A retrospective study on high volume peritoneal dialysis in AKI among ICU patients in a tertiary care teaching hospital

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Abstract
Acute kidney injury is a syndrome characterised by the rapid loss of the kidney's excretory function and is typically diagnosed by the accumulation of end products of nitrogen metabolism (urea and creatinine) or decreased urine output, or both. Dialysis modalities used in AKI (Acute Kidney Injury) are HD (Hemodialysis), CRRT (Continuous renal replacement therapy) acute PD and CAPD either manually or with automated machine in advanced centers. Peritoneal dialysis, initially used as first modality of renal replacement therapy in AKI patients before HD is widely available. Usage of PD in developing countries is advantageous due to its lower cost and minimal infrastructural requirements. This is a Retrospective cross sectional study indicating an importance of High Volume Peritoneal Dialysis (HVPD) in ICU patients who had AKI according to AKIN/KDIGO definition, with good outcome, which can be used as a modality of RRT in resource poor countries.

Keywords: HVPD, AKI, AKIN.

Introduction
Acute kidney injury is a syndrome which is characterised by the rapid loss of the kidney's excretory function and it can be diagnosed by the buildup of end products of nitrogen metabolism i.e, Urea and Creatinine or reduced urine output, or both. It is an indication of several disorders that affect the kidney acutely. Acute kidney injury is familiar i.e, 8-16% in hospital patients and very common in Intensive care unit i.e. 1-25%.[1,6,7] Dialysis modalities used in Acute Kidney Injury are Hemodialysis (HD),Continuous Renal Replacement Therapy (CRRT) and Acute Peritoneal dialysis (PD) either manually or with automated machine in advanced centers. Peritoneal dialysis was the first modality of renal replacement therapy used for AKI Patients.[2] Usage of PD in developing countries is advantageous due to its lower cost and minimal infrastructural requirements.[3,4] PD, previously widely accepted as a modality for acute kidney injury management, but its usage is decreased in raise of other types of extracorporeal therapies. Though PD contain some disadvantages like clearance per exchange can decrease if a shorter dwell time is applied, a lower efficiency can be observed in large-sized and severely hyper catabolic patients, fluid removal can be limited, and there is a high risk of infection. The limitations of PD use in AKI, can be overcome by the use of cycles, flexible catheter, and a high volume of dialysis fluid.[9-13] PD is not a best option in patients who undergone recent abdominal surgery, a dynamic ileus, intra-abdominal adhesions, peritoneal fibrosis, or peritonitis. However, in many countries with poor resources where there was no alternative treatment plan, PD is still considered as a lifesaving option in these patients who are at higher risk. Since volume and solute removal are slow and unpredictable parameters, PD may not be as efficient as extracorporeal blood purification techniques for the treatment of emergencies such as acute pulmonary edema or life threatening hyperkalemia.[15-17] There are so many advantages of PD over other therapies. International Society of Peritoneal Dialysis (ISPD) proposed guidelines on PD for AKI are an important step in providing RRT uniformly.[14] It is a simple technique as it does not require expensive equipment and can be used in all types of AKI. It is considered as the best method for Children, patients with Heart failure, Cirrhosis, Bleeding diathesis. It is used to remove high molecular weight toxins of around 10KD. It shows fast renal recovery. Minimum loss of blood is observed by this method. Continuous RRT and Cardiovascular stability is achieved by Peritoneal Dialysis. It helps in better preservation of local renal hemodynamics and may be more physiologic and less inflammatory than HD due to the absence of contact between blood and synthetic membrane. Thus PD is a safe and effective practice in the treatment of AKI. The composition of peritoneal dialysis fluid include sodium 132-134 mmol/L, Potassium 0-2 mmol/L, Magnesium 0.25-0.75 mmol/L, Calcium 1.25-1.75 mmol/L, Chloride 95-106 m m o l /L, Lactate 35-40 mmol/L or HCO3 34 mmol/L, Glucose 1.5-4.25 g/dL, pH-Neutral. To treat certain specific conditions, some drugs are added to PD fluid i.e., Heparin of dose 250-500 units/liter is used when strands of fibrin and plugs are seen in drained fluids. Insulin is added for glycemic control in Diabetic patients as there is raise in glucose level when hypertonic fluid is used but it should not be used in last 2-3 exchanges to prevent post dialysis hypoglycaemia. Potassium of dose 3-4 meq/L is added to maintain Hypokalemia as there is a lack of potassium in PD fluid. Antibiotics are used among patients with poor vascular access and peritonitis. The classification systems like RIFLE/AKIN and Kidney Disease: Improving Global Outcomes (KDIGO) is based on identifying a minimal change in renal functional parameters that are related to an outcome and a gradation of severity that associates with risk of worse outcomes.[1]

