Spectrum of Acute Kidney Injury and its Outcome in Intensive Care Unit in Tertiary Care Center in India

Hindistan'da Bir Tersiyer Bakım Merkezinde Yoğun Bakım Ünitesinde Akut Böbrek Hasarı Spektrumu ve Sonuçları

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ABSTRACT

OBJECTIVE: To determine the incidence and outcome of acute kidney injury (AKI) in critically ill patients and to evaluate RIFLE criteria in critically ill patients. Prospective observational study.

MATERIAL and METHODS: 130 patients diagnosed with AKI in the intensive care unit were studied prospectively. All patients were evaluated for the etiology of AKI. Serum creatinine levels were measured at the time of discharge from the hospital as well as during the follow-up period (2 months).

RESULTS: The incidence of AKI was 17.81%. The mean age of the study group was 57.9 years. Sepsis was the predominant cause of AKI (35%). The distribution of the RIFLE group was Risk-6.9 %, Injury – 41.5 % and Failure – 46.6 %. Increasing severity of acute kidney injury is associated with the need for longer duration of inotropes, number of inotropes and ventilator care. The overall mortality was 24.62 %, the highest in loss group (57.1%) followed by failure (31.7%), injury (14.8 %) and risk group (11.1%). Renal replacement therapy (RRT) was required in 58 patients (44.6 %). The mortality in the RRT group was 75%. Survival benefit was more among patients with early initiation of RRT (p=<0.001). At the end of 60 days of follow-up, out of 130 patients with AKI, 98 patients had recovery of their renal function. Complete recovery was found in 85% of patients and the rest 15% had only partial recovery of their renal function.

CONCLUSION: This study shows that there is a stepwise increase in relative risk of death going from Risk to Failure of RIFLE stage and early initiation of RRT may be beneficial in critically ill AKI patients.

KEY WORDS: Acute kidney injury, Mortality, RIFLE, Renal replacement therapy, Sepsis

ÖZ

AMAÇ: Ağır hasta kişilerde akut böbrek hasarı insidansı ve sonucunu belirlemek ve bu hastalarda RIFLE kriterlerini değerlendirmek. Prospektif gözlemsel çalışma.

GEREÇ ve YÖNTEMLER: Yoğun bakım ünitesinde ağır böbrek hasarı tanısı konan 130 hasta prospektif olarak çalışıldı. Tüm hastalar ağır böbrek hasarı etiyolojisi açısından değerlendirildi. Hastaneden taburcu olma zamanında ve ayrıca takip döneminde (2 ay) serum kreatinin seviyeleri ölçüldü.

BULGULAR: Ağır böbrek hasarı insidansı %17,81 bulundu. Çalışma grubunun ortalama yaşı 57,9 yıldı. Ağır böbrek hasarının temel nedeni sepsisti (%35). RIFLE grubunun dağılımı risk %6,9 hasar %41,5 ve yetmezlik %46,6 şeklindeydi. Akut böbrek hasarının şiddeti daha uzun süre inotrop gerekmesi, inotrop sayısı ve ventilatör bakımıyla ilişkiliydi. Genel mortalite oranı %24,62 oldu ve bu oran kayıp grubunda en yüksek olup (%57,1) bunu yetmezlik (%31,7), hasar (%14,8) ve risk (%11,1) grupları izliyordu. Renal replasman tedavisi (RRT) 58 hastada (%44,6) gerekti. RRT grubunda mortalite %75'ti. RRT'nin erken başlandığı hastalarda sağkalım faydası daha yüksekti (p=<0,001). 60 gün takip sonunda ağır böbrek hasarlı 130 hastadan 98'inde böbrek işlevi geri kazanıldı. Hastaların %85'inde bu geri kazanma tam olurken %15'inde ancak kısmi idi.

SONUÇ: Bu çalışma, RIFLE evrelerinde Risk durumundan Yetmezlik durumuna gidildiğinde relatif ölüm riskinin kademeli olarak arttığını ve akut böbrek hasarı bulunan ağır hastalarda erken RRT başlanmasının faydalı olabileceğini göstermiştir.

