ORIGINAL ARTICLE

Acute Kidney Injury in Patients of Intensive Care Unit

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ABSTRACT

Background: Acute Kidney Injury (AKI) is a common complication in patients admitted to the intensive care unit (ICU) and numerous causes are responsible for its development. The aim of the present study is to assess the incidence, risk factors, and outcome of patients who develop AKI in our ICU.

Methodology: This study was conducted by the Department of Nephrology, Anwer Khan Modern Medical College Hospital (AKMMCH), a tertiary level center of Dhaka, during the period of January 2015 to December 2015. This is a Cross Sectional Descriptive type of Observational study on patients of Acute Kidney Injury (AKI) admitted to Intensive Care Unit (ICU) of AKMMCH.

Result: A total number of 271 patients were admitted. Out of 271 patients, 59 (21.77%) patients with AKI who met our study requirements were included in the study and were evaluated. Among 59 patients 32 (54.23%) were males and 27 (45.77%) were females, with a male to female ratio of 1.19:1. The cause of admission were Diabetes mellitus with complication 11 (18.64%), Hepato-renal syndrome 10 (16.94%), Malignancy 7 (11.86%), Septicaemia 6 (10.18%), Pneumonia 6 (10.18%), Intra-uterine death (IUD) 5 (8.48%) and others (Acute Myocardial Infarction, Non ST segment Elevated MI, Cerebro Vascular Disease, Gullain Burre Syndrome, Laparatomy, Type I and Type II Respiratory failure) 14 (23.72%). According to RIFLE's criteria most of the patients were from Injury group 32 (54.23%). Next to this, was Risk group 17 (28.83%) and in Failure, Loss and ESRD group were 7 (11.86%), 1(1.69%) and 2 (3.39%) accordingly. Regarding biochemical abnormality, mean Serum creatinine was 3.68 $\pm$ 2.15 and that of Urine output, HbA1C and HCO3 level (in ABG) were 4.57 $\pm$ 8.89, 6.91$\pm$1.4 and 17.14 $\pm$ 3.8 respectively. Out of 59 patients 10 (16.95%) needed Haemodialysis. According to RIFLE's criteria 7 (70%) were from Failure group, 1 patient from Loss group and 2 from ESRD group who received haemodialysis. 72.88% (43) patients improved, out of which 57.62% (34) got discharged from ICU after full recovery. 6.48% (4) patients expired and 3.38% (2) turned into ESRD and advised for regular haemodialysis.

Conclusion: The incidence of AKI is high in patients admitted to ICU, and the development of AKI is associated with poor outcome and reduced survival. AKI significantly increases the duration of ICU stay, and this is likely to add to the healthcare burden. Age, gender or the presence of comorbidities do not appear to influence the incidence of AKI in our ICU patients.

Key Words: Acute Kidney Injury, Intensive Care Units

Introduction

Acute kidney injury (AKI) is a complex disorder that occurs in a variety of settings, with clinical manifestations ranging from a minimal elevation in serum creatinine to anuric renal failure.[1] AKI is a common complication in patients admitted to the intensive care unit (ICU) and numerous causes are responsible for its development.[2] Moreover, it occurs as a part of a multiple organ dysfunction syndrome or as a separate event.The AKI incidence in ICU patients varies widely from 3 to 30%, with mortality ranging from 36 to 90%, depending on the type of ICU, study population, the period during which the study is conducted, and the criteria used to define AKI.[3,4,5,6]

The relative importance of factors contributing to AKI varies according to the underlying pathology and patients' characteristics. Several risk factors involved in the genesis of AKI have been analyzed in the medical literature, including obstetric bleeding and digestive hemorrhage, sepsis, shock, infections, use of contrast, and drug toxicity.[3,6] There have been many studies about the epidemiology and risk factors of AKI in critically ill patients in the different regions of the world.[3,7,8,9] However, little data on the risk factors for development of AKI in critically ill patients are available in our country.

Acute kidney injury (AKI) represents the entire spectrum of renal insufficiency and refers to a pathological event that causes functional or structural changes to occur in the kidneys.[10] The development of AKI has also been shown to be associated with higher patient mortality and increased hospital length of stay and cause a rise in health care expenditure.[11] The aim of the present study is to assess the incidence, risk factors, and outcome of patients who develop AKI in our ICU thus reduce the morbidity and mortality of these patients.

