

Peritoneal Dialysis in Children with Acute Renal Failure in Ibn Al-Balady Hospital

Salim Ziyarah Abdullah

ABSTRACT:

BACKGROUND :

Acute renal failure (ARF) is most important condition in pediatric nephrology units with variable causes vary from place to place and peritoneal dialysis(PD) is the easy and feasible modality of treatment for acute renal failure in small and young children and hemodynamically unstable patients were other modalities not suitable for them.

OBJECTIVE:

To study the aetiology and prognosis of the patients with acute renal that required peritoneal dialysis in Ibn Al-Balady hospital.

METHODS:

A retrospective study involved 82 patients with acute renal failure admitted to dialysis in Ibn Al-Balady hospital for a period of 32 months from August 2011 to April 2014. Data were collected from patients records and involved clinical parameters of the patients, causes of ARF, indications of PD, complications of PD and the outcome of PD(deaths).

RESULTS :

The study involved 82 children of whom 47(57.3%) male, with a mean age of 13 +19.5 months. Azotemia was presented in all patients (100%) with oliguria in 60(73.2%) or anuria in 26 patients (31.7%), volume overload in 32(39%), encephalopathy in 28 patients (32.9%). Sepsis was the most common cause of ARF in 32 patients (39%) while gastroenteritis in 16 patients (19.5%), glomerulonephritis in 10 patients (12.2%) and hemolytic uremic syndrome (HUS) in 9 patients (11%). Peritonitis is the commonest complication of PD represents 33(40.2%) of patients. The overall mortality was 32.9% mostly related to septicemia (63%) and the presence of fluid overload, peritonitis, encephalopathy and anuria (66.7, 66.7, 63 and 59.3%) respectively.

CONCLUSION :

Peritoneal dialysis is the preferred modality of renal replacement therapy (RRT) for children with acute renal failure (ARF) because its simple and feasible especially neonates and young infants and hemodynamically unstable patients. Septicemia and severity of ARF are contributory factors to high mortality in pediatric ARF. Early detection and referral of patients at risk is of great value for reducing mortality.

KEYWORDS : children, peritoneal dialysis, acute renal failure.

INTRODUCTION:

Acute renal failure (ARF), also called acute kidney injury (AKI) is defined as the sudden loss of renal function that may result from inadequate renal perfusion

associated with a decrease in effective circulation, arterial or venous obstruction, renal cell injury or obstruction to urine flow as occurs in obstructive uropathy.⁽¹⁾

Acute renal failure is most important condition in pediatric nephrology units. The causes of ARF and its outcome vary from place to place and have changes with time. Dialysis therapy has changed the outlook for ARF⁽²⁾. In the recent

years, the use of continuous renal replacement therapy (CRRT) has been increasingly preferred over peritoneal dialysis (PD) for the pediatric population in most centers in the developed world^(3,4), however, in developing countries, PD remains a viable option for the treatment of children with acute renal failure, particularly in patients with hemodynamically compromise, severe coagulation abnormalities, difficult obtaining vascular access especially small children and in availability of blood lines compatible with neonates or young infants (2 - 8). In this study I wish to record the experience of PD for children admitted to dialysis unit in Ibn Al-Balady hospital for the period since opening of this unit in August 2011 until April 2014.

Department of Pediatrics, Dialysis unit, Ibn Al-Balady Hospital for pediatrics & gynecology, Baghdad.

PATIENTS AND METHODS:

This retrospective study of children with acute renal failure that required peritoneal dialysis (PD) who were admitted to dialysis unit in Ibn Al-Balady hospital for pediatrics and gynecology since the opening of this unit at August 2011 till April,2014(32 months) were 125 children admitted during this period , only 82 patients included in this study, excluded patients were 34 ,15 of them with chronic renal failure, the other have incomplete or absence of their records.

