those previously reported using urgently PD catheters when PD could be initiated immediately after catheter implantation. In addition, it could be a safe bridge between end-stage renal failure and transplantation

Acknowledgment:

The authors would like to acknowledge support of this research by Nephrology-Urology and Transplantation Research Center, Urmia University of Medical Sciences-Iran.

Conflict of Interest: None

References

1. Basu RK, Wheeler DS, Goldstein S, et al. Acute renal replacement therapy in pediatrics. *Int J Nephrol* 2011;785392.
2. Subramanian S, Agarwal R, Deorari AK, et al. Acute renal failure in neonates. *Indian J Pediatr* 2008;75(4):385-91.
3. Chien JC, Hwang BT, Weng ZC, et al Peritoneal dialysis in infants and children after open heart surgery. *Pediatr Neonatol* 2009;50(6):275-9.
4. Cerd'a J, Bagga A, Kher V, et al. The contrasting characteristics of acute kidney injury in developed and developing countries. *Nat Clin Pract Nephrol* 2008;4(3):138-53.
5. Watson AR, Gartland C;European Paediatric Peritoneal Dialysis Working Group, "Guidelines by an Ad Hoc European Committee for Elective Chronic

- Peritoneal Dialysis in Pediatric Patients. *Perit Dial Int* 2001;21(3):240-44.
6. Leblanc M, Ouimet D, Pichette V. Dialysate leaks in peritoneal dialysis. *Semin Dial* 2001;14(1):50-4.
 7. Asif A. Peritoneal dialysis access-related procedures by nephrologists. *Semin Dial* 2004;17(5):398-406.
 8. Rahim KA, Seidel K, McDonald RA. Risk factors for catheter related complications in pediatric peritoneal dialysis. *Pediatr Nephrol* 2004;19(9):1021-8.
 9. Warady BA, Schaefer F, Holloway M, et al. Consensus guidelines for the treatment of peritonitis in pediatric patients receiving peritoneal dialysis. ISPD guidelines/recommendations. *Perit Dial Int* 2000;20(6):610-24.
 10. WHO BMI charts for pediatrics. Available at: http://www.cdc.gov/growthcharts/who_charts.htm Access date:
 11. Hooman N, Esfahani ST, Mohkam M, et al. The outcome of Iranian children on continuous ambulatory peritoneal dialysis: the first report of Iranian National Registry. *Arch Iran Med* 2009;12(1):24-8.
 12. Alexander SR, Salusky IB, Warady BA, et al. Peritoneal dialysis workshop: Pediatric Recommendations. *Perit Dial Int* 1997;17(Suppl 3):S25-7.
 13. Tzamaloukas AH, Gibel LJ, Eisenberg B, et al. Early and late peritoneal dialysate leaks in patients on CAPD. *Adv Perit Dial* 1990;6:64-71.
 14. Winchester JF, Kriger FL. Fluid leaks: prevention and treatment. *Perit Dial Int* 1994;14(Suppl 3):S43-8.
 15. Chan MR. Hemodialysis central venous catheter dysfunction. *Semin Dial* 2008;21(6):516-21.
 16. Goldstein SL, Ikizler TA, Zappitelli M, et al. Non-infected hemodialysis catheters are associated with increased inflammation compared to arteriovenous fistulas. *Kidney Int* 2009;76(10):1063-9.
 17. Sipahioglu MH, Aybal A, Unal A, et al. Patient and technique survival and factors affecting mortality on peritoneal dialysis in Turkey: 12 years' experience in a single center. *Perit Dial Int* 2008;28(3):238-45.
 18. Gokal R, Alexander S, Ash S, et al. Peritoneal catheters and exit-site practices toward optimum peritoneal access: 1998 update. Official report from the International Society for Peritoneal Dialysis. *Perit Dial Int* 1998;18(1):11-33.
 19. Ghaffari A. Urgent-start peritoneal dialysis: a quality improvement report. *Am J Kidney Dis* 2011;59(3):400-8.
 20. Jo YI, Shin SK, Lee JH, et al. Immediate initiation of CAPD following percutaneous catheter placement without break-in procedure. *Perit Dial Int* 2007;27(2):179-83.
 21. Leonard MB, Donaldson DA, Ho M, et al. A prospective cohort study of incident maintenance dialysis in children: an NAPRTC study. *Kidney Int* 2003;63(2):744-55.
 22. Honda M. The 1997 report of the Japanese National Registry data on pediatric dialysis patients. *Perit Dial Int* 1999;19(Suppl 2):S473-8.
 23. Bakkaloglu SA, Ekim M, Sever L, et al. Chronic peritoneal dialysis in Turkish children: a multicenter study. *Pediatr Nephrol* 2005;20(5):644-51.
 24. Prasad N, Gulati S, Gupta A, et al. Continuous peritoneal dialysis in children: a single-centre experience in a developing country. *Pediatr Nephrol* 2006;21(3):403-7.
 25. Kari JA. Peritoneal dialysis in children. *Saudi J Kidney Dis Transplant* 2005;16(3):348-53.
 26. Boehm M, Vecsei A, Aufricht C, et al. Risk factors for peritonitis in pediatric peritoneal dialysis: a single-center study. *Pediatr Nephrol* 2005;20(10):1478-83.
 27. Verrina E, Edofonti A, Gianoglio B, et al. A multicenter experience on patient and technique survival in children on chronic dialysis. *Pediatr Nephrol* 2004;19(1):82-90.
 28. Hoshii S, Wada N, Honda M. A survey of peritonitis and exit-site and/or tunnel infections in Japanese children on PD. *Pediatr Nephrol* 2006;21(6):828-34.