ORIGINAL ARTICLE

Peritoneal Dialysis in Children with Acute Kidney Injury: Dhaka Shishu (Children) Hospital Experience.

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ABSTRACT

Background: The choices for renal replacement therapy (RRT) in children with acute kidney injury (AKI) are limited in developing countries. Peritoneal dialysis (PD) is the preferred and convenient treatment modality for acute kidney injury (AKI) in children and hemodynamically unstable patients.

Methods: This is a cross sectional descriptic type of observational study of children who underwent PD for AKI in 43 children (27 boys) in nephrology department of Dhaka Shishu (children) Hospital from January 2013 to December 2013.

Result: The study included 43 children (62.8 % male). Mean age was 2 ± 1.07 years, with the youngest being 2 months, and the oldest, 14 years. Most common causes was septicaemia (25.6%) and hypovolumia (25.6%) followed by unknown etiology (16.2%), glomerulonephritis (11.6%), wasp sting (9.3%) and hemolytic uremic syndrome (7%). Overall mortality was 32.5%, most common in unknown etiology and high in male but not statistically significant (p=0.42).

Conclusions: In the developing countries, PD can be successfully performed for the management of childhood AKI. Septicaemia and hypovolumia are the leading causes of AKI, however mortality higher in male and unknown etiology.

Key words: AKI, Peritoneal Dialysis, Septicaemia, Hypovolumia

Introduction

Acute kidney injury (AKI) is a common problem associated with increased mortality and health care costs. Renal replacement therapy (RRT) is the main option for management of AKI patients. Continuous RRT and intermittent hemodialysis (HD) are the modalities most commonly used in developed countries[1,2]. In the developing countries PD is frequently used because of its lower cost and minimal infrastructure requirements[3,4]. Recently, interest in using PD to manage patients with AKI has been increasing. It has been postulated that PD may be more physiologic and less inflammatory than HD in AKI because of the absence of contact between blood and synthetic membranes[5]. On the other hand, the technique for PD is relatively simple[6].

In the developing countries or resource-poor settings, continuous RRT is limited because of a lack of age-appropriate vascular catheters, pediatric blood lines, and dialyzers, combined with the cost of treatment, challenges in obtaining vascular access, and a need for specialized staff. Intermittent HD is also technology-dependent, and in our country, age- and size-appropriate blood lines, dialyzers, and catheters for infants and young children are also scarce. Furthermore, young children may not tolerate the volume shifts that occur during HD[7]. The most readily available modality of RRT for young children with AKI in resource-limited countries is PD[8,9].

The mortality rate in children with AKI is highly variable and considered to depend largely on the nature of the underlying disease process and early initiation of PD rather than on renal failure itself. Children with AKI caused by a renal-limited condition such as post-infectious glomerulonephritis reportedly have a very low mortality rate (<1%),

while mortality is usually very high (up to 90%) in patients with AKI related to multiorgan failure 10.

Knowledge of the outcomes of PD and the associated challenges in resource-limited settings are crucial in identifying modifiable risk factors for adverse outcomes and in developing strategies to improve the care of children with AKI in Bangladesh. Our objective was therefore to evaluate outcomes of all pediatric patients who underwent PD for AKI in a single tertiary-care center in Dhaka Shishu (Children) Hospital.

Methods

This cross sectional descriptic type of observational analysis includes 43 children with AKI requiring acute PD those were admitted in nephrology department of Dhaka Shishu Hospital between January 2013 and December 2013.

Acute kidney injury was defined according to the modified pediatric RIFLE (risk, injury, failure, loss, end-stage renal disease) criteria[11]. Patients was selected as per the RIFLE criteria, all the patients were at the Failure stage at the time of the decision to start PD. A detailed history was recorded, and a clinical examination was performed for every patient. A complete hemogram, peripheral blood smear, blood urea, serum creatinine, electrolytes, calcium, phosphate, arterial blood gases, electrocardiogram, and chest radiograph were obtained for every patient. Blood urea and serum creatinine measurements were repeated after following day of dialysis. Urinalysis and cultures were performed in the patients who passed urine. Antistreptolysin O titer, prothrombin time, activated partial thromboplastin time, blood culture, and renal ultrasonography were performed as clinically indicated.