Materials and Methods

This is a Retrospective cross sectional chart review of patients of age above 18 years for a period of 3 months (April-June) who were admitted in ICU in Santhiram General hospital, Nandyal. The incidence of AKI was diagnosed using the AKIN (Acute Kidney Injury Network) and KDIGO (Kidney Disease: Improving Global Outcomes) definition. Initiation of Peritoneal dialysis was done according to classical indications like fluid overload, electrolyte imbalance, acid base disturbances and uremia. Primary outcome variables included recovery, length of in- hospital stay and mortality rates. High volume PD is performed with insertion of temporary rigid catheter with hourly cycles with dwell in over 10minutes, with dwell time half an hour with dwell out over 15minutes with dwell volume of 1litre, which differs from routine CAPD used in CKD patients is in fluid requirement. HVPD requires more fluid like 24litres compared to 8litres in CKD patients in a day, constituting the one session in one day. On average 48- 60 cycles (2-3sessions) are required for AKI patients in ICU, those who had longer sessions of requirement converted to flexible catheter.

Results

Out of 102 patients who are included in the study, 47 patients are female, 55 are male patients. The mean age is 55 years, According to AKIN/KDIGO criteria, 32 developed AKI, among them 6 in Stage I, 4 in Stage II, 22 in Stage III(fig 2). Hospital stay is longer in patients with AKI with a mean length of stay of 13 days. Dyselectrolytemia is observed in patients, 14 with Hyponatremia, 5 with Hypokalemia, 8 with Hyperkalemia. Among 32 AKI patients, 19 are initiated on High volume peritoneal dialysis according to the standard indication (fig 1). Mean number of cycles are 55.4 and Mean Balance is +2582.25 ml. In AKI group with and without RRT, Sepsis was the most common etiology present in 23 patients, Other etiologies include 3 with RPRF, 1 with GE AKI, 1 with Contrast induced AKI, 1 with pancreatitis and 3 patients are presented with cardio renal cause(fig3). In these 19 patients, HCO3 stabilization was observed in 12 patients after first session. Infectious Complication like peritonitis was seen in 3 Patients, Mechanical complications like Peri catheter leak in 3(16%), Due to longer requirement of RRT, we have converted 3 patients to CAPD and 2 patients expired in AKI on RRT and 2 Patients expired in non PD patients are due to other co-morbities. Fig. 1

Investigations of AKI patients

Investigations of AKI Patients and it's frequency include: Haemoglobin-9.8%+/-2.2, Anaemia-21(65.63%), Increased WBC count-16(50%), Thrombocytopenia- 10(31.25%), ESR (>20mm/hr)-24(75%), Hyponatremia- 14(43.75%), Hyperkalemia-8(25%), Hypokalemia- 5(15.63%).

Staging of AKI

Fig. 2

Etiology in AKI Patients

Fig. 3

Symptoms of AKI patients

Symptoms of AKI Patients include: Fever-7(21%), Oliguria-20(66%), Anasarca-11(34.38%), Shortness of breath-22(68.75%), Pallor -21(65.63%).

