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Original Research Article

Analysis of Acute Peritoneal Dialysis in Children

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Abstract

Introduction: Acute peritoneal dialysis is used for a short duration, after which chances of peritonitis get increase. While chronic i.e. continuous ambulatory peritoneal dialysis (CAPD) and continuous cycling peritoneal dialysis (CCPD) is used on a long-term basis. Using peritoneal dialysis as a treatment modality, patients are monitored regarding their clinical status. It is widely available and technically easy to perform, large amounts of fluid can be removed in hemodynamically unstable patients, and easy and gradual correction of acid-base and electrolyte imbalance may be performed. Peritoneal dialysis access placement is relatively easy, particularly in children. In the present study, we analyzed the clinical profile of all patients who underwent peritoneal dialysis for various reasons along with their complications and outcome.

Methods: The present prospective observational study was carried out in the Pediatric intensive care unit in a tertiary care hospital amongst 48 cases presented as acute renal failure. In this study, we enrolled 48 patients presenting with acute renal failure or uremia. A detailed history was recorded regarding complaints, their onset, duration and progress, past history was noted. The outcome of the procedure was noted as improvement, whether complete or partial or death. Acute peritoneal dialysis was performed manually.

Results: In this study, the most common age group affected was 1 – 4 years (33.33 %). Among 48 patients presenting with acute renal failure, the most common cases were due to urolithiasis (25 %), and patients with chronic renal failure constituted 14.58 % of the total cases. The most common indication of peritoneal dialysis was fluid overload in 66.67 %. In the present study, 18.75 % of patients required peritoneal dialysis for less than 60 hours while 81.25 % of patients underwent dialysis for more than 60 hours. In the present study, catheter malfunction (25.00 %) was the most common complication, followed by hypokalemia (20.83 %). In the present study, 47.92 % of patients had complete improvement, while 37.5 % had partial improvement.

Conclusion: There was a significant reduction in the blood urea and creatinine levels along with normalization of serum potassium levels after the session of peritoneal dialysis. The outcome of pediatric peritoneal dialysis was good with a mortality of 12.5 % in the present study, cause of death mostly related to associated co-morbid systemic disorder.

Keywords: Peritoneal, Dialysis, Urolithiasis, Ambulatory peritoneal, Peritonitis.

Introduction

Peritoneal dialysis is a process involving the exchange of and movement of fluid across the semipermeable peritoneal membrane. [1] Solutes are exchanged across their concentration gradient between peritoneal capillaries and dialysis solution. Those that are in higher concentration in blood (urea, K^+, creatinine) move into dialysis fluid (dialysate) and those with higher concentration in dialysate move in opposite direction (glucose, calcium).

Acute peritoneal dialysis is used for a short duration, generally around 72 hours, after which chances of peritonitis get increased. While chronic i.e. continuous ambulatory peritoneal dialysis (CAPD) and continuous cycling peritoneal dialysis (CCPD) is used on a long-term basis. It is preferred in patients requiring long-term renal replacement therapy. [1] Using peritoneal dialysis as a treatment modality, patients are monitored regarding their clinical status e.g. sensorium, vital parameters as well as their laboratory parameters like renal function tests, electrolytes, and arterial blood gas analysis. Any improvement or deterioration in these parameters guides for further changes. [1]

It is widely available and technically easy to perform, large amounts of fluid can be removed in hemodynamically unstable patients, and Easy and gradual correction of acid-base and electrolyte imbalance may be performed. Peritoneal dialysis access placement is relatively easy, particularly in children. It is a highly biocompatible technique and dosing is easy, particularly in children and in most pediatric intensive care units, acute peritoneal dialysis has been the renal replacement therapy of choice for decades in part because of its simplicity and safety. In developing countries like India, even today lack of adequate expertise, economical constraints and availability of well-equipped hemodialysis centres, peritoneal dialysis is preferred as the modality of treatment of acute as well as chronic renal failure but also of inborn errors of metabolism, drug intoxication and salt poisoning. [1]

In the present study, we analyzed the clinical profile of all patients who underwent peritoneal dialysis for various reasons along with their complications and outcome.

Material and Methods

The present prospective observational study was carried out in the Pediatric intensive care unit in a tertiary care hospital amongst 48 cases presented as Acute renal failure.

