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Acute Peritoneal Dialysis is Life Saving in Critically ill Acute Kidney Injury Patients: Single Centre Experience

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Abstract **Original Research Article**

Background: Use of Acute peritoneal dialysis (PD) is underutilized in treatment of critically ill acute kidney injury (AKI) patients admitted at intensive care units (ICU). At places where bedside Hemodialysis is not available in ICU, acute PD may provide a useful and equally effective alternative renal replacement modality. ***Methods:*** Acute PD sessions performed at our ICU during last 3 years, were analyzed. Demographic profile of patients, various complications reported, and patient outcome was studied. ***Results:*** Total 432 Acute PD sessions were performed during study period. Mean Duration was 43.8± 14.5 hours. Poor outflow was the most common complication observed (n-33, 7.6%), while peritonitis was observed in 26 (6.01%) cases. Mortality rate was 38.7%, but none of the death was directly attributed to acute PD complications. Mean Urea reduction ratio were 51.3% and 62.9%, at 24 hours and at end of sessions, respectively. ***Conclusion:*** Acute PD is an efficient and cost-effective renal replacement modality in critically ill ICU patients with minimal complication rates. In resource poor settings, it provides a viable alternative to hemodialysis.

Keywords: Acute kidney injury, Hemodialysis, Peritoneal dialysis, Developing country, Renal replacement therapy.

INTRODUCTION

Acute kidney injury (AKI) is a quite common complication noted in critically ill patients, admitted at Intensive Care Units. The reported incidence of AKI in ICUs varies from 30 to 70% [1-4]. Occurrence of AKI in these patients, dramatically increase morbidity and mortality [1, 4]. Improved nephrology care and dialysis may lower the mortality from AKI in such cases. Till 90s, Acute PD was most common and most of times, only renal replacement modality for AKI, but wide-spread availability of hemodialysis gradually replaced acute PD in treatment of AKI [5, 6]. However, hemodialysis is expensive and technically challenging in resource-limited settings. In majority of ICUs, bedside Hemodialysis facility is not available, and patients have to be transported to dialysis units for dialysis. This process consume a lot of man-power and posts a threat to patient's life since patients who are on mechanical ventilators or are on inotropic support, may become hemo-dynamically unstable during transportation. Acute peritoneal dialysis is an effective but underutilized dialysis modality in such cases [6, 7]. Here, we document outcome of acute PD done during last 3 years at our centre, in critically ill ICU patients.

METHODS

This study was done at Dr SN Medical College, Jodhpur. It is a tertiary level referral centre located at western Rajasthan. In this retro-spective study, all acute PD procedures done at our ICU, between the period of July 2017 and February 2020, were included in analysis. Both male and female adults (age >18 yrs) with a history and clinical investigations suggestive of severe AKI, underwent Acute PD. Acute kidney injury was defined according to AKIN criteria (8). Indications of dialysis included uremic encephalopathy, uremia, refractory hyperkalemia and other electrolyte imbalance, refractory metabolic acidosis, and oligo-anuria with life-threatening fluid overload.

Bed side acute PD Catheter insertion was performed using blind technique, after creation of artificial ascites. Procedure was under cover of Ceftriaxone, if patient was not being administered antibiotics. Commercially available semi-rigid acute PD catheter made of PVC was used for PD purpose. 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. Once a catheter was inserted and tested, dialysis exchanges were started immediately and repeated every hour. Duration of each exchange was 1 hour. For average built adults, 2 L of 1.5% dextrose, PD solution was prescribed, while in larger built case the dwell volume was kept 2.5 L. Extra 25% Dextrose was added to make final concentration of 4.25%, in cases where rapid ultrafiltration was needed.

Heparin (1000 units per exchange) was added to each PD session, from beginning. While, potassium (4 mmol/L) was added to the PD fluid after the 6-8th cycle; depending upon serum potassium level. Arterial blood gas analysis was done at every 6 hours to assess electrolytes and acid-base balance. Blood urea and serum creatinine were measured a beginning of session, at 24 hours, and after completion of session, to assess clearance. Acute peritonitis was suspected whenever there was cloudy outflow or signs and symptoms of peritonitis were present. In each suspected case, total and differential cell count, gram and AFB staining, and culture were performed to confirm occurrence of peritonitis. The maximum duration of each session was 48 hours, after which, the PD catheter was removed. A new catheter was inserted after a minimum gap of 48 hours from previous session, if patient needed further dialysis.