ANAHTAR SÖZCÜKLER: Akut böbrek hasarı, Mortalite, RIFLE, Renal replasman tedavisi, Sepsis

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INTRODUCTION

Acute kidney injury (AKI) in the setting of intensive care unit had been the subject of a number of publications over the last two to three decades. It is recognized that the epidemiology of AKI in developing countries differs from that of the developed world in many important ways (1,2). Recent reviews emphasize that disparities in the definition of AKI have resulted in large variations in reported incidence and outcomes from developing and developed world (2). The definition and staging of AKI has been recently standardized using the RIFLE classification proposed by the Acute Dialysis Quality Initiative Group and the one suggested by the Acute Kidney Injury Network (AKIN) (3). Most studies on the incidence of AKI are limited to the developed countries and are based on retrospective analysis of records.

A comprehensive understanding of the clinical spectrum of a disease is needed in order to identify potential areas of intervention. With this in view, given that the spectrum of AKI differs in developing countries and that retrospective ascertainment of diagnosis is difficult, we aimed to prospectively determine the incidence and outcome of AKI in critically ill patients, hospitalized in intensive care unit at Lilavati Hospital which is a tertiary care center in metropolitan city in India.

Aims and Objectives

1. To study the spectrum of AKI in intensive care unit (ICU) in tertiary care center in India,
2. To evaluate RIFLE criteria in critically ill patients admitted in ICU,
3. To study relationship of RIFLE criteria with the patient outcome.

MATERIALS and METHODS

This prospective study was carried out at Lilavati hospital and research centre, Mumbai between January 2009 and December 2010. 130 patients diagnosed to have AKI in ICU were studied prospectively. AKI was diagnosed and staged using RIFLE criteria (3). All patients were evaluated for the etiology of AKI based on detailed history, clinical and laboratory data. All the important major chronic preexisting co-morbid conditions such as respiratory, cardiovascular, hepatic, neurological and gastrointestinal diseases were noted. In addition preexisting malignancy, tuberculosis, any immunocompromised state were documented.

The clinical parameters in the first 24 hours of admission including heart rate, mean arterial pressures, respiratory rate, temperature, and the urine output measure in ml/ kg/hour was calculated. The laboratory parameters measured were complete blood count, blood glucose, renal function tests, serum electrolytes, liver function tests, coagulation profile and arterial blood gases. As a reference we also evaluated a general severity of illness scoring system APACHE II (Acute Physiology And Chronic Health Evaluation), SAPS II (Simplified Acute Physiology Score) and its probability of death based on the score. Both scores were calculated within first 24 hours of admission and we used OPUS 12 Foundation, Inc. Computer software program available on Internet. Serum creatinine levels were measured at the time of discharge from the hospital as well as during follow-up period (2 months) to find out how many had complete recovery, partial recovery and no recovery of renal function. Complete recovery is defined as those patients whose serum creatinine returned to baseline following recovery from AKI, partial recovery is defined as those patients whose creatinine has dropped following an AKI but did not return to their baseline values and no recovery is defined as those patients whose creatinine has never dropped following an AKI.

Inclusion Criteria: All adult patients, age 18 and above, with evidence of normal baseline serum creatinine, admitted with AKI as per RIFLE criteria in the ICU are prospectively enrolled in the study.

Exclusion Criteria: Chronic kidney disease as per KDOQI (Kidney disease outcome and quality initiative), Renal transplant recipients and patients with Obstructive uropathy are excluded from this study.

STATISTICAL ANALYSIS

Quantitative variables were presented by mean +/- SD (if data passes normality test) or median & inter-quartile range (if data fails Qualitative variables were represented in form of frequency and percentage. normality test). Cross-tabulations between Qualitative variables were assessed by chi-square test (with continuity correction for 2 X 2 tables). If chi-square test was found to be not valid due to small counts, data of adjacent rows and/or columns was pooled and chi-square test reapplied. If it still remained invalid, p-value of Fisher's exact test was considered for discussion. Comparison between pair of groups for Quantitative variables was done by application of unpaired t-test (if data passes normality test) or Mann Whitney test (if data fails normality test). p- Values of 0.05 were taken as the cut-off for statistical significance.

RESULTS

A total of 730 patients admitted during January 2009 to December 2010 to the ICU were enrolled in this study. Of this nephrology reference was sought in 230 patients. Out of these, 70 patients were excluded from study because they had underlying CKD, 18 patients had post renal transplant status and 12 patients had obstructive nephropathy. After these exclusions, 130 patients with AKI were enrolled in the study. This gives an incidence of AKI of 17.81% in the ICU.