Inclusion criteria: Patients of both gender between 0 – 12 years underwent peritoneal dialysis for renal as well non-renal indications.

Exclusion criteria: Dialysis terminated prior to completion of 48 hours due to any reasons.

Methods

In this study, we enrolled 48 patients presenting with acute renal failure or uremia. A detailed history was recorded regarding complaints, their onset, duration and progress, past history was noted.

General examination, vital parameters, systemic examination, and laboratory investigations were performed on each patient. Also, Ultrasonography of the abdomen and pelvis for renal sizes, renal echogenicity and corticomedullary differentiation, presence of calculi and hydronephrosis and hydroureter was done. Arterial blood gas analysis, X-ray chest, and liver function tests were done in indicated patients. Peritoneal fluid examination in gross appearance and microscopy for the presence of red blood cells and pus cells, peritoneal fluid culture and sensitivity was performed in all patients.

The outcome of the procedure was noted as improvement, whether complete or partial or death. Once the patients came out of complications and general conditions improved, they were discharged. Any morbidity or mortality in any of these patients was studied in detail.

In the present study, the peritoneal dialysis solution containing 2 mEq / L of potassium, 0.75 mEq / L of magnesium and 1.5 mEq / L of calcium was used instead of the above values, with an osmolality of 368 mOsm / kg, because of the availability of the same.

Additives: [2]

Heparin 500 U / L was added so as to prevent a catheter block. Lignocaine 2% was added as 2 ml / L as a local anaesthetic in all patients. Potassium as KCl was added at 4 mmol / L when serum potassium was < 3.5 mmol / L. 10 % Dextrose was added so as to increase the concentration of peritoneal dialysis solution when required. Intraperitoneal antibiotics like vancomycin 30 mg/kg and ceftazidime 15 mg/kg in one cycle were added when peritonitis was suspected.[1] 10 % or 25% dextrose was added to increase the concentration of the dialysis fluid in patients with volume overload. [3]

Acute peritoneal dialysis can be performed either manually or by a machine (acute cycler dialysis). It was performed manually in this study. Each cycle in peritoneal dialysis consists of a "fill" period i.e time taken to infuse the dialysate into the peritoneum; "dwell" phase i.e. the time during which the dialysate is allowed to stay in contact with the peritoneal membrane to allow ultrafiltration and solute movement and the "drain" phase i.e. the time during which the abdomen is emptied of dialysate. [1]

Patients on peritoneal dialysis are monitored daily with respect to their clinical improvement and changes in biochemical parameters. The amount of ultrafiltration i.e. the net amount of fluid that is drained out through dialysis per day is noted. Simultaneously, patients were monitored for the development of complications like flow-related problems, and electrolyte imbalances like hypokalemia, and peritonitis. Peritoneal fluid was examined routinely for the presence of pus cells and was sent for culture and sensitivity. Dialysis was terminated at the end of 72 hours, as chances of peritonitis increased thereafter. [1]

Results

In the present study, we analyzed clinical profile of all patients who underwent peritoneal dialysis for various reasons along with their complications and outcome.

Table 1: Distribution of patients according to Age and Gender.

Age group	Gender		Total
	Male	Female	
0 – 1 years	03 (06.25 %)	03 (6.25 %)	06 (12.50 %)
1 – 4 years	14 (29.16 %)	02 (04.16 %)	16 (33.33 %)
5 – 8 years	05 (10.41%)	10 (20.83 %)	15 (31.25 %)
9 – 12 years	08 (16.67 %)	03 (06.25 %)	11 (22.91 %)
Total	30 (62.5 %)	18 (37.5 %)	48 (100 %)

Table no.1 shows Chi square (X^2) test reveals significant difference between male and female patients with more number of male patients in the age group of 1 – 4 years. $X^2 = 10.60$, d (f) = 3, $p < 0.05$.

Table 2: Distribution of patients according to indications of peritoneal dialysis.