Materials and Methods

This study was conducted by the Department of Nephrology, Anwer Khan Modern Medical College Hospital (AKMMCH), a tertiary level center of Dhaka, during the period of January 2015 to December 2015. This is a Cross Sectional Descriptive type of Observational study on patients of Acute Kidney Injury (AKI) admitted to Intensive Care Unit (ICU) of AKMMCH. Duration of the study was 1 year. Intending sample size depending upon the coverage of the patients during the study period. Our Inclusion criteria were as follows-Adult population > 18 years, all patients of ICU, suffering from Acute Kidney Injury(AKI) who fulfills the RIFLE criteria,Adult patients without evidence of end-stage renal disease with more than two creatinine measurements and at least a 6-hr urine output recording who were admitted to the intensive care unit in the study period. Age below 18 years, Other patients admitted in ICU and Patients with Chronic Kidney Disease (CKD) were excluded from the study.

A detailed history had been taken and physical examination had done and necessary investigations were carried out to diagnose the patients of AKI and all are recorded on data collection sheet with structured questionnaire.

All the patients admitted to Intensive Care Units who fulfills the RIFLE criteria of Acute Kidney Injurywere included in the study.Intending sample was depending upon the coverage of patients during study period.The patients below 18 years of age and known cases of CKD were excluded. All clinical & biochemical parameters of the patients were noted onData collection sheet. Blood samples were drawn in the morning, all the subject had rested for at least 10 minutes before blood sampling. Venous blood were collected from the anticubital vein of the hand of the patients with minimal stasis without frothing using standard equipment. Serum were collected and were send for biochemical test.

Data were processed and analyzed using computer software SPSS (Statistical Package for Social Science) version[16]. The test statistics were used to analyze the data by descriptive statistics and Chi-square Test. The descriptive statistics are frequency, mean and standard deviation of mean. The data measured on continuous scale were presented as mean and standard deviation from the mean (SDM) were compared using Chi-square Test. Categorical data were expressed as percentages and were evaluated using Chi-square Test. The level of significance is 0.05. P-value < 0.05 were considered significant. The summarized information were than presented in the from of tables and charts.

Operational Definition

Acute Kidney Injury (AKI) and RIFLE's Criteria

Acute Kidney Injury was defined as patients whose serum creatinine and/or urine output fulfilled the RIFLE criteria. Risk class was defined as increase in serum creatinine ≥1.5 x baseline or urine output <0.5 ml/kg/hour for the duration of ≥ 6 hours. Injury class was defined as increase in serum creatinine ≥2 x baseline or urine output <0.5 ml/kg/hour for the duration of >12 hours. Failure class was defined as increase in serum creatinine >3 x baseline or an absolute serum creatinine 4mg/dl or urine output ≥0.3 ml/kg/hour for the duration of≥24 hours or anuria >12 hours. Loss was defined as complete loss of kidney function >4 weeks, requiring dialysis. ESRD was defined as complete loss of kidney function, requiring dialysis for >3 months. Oliguria was defined as urine output below 500ml/day. Patients who fulfilled RIFLEcriteria within 48 hours of admission were classified as community acquired AKI (CAAKI) and patients who fulfilled RIFLEcriteria 48 hours after admission were classified as hospital acquired AKI (HAAKI). Complete renal recovery was defined as estimated glomerular filtration rate (eGFR) returning to a value of >60 ml/min/1.73m^2 with in 3 months. Chronic kidney disease (CKD) was defined as persistant reduction in eGFR after 3 months with a value <60 ml/min/1.73 m^2. Mortality was defined as patients expiring during the hospital stay[12,8,13].

Result

A total number of 271 patients were admitted in the ICU during the study period (January 2015 to December 2015). Out of 271 patients, 59 (21.77%) patients with AKI who met our study requirements were included in the study and were evaluated.

Among 59 patients 32 (54.23%) were males and 27 (45.77%) were females, with a male to female ratio of 1.19:1. The mean age of the patients was 56.40±15.63 (Range 18-90 years). Most of the patients 37.29% (22) were from 51-60 years age group where as 22.05% (13) patients were from 61-70 years age group (Table 1).

The cause of admission were Diabetes mellitus with complication 11 (18.64%), Hepato-renal syndrome 10 (16.94%), Malignancy 7 (11.86%), Septicaemia 6 (10.18%), Pneumonia 6 (10.18%), Intra-uterine death (IUD) 5 (8.48%) and others (Acute Myocardial Infarction, Non ST segment Elevated MI, Cerebro Vascular Disease, Gullain Burre Syndrome, Laparatomy, Type I and Type II Respiratory failure) 14 (23.72%) (Table 2).

According to RIFLE's criteria most of the patients were from Injury group 32 (54.23%). Next to this, was Risk group 17 (28.83%) and in Failure, Loss and ESRD group were 7 (11.86%), 1 (1.69%) and 2 (3.39%) accordingly (Table 3). Regarding biochemical abnormality, mean Serum creatinine was 3.68 ± 2.15 and that of Urine output, HbA1C and HCO3 level (in ABG) were 4.57±8.89, 6.91±1.4 and 17.14±3.8 (Table 4) respectively.