These 130 patients were prospectively studied and stratified by the RIFLE criteria. There were 81 Males (62.3%) and 49 Females (37.7%). Majority of patients (38.5%) belonged to 60-69 year age group. The mean age of the study group was 57.9 years

(Age from 20-95 years, range 77 years). Laboratory parameters of the studied subjects were depicted in Table I. Sepsis was the predominant cause for AKI in our study (Figure 1). A total of 35% of patients admitted with AKI in the ICU had sepsis.

The distribution of the RIFLE group was Risk-6.9 %, Injury – 41.5 % and Failure – 46.6 % (Figure 2). The various clinical and laboratory parameters of the RIFLE groups are listed in Table II. Increasing severity of acute kidney injury is associated with the need for longer duration of inotropes, number of inotropes and ventilator care. Inotropes were needed in Failure group for an average of 2.37 days, whereas in Injury and Risk it was 0.44 and 0.7 days respectively. The mean values for ventilator support required in the various groups were Risk-0.22 days, Injury – 0.68 days and Failure – 2.35 days. The length of stay in the ICU significantly increased with worsening RIFLE group. The mean length of stay in the ICU for risk group was 3.56 days, injury group was 5.39 days and Failure group was 7.73 days. The overall mortality was 24.62 %, the highest in loss group (57.1%) followed by failure (31.7%), injury (14.8 %) and risk group (11.1%) and this observation reached statistical significance (p= 0.026) (Table III).

Renal replacement therapy was required in 58 patients (44.6 %). The various modalities of RRT were intermittent hemodialysis (IHD) in 16 patients (27.9%), sustained low efficiency dialysis (SLED) in 33 (56.9%) and continuous renal replacement therapy (CRRT) in 9 patients (15.52%). The mortality in the RRT group was 75%. Mortality rate among the various modalities were IHD-25 %, SLED-45.5% and CRRT-55.6 % (Table IV). A significant correlation was found between the time of initiation of RRT and outcome. In 12 cases RRT was initiated on day 1, of admission to ICU, of whom 10 survived (83.2%) and 2 expired (16.7%). In 29 patients RRT was initiated on day 2, of whom 19 survived (65.5%) and 10 expired (34.5%). In 16 patients RRT was initiated from day 3 to day 6 of ICU admission and only 4 (25 %) survived whereas 12 expired (75 %). This difference was found to be statistically significant (Table V).

Table I: Comparison of laboratory parameters according to RIFLE.

	Risk	Injury	Failure
Serum Creatinine (mg/dl)	3.75±0.35	3.31±0.68	3.95±0.48
Serum Albumin (g/dl)	2.68±0.75	2.45±0.75	2.27±0.36
$HCO3^-$ (mg/dl)	18.24±4.19	17.03±4.13	16.45±4.73
Hemoglobin (g/dl)	10.46±1.19	9.8±1.08	9.6±0.78
Calcium (mg/dl)	9.64 ± 3.84	9.48 ± 2.78	9.20 ± 3.46
Phosphorus (mg/dl)	4.46 ± 1.18	4.64 ± 1.24	4.72 ± 1.62