RESULTS

During study period, 437 sessions of acute PD were performed in 403 patients. Five patients died shortly after catheter insertion, none of these deaths was attributed to complications of acute PD. While, in 34 patients acute PD was performed two occasions. These 5 cases were not included in analysis, and remaining 432 sessions performed on 398 patients, were analyzed regarding PD outcome. Patients with contraindication to PD i.e. abdominal wall cellulitis, paralytic ileus, abdominal surgery, abdominal scarring due to multiple surgeries, and severe thrombocytopenia, were not offered acute PD and were straight away taken for hemodialysis.

The baseline clinical and biochemical parameters are shown in table 1. The male/female ratio was 53.5%/46.5%, while mean age of study population was 51.4±8.6 years with wide range of 18 to 91 years. Infection related (with- or without septic shock) AKI was the leading cause of AKI (60%), while hypovolemia (20.1%), and obstructive uropathy (13.6%) were other important causes of AKI. Among 6 cases of drug induced AKI, 3 cases were related to aminoglycosides, while one case each was attributed to Vancomycin, Tenofovir, and contrast agent. Majority of study patients were critically ill; 70.1% cases were on mechanical ventilatory support, and 50.8% required inotropic support to maintain blood pressure. Transportation of such patients to dialysis units is difficult task, hence acute PD could be useful RRT modality in this scenario. The mean numbers of PD cycles were 43.8±14.5 with total PD fluid volume of 88.2±16.8 L per session.

Table-1: Baseline demographic and laboratory characteristics of the patients (n=398)

Variable	Mean (range)
Male/female (n)	213/185
Age (years)	51.4±8.6 (18-91)
Cause of AKI (n)	
Hypovolemia/blood loss	80 (20.1%)
Sepsis ±septic shock	239 (60%)
Snake bite	10 (2.5%)
Drug induced	6 (1.5%)
Hypercalcemia	9 (2.3%)
Obstructive uropathy	54 (13.6%)
Co-morbidity (n)	
Use of Mechanical ventilator	277 (70.1%)
Use of inotropic support	202 (50.8%)
Hypertension	60 (15.1%)
Diabetes	169 (42.5%)
Cerebro-vascular accidents (CVA)	49 (12.3%)
Malignancy	18 (4.5%)
Hemoglobin (mg/dl)	8.7±3.2 (5.7-16.9)
Serum sodium (meq/L)	132.5±8.3 (112-161)
Serum potassium (meq/L)	4.9±1.7 (2.3-9)
Serum bicarbonate level (meq/L)	15.4±7.9 (3.2-28.3)
Serum Calcium (meq/L)	8.1±2.2 (5.7-15.8)
No of PD cycles*	43.8±14.5 (12- 48)
Total dialysate volumes (L)*	88.2±16.8 (24-102)

* n= 432 (total no of PD sessions performed).

Table-2 summarizes the complication profile related to acute PD procedure, in study population. Poor Outflow due to catheter malposition and fibrin clot deposition, was the most common complication (n=33, 7.6%) noted. However, in all except 3 cases, it was successfully managed with catheter repositioning. In these 3 cases, initially PD procedure was excellently started; however, later-on, omental wrapping led to PD failure and these patients were shifted to hemodialysis. Hemorrhagic outflow (n=31, 7.1%) was mild and spontaneously cleared in few sessions, it didn't cause PD failure. Acute peritonitis developed in 26 (6%) sessions during course of acute PD. It was easily managed with intraperitoneal ceftriaxone (1 gram/exchange) and acute PD was continued. None of the acute peritonitis patients had to be prematurely terminated. Peri-catheter leak was observed in 8 cases, it was successfully managed with temporary stoppage of PD for few hours and tight purse string suturing around the catheter. In one patient, initial PD placement was excellent, however, after 24 hours fecal particles were noted in PD outflow drain. The most logical explanation was spontaneous bowel puncture due to semi rigid catheter. PD was stopped, catheter was removed and i.v. metronidazole and ceftazidime were started. Patient survived with further hemodialysis sessions.

