Adapted Acute Peritoneal Dialysis, A Rescue Management Modality In Acute Kidney Injury In A Resource -Limited Setting- A Case Report

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Abstract

Background: Acute peritoneal dialysis(PD) is a form of renal replacement therapy often useful in younger children with Acute Kidney Injury (AKI). However, in developing countries with limited resources, the consumables, such as peritoneal dialysate as well as PD catheter are not readily affordable for patients of low socio-economic status, thus making the procedure sometimes out of their reach.

Case study: We present the case study of a 2- year old girl with diagnosis of malaria complicated by cerebral malaria and non-oliguric AKI whose parent had financial constraint. She was treated for severe malaria with intravenous artesunate and had improvised PD with 1.5% Dextrose in Ringer's lactate fluid, 3-way valve connector, fenestrated nasogastric tube and uro-bag as waste bag while maintaining strict asepsis. The pre-dialysis serum urea peak was 32.57mmol/L while the serum Creatinine was 352µmol/L, urine output was 1.5mls/kg/hour. The patient had a total of 40 cycles of peritoneal dialysis over 4 days with subsequent serial clinical and biochemical improvement. PD was discontinued at Serum K of 2.65mmol/l, Na - 137.5mmol/l, Cl - 106.5mmol/l, urea - 9.43mmol/l and Creatinine of 94.1µmmol/l. Hypokalemia was corrected orally and she was subsequently discharged home and currently being followed up in the clinic.

Conclusion: Adaptation using available resources for PD under strict asepsis could be lifesaving in resource limited settings.

Keywords: Peritoneal dialysis,acute kidney injury, severe malaria, renal replacement therapy

Introduction

Acute peritoneal dialysis(APD) is useful in young children with Acute Kidney Injury (AKI) when renal replacement therapy is indicated.[1,2] It is the preferred modality in young children whose blood vessels are too small for hitch free haemodialysis

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vascular access. There are challenges that impede its use regularly in developing countries. These include the cost of the consumables such as acute peritoneal dialysis catheter, peritoneal dialysate fluid and availability of expertise for the procedure.[3] However, the training organized by International Society for Peritoneal Dialysis (ISPD) and International Pediatric Nephrology Association (IPNA) for medical personnel from developing countries which was subsequently stepped down in their home countries has contributed remarkably to the use of APD.[4]

Previous studies done in low socio-economic setting had shown some success rate in adapting readily available resource for APD in children with AKI.[4-7] Zhang et al [8] made use of 16G single lumen central venous catheter instead of the Tenckhoff peritoneal dialysis catheter as a PD catheter, his conclusion was that PD was a safe, feasible procedure even in paediatric patients with post-cardiac surgery complication of heart failure and AKI. In index case, we made use of adaptations of available materials in my institution for the APD. The patient recovered and is being followed up. The aim of this write up is to show that an adaptation of APD could be a way out when faced with the challenge of sick children that need APD but the resources are not within the reach of primary caregivers who often have to pay out of pocket.

Severe malaria remains a major cause of morbidity and mortality among under five children in sub-Saharan Africa.[8] Severe malaria-associated acute kidney injury (AKI) is a life-threatening complication requiring prompt recognition and intervention. In resource-limited settings, modified peritoneal dialysis (PD) may be lifesaving when faced with non availability of standard consumables for APD.[6]

Case Presentation

The patient was a 2-year old girl referred from a private hospital on account of fever of 3 days, multiple episodes of convulsions and loss of consciousness for 2 days and passage of dark-brown urine of a day duration. There was no reduction in urine output.She was initially managed at a private hospital where she received intravenous medications and had blood transfusion on account of anaemia (Packed cell volume PCV was 21%) but was referred due to persistent convulsions.She had no prior hospital admissions, blood transfusions, or surgeries and had no history suggestive of sickle cell anaemia. There were no known drug or food allergies.

Pregnancy, delivery and neonatal period were not adversely eventful. Her development has been normal prior to this illness, and she was well vaccinated for age

She is the only child in a monogamous family setting. Her mother was a 23-year-old baker apprentice with secondary school education, while her father was a 30-year-old fuel station attendant with a university degree. The family income was estimated to be 15,000-20,000 Naira per month

On Examination

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She was unconscious, febrile (39.4°C), not pale, anicteric, acyanosed, not dehydrated, no pedal oedema, Weight: 10 kg (83% of expected).