Indication	No. of patients (n = 48)	Percentage
Uremic encephalopathy	14	29.17 %
Fluid overload	32	66.67 %
Uremic bleeding	04	8.33 %
Hyperkalemia	07	14.58 %
Symptomatic hyponatremia	04	8.33 %
Metabolic acidosis	10	20.83 %

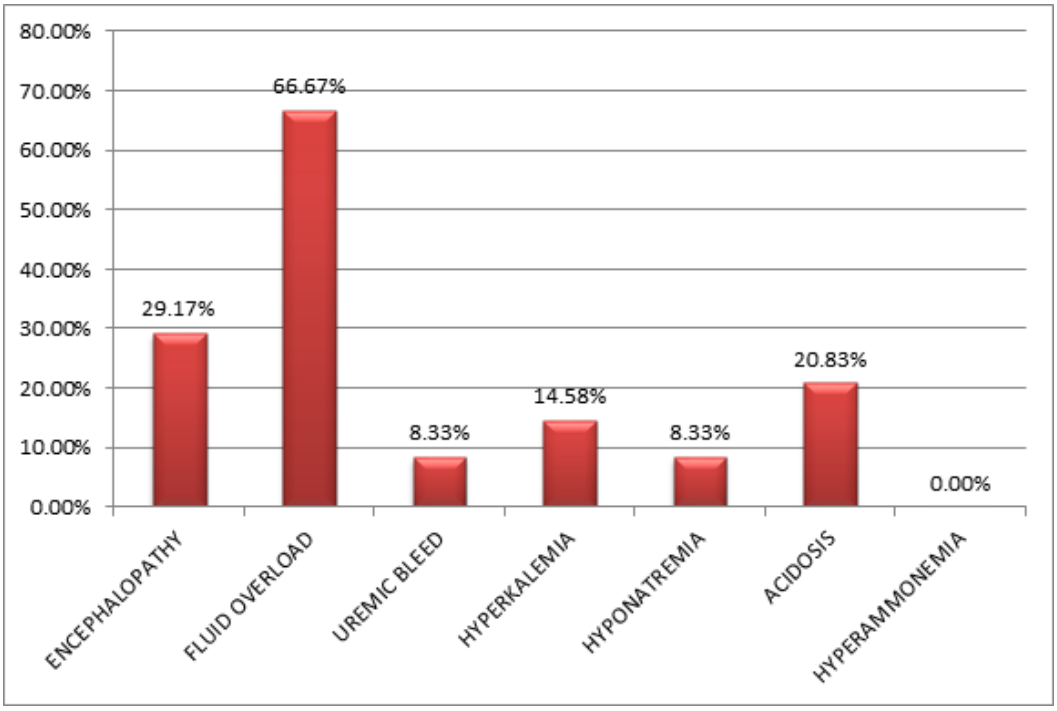

Figure 1: Showing graphical representation of indications of peritoneal dialysis.

Table no.2 shows that most common indication of peritoneal dialysis was fluid overload in 66.67 % of patients followed by uremic encephalopathy in 29.17 % patients and metabolic acidosis in 20.83 % patients.

Table 3: Concentration of peritoneal dialysis fluid.

Peritoneal dialysis fluid concentration	No. of patients (n = 48)	Percentage
1.5 %	43	89.58 %
4.5 %	05	10.42 %
Total	48	100 %

Table no.3 shows that, 89.58 % patients were dialyzed with peritoneal dialysis fluid of 1.5 % concentration, while 10.42 % of patients required concentration of 4.5 %.

Table 4: Showing changes in biochemical parameters during peritoneal dialysis.

Parameter	Urea	Creatinine	Potassium
Pre – dialysis	152.3 ± 74.34 mg / dl	5.79 ± 3.24 mg / dl	5.1 ± 1.1 mEq / L
Post – dialysis	046.6 ± 23.11 mg / dl	1.68 ± 1.48 mg / dl	3.7 ± 0.8 mEq / L

Table no.4 shows that results of paired t test for urea levels (t) = 9.713, d (f) = 47, p < 0.0001. Paired t test revealed highly significant difference between urea values

before and after peritoneal dialysis. Results of paired t test for creatinine levels (t) = 8.648, d (f) = 47, p < 0.0001. Paired t test revealed highly significant difference between creatinine values before and after peritoneal dialysis. Results of paired t test for potassium levels (t) = 6.942, d (f) = 47, p < 0.0001. Paired t test revealed highly significant difference between potassium values before and after peritoneal dialysis.

Table 5: Showing complications of peritoneal dialysis.