Data collected on baseline demographics, causes of ARF ,serum urea and creatinine at presentation and at the end of PD sessions , indications of PD , complications (peritonitis , pericatheter leakage, catheter obstruction) and outcome(death).The diagnosis of ARF was defined as rapidly progressing azotemia (elevation of blood urea nitrogen (BUN) and serum creatinine above the reference range (BUN is 8 to 20 mg/dL (2.5 to 7.1 mmol/L) , serum creatinine (table 1) , with or without oliguria (urine output < 0.5 ml/kg/hr).Peritonitis diagnosed as the presence of abdominal pain, diffuse tenderness or cloudiness of the drained peritoneal fluid with the increase of polymorphonuclear leukocyte count with or without culture positivity⁽²⁾ . Peritoneal dialysis was performed manually using disposable pediatric size semi rigid PD catheter with strict aseptic conditions. The catheter inserted percutaneously through a sub umbilical (about 2-3cm) midline incision with a trocar under local anesthesia and connected to the PD set with bags

containing PD fluid.The dialysis started with 10-20ml/kg dialysate increasing to 30 – 40ml/kg in hourly ragmen for 72 sessions.A PD data sheets used to record and monitor the following : time, volume of PD fluid delivered ,fluid drained and dwell time, heart rate blood pressure, urine output and biochemical parameters.After complete 72 sessions dialysis was electively discontinued and the patients were observed for further recovery of urine output even if biochemical levels were still elevated then PD catheter was removed, patients monitored in nephrology unit until normalization of biochemical parameters and then discharged.

STASTICAL ANALYSIS:

The data were analyzed by using Statistical Package for Social Science (SPSS) software for Windows version 20 to generate the general characteristics of the study, demographic and clinical parameters were analyzed by using means and standard deviations , the chi-square tests were used to analyze proportions , a p value of less than 0.05 was considered significant.

RESULTS:

The study included 82 children, of whom 47(57.3%) were male and 35(42.7%) females with M:F ratio of 1.3:1 and a mean age 13 + 19.5 months, 27 (32.9%) their age were ≤ 1 month, 35(42.7%) were above 1month to 12 months and 20(24.4%) of them were above 1 year to 6 years , the youngest age was 2 days and the oldest was 6 years. Other clinical and biochemical features listed at table 2.

Table 1 : Plasma creatinine in childhood(9).

Age(y)	Mmol/l	Mg/l
<2y	35-40	0.4-0.5
2-8y	40-60	0.5-0.7
9-18y	50-80	0.6-0.9

Table 2 : Clinical & biochemical features.

Variables	Mean	Overall n(%)
Age:		
≤ 1mo	13.7 ± 9.4	27 (32.9)
>1 –12 mo	6 ± 3.6	35 (42.7)
> 13-72 mo	42.5 ± 19.1	20 (24.4)
Sex : Male	-	47(57.3)
Female		35(42.7)
BUN(mmol/l)		
Predialysis	34.7 ± 10.5	-
Postdialysis	20 ± 9.2	-
S.cr(mg/dl)		-
Pre dialysis	3.7±2	-
Post dialysis	2.5 ± 1.4	-

Table 3 : Causes of ARF.

Causes	Overall N(%)
Septicemia	32(39.0)
Gastroenteritis	16(19.5)
GN	10(12.2)
HUS	9(11.0)
VUR	3(3.7)
PUV	4(4.9)
CKD	3(3.7)
Asphyxia	2(2.4)
RDS	1(1.2)
Burn	1(1.2)
Unkown	1(1.2)

Causes of acute renal failure:

Table 3 shows the causes of ARF in patients that required PD . Septicemia was the cause of ARF in 32 patients (39.0%) ,14 (43.8%) were females and 18 (56.2%) males,15 (46.9%) of them were ≤ 1month of age,17(53.1%) at age between 1 - 12 months. Gastroenteritis that cause dehydration and ARF forms 16 patients (19.5%), 4 (25.0%) were at age 1month,10(62.5%) at age between 1 and 12 months and 2(12.5%) above age of 1 year. Glomerulonephritis(GN) was responsible for ARF in 10 patients (12.2%) ,2 (20%) at age of 1yr and 8 (80%) at age above 1yr to 6 yr. Hemolytic Uremic Syndrome (HUS) was responsible for 9 patients (11.0%), 6 (66.7%) males and 3(33.3%) females with 2(22.2%) below 1yr and 7(77.8%) above 1yr.Post renal causes include reflux nephropathy and posterior urethral valve were forms : 3(3.6%) and 4(4.8%) respectively of patients. Other causes are listed in

the table 2.

