Original Article

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Internal Medicine Section

Evaluation of Prevalence and Causes of Acute Kidney Injury and its Effect on Short Time Mortality in Intensive Care Unit Patients

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ABSTRACT

Introduction: Hospital mortality of Intensive Care Unit (ICU) patients has shown correlation with severity of the Acute Kidney Injury (AKI). There are a few studies regarding short term or long term morbidity and mortality of the ICU patients after hospital discharge.

Aim: The aim of the study was to evaluate predisposing factors, in hospital mortality and six months followup of the ICU admitted patients in two general hospitals.

Materials and Methods: This prospective descriptive study was carried out on 520 ICU admitted patients, in Hajar and Kashani Hospitals, Shahrekord, Iran. The patients were evaluated for causes of hospital admission and inpatient and outpatient mortalities three and six months after discharge. Data were collected and analyzed by SPSS version 19.0 through Spearman's and Pearson's correlation tests.

Results: Of 520 patients under study, 350 were male and others were female. Mean age of the patients was 55.06±23.3 years. During ICU admission, AKI developed in 147 (28.2%) patients. Based on RIFLE criteria, in the patients with AKI, prevalence of risk, injury and failure were 51 (35%), 44 (30%) and 52 (35%) patients respectively. In the patients older than 65, AKI was more common (p=0.03). In the patients with AKI compared to other patients, serum sodium (Na), Potassium (K), was higher but haemoglobin and platelet were significantly lower. During ICU admission 91 (17.5%) patients died, out of which 56 (38%) cases had AKI and 35 (9.3%) had not (p<0.001). Among dead patients, prevalence of risk, injury and failure were 16%, 30.3% and 53.5% respectively. Among the alive patients, after hospital discharge, 3 months survival were 55.1%, 54.9%, 46.8% and 68.9% in risk, injury, failure and non AKI groups respectively (p=0.002), however six months survival of the AKI patients were 54.7%, 46.3% and 24.9% in risk, injury and failure patients comparing to 69.2% in non AKI patients respectively (p=0.001).

Conclusion: The study showed that inpatient mortality and short term survival of the ICU admitted patients had correlation with severity of AKI, based on RIFLE criteria. So, proper prophylaxis and treatment methods for prevention of AKI are very important and critical in these patients.

Keywords: In-patients mortality, Out-patients mortality, RIFLE criteria, Short term survival

INTRODUCTION

Acute renal failure is defined as abrupt loss or decrease of kidney function that results in aggregation of waste products as urea in addition to water and electrolyte imbalance. RIFLE criteria have been used for definition and classification of AKI [1]. Severity of AKI is characterized by RIFLE criteria as: risk means increased serum creatinine 1.5 fold or decline of GFR by 25%, injury is defined as two fold increase in serum creatinine or GFR decreasing to 50%. failure, as three fold increase of serum creatinine or GFR decline 75%, Loss and End stage renal failure defined as complete loss of renal function for four weeks and three months respectively [2].

The incidence of AKI in hospitalized patients has increased during the past decade probably due to more sensitive methods of renal function measurement and using of RIFLE criteria [3]. The criteria for recovery of AKI has been mentioned as complete or incomplete, in a way that complete means return of renal function to normal limit based on RIFLE criteria, and incomplete indicates a persistent renal failure but no need to dialysis. Hospital mortality of ICU patients has correlation with RIFLE criteria [4], so based on the results of a study, hospital mortality was 5% to 10% with no renal dysfunction, up to 27% in patients at risk, up to 30% with injury, and 26% to 40% with failure [3,5]. Some predisposing factors of AKI are preoperative hypotension, hypertension, diabetes mellitus, contrast media, medications (NSAIDs, ACEi, ARBs), liver failure, cardiac or pulmonary failure, sepsis, cardiac surgery [6]. Severity and outcome of AKI depend on severity of underlying factor, duration of kidney injury and adding other nephrotoxic factors to first insult. There are many studies about AKI in ICU patients such as causes and predisposing factors of AKI or epidemiology and mortality rate of the patients [7,8]; however, there are a few studies regarding the follow up of the patients especially long term morbidity or evaluation of mortality after hospital discharge [4], so the aim of this study was to evaluate predisposing factors, in hospital mortality and six months follow-up of the ICU admitted patients in two hospitals of Shahrekord, Iran.