Outcome of RRT Patients

Fig. 4

Statistics

All the results were analyzed by STATA version 13.

Demographics of AKI Vs NON AKI

Table 1

Predictors of requirement of RRT in AKI using a bivariate logistic regression analysis of Demographics

Table 2

Predictors of requirement of RRT in AKI, using a bivariate logistic regression analysis of Investigations

Table 3

Table 1: Demographics of AKI Vs NON AKI.

Variable		Cause of ICU admission		Un adjusted odds ratio (95% CI)	p-value
		Non AKI n(%)	AKI n(%)		
Age in years (mean ± SD)		54.74+/_17.46	56.47+/_14.18	----	
Gender	Male	45(81.82%)	10(18.18%)	0.25(0.10-0.62)	0.003
	Female	25(53.19%)	22(46.81%)	Ref.	
Diabetes mellitus	Yes	28(60.87%)	18(39.13%)	1.9(0.83-4.5)	0.12
Hypertension	Yes	27(55.10%)	22(44.9%)	3.5(1.44 -8.5)	0.006
Smoking	Yes	16(80%)	4(20%)	0.48(0.14-1.58)	0.23
Alcohol	Yes	11(64.71%)	6(35.29%)	1.29(0.41-3.7)	0.7

Table 2: Predictors of requirement of RRT in AKI using a bivariate logistic regression analysis of Demographics.

Variable	Peritoneal dialysis	No dialysis	Un adjusted odds ratio (95% CI)	p-value
Gender (M)	13 (59%)	9 (41%)		
(F)	6 (60%)	4 (40%)	1.04 (0.23-4.77)	0.961
Diabetes mellitus	11(61.11%)	7(38.89%)	1.18 (0.28-4.88)	0.8
Hypertension	15(68.18%)	7(31.82%)	3.2(0.68-15)	0.14
Smoking	3(75%)	1(25%)	2.25(0.20-24)	0.5
Alcohol consumption	5(83.33%)	1(16.67%)	4.2(0.43-41)	0.2

Table 3: Predictors of requirement of RRT in AKI, using a bivariate logistic regression analysis of Investigations.

Variable	Peritoneal dialysis	No dialysis	Un adjusted odds ratio (95% CI)	p-value
Anaemia	13(61.9%)	8(38.1%)	1.3(0.3-5.9)	0.6
Increased WBC count	8(50%)	8(50%)	0.45(0.10-1.9)	0.2
Thrombocytopenia	6(60%)	4(40%)	1.04(0.23-4.7)	0.9
ESR (>20 mm/hr)	14(58.33%)	10(41.67%)	0.35(0.03-3.6)	0.37
Recovery	17(62.96%)	10(37.04%)	0.39(0.05-2.7)	0.34
Not Recovered	2(40%)	3(60%)		

Table 4: Comparison of our study with Daniel Ponce study.

Characteristics	Our study	Daniel ponce study
Type of study	Retrospective study	Prospective study
Duration of study	3months	7 years
Inclusion criteria	ICU	ICU and Non ICU stay
Mean age	55	64
Most common etiology	Sepsis	Sepsis
Indication for dialysis	Hyper kalemia – 7.8% Fluid over load – 34.38% Severe metabolic acidosis – 19%	Hyper kalemia – 11% Fluid overload – 13.6% Severe metabolic acidosis -54%
Requirement of RRT	18% of all icu admissions	21.8%
Duration of in hospital stay	13	12
Most common complication	Peritonitis and mechanical complications	Peritoneal and mechanical complications
Acid base stabilization	63.1% after second session	39.2%
Mortality	9.38% of AKI	62.9%