Out of 59 patients 10 (16.95%) needed Haemodialysis. Out of 10, 3(30%) were the patients of IUD and others were 7 (70%). According to RIFLE's criteria 7 (70%) were from Failure group, 1 patient from Loss group and 2 from ESRD group who received haemodialysis (Table 5). 72.88% (43) patients improved, out of which 57.62% (34) got discharged from ICU after full recovery. 32.22% (19) were given Discharge on request or transferred to ward or cabin. 6.48% (4) patients expired and 3.38% (2) turned into ESRD and advised for regular haemodialysis (Table 6).

Table I: Distribution of Patients according to Age

Age Range	No	%
18 - 30	3	5.08
31 - 40	9	15.26
41 - 50	3	5.08
51 - 60	22	37.29
61 - 70	13	22.05
71 - 80	6	10.16
81 - 90	3	5.08
Total	**59**	**100.00**

Table II: Distribution of Patients according to Causes of Admission in ICU:

Causes of Admission	No	%
Diabetes mellitus with complications	11	18.64
Hepatorenal Syndrome	10	16.94
Malignancy	7	11.86
Septicaemia	6	10.18
Pneumonia	6	10.18
Intra Uterine Death	5	8.48
Others (Acute MI, NSTEMI, CVD, GBS, Laparatomy,Type 1 & Type 2 Respiratory Failure	14	23.72
Total	**59**	**100.00**

Note: AMI- Acute Myocardial Infarction NSTEMI- Non ST Elevated MI CVD- Cerebrovascular Disease GBS- Gullain Burre Syndrome

Table III: Distribution of Patients according to RIFLE's criteria:

RIFLE's Criteria	No	%
Risk	17	28.83
Injury	32	54.23
Failure	7	11.86
Loss	1	1.69
ESRD	2	3.39
Total	**59**	**100.00**

Note: ESRD - End Stage Renal Disease

Table IV: Physical and Biochemical Abnormalities

Physical and Biochemical Parameters	Mean
Urine Output	4.57 ± 8.89
Serum Creatinine	3.68 ± 2.15
HbA_1C	6.91 ± 1.4
HCO_3 (in ABG)	17.14 ± 3.8

Note: HbA_1C - Glycated Haemoglobin HCO_3 - Bicarbonate Level ABG - Arterial Blood Gas Analysis

Table V: Distribution of Patients in RIFLE's Criteria and Cause according to need of Haemodialysis

RIFLE's Criteria	No	%
Failure	7	70
Loss	1	10
ESRD	2	20
Total	**10**	**100**
Cause	**No**	**%**
IUD	3	30
Others	7	70

Note: ESRD - End Stage Renal Disease IUD - Intra Uterine Death

Table VI: Distribution of Patients according to Outcome

Outcome	No	%
Improved	34	57.62
DOR/Transferred	19	32.22
ESRD	2	3.38
Expired	4	6.78
Total	**59**	**100.00**

Note: DOR - Discharge on Request ESRD - End Stage Renal Disease

Discussion

In our study Mean age of the patient was 56.40 + 15.63 (Range 18-90 years). In the study of E S Wijewickrama et al the Mean age of the patient was 47.8+19.4 (Range 12-94 years) and 61.5%(67) were male1. Whereas in our study 54.23%(32) were male and 45.77%(27) were female with a male female ratio of 1.19:[14].

The mean age in the study by Liano and Pascual was 64, in the study by Stevens et al. was 73 and in an American ICU-based study was 67 [15, 16, 17]. Waikar et al. reported median age in patients who were identified between 1998 and 2002 as 72[18]; In the study of Tarik Ali et al had a median age of 77, and this was higher in those with ACRF(Acute on Chronic Renal Failure)[19].

A similar but larger study in Italy showed that around half the patients admitted to ICU showed some form of AKI, and 65% of patients in ICU developed AKI at some stage during their stay, which was not similar to that seen in our study [20]. Whereas in our study 21.77%(59) patients developed AKI which was lower than Italian study.

In the study of T B Singh of India the incidence of HAAKI(Hospital Acquired Acute Kidney Injury) was 2.2% in ICU patients comparative to 0.54% and 0.72% in medical and surgical unit21.Higher incidence of AKI in ICU patients may be due to a more severe nature of the primary illness. Similar incidences of HAAKI were reported from other Indian studies[22,23]. However, a slightly higher incidence of AKI in hospitalized patients was observed from other centers (between 1% and 4.9%)[24,25,26]. The lower incidence of HAAKI in our patients may be due to the improvement in the health-care system and effective treatment modalities in comparison to earlier decades.