Complication	No. of patients (n = 48)	Percentage
Hypokalemia	10	20.83 %
Peritonitis	05	10.41 %
Hemorrhagic outflow	05	10.41 %
Poor outflow	06	12.50 %
Pericatheteral leak	06	12.50 %
Hyperglycemia	05	10.41 %
Catheter malfunction	12	25.00 %
No complication	18	37.5 %

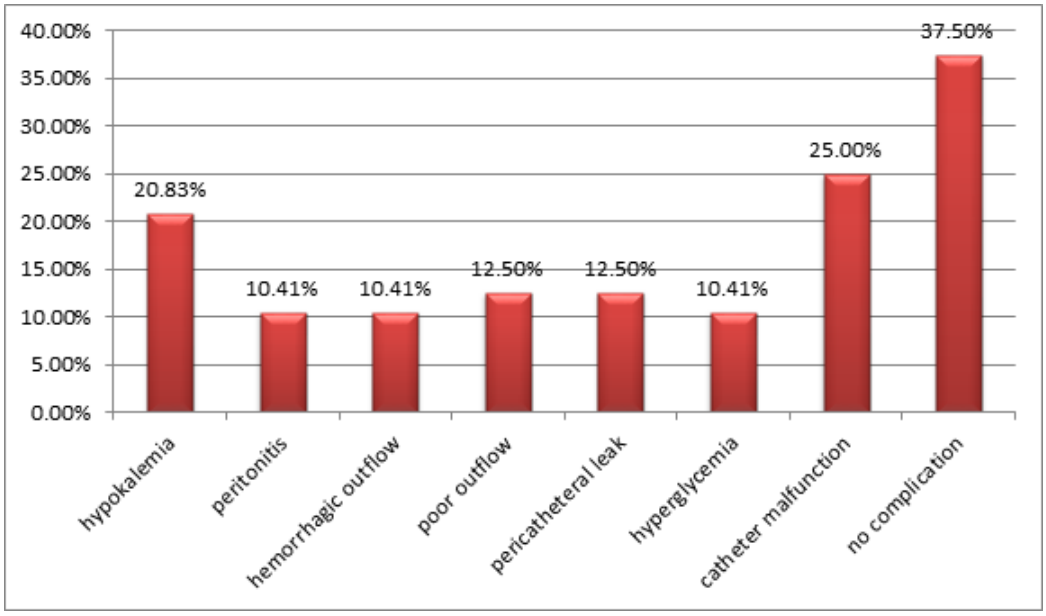

Figure 2: showing graphical representation of complications of peritoneal dialysis

Table no.5 shows that, catheter malfunction (25.00 %) was the most common complication, followed by hypokalemia (20.83%), then poor outflow (16.22%) and pericatheteral leak (16.22%). Peritonitis occurred in 13.51 % of the patients who were dialyzed.

Discussion

The study was carried out to study the different indications and outcomes of acute peritoneal dialysis as well as to study various complications associated with the procedure.

In the present study, the highest incidence of acute renal failure was found in 1 – 4 years of age, followed by 5 – 9 years. Shrivastava et al [4] and Arora et al [5] also found a high incidence of acute renal failure in children between 1 – 4 years of age in their studies. The most common cause of acute renal failure in children below 4 years of age is hemolytic uremic syndrome as shown by Shrivastava et al [4] in their studies.

In the present study, there were 30 males affected while females were 18. The male:

female sex ratio of 1.67: 1. Kandoth et al [6] reported a male: female ratio of 1.54: 1.

In the present study, the most common cause of acute renal failure was obstructive uropathy (27.08%) followed by hemolytic uremic syndrome (20.83 %). Obstructive uropathy was mostly due to renal stones, ureteric stones, pelvic–ureteric junction obstruction and posterior urethral valves. Phadke et al [7] also reported obstructive uropathy as the commonest cause of end-stage renal disease. Most of these cases may be due to delays in seeking treatment.

The present study had hemolytic uremic syndrome as the second most common cause of acute renal failure (20.83 %). Shrivastava et al [4] also had hemolytic uremic syndrome as the most common cause of acute renal failure. The present study as well as studies by Shrivastava et al [4] and Arora et al [5] had 1 – 4 years as the most common age group affected where the hemolytic uremic syndrome is the commonest cause for acute renal failure. Kandoth et al [6] have reported acute glomerulonephritis as the most common cause of acute renal failure.