MATERIALS AND METHODS

A prospective descriptive study carried out on 520 ICU admitted patients, in Hajar and Kashani Hospitals, Shahrekord, Iran, from May 2012 to February 2013. At first medical files of 720 ICU patients was evaluated and study continued on 520 patients with age greater than 18, we excluded by patients with history of chronic kidney disease and lack of cooperation by patients or his/her family during hospitalization or follow up period. The patients evaluated for development of AKI during hospital stay as well as, causes of admission such as trauma, medical problems (lung or cardiac disease), in addition of predisposing factors of renal failure such as hypertension, infection, surgery, diabetes mellitus, benign prostatic hyperplasia. The patients evaluated for incidence of hospital mortality and outpatient mortality during three and six months after discharge. Laboratory data such as Blood Urea Nitrogen (BUN), Creatinine (Cr), Blood Sugar (BS), liver enzyme (ALT, AST), Prothrombin Time (PT),

Partial Thrombin Time (PTT) and serum albumin were checked in hospital laboratory by standard kits and methods.

STATISTICAL ANALYSIS

Data were collected by SPSS (Statistical Package for the Social Sciences, version 19.0, SPSS Inc, Chicago, Ill, USA) through Spearman and Pearson tests. Data were confidential and study was done under permission and support of research deputy of Shahrekord University of Medical Sciences with grant No.981.

RESULTS

Mean age of the patients was 55.06±23.3 and 350 patients were male and others were female. AKI developed in 147 (28.2%) of total 520 patients, during the ICU admission, of which 93 patients were male and others were female. Based on RIFLE criteria, in patients with AKI, prevalence of risk, injury and failure were 51 (35%), 44 (30%) and 52 (35%) patients respectively. There is no significant difference based on age between patients with and without AKI, however in the patients with age greater than 65, AKI was more common (p=0.03). As mentioned in [Table/Fig-1], medical problems of the patients were HTN (Hypertension), IHD (Ischemic Heart Disease), DM (Diabetes Mellitus), CHF (Congestive Heart Failure), CVA (Cerebrovascular Accident), COPD (Chronic Obstructive Pulmonary Disease), BPH (Benign Prostatic Hyperplasia) or combination of these problems. Prevalence of HTN was significantly higher in the alive and dead patients with AKI, but there was not any correlation with AKI and other medical problems, in addition, multiple trauma was not a risk factors of AKI (p=0.382). In the patients with AKI compared to other patients, serum Na, K, were higher but haemoglobin and platelet were significantly lower, however, there was no difference between two groups of the patients based on PT, PTT, AST, ALT, bilirubin or fasting blood sugar [Table/Fig-2]. During ICU admission, 91 (17.5%) patients died, out of which 56 (38%) cases had AKI and 35 (9.3%) did not have (p<0.001). As mentioned in [Table/Fig-3], in dead patients prevalence of risk, injury and failure were 16%, 30.3% and 53.5% respectively. In alive patients, after hospital discharge, three months survival were 55.1%, 54.9%, 46.8% and 68.9% in risk, injury, failure and non AKI groups respectively (p=0.002), however 6 months survival of the AKI patients were 54.7%, 46.3% and 24.9% in risk, injury and failure patients comparing to 69.2% in non AKI patients respectively (p=0.001). Mean duration of ICU admission in the patients with AKI was 11.69±10.83 day versus 8.71±7.21 in other patients (p=0.02). Mean duration of ICU admission in dead and alive patients were 10.22±9.31 and 12.61±11.22 respectively (p>0.05). Of 159 brain CT scan that were taken from the patients with intracranial haemorrhage, brain ischemia, hydrocephalus, brain tumour and normal results were reported in 51, 14, 12, 5, and 77 patients respectively. Significant correlation was not seen between brain CT results and occurrence of AKI. Mechanical ventilation has been required in 105 (71.4%) cases with AKI and 120 (32.2%) patients without AKI (p<0.001). RRT (renal replacement therapy) as haemodialysis was done in 34 (23.1%) of 147 patients with AKI. Vasopressor drugs were used in 43% and 12.7% of AKI and non AKI patients respectively (p=0.03).

