

Peritoneal dialysis in PICU in a tertiary care hospital- a one year analysis

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Abstract

Background: Renal replacement therapy has an established role in the pediatric intensive care unit. Peritoneal dialysis (PD) has been successfully used as a therapy for Acute Kidney Injury (AKI) since 1946. It is a frequent choice for chronic dialysis support, especially in children. There has been a shift in developed countries of using hemodialysis and hemofiltration for renal replacement therapy in AKI, though observational studies in children and systematic review in adults show no difference in mortality between PD and Hemodialysis and hemofiltration. Today acute PD is a modality most often used in the developed world where its simplicity, effectiveness, and low cost make it attractive. The role of peritoneal dialysis in PICU is not well defined, although it remains frequently used, especially in low-resource settings. Hence the present study was performed to describe the indications and outcome of patients on PD. **Objectives:** Peritoneal dialysis in PICU – Indications and outcome. **Materials and methods: Study design-** Retrospective study. **Methods-** All patients between the age group of 1 month to 15 years, admitted to PICU and requiring PD formed the study group. All details i.e demographic data, indications for PD, complications and outcome was entered in systematically designed proforma and analysed. **Results:** Total of 30 patients was included in the study group. Out of 30, 21 children less than 5 years, 6 patients were between 5 to 10 years and 3 patients were between 10 to 15 years. Acute kidney injury (AKI) was the most common indication for PD (46%), followed by metabolic acidosis (40%) and chronic kidney disease (10%). Out of 30 patients, 16 patients recovered, 8 patients succumbed to the illness and 6 patients were referred to higher centre for Hemodialysis. Catheter blockage was the most common complication followed by bleeding and peritonitis. Hyperglycaemia was the most common metabolic disturbance seen followed by hypokalaemia. **Conclusion:** PD is still one of the most commonly used renal replacement therapy in PICU in resource limited settings. AKI is the most common indication for PD followed by CKD and metabolic acidosis. Outcome of PD is better in infants than in other age group. Catheter blockage was the most common complication and hyperglycaemia was most common metabolic abnormality.

Key words: PD- peritoneal dialysis, PICU, Acute kidney injury

Introduction

Renal replacement therapy has an established role in the paediatric intensive care. Peritoneal dialysis (PD) has been successfully used as a therapy for acute kidney injury (AKI) since 1946. PD is especially important for developing countries with limited resources.

Though rates of use have been decreased in the PICU, it is still the most commonly used method of RRT in children in the world. This modality does not require

anticoagulation and is ideal for neonates and children who can tolerate slower fluid removal and electrolyte correction [1]. For most cases of AKI, peritoneal dialysis (PD) is comparable in effectiveness to other renal replacement therapy in managing the complications of AKI [2].

According to the most recent European registry for Paediatric Nephrology /European renal association-European dialysis and transplant association (ESPN/ERA-EDTA) registry annual report, in 2015, the number of children with end stage renal disease (ESRD)

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in whom hemodialysis (HD)(41.6%) and PD (39.5%) was initiated was similar[3]. The outcome of critically ill patients with AKI treated with PD are comparable to other dialysis modalities.

There has been shift in developed countries of using haemodialysis and haemofiltration for RRT in AKI, though observational studies in children and systemic review in adults show no difference in mortality between PD and haemodialysis. Today acute PD is a modality most often used in the developed world where its simplicity, effectiveness and low cost make it attractive. The role of peritoneal dialysis in PICU is not well defined, although it remains frequently used, especially in low resource settings.

Peritoneal dialysis: peritoneum acts like semi permeable membrane between peritoneal cavity and vascular compartment with plasma. Acute peritoneal dialysis is done with polyurethane catheter. Two studies from INDIA showed that acute PD cost approximately half the cost for haemodialysis [4].

Hence present study was performed to describe the indications and outcomes of patients on PD

Objectives

Peritoneal dialysis in PICU – Indications and outcome

Methodology

All patients between the age group of 1 month to 15 years, admitted to PICU and requiring PD formed the study group

This retrospective analysis includes 30 children with AKI requiring acute PD who were admitted to the tertiary care center of a pediatric teaching hospital between May 2017 and May 2018. The protocol of the study was approved by the local ethics committee, and consent was obtained from parents.

Acute kidney injury was defined according to the modified pediatric RIFLE (risk, injury, failure, loss, end-stage renal disease) criteria [5]. A detailed history was recorded, and a clinical examination was performed for every patient. Fluid overload was quantified by the percentage increase relative to the last recorded or estimated pre-illness weight. 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 20 continuous cycles 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.