Acharya et al [8] also had a maximum no. of cases of acute gastroenteritis leading to acute renal failure. His study had a maximum number of patients between 1 – 4 years of age where the incidence of acute gastroenteritis is higher. It was because that patients with diarrhoea were referred late from the peripheral hospitals to the tertiary care hospital in the moribund state.

The present study had only one such patient with acute gastroenteritis leading to acute renal failure. Phadke et al [7] also had less incidence of acute gastroenteritis leading to acute renal failure. Acute tubular necrosis was the commonest cause of acute renal failure as reported by Shah PR et al [9],

while Phadke et al [7] reported chronic renal failure presenting with acute presentation as the most common cause of acute renal failure.

Fluid overload resistant to diuretics was the most common indication of peritoneal dialysis in the present study (66.67 %). Phadke et al [7] reported fluid overload as the most common indication for dialysis. In acute renal failure, the patients are oligouric or they are in anuria. There is a fluid overload in most of the patients with acute renal failure and dialysis is indicated when it manifests as pulmonary oedema or intractable hypertension or congestive cardiac failure which is resistant to diuretics. In the present study, shorter dwell times were used along with hypertonic peritoneal fluid for some time to treat fluid overload similar to a study by Phadke et al. [7]

Uremic encephalopathy was the second most common indication of peritoneal dialysis in the present study. Anochie et al [10] had uremic seizures as the commonest indication of peritoneal dialysis. Flynn et al had uremia as the most common indication of dialysis in their study. [11]

Electrolyte disturbances like hyperkalemia and metabolic acidosis were the other significant indications for dialysis in children with acute renal failure in the present study which were present along with other indications of dialysis. As the disease process involves dysfunction of the kidneys, it is expected to have fluid overload to occur simultaneously with electrolyte imbalances and metabolic acidosis. Flynn et al [11] and Anochie et al [10] also reported more patients having more than one indication for peritoneal dialysis.

In the present study, biochemical azotemia or oligo–anuria was not used as a separate indication as almost all patients with acute renal failure included in this study were having these findings. We could not find any patient with hyperammonemia in our study. Phadke et al [7] and Hagras et al [12] also used biochemical azotemia as one of the indications in their studies.

The present study had 31.25 % of the patients with blood pressure within the hypertensive range for their age. Patients of chronic renal failure presenting with an acute indication were also more, where also the incidence of hypertension is high. In the present study, a low incidence of hypotension was found as only 2 patients with septicemia were found to have low blood pressure for their age. These were followed by acute glomerulonephritis, which was the commonest cause of acute renal failure as reported by Kandoth et al [6] in their study, where also the incidence of hypertension is high and also reported a greater number of hypertensive patients than hypotensives.

In the present study, 27.08 % of patients had bilaterally reduced renal sizes while 50 % were having normal renal sizes. This is mainly because of the higher number of patients with chronic renal failure. The present study had 14.58 % of patients with chronic renal failure. 25 % of patients were of urolithiasis which had already reached a stage of chronic renal failure when presented to us for the first time.

In the present study, 22.91 % of patients had other coexisting non-renal systemic disorders, of which sepsis was the most common (36.36 %). Ghani et al [13] found sepsis to be one of the commonest (28.1 %) co-morbidities associated with acute renal failure, which also was the most common cause of acute renal failure in his study. The Co-morbid conditions like the presence of sepsis or multiorgan failure affect the outcome of acute renal failure and peritoneal dialysis contributing to increased mortality.

In the present study, peritoneal dialysis solution of 1.5 % concentration was used in 89.58 % of the patients, while 10.42 % of patients required a solution of 4.5 % concentration. Passadakis et al [14] used 2.5 % or 4.5 % solution to drag extra fluid out in cases with fluid overload. Anochie et al [10] used 50 % dextrose to add to 1.5 % solution to make it hypertonic for the same purpose in conditions associated with pulmonary oedema.

The average dwell time used in the present study was 32.5 minutes, where shorter dwell times were used initially to drag extra fluid out and in cases with metabolic acidosis. Hagras et al [12] also used shorter dwell times for peritoneal dialysis in cases with fluid overload and metabolic acidosis.

