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Comparison of Modes of Renal Replacement Therapies in Intensive Care Unit A Prospective Observational Study

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ABSTRACT

Introduction - *Acute Kidney Injury (AKI) is an independent predictor of mortality and associated with End Stage Renal Disease. Evidence suggests no survival benefit with different modalities of Renal Replacement therapies (RRT).*

Aim – *To Evaluate the modes of Renal Replacement therapies and outcomes in the Intensive care unit (ICU).*

Methods - *A Prospective observational study done for a period of 6 months at 6 Intensive care units associated with Apollo Health City. All patients admitted to the ICU with AKI requiring RRT were eligible to enroll. Exclusion Criteria were post cardiac arrest, age less than 18 years, chronic kidney disease and DNR (do not resuscitate) status. The Primary end point was In-hospital mortality. The following were the parameters monitored Age, Sex, mode of RRT, indication of RRT, Comorbidities, source of sepsis, vasopressors, cumulative balance at RRT, ICU and hospital length of stay, mechanical ventilation duration, APACHE II and SOFA score at admission.*

Results- *The total number of patients were 75 which were grouped into Intermittent hemodialysis 14 patients (IHD), Sustained low efficiency dialysis 34 patients (SLED), Continuous renal replacement therapy 27 patients (CRRT). The In- hospital mortality in IHD, SLED and CRRT were 0, 52.94, 37.03 % respectively. The statistically significant factors influencing the increased mortality rate in the SLED and CRRT group were age >56years , ICU length of stay >11days, hospital length of stay >19days, Comorbidities > 2, mechanical ventilation duration >10 days, vasopressors>1, SOFA score >10 at RRT, Blood urea >130 mg/dl at the RRT and serum creatinine >4mg/dl at RRT. . The patients with septic shock in SLED group and CRRT group were 82.34% and 37.03% respectively. 92% of our study group are medical patients. The In-hospital and 30 day mortality in the SLED group is more than the IHD and CRRT. The Mechanical ventilator days, ICU and hospital length of stay is more in the SLED group compared with IHD and CRRT group. The ICU free days is more in CRRT group than SLED and IHD group.*

CONCLUSIONS- *The In-hospital mortality in IHD was 0%. The In-hospital mortality in the CRRT group is less than SLED group. The In-hospital mortality is increased by increased age, increased ICU and hospital length of stay, Comorbidities more than 2, increased mechanical ventilation duration, vasopressors >1. Further randomized study with more number of patients are required to validate the superiority of the RRT mode.*

KEYWORDS : Acute Kidney Injury(AKI), Intensive care unit (ICU), Acute Physiology and Chronic Health Evaluation II (APACHE II).

INTRODUCTION

Acute Kidney Injury (AKI) requiring intermittent or continuous renal replacement therapy significantly affects morbidity and mortality of critically ill patients.1 AKI constitutes an independent risk factor for death in the intensive care unit (ICU), and data indicate that early induction of RRT significantly improves the prognosis of affected patients2,3. Continuous Renal replacement therapy (CRRT) is widely used in ICUs and is often viewed as the preferable approach in critically ill AKI patients. It remains unclear whether the choice of initial RRT modality may affect patient outcomes, as only few prospective randomized controlled trials (RCTs) have directly compared the different approaches4.The available data did not demonstrate a survival benefit for SLED and CRRT therapy5,6,7,8. We have very few data from India regarding the modality of RRT in the ICU with AKI patients. We planned for a prospective observational study which can impact the initial choice of RRT modality of AKI patients in 6 Intensive Care Units of a tertiary care academic center.

OBJECTIVES. –

To Evaluate the impact of initial choice of RRT modality of AKI patients and outcomes in 6 Intensive Care Units of a tertiary care academic center.

METHODS -

A Prospective observational study done for a period of 6 months at 6 Intensive care units associated with Apollo Health City, Hyderabad. The Uniform protocols were followed in all the 6 ICU. All patients admitted to the ICU with AKI requiring RRT were eligible to enroll. Exclusion Criteria were post cardiac arrest, malignancy, age less than 18 years, chronic kidney disease and DNR status. The Primary end point was In-hospital mortality. The following were the parameters monitored Age, Sex, mode of RRT, indication of RRT, Co-morbidities, source of sepsis, vasopressors, cumulative balance, ICU and hospital length of stay, mechanical ventilation duration, APACHE II and SOFA score at admission, APACHE II and SOFA score at RRT, medical patients, surgical patients, blood urea and serum creatinine at initial RRT. The 3 modes of RRT used were Intermittent hemodialysis (IHD), Sustained low efficiency dialysis(SLED), Continuous renal replacement therapy (CRRT). The mode of RRT depends on the treating critical care consultant and the nephrologist of the concerned unit. The patients can receive any of the 3 modalities of the RRT during the hospital stay. Depending on the clinical condition the mode of dialysis can change from one mode of RRT to other mode of RRT. The patients are grouped into the initial mode of the RRT for the statistical analysis.