Patients were managed using our standard hospital protocol for AKI (including management of fluid and electrolyte disturbances, anemia, and hypertension), and the underlying condition was appropriately addressed. In breastfed infants, breastfeeding was continued. Older infants and children were put on salt restriction and received 100% of the dietary reference intake for energy as carbohydrate and fat. Protein was administered at 1 – 1.5 g/kg daily. In unconscious patients, enteral feeding was given by nasogastric tube until consciousness was regained and spontaneous oral food intake could be resumed.

Peritoneal dialysis was performed in the pediatric intensive care unit 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 5 – 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 25 – 30 mL/kg in younger children and 30 – 40 mL/kg in older children.

A deep subcutaneous purse-string suture was usually applied around the PD catheter at the site of entry into the peritoneal cavity to minimize the risk of fluid leakage. Leaking catheters were exchanged immediately. Total duration of each cycle was about 45 – 60 minutes (24 cycles daily). A total of 40 – 60 cycles were performed manually by a resident physician, after which a break of 12 – 24 hours was used to observe for the recovery of renal function. Dialysis was resumed if oliguria or anuria and azotemia persisted. The commercial PD solution used contained dextrose 1.7%, Na⁺ 130 mmol/L, Ca⁺⁺ 1.5 mmol/L, Mg⁺⁺ 0.75 mmol/L, Cl⁻ 100 mmol/L, and HCO₃⁻ 35 mmol/L.

In patients presenting with features of fluid overload (assessed by tachypnea, raised jugular venous pressure, hepatomegaly, basal crepitations, and cardiomegaly in chest radiographs), PD fluid containing 2.5% dextrose was used initially for several exchanges and then switched over to 1.7% once euvoemia was attained. Potassium (4mmol/L) was added to the PD fluid after the 4th cycle, and serum potassium was monitored. Clinical monitoring during PD included heart rate,

blood pressure, oxygen saturation, and continuous electrocardiography on a dynamic monitor. Urine output and biochemical parameters (blood urea, serum creatinine, electrolytes, and arterial blood gases, among others) were monitored. After 40 – 60 continuous cycles, dialysis was electively discontinued in the survivors, and patients were observed. without dialysis for further recovery of urine output even if biochemical retention levels were still elevated. This procedure was chosen to minimize treatment cost. At the end of the session, the catheter was removed, the reservoir was emptied, and the peritoneal fluid was sent for culture. Biochemical monitoring continued until normalization, and then patients were discharged.

Standard diagnostic criteria were used to categorize the causes of AKI according to the predominant patho-physiologic mechanism:

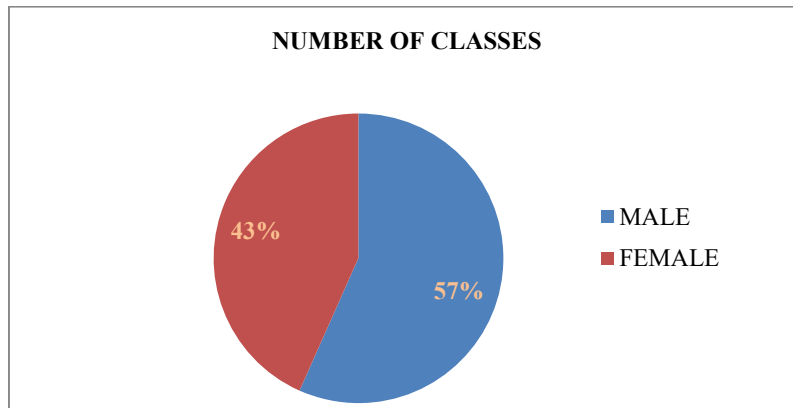
- Acute tubular necrosis
- Hemolytic uremic syndrome
- Acute glomerulonephritis
- Obstructive uropathy
- Septicemia

All details including demographic data, Indication, Complications and outcomes of PD were systematically analysed.

Results

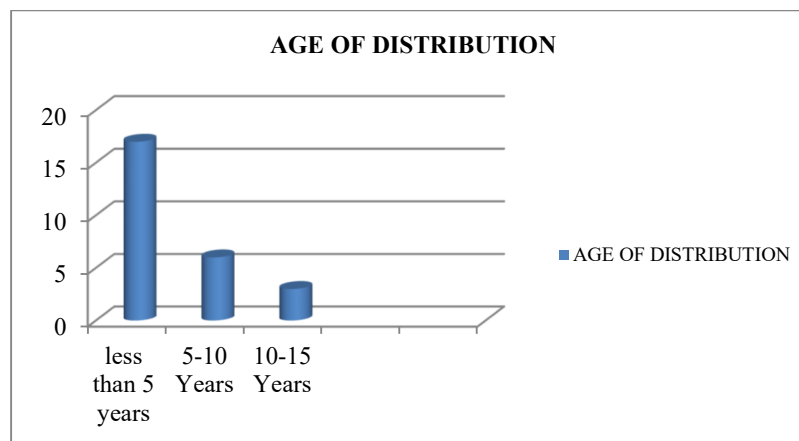
Total of 30 patients was included in the study group. The group included 17 male and 13 female children.