GN: glomerulonephritis; HUS: hemolytic uremic syndrome; VUR: vesico-uretral reflux; PUV: posterior-urethral valve; CKD: cystic kidney disease ; RDS : respiratory distress syndrome.

Indications of PD:

Table 4 : Shows the main indication of peritoneal dialysis , azotemia was the main indication in all patients(100%) with oliguria in 60 patients (73.2%) or unuria in 30 patients(36.6%) , electrolyte disturbances especially hyperkalemia was the indication for PD in 50 patients(61%), fluid overload in 35 patients (42.7%) and neurologic abnormalities that indicate uremic encephalopathy in 28 patients (32.9%) in form of loss of conciseness in 12 patients and fit in 16 patients.

Table 4 : Indications of PD.

variable	Overall n(%)
Azotemia	82(100)
Oliguria	60(73.2)
Unuria	26(31.7)
Fluid overload	32(39.0)
Encephalopathy	28(32.9)

Complications of PD :

Table 5 shows the most complications that occurs to the patients undergo peritoneal dialysis in our unit , peritonitis was the major challenging one and carry a high risk of death it was presents in 30 patints (36.6%), other complications were easily to deal with and have no impact on patients

life which include catheter outflow obstruction in 17(20.7%) that required to change the catheter ,pericatheter leakage in 24 patients (29.3%) and bleeding from the site of catheter insertion in 10 patients(12%).

Table 5 : Complications of peritoneal Dialysis.

Variable	Overall n(%)
Peritonitis	33(40.2)
Outflow obstruction	17(20.7)
Pericatheter leakage	24(29.3)
Bleeding	10(12)

Outcome of PD :

Table 6 shows the outcome of the patients treated with PD that followed in nephrology unit until discharging them home when their clinical and biochemical conditions are improved .

As shown in table 5 patients with age below 1 year forming the largest number of deaths 23 from 27 patients died(85.2%), males 55.6 % and females forming 44.4% of deaths .

The severity of renal failure play significant role in the outcome of PD, patients with unuria that expired during or soon after PD were 20 forming

74.1% of deaths, also 20 of 35 patients presented with fluid overload were died forming 74.1% of death, while patients with encephalopathy that expired were 17 (63% of deaths). Septicemia and peritonitis (as complication of either septicemia or PD) were carrying a significant risk of death in patients treated with PD(p value < 0.05). Seventeen of 32 patients with septicemia 17 were died (63% of deaths) and 18 of those with peritonitis (66.7% of deaths) also die.

Table 6 : Outcome of patients treated with PD.

variable	category	Non survivors(n=27)
Age	<1y	23(85.2)
	>1y	4(14.8)
Sex	Male	15(55.6)
	Female	12(44.4)
Fluid overload*	Presence	18(66.7)
	Absence	9(33.3)
Unuria*	Presence	16(59.3)
	Absence	11(40.7)
Encephalopathy*	Presence	17(63.0)
	Absence	10(37.0)
Peritonitis*	Presence	18(66.7)
	Absence	9(33.3)
Causes	Septicemia*	17(63.0)
	HUS	5(18.5)
	Gastroenteritis	2(7.4)
	GN	1(3.7)
	Post renal	1(3.7)
	Others	1(3.7)

*p value < 0.05

DISCUSSION:

The management of ARF has been revolutionized in recent years by the development of new continuous dialysis modalities that have made it possible to provide CRRT to patients who are sicker and less stable than those treated by dialysis in the past. Improvement in equipments and technique have enabled pediatric nephrologists to utilize these modalities, particularly pump- assisted veno-venous hemofiltration and hemodiafiltration in wide spectrum of patients including newborn infants with acute renal failure of any cause. The drawbacks of these modalities are their technology dependent and increased financial cost.

Pediatric application of continuous therapies is more difficult than adults because of the need for specialized blood pumps, hemofilters, and blood lines of varying sizes in order to accommodate both large and small patients. In addition, specialized nursing personnel experienced in caring for such patients are mandatory in order to safely deliver this complex therapy⁽⁷⁾.