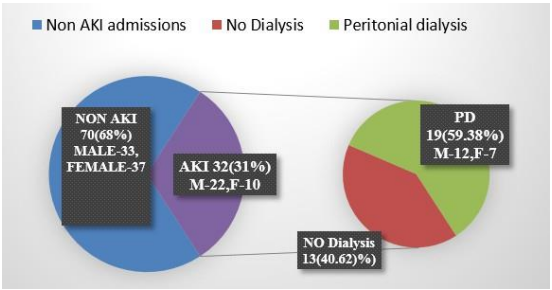

Fig. 1: Study cohort analysis

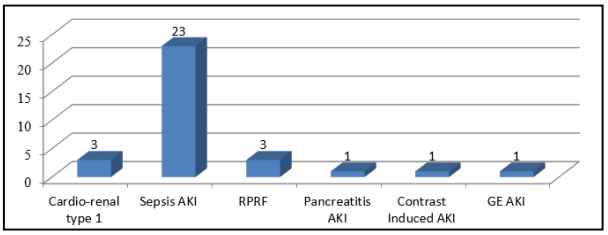

Fig. 3: Etiology of AKI

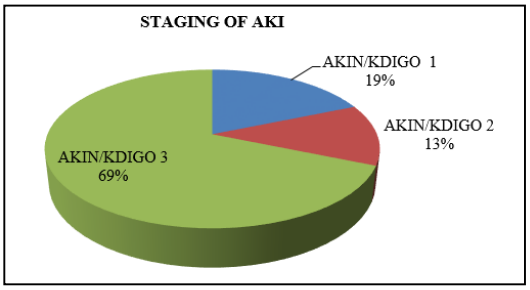

Fig. 2: Staging of AKI

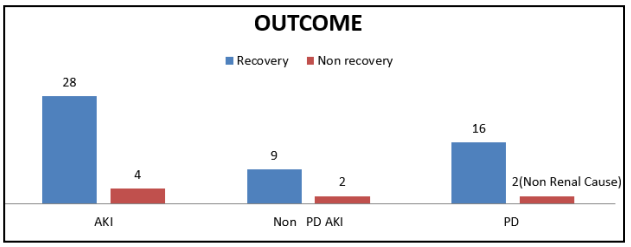

Fig. 4: Outcome of AKI

Discussion

Our study is Retrospective on ICU patients for a period of 3 months is compared with Daniel ponce's Prospective study in which both ICU and Non- ICU patients are included in their study for a period of 7 years. Sepsis is the most common etiology in both the study groups. On comparison, in our study the most common indication for dialysis is fluid overload while in Daniel Ponce study is metabolic acidosis. Requirement of RRT is less in our study compared with Daniel Ponce study. We used rigid catheter initially on all patients and converted to flexible catheter who are in need of longer requirement of RRT, while Flexible catheter is used in Daniel Ponce to all. Peritonitis and mechanical complications in our study are similar to the study by Daniel ponce. The mortality rate is less i.e., 9.38% when compared to Daniel ponce (62.9%) study though our study is only on ICU patients.

Table 4

Conclusion

This study shows that PD is a simple, safe, and efficient way to correct metabolic, electrolyte, acid-base and volume disturbances generated by AKI and it can be used as an RRT modality to treat AKI, in Inpatients of the ICU setting of resource driven countries. High volume peritoneal dialysis is effective for a selected AKI patient group like sepsis and Cardio vascular comorbidities with Good outcome. The Concerns regarding inefficiency were comparable with those modalities, and peritonitis, protein loss and respiratory mechanics have been largely dispelled. Recent reports have shown that in units regularly performing PD for AKI, mortality and complication rates have fallen further and there is no reason to believe that other modalities offer any outcome benefit over PD. Mortality rate is very much low in our study compared with other studies and those who required more number of cycles had infectious complication. The two who expired were in positive balance. Acid-Base Stabilization, Correction of Dyselectrolytemia and requirement of inotropes was decreased after 48 cycles of PD with appropriate treatment of etiology of AKI in majority of our patients. The ISPD have firmly recommended that PD is a suitable modality for treating patients with AKI.

Source of Funding

None.

Conflict of Interest

None.

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