Table-1: Total Number of Cases.



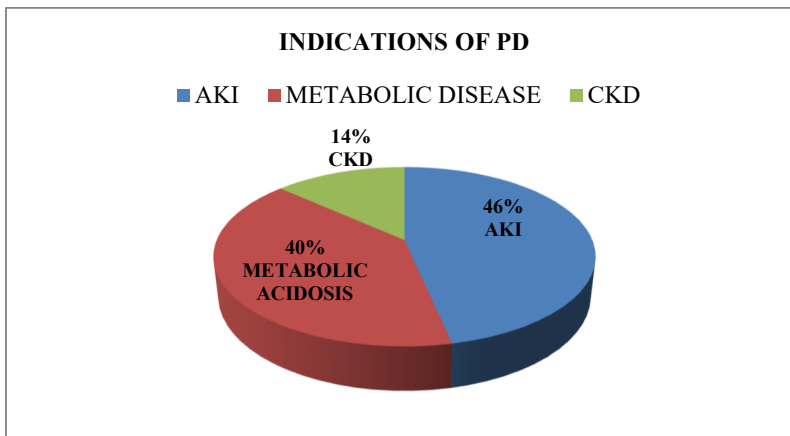
Out of 30, 21(70%) children were less than 5 years, 6 (20%) patients were between 5 to 10 years and 3(10%) patients were between 10 to 15 years.

Table-2: Age Distribution of Cases.



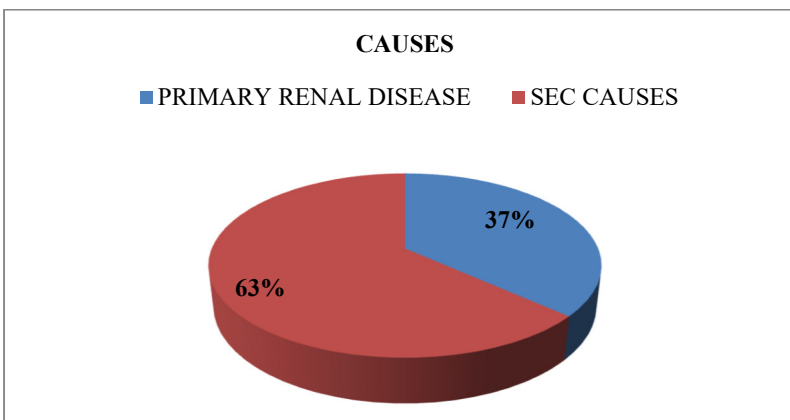
Acute kidney injury (AKI) was the most common indication for PD (46%), followed by metabolic acidosis (40%) and chronic kidney disease (10%).

Table-3: Indications of peritoneal dialysis.



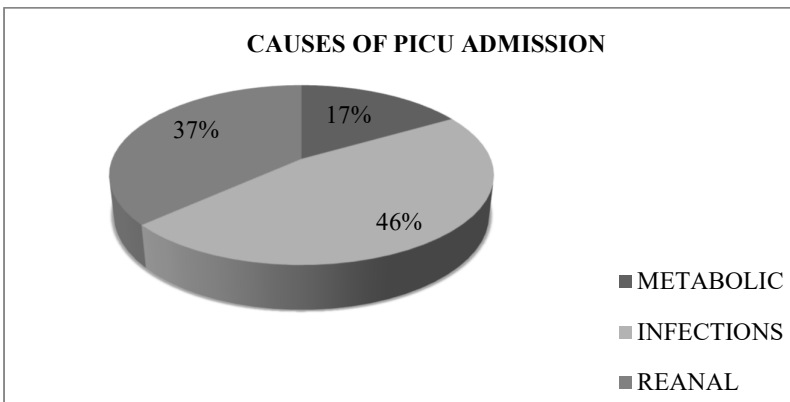
Out of 30 patients, primary renal disease was the cause of PD in 11 cases (37%) while secondary causes were noted in 19 cases (63%).