In our study the most common cause of admission in ICU was Diabetes mellitus with complications with metabolic acidosis 18.64%(11) and Hepatorenal syndrome was the second, 16.94%(10). But in the study of T B Singh, in ICU patients, respiratory tract disease (23.52%) was the most primary disease at admission that developed HAAKI whereas Hepatobiliary diseases (25.49%) were the cause in medical units[8]. This finding is similar with that of de Mendonca et al., who found various medical and surgical patients in ICU admission[27].

Sepsis was the most frequent precipitating factor (47%) for AKI in the study of Tarik Ali et al, which was different from our study but similar to the findings of others[19,24,28,29]. Tarik Ali et al also found that >80% of patients had at least one comorbid illness and that the majority, approximately 70% of patients with AKI, were in the high-risk group which was similar to our sstudy. This is slightly higher than the 65% (of 310 patients) in the high-risk group in a study in the same geographic area in 1989 to 1990, although, in that study, the entry criterion was a serum creatinine 300 μmol/L[30].

In a study of Srilanka sepsis and cardiovascular causes resulted in a high incidence of AKI, and older age was also an important risk factor. In their study they found no correlation between age, gender or any of the co-morbidities and the incidence of AKI; in contrast other studies have shown AKI to be associated with older age, male gender and cardiovascular disease and hypertension[14,20].

In a study of T B Singh et al sepsis was the commonest cause among ICU patients where the incidence of sepsis was 35.2% which was similar to that of Uchino et al. and Prakashet al[21, 31,32].In our study metabolic acidosis due to diabetic complications was the commonest cause of AKI. In our study most of the patients presented with anuria and oliguria. Mean urine output of our patients was 4.57+8.89. In a study of T B Singh et al there was higher incidence oliguria observed in ICU patients 61%, may be due to a higher incidence of ATN(50%) and multi-organ failure in this unit[21].

A recent survey in Europe showed that the RIFLE classification is being used more commonly[33]. Two studies showed a higher number of patients in the F category than the study of Tarik Ali et al, but both of these were in an ICU setting, where more advanced AKI would be expected[19, 34,35]. This study differs from all others by including patients who were identified from a single biochemistry laboratory database that serves the whole population and setting a relatively low threshold creatinine value for entry. This may explain why the number of patients in the R category was lower than that in the I category. An ICU-based study in the United Kingdom showed similar percentages in R and I categories, and another study found that <10% were in the R category, but that study was restricted to those who required RRT in the ICU[34,35]. Therefore the percentages in each category will vary with the question being posed by the investigator and the patient group being studied. In our study according to RIFLE criteria most of the patients in the I caregory 28.83%(17).

RRT(Renal Replacement Therapy) requirement was significantly higher in those in the F group than in the R and I groups ($P < 0.001$); this was also found in the ICU-based studies in the United Kingdom and Sweden[34,35.] Although the referral rate was higher in F, this did not completely explain the higher rates of RRT that were observed in the F category-considering only those who were referred, there was a much higher likelihood of receiving RRT when they were in the F category than in the R or I categories in Tarik Ali et al study[19.] In their study 37(8%) patients with AKI received RRT[19]. In our study 16.95%(10) patients needed haemodialysis which was less than half of that of Tarik Ali et al study. Most of them 70%(7) were from F category of RIFLE criteria which was similar to other study. In the study of T B Singh et al the need for haemodialysis was 20.58% in ICU patients which was almost similar to our study[21].

Other previous studies found dialysis requirement in 7.7-19% of HAAKI, and this lower incidence may be due to difference in the criteria for initiation of dialysis and heterogeneity of patients population [24, 37,38]. A systematic review reported overall mortality of 50% in various groups of patients who had AKI and were measured at various time points[10]. The mortality figures in Tarik Ali et al study were consistent with those of Stevens et al.[16,19]. Mortality was the highest in ICU (73.5%) in T B Singh et al study[21]. This higher incidence may be partly due to the high percent of multiple organ involvement in the ICU patients. In general, indication for ICU admission itself also is an indicator of the severity of primary illness which directly influences the mortality rate. In our study only 6.78%(4) patients expired and 2(3.38%) patients turns into CKD. The lower incidence of death may be due to less no of patients of septicemia and prompt management of the patients and also less no of multi-organ failure.

Conclusions

The incidence of AKI is high in patients admitted to ICU, and the development of AKI is associated with poor outcome and reduced survival. AKI significantly increases the duration of ICU stay, and this is likely to add to the healthcare burden. Age, gender or the presence of comorbidities do not appear to influence the incidence of AKI in our ICU patients.

Conflict of Interest: no.

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