Table-2: Distribution of complications of Peritoneal dialysis procedure in study population (n=432)

Variable	Number (percentage)
Poor outflow	33 (7.6%)
Hemorrhagic outflow	31 (7.1%)
Peritonitis	26 (6%)
Peri-catheter leak	08 (1.9%)
Bowel perforation	01 (0.2%)

Mean blood urea levels were 242.1±91.9 mg/dl at baseline. While it declined to 117.9±52.2, and 89.8±34.6 mg/dl after 24 hours and at end of session; thus denoting a urea reduction ratio of 51.3% at 24 hours, and 62.9% at end of therapy, respectively. Baseline mean serum creatinine levels were 8.4±2.9 mg/dl, while levels declined to 5.5±2.2 mg/dl (34% fall) and 4.8±1.9 mg /dl (43.4% fall) after 24 hours, and at end of session, respectively. Thus adequacy of acute PD was comparable to conventional hemodialysis. Mortality rate of 38.7% (n=154) was observed in present study, results are comparable to studies around the world.

DISCUSSION

Acute kidney injury is relatively common occurrence, affecting approximately 5 to 8% of all hospitalized patients, while a higher prevalence of 30-70% is observed in patients in ICUs [1, 4]. Clinical spectrum of AKI differs in developed and developing countries. In developed world, AKI is usually seen in elderly patients with multiple co-morbid conditions, and is part of multi-organ dysfunction with high mortality rate. In contrast, AKI in developing countries is mainly community acquired, and diarrhea, infections, insect bites, and pregnancy related problems being important causes in these cases [8-10].

Peritoneal dialysis was the first successful renal replacement modality for patients with AKI. Till 90s, acute PD was widely accepted for AKI treatment in India, but its practice progressively declined in favor of Hemodialysis [6, 11]. Concern regarding inability to provide adequate clearance in hyper catabolic AKI cases further dampened its use in management of AKI [12, 13]. Currently, PD is underutilized for management of AKI, both in India and around the world. However, hemodialysis is expensive, technically challenging, and not readily available in resource-limited settings. Moreover, PD itself has certain advantages. Being technically simple procedure, it does not require highly trained staff or a complex apparatus, and can be easily initiated. It is much cheaper in comparison to hemodialysis set-up, which is quite useful in developing countries. PD does not require systemic anticoagulation; hence it is safer in patients with high bleeding risk. It can be used both as continuous or intermittent therapy and, due to slow rate of fluid and solute removal; it is suitable in hemodynamic unstable critically ill patients [7]. These advantages of PD should be weighed against certain limitations; such as risk of peritonitis, occurrence of obligatory protein loss, need for an intact peritoneal cavity and overall lower effectiveness. Because the daily clearances of solutes are lower with PD than with daily hemodialysis, there has been concern that PD cannot control the uremia seen in acutely ill hyper catabolic ARF patients. However, many small size studies have reported adequate clearance and comparable outcome in critically ill AKI patient with use of PD [14, 15]. Due to scarcity of data, there is a pressing need to re-evaluate the role of PD in AKI cases.

This study aimed to measure clearance and safety outcome of acute PD done in critically ill patients, admitted at our ICU during last 3 years. We used commercially available PD solutions and disposable catheters under aseptic conditions with standardized monitoring of vital functions and biochemical parameters. Technique success rate was excellent and in all patients acute PD could be initiated easily, while only 3 cases (0.7%) had to be shifted to HD due to omental entrapment. In accordance to literature, our study reiterate the fact that acute PD can be initiated anywhere with minimal infrastructure and negligible training. Thus, it could be very useful and life saving modality in poor countries, where modern medical facilities are almost non-existent [11, 16-18]. Complication profile was also very favorable in our study. The most common complications noted, was poor outflow of peritoneal dialysate due to catheter mal-position. However, in none of the cases, it led to technique failure, and was easily fixed by re-positioning of the catheter. The commercially available semi-rigid acute PD catheter doesn't has any securing mechanism, hence it easily rotate when patient body position is changed. This problem may be mitigated by slight change in catheter design, with provision of side-hinges which may be sutured to skin.

Concerning infectious complications, the rate of peritonitis was much lower (6%) in comparison to reported literature incidence of 12% – 15% [11]. Due to short duration of PD session (<48 hours), it was successfully managed in all patients with use of antibiotics. In contrary, the available literature suggests less success rate in treatment of acute peritonitis in acute PD [16-18]. But these studies used single cuff silicon catheter and duration of acute PD was much longer (7 to 10 days). The incidence of peri-catheter leakage was minimal (1.9%) in comparison to reported rates of 10-12% [11, 18]. This was another advantage of use of semi rigid catheter since its insertion causes minimal trauma. The only serious complication noted was occurrence of spontaneous bowel perforation in one case, which was successfully managed and patient survived. So, the present study reports favorable safety profile of acute PD in AKI cases. With respect to the efficacy of PD in our study, both blood urea and serum

creatinine values decreased significantly at 24 hours and at end of session, indicating efficient purification. Urea reduction ratio of 62.9% was observed with single PD session, which is comparable to conventional hemodialysis session

In conclusion, this study suggests that acute PD can be successfully done in patients with AKI. The adequacy achieved with single session of PD is comparable to Hemodialysis. With proper training of staff, the risk of peritonitis may be reduced significantly. Due to simplicity of procedure, and cost effectiveness, use of acute PD should be encouraged in critically ill AKI patients.