STATISTICAL ANALYSIS -

Statistical analysis was done using Chi-square test or Fisher's exact test, Student's t-tests and multivariate logistic regression analysis. SPSS 16 was used for the analysis.

RESULTS

The total number of patients admitted to the ICU were 872 pa-

tients. The renal replacement therapy was done in 172 patients of which only 75 patients met the inclusion criteria. 97 patients were not included in the analysis as per the exclusion criteria were post cardiac arrest, malignancy, age less than 18 years, chronic kidney disease and DNR status.

The 75 study patients were grouped into Intermittent hemodialysis 14 patients (IHD), Sustained low efficiency dialysis 34 patients (SLED), Continuous renal replacement therapy 27 patients (CRRT)). The mode of RRT depends on the treating critical care consultant, nephrologist of the concerned unit and the medical condition of the patient. The patients are not equally distributed in view of non randomisation and only an observational study.

the baseline characteristics of the patients are in the table 1.

Table 1 The Baseline Characteristics of the study group.

Variable	IHD	SLED	CRRT
Age years	57.71	61.7	55.28
Number of patients n	14	34	27
Male n	13	7	11
Female n	1	27	16
APACHE II at admission	15	15	21.7
APACHE II at RRT	15	18	24.07
SOFA at Admission	8.89	7.1	11
SOFA at RRT	9.94	9.1	11.7
Medical n	14	33	22
Surgical n	0	1	5
Sepsis n	14	6	12
Septic shock n	0	28	10
Non septic n	0	0	5
Blood Urea mg/dl	144	129	130.9
Serum creatinine mg/dl	5.6	3.9	4.1
Serum lactate mmol/dl	1.9	2.3	3.1

Sepsis was the most common cause of the AKI. The most common cause of sepsis in our study was lung. The number of patients with causes of sepsis are Lung, urinary tract infection, abdominal sepsis and cellulitis were 34, 16, 6 and 6 patients respectively. The non sepsis patients underwent RRT are 5 patients. The initial vasopressor of choice is noradrenaline, the vasopressin will be added as the second vasopressor and third added vasopressor will be the adrenaline. The number of patients on 3 vasopressors, 2 vasopressors, 1 vasopressor were 12, 11 and 32 patients respectively. The most common indication for the RRT is oliguria. The indications for the RRT oliguria, metabolic acidosis, metabolic acidosis+ oliguria, fluid overload, Uremia were 29, 11, 17, 9 and 9 patients respectively.

The age in years , females, number of patients, septic shock patients were higher in the SLED group.

The serum lactate, APACHE II at admission and RRT, SOFA SCORE at admission and RRT were higher in the CRRT group. The medical patients dominate in our group with 92% and the surgical patients 8%. In the IHD group none of the patients are in septic shock. The non septic patients requiring RRT are 6.67 % and all patients required CRRT. The blood urea and serum creatinine are highest in the IHD group.

The In-hospital mortality in IHD, SLED and CRRT were 0 %, 52.94 %, 37.03 % respectively. The Primary outcomes the In-hospital and 30 day mortality in the SLED group were more than the IHD and CRRT. The mortality in the IHD group was 0% as these patients are less sick compared to the other 2 groups.

The increased ICU length of stay (LOS), increased Mechanical ventilation duration seen in the SLED group compared with IHD and CRRT group and were statistically significant. The ICU free days was more in CRRT group than SLED and IHD group.

Table 2
Primary and Secondary Outcomes of the study group.

Variable	IHD	SLED	CRRT	pvalue
In-hospital mortality n (%)	0	18 (52.94)	10 (37.03)	0.01
30 day mortality % n(%)	0	18 (52.94)	10 (37.03)	0.01
ICU length of stay (days)	4.6	17	8.7	0.002
Hospital Length of stay (days)	9.5	22.5	19.8	0.17
Mechanical ventilator days	4	13.2	7.7	0.001
Cumulative balance ml at RRT	725	3414	4851	0.001

(pvalue<0.05 Statistically significant)

The cumulative positive balance was highest in the CRRT group. The statistically significant factors influencing the increased mortality rate in the SLED and CRRT group were age >56years , increased ICU length of stay >11days, hospital length of stay >19days, Comorbidities > 2, mechanical ventilation duration >10 days, vasopressors>1, SOFA >10 at RRT, Blood urea >130 mg/dl at the RRT and serum creatinine >4mg/dl at RRT.