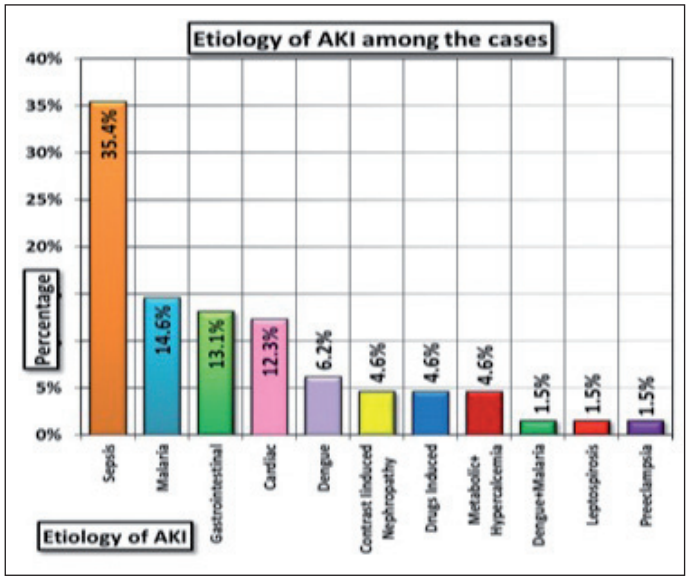

Figure 1: *Etiology of AKI.*

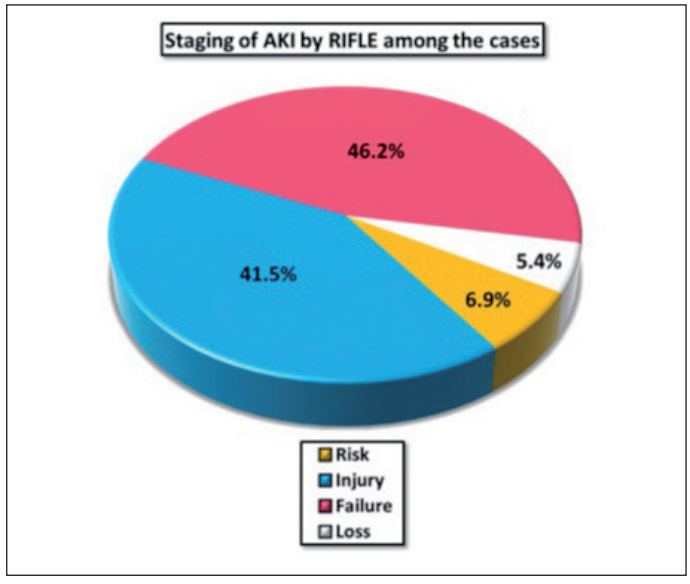

Figure 2: *Staging of AKI.*

Table II: Comparison of clinical and laboratory parameters between RIFLE groups.

Variables	Staging of AKI by RIFLE	Mean	SD	Median	IQR	Chi-Square	p-value
Ventilation days ^	Risk	0.22	0.44	0.00	0.50	28.807	2.46E-06
	Injury	0.68	1.82	0.00	0.00	Difference is significant	
	Failure	2.35	2.95	0.50	4.00		
	Loss	9.43	4.76	12.00	6.00		
ICU days ^	Risk	3.56	1.13	4.00	2.00	32.559	3.99E-07
	Injury	5.39	2.84	5.00	3.50	Difference is significant	
	Failure	7.73	4.49	6.00	5.00		
	Loss	18.43	10.00	24.00	22.00		
Inotrope days ^	Risk	0.44	0.53	0.00	1.00	27.302	5.09E-06
	Injury	0.70	1.84	0.00	1.00	Difference is significant	
	Failure	2.37	2.80	2.00	3.75		
	Loss	7.00	4.51	6.00	8.00		
No. of inotropes ^	Risk	0.89	1.27	0.00	2.00	20.063	0.0002
	Injury	0.63	1.00	0.00	1.00	Difference is significant	
	Failure	1.42	1.20	2.00	2.00		
	Loss	2.43	1.13	3.00	1.00		
Apache II ^	Risk	16.00	7.60	19.00	16.00	33.371	2.69E-07
	Injury	22.72	5.94	23.00	9.00	Difference is significant	
	Failure	31.02	9.72	29.00	18.00		
	Loss	38.57	11.49	44.00	15.00		
SAPS II ^	Risk	30.22	10.06	32.00	20.50	40.589	7.99E-09
	Injury	31.91	13.78	29.00	15.25	Difference is significant	
	Failure	55.22	23.35	55.00	28.00		
	Loss	55.43	22.71	47.00	50.00		

At the end of 60 days of follow-up, 98 of the 130 patients with AKI had recovery of their renal function. Complete recovery was found in 85% of patients and the remaining 15% had only partial recovery of their renal function (Figure 3). It was found that almost all (100%) patients in Loss stage of RIFLE had partial recovery of their renal function. Recovery of renal function among the RIFLE class was statistically significant. There were no dialysis dependent patients at the end of two months.

DISCUSSION

Acute kidney injury, as defined by the RIFLE criteria, is a complication increasingly encountered in hospitalized patients that often portends worse clinical outcome, including increased duration of hospitalization, need for ICU admission, and mortality.