These considerations put such type of therapies out of reach for many centers dealing with pediatrics ARF, especially in developing countries including our unit.

Peritoneal dialysis, on the other hand, is relatively uncomplicated modality with long track record of successful application for the treatment of pediatrics ARF^(5,7,10), this also emphasized by Mohandas and Chellapandian who recommended that it should be instituted as early as possible, thus avoiding the delay caused by referring critically ill patients to nephrologist⁽¹¹⁾, such scenario occurred in our unit where patients referred to us quite late, often presenting at admission with oliguria or anuria and life threatening complications like septic shock and peritonitis.

In present study the male : female ratio is 1.3:1, which is similar to other studies^(2,6). Ademola et al found that 55.6% of their patients were females⁽⁵⁾, most of them were at age ≤ 12 months, forming 74.4% including 44.3% of them were at neonatal period (1 day -30 days), results disagree to that found by Mishra et al (2) and Ademola et al (5) where infants ≤ 12 months forming 24.6% and 26%, respectively.

The study shows that the patterns of causes of ARF are different from those observed in developed countries where ARF occurs mainly as a consequence of open heart surgery and in bone marrow and solid organ transplantations for the management of oncologic disorders^(2,5,12-18).

The predominant causes in patients were septicemia, gastroenteritis. Glomerulonephritis and HUS, these findings also emphasized by Mishra et al they found that HUS, septicemia and acute tubular necrosis (resulting from dehydration) were the most common causes of ARF⁽²⁾. Ademola et al also found that intravascular hemolysis and septicemia were the major causes of ARF⁽⁵⁾. Van Biljon⁽¹⁹⁾ and Vachvanichsanong et al⁽²⁰⁾ also emphasized these facts in their experience of pediatrics ARF in developing countries.

The complications of PD in our patients were catheter and infection related, these findings also emphasized by Flynn et al (7) and Ademola et al (5). Peritonitis most likely reflected the septic disease process rather than the complication of PD because of strict aseptic measures were taken during catheter insertion.

Regarding the efficacy of PD, as shown in table 1 the BUN and serum creatinine were reduced to a significant level, which means that PD were of significant value in improving children with ARF.

The mortality rate in children with AKI is highly variable and considered to depend on the nature of the underlying disease rather than on renal failure only^(19,21).

The overall mortality in our unit was 32.9% (67.1% survivors) which is less than that found in Mishra et al study where the overall mortality was 36.8%⁽²⁾. Ademola et al found that 70% of their patients were survived⁽⁵⁾. Kari⁽²²⁾ also found 33% mortality in his study in Saudi Arabia. These results indicate that mortality is still high in the developing countries as some reports indicate that the standard survival of patients on PD has been improved⁽⁶⁾.

The presence of anuria, fluid overload and peritonitis together with septicemia were associated with higher mortality, these findings also emphasized by Mishra et al (2) and Goldstein et al⁽²³⁾. Van Biljon⁽¹⁹⁾ also found a higher incidence and duration of anuria in non-survivors with ARF.

Peritonitis also significantly affects the outcome in our study as it caused 66.7% of deaths, Mishra et al also found that presence of peritonitis multiplies the risk of a fatal outcome⁽²⁾.

CONCLUSION:

The present study concludes that PD is an easy and feasible modality of ARF therapy with acceptable results. The complications and mortality may be improved by efficient primary health care, better identification and earlier

referral of children at high risk of ARF, to gather with implementation of CRRT like CAPD or APD for patients requiring mc`ysis duration and difficult to join or 5 not tolerate hemodialysis.