Table-4: Causes of PD initiation.



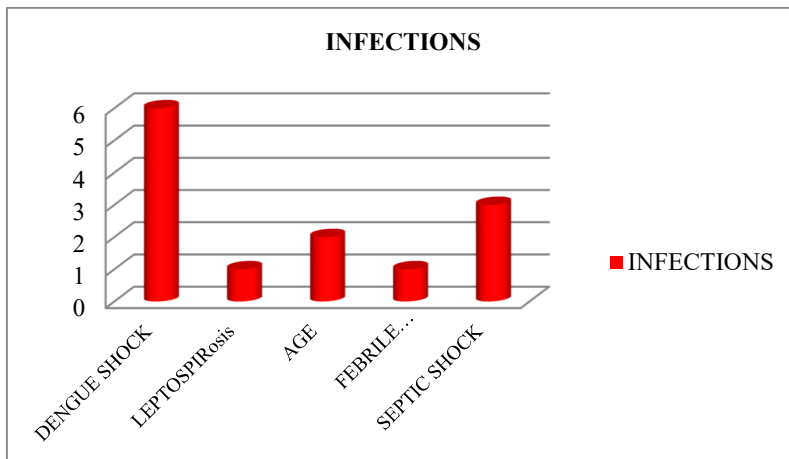
The main causes for ICU admission were found to be infectious which constituted about 13 cases (46%) followed by renal cause which accounted for about 11 cases (37%) followed by metabolic causes that included inborn errors of metabolism and diabetic ketoacidosis which constituted about 5 cases (17%).

Table-5: Indications for PICU admission.



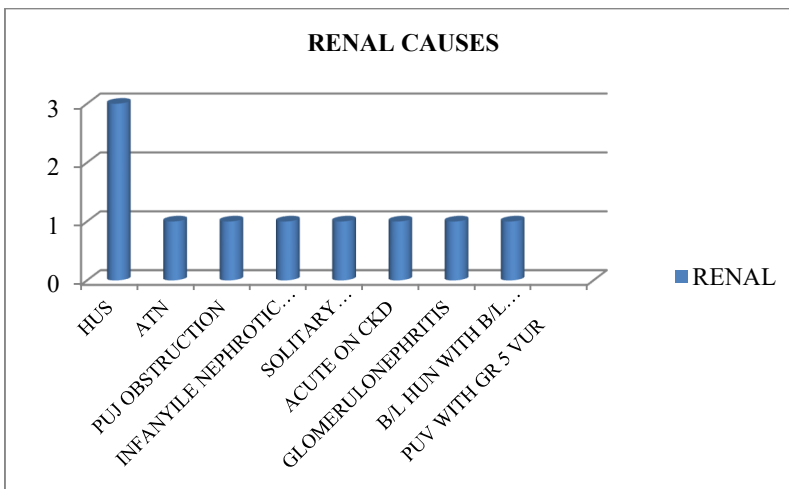
Of the 14 infectious causes, dengue accounted for 6 cases followed by septic shock, acute gastroenteritis, leptospirosis, febrile encephalopathy in descending order of occurrence.

Table- 6: Infectious Causes.



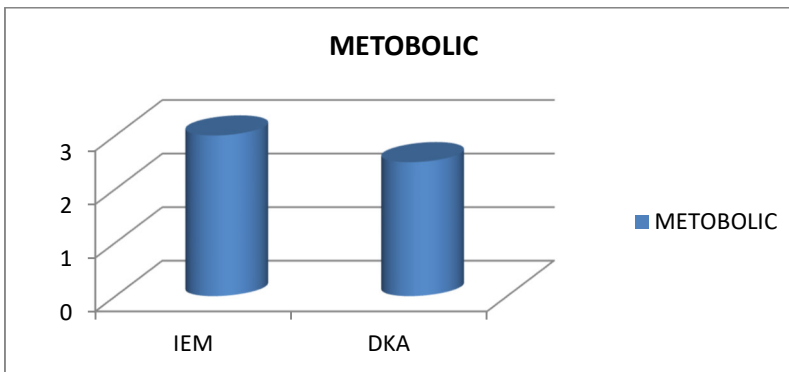
Of the 11 cases admitted with a renal cause, haemolytic Uremic syndrome was the found to be the common cause.

Table- 7: Renal Causes.