Peritoneal dialysis was performed in the dialysis ward by placing a commercially available disposable pediatric-size semi-rigid PD catheter. Maintaining strict aseptic conditions, the catheter was placed percutaneously with the help of a trocar under local anesthesia and connected to the PD set with bags containing PD fluid. We used 10 mL/kg of PD fluid for the initial 1 - 2 cycles to check for smooth filling and drainage of fluid without leakage. Thereafter, the fill volume was increased to 20 - 30 mL/kg. Total duration of each cycle was about 45 - 60 minutes (24 cycles daily) performed for 72 hours. We added heparin 500 IU/L to prevent blood clot that may block PD effluent and appropriate antibiotics in PD fluid where indicated. Potassium (4 mmol/L) was added to the PD fluid if serum potassium was < 4 mEq/L. During PD, Clinical monitoring, urine output and biochemical parameters (blood urea, serum creatinine, electrolytes, and arterial blood gases, among others) were monitored. Obstructed catheter exchange immediately. We observed renal function daily for recovery of patients. The commercial PD solution used contained dextrose 1.5%, Na+ 130 mmol/L, Ca++ 3 mmol/L, Mg++ 1.5 mmol/L, Cl- 100 mmol/L, and HCO3- 35 mmol/L

Statistical analysis

The chi-square tests were used for analysis of proportions. A p value of less than 0.05 was considered significant. The data were analyzed using the SPSS (Statistical Package for the Social Sciences) software application (version 16.0).

Results

The study included 43 children, of whom 27 (62.8%) were male. The ages of the children ranged from 2 months to 14 years [mean: 2 ± 1.07 years. Most of the patients were < 1 year (39.5%) of age (Table-1).

Table1: Age distribution of patients

Age	*No*	*%*
< 1year	17	39.5
1-5 years	16	37.2
5-10 years	3	7.0
10 -14 years	7	16.3
Total	43	100.0

Table 2: Causes of Acute Kidney Injury (AKI)

Causes of AKI	*No*	*%*
Septicaemia	11	25.6
Hypovolumia	11	25.6
GN	5	11.6
Wasp sting	4	9.3
HUS	3	7.0
PUV	2	4.7
Unknown	7	16.3
Total	43	100.0

Table 2 shows the causes of AKI in the study patients. Septicaemia (25.6%) and hypovolumia due to gastroenteritis (25.6%) were the most common cause of AKI in this study. Glomerulonephritis (GN) was the cause of AKI in 5 patients (11.6%) Others causes of AKI was wasp sting 4 (9.3%), Hemolytic Uremic Sundrome (HUS) 3 (7%) and posterior urethral valve (PUV) 2 (4.7%). However 7 (16.3%) patients of AKI causes were unknown.

Table 3: Outcome of patients according to causes

Causes of AKI	Outcome of patient		Total	p
	Improve	Death		
Septicaemia	7 (63.6%)	4 (36.4 %)	11	
Hypovolumia	10 (90.9%)	1 (9. 1%)	11	
GN	2 (40 %)	3 (60 %)	5	
Wasp sting	4 (100 %)	--	4	0.006
HUS	3 (100 %)	--	3	
PUV	2 (100 %)	--	2	
Unknown	1 (14.3%)	6 (85.7 %)	7	
Total	29 (67.4%)	14 (32.6 %)	43	

Overall mortality was 32.6%. Mortality was higher in patients whose AKI was attributable to unknown etiology than in patients whose AKI had other causes that was statistically significant (p = 0.006). However no death among HUS, wasp sting and posterior urethral valve (PUV) causing AKI (table-3).