Neurological Examination

Glasgow Coma Score: 8/15 (E-1; V-2; M-5). Both pupils were equal in size. 3 mm and reactive to light. The neck was supple and the tone was normal.

Cardiovascular System

The Pulse rate was172 beats/min with the first, second and third heart sound heard, no murmur.

Respiratory System: Respiratory rate was 80 cycles/min with vesicular breath sound

Gastrointestinal system: Abdomen was full, moved with respiration with soft, tender hepatomegaly.

An assessment of malaria complicated by (i) cerebral malaria,(ii) haemoglobinuria (iii) hypoglycaemia (iv) AKI in heart failure was made.

Investigations

Investigation results revealed hypoglycaemia with random blood sugar of 21 mg/dL which was corrected, malaria rapid diagnostic test was positive. The cerebrospinal fluid (CSF) analysis was normal. The urinalysis revealed haemoglobin:+++,Protein: ++, pH: 7.0. The packed cell volume was 21% and subsequently became 32% post blood transfusion. The serum urea peak was 32.57mmol/L while the serum Creatinine was 388.7µmol/L, urine output was 1.5mls/kg/hour. The highlight of the electrolyte and urea values pre-dialysis and intra-dialysis are as shown in Tables I and II respectively.

Management

Initial Treatment

Hypoglycaemia was corrected with intravenous 10% dextrose. Urethral catheter was passed for close monitoring of the urine output.

Intravenous diazepam and phenobarbitone were administered for seizure control while cerebral malara was treated with intravenous artesunate.

Renal Complication and Dialysis

Progressive rise in urea and creatinine despite conservative management of AKI led to the decision on alternative care for the patient.

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Caregivers were counseled for peritoneal dialysis and the need for adaptation modality due to their serious financial constraint. The parents couldn't afford PD catheter (cost 200,000 naira) and PD Dialysate (cost 50,000 naira per bag of 1 litre). Following their consent, she was subsequently commenced on peritoneal dialysis using adaptations because. Peritoneal dialysis commenced using improvised dialysate: 1.5% Dextrose in Ringer's lactate which was constituted by using 50% dextrose water and Ringer's lactate fluid under strict asepsis and 500 mg ceftriaxone was added into 1 litre of the constituted fluid. The modified PD involved the use of improvised peritoneal catheter (size 10 feeding tube with additional fenestrations created under strict asepsis), this was inserted under local anaesthesia with lidocaine and secured with sutures by the Paediatric surgeon after ensuring that the tube was functional. A 3-way valve to ensure close circuit system and limit the likelihood of infection was used. One end was connected to a soluset, which was used to ensure accurate volume of the improvised PD fluid was dispensed, another end to the improvised PD catheter while the 3rd outlet was attached to a uro-bag which served as the waste bag. The catheter exit site was checked for leakage before covering with sterile gauze and plaster. A total of 40 cycles of peritoneal dialysis over 4 days were performed. The fill time was 10-15minutes; the dwell time was 20-30minutes while the targeted drain time was 10-15minutes. The exchanges were manually done by the doctor while an attending nursing officer was recording the exchange volume and timing. The dressing over the site of catheter insertion was closely observed and changed daily. The effluent was clear and there was no undue abdominal tenderness as well as fever that would have suggested peritonitis.

The patient had a total of 40 cycles of peritoneal dialysis over 4days with subsequent serial improvement and regained consciousness. Intra-dialysis she was on intravenous fluid 5% Dextrose in half strength Darrows solution at maintenance dose of 100mls/kg(her weight was 10kg). PD was discontinued at Serum K- 2.65mmol/l, Na-137.5mmol/l, Cl-106.5mmol/l, urea-9.43mmol/l and Creatinine- 94.1µmmol/l. Hypokalemia was corrected orally.