The occurrence of AKI has varied widely across studies, being largely dependent on the setting and the at-risk populations being investigated. Historically, a wide spectrum of definitions for AKI has been used in the literature. These definitions employed a range of different conventional surrogates of kidney function, such as serum urea, creatinine (SCr), urine output, or a combination of these descriptions, and they essentially described a vast continuum in grades of severity of loss of function. The Acute Dialysis Quality Initiative group published a consensus definition referred to as the risk, injury, failure, loss and end-stage renal disease (RIFLE) classification system. This novel classification scheme has been shown to have value for identifying/classifying acute renal failure as AKI across a range of clinical studies, along with a robust prediction for

Table III: Staging of AKI by RIFLE and outcome.

Staging of AKI by RIFLE		Outcome		Total
		Expired	Recovered	
Risk	No.	1	8	9
	%	11.1%	88.9%	100.0%
Injury	No.	8	46	54
	%	14.8%	85.2%	100.0%
Failure	No.	19	41	60
	%	31.7%	68.3%	100.0%
Loss	No.	4	3	7
	%	57.1%	42.9%	100.0%
Total	No.	32	98	130
	%	24.6%	75.4%	100.0%

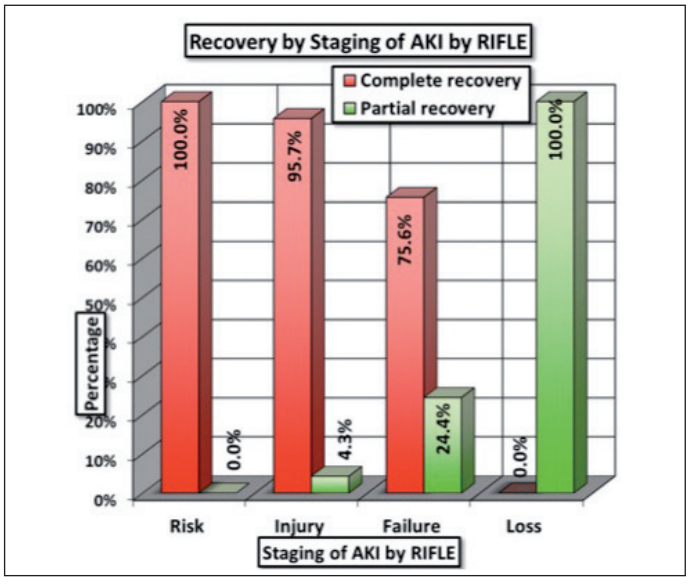

Figure 3: *Staging of AKI by RIFLE and recovery.*

clinical outcomes, and it has been rapidly adopted by the medical community (4). Using the RIFLE classification, we prospectively classified patients according to the maximum RIFLE class (class R, class I or class F) reached during their hospital stay. The RIFLE class was determined based on the worst serum creatinine, glomerular filtration rate criteria or urine output criteria.

Hoste et al. showed that more than 50% of the patients with RIFLE class R progressed to RIFLE class I or class F, and more than one-third of the patients with RIFLE class I progressed to class F. Hence it is ideal to stratify patients with AKI based on

Table IV: Type of dialysis and outcome.

Type of Dialysis		Outcome		Total
		Expired	Recovered	
SLED	No.	15	18	33
	%	45.5%	54.5%	100.0%
HD ^	No.	4	12	16
	%	25.0%	75.0%	100.0%
CRRT ^	No.	5	4	9
	%	55.6%	44.4%	100.0%
No dialysis	No.	8	64	72
	%	11.1%	88.9%	100.0%
Total	No.	32	98	130
	%	24.6%	75.4%	100.0%

Table V: Time to initiate RRT and outcome.

Time to initiate RRT (days)		Outcome		Total
		Expired	Recovered	
1	No.	2	10	12
	%	16.7%	83.3%	100.0%
2	No.	10	19	29
	%	34.5%	65.5%	100.0%
3	No.	7	3	10
	%	70.0%	30.0%	100.0%
4	No.	2	1	3
	%	66.7%	33.3%	100.0%
5	No.	2	0	2
	%	100.0%	0.0%	100.0%
6	No.	1	0	1
	%	100.0%	0.0%	100.0%
Total	No.	24	33	57
	%	42.1%	57.9%	100.0%

the maximum RIFLE class reached during their hospital stay (5). In a large cohort of hospitalized patients at a tertiary hospital in Australia, 18% of all admitted patients had AKI (risk 9.1%, injury 5.2%, and failure 3.7%). Studies focused on critically ill patients have found the incidence to range from 30-70 %, 10.8% developed AKI and 19% were classified as risk (R), 35% as injury (I), and 46% as failure (F) (6). Our study has almost similar incidence of AKI (17.8%). As per RIFLE, 6.9% of patients had

risk, 41.5% had injury and 46.2% had failure stage of AKI. These data imply that the burden of illness attributable to AKI has increased significantly. There are plausible explanations for these trends. In particular, there has been a transition in patient demographics such that patients are older and have a greater burden of comorbid disease. These patients are more likely developing AKI in the context of multiple organ failure (7).