REFERENCES:

1. Siegel NJ, Van Way SK, Devarajan P. Acute renal failure, pathogenesis of acute renal failure .*Pediatr Nephrology* 5th ed 2004;10:1221- 32.
2. Mishra OP, Gupta AK, Pooniya V , Prasad R, Tiwary NK, Schaefer F. Peritoneal dialysis in children with acute kidney injury: A developing country experience.*Perit Dial Int* 2012;32:431-36.
3. KDIGO clinical guidline for acute kidney injury:modality of renal replacement therapy for patients with AKI.*Kidney Int Suppl* 2012;2:107-10.
4. Walters S, Porter C, Brophy PD. Dialysis and pediatric acute kidney injury: choice of renal support modality. *Pediatr Nephrol* 2009;24:37-48.
5. Ademola AD, Asinobi AO, Ogunkunle OO, Yusuf BN, Ojo OE.Peritoneal dialysis in childhood acute kidney injury: experience in Southwest Nigeria.*Perit Dial Int* 2012;32:267-72.
6. Nikibakhsh AA, Mahmoodzadeh H,Vali M, Enashaei A, Asem A, Yekta Z.Outcome of immediate use of the permanent peritoneal dialysis catheter in children with acute and chronic renal failure.*Iran J Pediatr* 2013;23:171-76.
7. Flynn JT, Kershaw DB, Smoyer WE, Brophy PD, McBryde KD, Bunchman TE. Peritoneal dialysis for management of pediatrics acute renal failure. *Perit Dial Int* 2001;21:390-94.
8. Passadakis PS, Oreopoulos DG. Peritoneal dialysis in patients with acute renal failure.*Adv Perit Dial* 2007;23:7-16.
9. Guignard J, Santos F.Clinical methods, Laboratory investigation. *Pediatric Nephrol.* 5th ed 2004; 4:399 - 424.
10. Anochie IC, Eke FU. Pediatric acute peritoneal dialysis in southern Nigeria.*Post Grad Med J* 2006;66:1541-48.
11. Mohandas N, Chellapandian D. Value of intermittent peritoneal dialysis in rural setup. *Indian J Perit Dial* 2004;6:19-20.
12. Santos CR, Branco PQ, Gaspar A, Bruges M, et al.Use of peritoneal dialysis after surgery for congenital heart disease in children.*Perit Dial Int* 2012;32:273-79.
13. Saddadi F, Najafi I, Hakemi MS, Falaknazi K, et al.Frequency, risk factors and outcome of acute injury following bone marrow transplantation at Dr Sharaiti Hospital in Tehran.*Iran J Kidney Dis* 2010;4:20-26.
14. Baily D, Phan V, Litalien C, Ducruet T, et al.Risk factors of acute renal failure in critically ill children:a prospective descriptive epidemiological study.*Pediatr Crit Care Med* 2007;8:29-35.
15. Goldstein SL. Overview of pediatric renal replacement therapy in acute renal failure.*Artif Organs* 2003;27:781-785.
16. Williams DM, Sreedhar SS, et al.Acute kidney failure : a pediatric experience over 20 years.*Arch Pediatr Adolesc Med* 2002;156:893-900
17. Hui-stickle S, Brewer ED, Golstein SL. Pediatric acute renal failure epidemiology at a tertiary care center from 1999 to 2001.*Am J Kidney Dis* 2005;45:96-101.
18. Bunchman TE, McBryde KD,Motter TE, Gardner JJ, et al. Pediatric acute renal failure:outcome by modality and disease.*Pediatr Nephrol* 2001;16:1067-71.
19. Van Biljon G. Causes , prognostic features and treatment results of acute renal failure in children treated in tertiary hospital in South Africa . *J Trop Pediatr* 2008;54:234-37.
20. Vachvanichsanong P, Dissaneewate P, Lim A, McNeil E. Childhood acute renal failure : 22-years experience in a university hospital in Southern Thailand. *Pediatrics* 2006;118:786-91.
21. Moghal NE, Brocklebank JT, Meadow SR. A review of acute renal failure in children:incidence,etiology and outcome.*Clin Nephrol* 1998;49:91-95.
22. Kari JA. Peritoneal dialysis in children.*Saudi J Kidney Dis Transplant* 2005;16:348-53.
23. Goldstein SL, Somers MJ, Baum MA, Symons JM, Brophy PD, Blowey D, et al. Pediatric patients with multi-organ dysfunction syndrome receiving continuous renal replacement therapy. *Kidney Int* 2005;67:653-58.