TABLE I; Electrolytes, Urea, Creatinine (Pre-dialysis Trend)

EUCr	5/3/26	7/3/26	9/3/26	10/3/26
K	4.31mmol/l	2.93mmol/l	3.00mmol/l	2.02mmol/l
Na	128.8mmol/l	122.5mmol/l	126.0mmol/l	123.0mmol/l
Cl	100.0mmol/l	93.0mmol/l	93.3mmol/l	93.5mmol/l
U	6.6mmol/l	23.74mmol/l	31.88mmol/l	32.57mmol/l
Cr	194.4µmol/l	317.1µmol/l	388.7µmol/l	352.9µmol/l
HCO3	NA	NA	NA	NA

NA-not available

TABLE II; Intra Dialysis Biochemical Trend

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E,U,Cr	12/3/26	13/3/26	14/3/26	16/3/26	18/3/26
K	3.62mmol/l	3.33mmol/l	2.58mmol/l	2.56mmol/l	2.65mmol/l
Na	123.6mmol/l	125.1mmol/l	125.1mmol/l	129.0mm0l/l	137.5mmol/l
Cl	93.8mmol/l	94.5mmol/l	94.5mmol/l	99.0mmol/l	106.5mmol/l
U	24.50mmol/l	24.92mmol/l	17.3mmol/l	11.71mmol/l	9.43mmol/l
Cr	323.2µmol/l	220.9µmol/l	191.3µmol/l	161.6µmol/l	94.1µmol/l

The patient showed improvement in renal parameters following dialysis. She regained full consciousness 48hours into the peritoneal dialysis. She was discharged home and currently being followed up in the clinic.

Discussion

Peritoneal dialysis is used more frequently in younger children with AKI when dialysis is indicated.[1,2] The challenge of limited resources in view of consumables for PD in developing countries should not be a rate limiting step in prescribing PD. Every child has a right to live. The PD guidelines encouraged that where resources do not permit the use of commercial PD fluid, locally prepared fluids can be used with careful observation of sterile preparation procedures.[1] The use of a 3-way valve ensured a closed delivery system and reduced propensity for infection by limiting the direct handling of the catheter site during the procedure. This adaptation is in line with a PD guideline[1] for use of closed delivery system with a Y connection. The use of fluid giving set, soluset to ensure prescribed volume of dialysate as well as calibrated uro-bag are also in keeping with the guideline of a system utilizing buretrols to measure fill and drainage volumes while performing manual PD in small children.[1] Perezella et al[9] suggested Ringer's lactate as an inexpensive and effective dialysate for continuous renal replacement therapy. Comparison of the composition of lactate-based PD solution and Ringer's lactate(a less expensive readily available option) is similar as shown by Perezzella et al.[9]

Composition	Peritoneal Dialystae(1litre) 1.5%	Ringer's lactate (1litre)
Dextrose g/dL	1.5	nil
Sodium (mmol/L)	132	130

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Potassium(mmol/L)	Nil	4
Chloride (mmol/L)	95	109
Calcium (mmol/L)	2.5	2.7
Magnessium (mg/dL)	0.5	0
Lactate (mmol/L)	40	28

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In this index case, 50%dextrose was added to the Ringer's lactate to constitute 1.5%dextrose in 1 litre of Ringer's lactate in order to create a makeshift hypertonic solution that will ensure excess fluid removal. This description has been reported by Jansen et al [10] to be safe provided strict asepsis is ensured. In his report, 1.5% dextrose in Ringer's lactate can be constituted by removing 15mls out of a 500mls of Ringer's lactate and replacing it with 15ml of 50% dextrose water. Palmer et al[11] in a study done in Cameroun also described the effectiveness of constituted 2.5% and 4.5%Dextrose in Ringer's lactate solution for the purpose of PD in instances of fluid overload. In index case report, the patient was on intravenous ceftriaxone and ceftriaxone was also added to the improvised dialysate to reduce the risk of infection. This has been reported to be beneficial in reducing the risk of peritonitis.[1.12] However heparin was not added to the dialysate because the effluent was clear throughout the procedure.

The patient regained consciousness with the decline in the urea level following peritoneal dialysis. This suggested that uraemic encephalopathy and other co-morbidities associated with impaired renal function are reversible when limitations to PD are overcome and hereby reducing morbidity and mortality.

Conclusion

Adaptation using readily available resource for acute peritoneal dialysis under strict asepsis could be lifesaving for children in resource limited settings.

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