In the present study, most patients were having ultrafiltration > 1000 ml over the entire duration of peritoneal dialysis. The ultrafiltration for each patient was on average 78.75 ml/kg over the dialysis session. Similar results were found in the study by Hagras et al [12] who reported net fluid removal of 86 ml/kg over the dialysis session.

In the present study, for all patient heparin and lignocaine were the two medications used intraperitoneally for every patient. 18.75 % of patients required three medications while 16.67 % of patients required four drugs intraperitoneally. In the present study, 10.42 % of patients required the addition of 10 % dextrose to the peritoneal fluid so as to make it hypertonic.

The present study had a 10.41 % incidence of peritonitis which required intraperitoneal instillation of antibiotics which were vancomycin and ceftazidime. Anochie et al [10] used intraperitoneal gentamycin as a routine in their study.

There was a significant reduction in deranged renal parameters after the session of peritoneal dialysis ($p < 0.0001$). These results are similar to the study by Anochie et al [10] where predialysis values of blood urea and creatinine were 108.7 mg/dl and 8.96 mg/dl, respectively; while their post-dialysis values were 33.33 mg/dl and 2.77 mg/dl respectively.

In the present study, catheter dysfunction requiring replacement of the peritoneal dialysis catheter was the most common complication, found in 25 % of the patients. This report was similar to studies by Flynn

et al [11] hypokalemia was the second most common complication in the present study. This finding was similar to the study by Szeto CC and Chow KM et al [15] who also reported hypokalemia to be common in Chinese peritoneal dialysis.

It is thus obvious from the present study and various other studies that the incidence of visceral organ trauma or perforation is less with acute peritoneal dialysis, especially when the procedure is performed with due precautions.

The incidence of peritonitis was 10.41 % in the present study. It was similar to the incidence reported by Passadakis et al [14] which was 12 % in his study. Grisaru et al [16] reported a slightly higher incidence of peritonitis (20 %) as compared to the present study.

The present study had seizure disorder as the most common co-morbid condition followed by sepsis. Ghani et al [13] had haematological malignancy as the most common co-morbid condition.

The present study had a mortality of 14.58% of which 8.33% of patients expired while peritoneal dialysis was going on and the remaining 6.25 % of patients expired after the termination of peritoneal dialysis. The mortality in the present study was due to delayed referral of the patients and hence delay in the initiation of treatment of the disease. It was also related to the underlying disease process as well. Most patients have already reached a state of chronic renal failure and now presenting for the first time. Other patients with high mortality were of septicemia (8.33 %) in which the high mortality remains due to the septicemia itself.

Shah PR et al [9] also had 17.7 % mortality in their study similar to the present study. The mortality in acute renal failure was more related to the underlying disease process and the presence of other complicating factors like central nervous system involvement, sepsis, delayed referral, malnutrition and multiorgan involvement. Peritoneal dialysis seems to be an effective and safe modality of renal replacement in most patients. Arora et al [5] had 34.61 % mortality in their study and the late referral, serious infections and presence of malnutrition were the contributory factors.

Among the discharged patients, 37.5 % of patients were having partial improvement which means these patients improved symptomatically but biochemical parameters were not settled to the normal limits. Phadke et al [7] also reported that in their study 8.69 % of patients had progressed to chronic renal failure evaluated again after the dialysis session was completed.

The most common cause of death was septicemia in the present study accounting for 71.43 % of the total deaths. This result was similar to the study by Flynn et al [11] where patients with sepsis and congestive cardiac failure had markedly worse survival as compared to other disease processes. [17]

Conclusion

We concluded that the commonest age group affected was 1 – 4 years with male preponderance. The most common underlying cause for acute renal failure was urolithiasis followed by hemolytic uremic syndrome and the most common indication of peritoneal dialysis was fluid overload followed by uremic encephalopathy. Most of the patients required dialysis for more than 60 hours and had ultrafiltrate volume > 1000 ml over the entire duration of peritoneal dialysis. Also, there was a significant reduction in the blood urea and creatinine levels along with normalization of serum potassium levels after the session of peritoneal dialysis. The outcome of pediatric peritoneal dialysis was good with a mortality of 12.5 % in the present study, cause of death mostly related to associated co-morbid systemic disorder.

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