REFERENCES

1. Hoste EA, Bagshaw SM, Bellomo R, Cely CM, Colman R, Cruz DN, Edipidis K, Forni LG, Gomersall CD, Govil D, Honoré PM. Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study. Intensive care medicine. 2015 Aug 1;41(8):1411-23.
2. Hoste EA, Schurgers M. Epidemiology of acute kidney injury: how big is the problem? Crit Care Med, 2008; 36:S146–S151
3. Lameire N, Biesen WV, Vanholder R. Acute renal failure. Lancet, 2005; 365: 417–430
4. Singh TB, Rathore SS, Choudhury TA, Shukla VK, Singh DK, Prakash J. Hospital-acquired acute kidney injury in medical, surgical, and intensive care unit: A comparative study. Indian journal of nephrology. 2013 Jan;23(1):24-29.
5. KDIGO clinical practice guideline for acute kidney injury: modality of renal replacement therapy for patients with AKI. Kidney Int Suppl, 2012; 2:107–10.
6. Mishra OP, Gupta AK, Pooniya V, Prasad R, Tiwary NK, Schaefer F. Peritoneal dialysis in children with acute kidney injury: a developing country experience. Peritoneal dialysis international. 2012 Jul 1;32(4):431-6.
7. Gaião S, Finkelstein FO, de Cal M, Ronco C, Cruz DN. Acute kidney injury: are we biased against peritoneal dialysis?. Peritoneal dialysis international. 2012 May 1;32(3):351-5.
8. Prakash J, Singh TB, Ghosh B, Malhotra V, Rathore SS, Vohra R, Mishra RN, Srivastava PK. Changing epidemiology of community-acquired acute kidney injury in developing countries: analysis of 2405 cases in 26 years from eastern India. Clinical kidney journal. 2013 Apr 1;6(2):150-5.
9. Shukla VS, Singh RG, Rathore SS, Usha. Outcome of malaria-associated acute kidney injury: A prospective study from a single center. Renal failure. 2013 Jul 1;35(6):801-5.
10. Hoste EA, Kellum JA, Selby NM, Zarbock A, Palevsky PM, Bagshaw SM, Goldstein SL, Cerdá J, Chawla LS. Global epidemiology and outcomes of acute kidney injury. Nature Reviews Nephrology. 2018 Oct;14(10):607-25.
11. Abraham G, Varughese S, Mathew M, Vijayan M. A review of acute and chronic peritoneal dialysis in developing countries. Clinical kidney journal. 2015 Jun 1;8(3):310-7.
12. Mehta RL, Letteri JM, for the National Kidney Foundation dialysis Council on Dialysis: Current status of renal replacement therapy in acute renal failure. Am Journal Nephrol, 1999;19:377–382.
13. Chionh CY, Ronco C, Finkelstein FO, Soni SS, Cruz DN. Acute peritoneal dialysis: what is the 'adequate' dose for acute kidney injury?. Nephrol Dial Transplant, 2010;25(10):3155-60.
14. Chitalia VC, Almeida AF, Rai H, Bapat M, Chitalia KV, Acharya VN, Khanna R. Is peritoneal dialysis adequate for hypercatabolic acute renal failure in developing countries?. Kidney international. 2002 Feb 1;61(2):747-57.
15. Gabriel DP, do Nascimento GV, Caramori JT, Martim LC, Barretti P, Balbi AL. High volume peritoneal dialysis for acute renal failure. Peritoneal Dialysis International. 2007 May 1;27(3):277-82.
16. 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: 267–272.
17. Kilonzo KG, Ghosh S, Temu SA, Maro V, Callegari J, Carter M, Handelman G, Finkelstein FO, Levin N, Yeates K. Outcome of acute peritoneal dialysis in northern Tanzania. Peritoneal Dialysis International. 2012 May 1;32(3):261-6.
18. Ponce D, Caramori JT, Barretti P, Balbi AL: Peritoneal dialysis in acute kidney injury: Brazilian experience. Perit Dial Int, 2012;32:242–246.