The commonest cause of AKI in the present study was sepsis related AKI (35%) followed by malaria (14%) and gastrointestinal problems (13%) such as diarrhea; persistent vomiting and upper GI bleed. This spectrum of AKI is comparable to the results of the study done by Chugh et al. (8) Sepsis was also a common cause of AKI in Chugh's study. However, Chugh et al. included all hospitalized patients with AKI, unlike the present study, which includes only the ICU patients. A study done by Bagshaw et al. also showed that septic AKI (47%) was the commonest cause of AKI in critically ill patients (9). Malaria was the second leading cause (14%) for AKI in our patients. Plasmodium falciparum malaria contributed to 73.8% (14 out of 19) of AKI, followed by plasmodium vivax 26.2% (5 out of 19). Our results are similar to data from Kaul et al., suggesting increasing incidence of complicated malaria in plasmodium vivax infections in India (10). Gastrointestinal problems, especially diarrheal diseases are more prevalent and are more prone to the development of AKI. (11) E coli was the leading etiological agent in our study, followed by salmonella and shigella. Acute cardiorenal syndrome where in Acute cardiogenic shock and acutely decompensated congestive heart failure leads to acute kidney injury was the fourth (12.3%) leading cause of AKI in our study. Dengue fever related AKI comprise 10.8% of AKI in a recent study from south India (12). In our study population, Dengue-related AKI contributed to 6.2% of the cases. Contrast-induced acute kidney injury is a well-known cause of AKI in a hospital setting. The frequency of contrast induced AKI is around 7% and its incidence has decreased significantly in recent years (13). In our study 4.6% of AKI has been attributed to contrast-induced AKI. Several large epidemiologic studies have shown that drugs were contributing factors in 19% to 25% of cases of severe acute renal failure in critically ill patients (14). These drugs in our study contributed 4.6% of AKI's.

Renal recovery following an episode of AKI is recognized as an important determinant of survival and quality-of-life. There is a relative paucity of data on renal recovery after AKI. Emerging data suggest hospital survivors of critical illness complicated by AKI have a greater than threefold increased risk for end stage kidney disease (ESKD) over the subsequent decade when compared with matched controls (10). Incomplete or partial recovery of kidney function following AKI is likely to become an increasingly recognized problem, and data suggest these patients also have a lower rate of survival and a higher risk of progression to ESKD (11,12). In our study, recovery of renal function was noted in 85% of patients. Complete recovery of renal function was found in earlier stages of AKI (risk 100% vs. loss 0%).

Advances in RRT in the last few years have resulted in multiple RRT modalities available for treating AKI in the ICU. CRRT is gaining greater acceptance with the use of venovenous access and its advantages in hemodynamically unstable patients. There are little data as to the best modality of RRT. There are few randomized controlled trials and most existing studies are retrospective and poorly controlled. Many confounders exist, such as severity of illness and etiology of renal failure, which are probably the most important factors affecting outcome in ICU patients with AKI. Some recent studies also suggest that higher doses of dialysis confer a survival advantage. Choice of modality should probably be tailored to the needs of the individual patient. In a study done by Rabindranath et al., no significant survival benefit was found between patients undergoing intermittent hemodialysis, SLED and CRRT (13). In our study we found that mortality rate was more among CRRT group as compared to SLED and IHD, this high rate of mortality in CRRT group could be due to the fact that patient selected for CRRT had persistent hypotension with maximum inotropic support along with multi-organ dysfunction. Among the recovered cases between SLED and CRRT there was no statistical significance. The presence and increasing severity of AKI has shown an association with an increasing duration of stay in both ICU and hospital, implying a greater treatment intensity and/or health resource utilization (9). A number of studies have shown that RIFLE class Failure is associated with significantly longer duration of stay in the ICU and hospital. In present study, length of hospital stay was 3.56 days for risk, 5.39 days for injury and 7.73 days for failure stage of AKI .The length of stay in the hospital was also significantly longer in the loss (18.43 days) and this duration of stay in ICU is statistically significant. This reflects the underlying severity of the multi organ dysfunction syndrome present in these patients, as evidenced by the higher APACHE II score and SAPII in the RIFLE failure class. Our study also showed a trend for the increased inotropes duration, ventilator support duration and ICU stay in Failure class. The difference between risk, injury and failure was statistically significant.