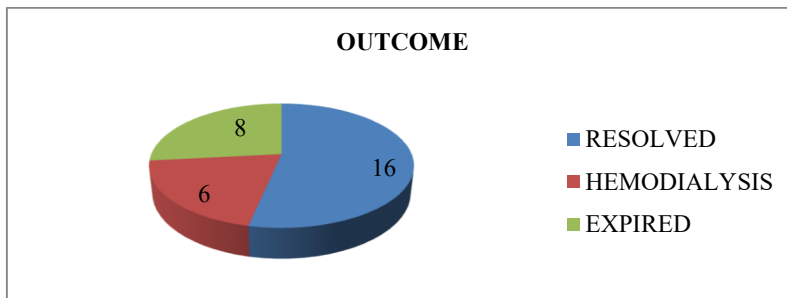
Out of the 5 metabolic causes of PICU admission, inborn errors of metabolism was the most common cause followed by diabetic ketoacidosis.

Table- 8: Metabolic Causes



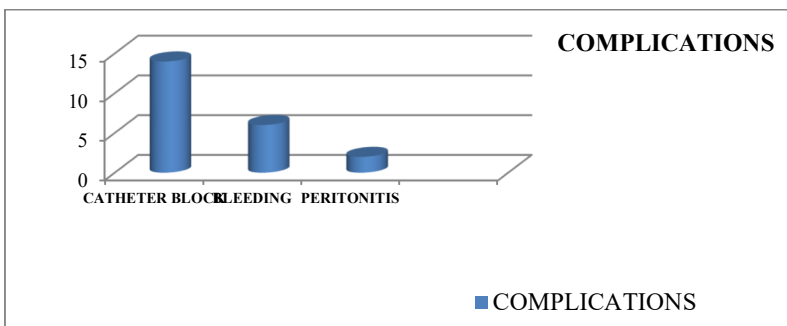
Out of 30 patients, 16 patients recovered, 8 patients succumbed to the illness and 6 patients were referred to higher centre for Hemodialysis.

Table- 9: Outcome of PD.



Catheter blockage was the most common complication followed by bleeding and peritonitis.

Table- 10: Complications of PD



Discussion

The predominant causes of pediatric AKI vary in different regions of the world [6]. We found that infectious causes (dengue, septic shock), haemolytic uremic syndrome, IEM and diabetic ketoacidosis were the predominant causes in our series from a single-center developing-country setting. Although multicenter or even population-based epidemiologic pediatric AKI data do not exist, early single-center studies reported a similar distribution of causes. 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 years [7-9].

Depending on the facilities and expertise available, PD, intermittent hemodialysis, and CRRT are all currently used for pediatric AKI [10]. The CRRT and hemodialysis technologies require vascular access, equipment, technical expertise, and financial resources, all of which largely preclude their use because of non-availability at most centers in developing countries, including ours. Hence, because of its simplicity and affordability, especially where extracorporeal techniques are not available, PD is clearly invaluable in reducing the mortality attributable to AKI in developing countries. The usefulness of PD in the treatment of AKI has also been emphasized in the past by Mohandas and

Chellapandian[11], who recommended that it should be instituted as early as possible, thus avoiding the delay caused by referring critically ill patients to nephrologists. Our centre is a good example of the foregoing scenario. Patients are typically referred to us quite late from remote places, often presenting at admission with oliguria or anuria and life-threatening complications such as septic shock and peritonitis. The mortality rate in children with AKI is highly variable and considered to depend largely on the nature of the underlying disease process rather than on renal failure itself.

The overall mortality in our study was 26.6%, not dissimilar to that in previous studies, which reported mortality rates of 22.2%–63.9% in AKI patients treated with PD [12,13]. The presence of anuria and features of volume overload at onset were associated with higher mortality. That finding accords with results from a study by Goldstein *et al.* of pediatric CRRT patients. We also noted significantly higher pre-dialysis serum creatinine and phosphorus concentrations in the non-survivors. Vachvanichsanonget *al.* [15]similarly found a 1.9 times higher risk of mortality when serum creatinine exceeded 2 mg/dL in patients with AKI. Independent of anuria and fluid overload, the presence of septicemia conferred a greater risk of death in our study. That

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finding is in keeping with previous experiences of pediatric AKI in developing countries (14,15). Septicemia leads to liberation of various nephrotoxins and may cause vasodilation and relative hypovolemia, thereby aggravating renal failure. The septicemic process also affects other organs, resulting in multiorgan dysfunction, with a detrimental effect on overall prognosis. Indeed, the occurrence of infectious complications (that is, septic shock or peritonitis, either at start of dialysis or during treatment) further multiplies the risk of a fatal outcome. In our patients, peritonitis most likely reflected the septic disease process rather than a complication of PD, even in patients who developed the complication during treatment, because strict aseptic measures were taken during catheter insertion.

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