Table 4: Age related outcome

Age	Outcome of patient		Total No (%)	p
	Improve No (%)	Death No %)		
< 1year	12 (70.6%)	5 (29.4%)	17 (100%)	
1-5 years	10 (62.5%)	6 (37.5%)	16 (100%)	0.56
5-10 years	3 (100 %)	--	3 (100%)	
>10 years	4 (57.1%)	3 (42.9%)	7 (100%)	
Age	29 (67.4%)	14 (32.6%)	43 (100%)	

In this study shown that no statistically significant death occurred in different age group. Specially, no death in 5-10 years group (table-4).

Table 5: outcome in sex differences

Sex	Outcome of patient		Total	p
	Improve No(%)	Death No(%)		
Male	17 (63.0%)	10 (37.0%)	27	0.42
Female	12 (75.0%)	4 (25.0%)	16	
Total	29 (67.4%)	14 (32.6%)	43	

Table 5 shown that 37% patients were died those were male and 25% among female patients. That was not statistically significant(p=0.42)

Discussion

The common causes of pediatric AKI vary in different regions of the world12. Our study shown that septicemia, and hypovolumia were the predominant causes of AKI in a single-center setting. The common cause of death was unknown. Although multicenter or even population-based epidemiologic pediatric AKI data do not exist. By contrast, other diagnoses such as post-cardiac surgery AKI, chemotherapy, and organ and bone marrow transplant have become more prevalent in tertiary care units in developed countries in recent years13,14.

In developed countries, AKI occurs mainly as a consequence of advancements in open-heart surgery and in bone-marrow and solid-organ transplantation for the management of oncologic disorders15,16. AKI therefore commonly occurs in the setting of multiorgan dysfunction syndrome, with hemodynamic instability and a need for vasopressors17. But in the present study, the patterns of causes and comorbidities of AKI are different from those observed in developed countries. Other studies done in many parts of sub-Saharan Africa, such advancements in medical care are not routinely available. Intravascular hemolysis (presumably secondary to malaria) and septicemia were the major causes of AKI18. Another study done in the same center also shown that septicaemia and hypovolumia was the common cause of AKI19, but Kamal et al shown that hypernatraemia was the common indication (50%) of peritoneal dialysis20. Because the most prevalent cause of AKI in our setting is severe dehydration secondary to acute gastroenteritis, the early detection of prerenal AKI by primary health care professionals and swift institution of fluid resuscitation would be the most effective measure to reduce the incidence of AKI.

In our study the overall mortality was 32.6% that is similar to the study done by Ademola AD et al in South-West Nigeria, which reported mortality rates of 22.2% - 63.9% in AKI patients treated with PD21. In the other study done by Om P. Mishra et al shown that overall mortality in AKI patients following PD was 36.8%20. In the presence study we found that mortality was higher in patients whose AKI was attributable to unknown etiology than in patients whose AKI had other causes and second common cause death in AKI following GN. But Om P. Mishra et al shown that anuria and features of volume overload at onset were associated with higher mortality22. That finding accords with results from a study by Goldstein et al. of pediatric CRRT patients. Those authors found significantly higher mortality in patients more marked fluid overload at the time of treatment initiation10. Both of the foregoing features not only indicate severity, but also reflect the late arrival of patients at hospital. Van Biljon21 similarly found a higher incidence and duration of anuria in non-survivors with AKI. Anochie and Eke24 found that lack of dialysis and intractable hypertension significantly increased mortality. Patients with AGN as the underlying cause of AKI most likely had rapidly progressive glomerulonephritis and were less

likely to recover renal function. Poor outcomes among the patients with AGN were related to their limited ability to offer long-term RRT25. Despite our limitations, we were able to use PD to provide successful RRT in most patients.

In our study shown that there was no significant death in age and sex variation. Similar findings also noted by Padke KD13.

Conclusion

In low-resource settings, PD should be promoted in the treatment of childhood AKI rather than the implementation of costly CRRT infrastructure. The use of PD was associated with relatively high survival despite poor socio-economic conditions; however, in our study septicaemia and hypovolumia are the leading causes of AKI, and mortality was higher in unknown etiology.

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