10 patients from the SLED group later required CRRT as the vasopressors requirement increased but these patients were included in the SLED group for the analysis. All the groups were treated as intension to treat analysis. Similarly All the 17 survived patients of CRRT group later received SLED and IHD but analysed in the CRRT group.

Table 3
Factors influencing the In-hospital Mortality

Variable	pvalue	Odds ratio	95% CI
Age > 56yrs	0.01	1.01	0.98-1.05
ICU length of stay>-11days	0.002	1.5	1.4-1.91
Hospital length of stay >19days	0.02	1.4	1.26-1.89
Comorbidites >2	0.01	1.36	1.06-1.74
Mechanical ventilation >10days	0.02	1.45	1.3-1.9
Vasopressors >1	0.007	2.58	1.4-4.47
SOFA >10 at RRT	0.05	1.01	1-1.4
Blood urea >130mg/dl at RRT	0.05	1.38	1.19- 1.79
Serum creatinine >4mg/dl	0.004	1.2	1.1- 1.4

(pvalue<0.05 Statistically significant)

DISCUSSION-

In Our study we have unequal distribution of the patients in the 3 modes of RRT as it is a prospective observational study. We compared our results with studies done by Ravindra Mehta, CONVINT trial, Robert L. Lins were the prospective randomised trials.

92% of our study group consists of medical patients which is higher compared with studies by RavindraMehta, CONVINT, Robertlins, Dominik and Abhijat.

CRRT Group

The mortality of the CRRT patients in our study group is 37.03%. The mortality in the studies by RavindraMehta, CONVINT, Robertlins,

Dominik and Abhijat were 65.5%, 43.9%, 58.1%, 47% and 61.4% respectively. The mortality in our group is less compared with the other studies. The CONVINT study mortality is almost similar to our group and compared with the APACHE II scoring system.

The mortality in the Ravindramehta and Robertlins study were higher in spite of almost the similar APACHE II score possibly these are the older published studies, the improved evidence based critical care medicine and the techniques of CRRT decreased the mortality in our study.

The APACHE II of the CRRT patients in our study group is 24. The APACHE II in the other studies by RavindraMehta, CONVINT, Robertlins were 25.5, 28.8, 26.3 respectively.

The SOFA Score of our study is 11 and Abhijat etal was 16.4. The mortality in the Abhijat etal study was higher than our study and the SOFA Score was also higher compared to our study.

The blood urea at the starting of the CRRT in our group was 130.9 mg/dl and the CONVINT group was 156mg/dl.

SLED Group

The mortality of the SLED patients in our study group is 52.94%. The mortality in the Abhijat and Mishra etal group were 54.1% and 65% respectively.

The SOFA Score of our study, Abhijat etal and mishra et al were 7.1, 15.4 and 13 respectively. The mortality in the Abhijat etal study was almost equal to our study. When the mortality is adjusted for the SOFA Score, the mortality of our group will be higher than the abhijat etal. The mortality in the Mishra etal group is higher than our study but their SOFA score is also higher than our study.

Even though the SLED group APACHE II and SOFA Score is less than CRRT group in our study the ICU LOS, hospital LOS and mechanical ventilation duration is much higher compared with the CRRT group. The septic shock in SLED group and CRRT group were 82.34% and 37.03% respectively.

The majority of SLED patients became more sick and started on CRRT as per the intension to treat analysis. 10 patients from the SLED group later required CRRT as the vasopressors requirement increased but these patients were included in the SLED group for the analysis.

Limitations of the study- Nonrandomized prospective observational study, the severity of the scoring is different for the 3 groups within the study, the modality of the RRT depends on the concerned unit Critical care physician and nephrologist, small group of patients and also unequal distribution of patients.

CONCLUSIONS

The In-hospital mortality in the IHD group was 0%. The In-hospital mortality in the CRRT group was less than SLED group. The In-hospital mortality was increased by increased age, increased ICU and hospital length of stay, Comorbidities more than 2, increased mechanical ventilation duration, vasopressors >1. Further randomized study with more number of patients were required to validate the superiority for the mode of RRT.

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