Another interesting finding in the present study is that outcome among patients treated with RRT was better when RRT was started early in the course of the ICU stay. Although in the present study we studied initiation of RRT in relation to ICU admission rather than to the onset of AKI as in most other studies, our results do agree with the findings of several retrospective studies that suggest that early initiation of RRT may be beneficial in AKI patients (15-18). The results of a recent prospective multicenter observational study also support our findings; with late RRT (defined as being initiated more than 5 days after ICU admission) being associated with greater crude and covariate-adjusted mortality compared with early (within 2 days) or delayed (2 to 5 days) initiation of RRT (19). However, a prospective randomized study in a mixed ICU population found no difference in survival between early (on average within 7 hours of development of AKI) and late (on average 42 hours

after development of AKI) initiation of RRT (20). Our results do agree with the findings of several retrospective studies that suggest that early initiation of RRT may be beneficial in AKI patients (15-18).

There is a strong relationship between severity of AKI and mortality (4). Indeed, even after adjustment for relevant covariates, several epidemiologic studies have shown the presence and severity of AKI to independently portend higher risk of death (7). A number of epidemiologic studies have tried to quantify the performance of the RIFLE classification with receiver operator characteristic curves (21,22). Some have compared it with other scoring systems. Although the findings are interesting, this type of analysis is inherently somewhat flawed. As RIFLE focuses on only the renal aspect of the patient's illness, its predictive ability is expected to be inferior to that of general illness severity scores (23). The RIFLE classification was originally intended to standardize the definition and severity of AKI, rather than be a tool which would predict mortality. Nevertheless, such a system should carry some overall predictive value to be clinically meaningful. With respect to non-AKI patients, there clearly appears to be a stepwise increase in RR for death going from Risk to Failure: this trend was confirmed in different patient populations (ICU, hospital, cardiac surgery, and pediatric.[4] In the study done by Ahlstrom et al., each subsequent stage of AKI, according to RIFLE criteria, showed greater mortality than the previous stage (21). Similar to this study, high rate of mortality was found in 'loss' stage (57%) of AKI in our study as compared to the 'risk' stage (11.1%). The exception was in RRT patients.

Wherein the RIFLE criteria appeared to be less effective in predicting risk of death. One possible explanation is that these patients are already gravely ill; such that RIFLE is no longer able to further discriminate between the R-I-Classes (24,25).

In a multinational, multicenter study conducted by Uchino et al., the observed mortality for the more severe end of the spectrum of AKI remains high in the range of 50-60%, when supported by RRT (26). This observed mortality has changed little in recent decades despite advances in renal support technology; however, this outcome largely reflects the transition in demographic and clinical characteristics of patients admitted to ICU. Similar to these observations, 58 patients out of 130 required RRT in our study and mortality among patients undergoing RRT was found to be 41%.

Our study has several limitations. Firstly, the number of studied patients is small in this study, considering high incidence of ICU admissions in the society. Secondly, the need for a baseline serum creatinine, which was not always available and thirdly, this study was not compared with the control group (non-AKI patients).

CONCLUSION

In conclusion, we presented the results of our study that utilized RIFLE criteria to correlate AKI diagnosis and prognosis. There appears to be a stepwise increase in relative risk for death going from Risk to Failure.

a) Sepsis was the predominant cause of AKI in ICU in tertiary care center in a metropolitan city in India.

b) In this light, the RIFLE classification appears to be a simple and useful clinical tool, using readily available clinical data, to detect and stratify the severity of AKI, and possibly predict outcome (4).

c) Early initiation of RRT may be beneficial in AKI patient

d) Future research might be directed to specify which kind of intervention (medical therapy, experimental therapy, and extracorporeal renal replacement) should be applied at the different levels of AKI: the timing of different therapeutic approaches is as fundamental as the efficacy of the treatment itself.

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