Underlying Disease	AKI Patients	Non AKI Patients	Dead AKI Patients
HTN	55 (37.4%)	75 (21.2%)	21 (42.0%)
IHD	32 (21.7%)	120 (32.1%)	14 (28.0)
DM	23 (15.6%)	81 (21.7%)	6 (12%)
CHF	12 (8.1%)	57 (15.2%)	7 (14%)
CVA	9 (6.1%)	297.7%)	5 (10%)
Asthma	4 (2,7%)	12 (3.2%)	0 (0.0%)
COPD	25 (7.2%)	32 (8.5%)	5 (10%)
BPH	4 (2.1%)	8 (2.1%)	2 (4%)
HTN, DM	12 (8.1%)	41 (10.9%)	8 (16.0%)
COPD, CHF	9 (6.1%)	22 (5.8%)	6 (12.0%)

[Table/Fig-1]: Comparison of the patients based on underlying disease.
HTN = hypertension, IHD = ischemic heart disease, DM = diabetes mellitus, CHF = congestive heart failure, CVA = cerebrovascular accident, COPD = chronic obstructive pulmonary disease, BPH = benign prostatic hyperplasia

Variables	AKI Patients	Non AKI Patients	p-value
PT(sec)	14.82±7.87	15.1±9.13	0.15
PTT(sec)	37.53±18.25	41.02±20.02	0.22
AST(IU/L)	22.72±36.85	21.09±32.83	0.43
ALT(IU/L)	29.63±30.23	26.05±21.64	0.44
BS(mg/dl)	163.02±10.23	221.23±32.42	0.19
Hb(g/l)	10.12±3.42	13.02±2.84	0.04
PLT(/ul)	150000±237000	219000±367000	0.03
BUN(mg/dl)	69.63±20.68	30.77±46.43	0.01
Cr(mg/dl)	3.57±0.68	1.32±3.02	0.02
Na(meq/L)	142.97±1.06	137.28±4.89	0.02
K(meq/l)	4.2±0.78	3.7±0.86	0.03
Alb(g/l)	3.35±0.82	3.46±0.78	0.27

[Table/Fig-2]: Comparison of some laboratory data in AKI and Non AKI patients.
AST=Aspartate Transaminase, ALT=Alanine Transaminase, BS=Blood Sugar, Hb=Haemoglobin, PLT=platelet, BUN=Blood Urea Nitrogen, Cr=Creatinine, Na=sodium, K=potassium, Alb=albumin

Condition	Alive patients (n=429)	Dead patients (n=91)	p-value
Mean age (years)	53.5±22.5	57.6±21.8	0.29
AKI	91 (21.2%)	56 (61.5%)	0.01
Risk	21 (4.2%)	9 (9.8%)	0.23
Injury	29 (5.8%)	17 (18.6)	0.03
Failure	41 (8.3%)	30 (32.9%)	0.001
Gastrointestinal Disease	30 (6.9%)	5 (5.4%)	0.23
Respiratory Disease	60 (13.9%)	11 (12.1%)	0.24
Infection	9 (2.0%)	1 (1.1%)	0.20
Trauma	57 (13.3%)	25 (27.5%)	0.01
Surgery	145 (33.7%)	29 (31.8%)	0.41
Neurologic Disease	57 (13.3%)	12 (13.1%)	0.50

[Table/Fig-3]: Comparison of alive and dead patients based on some conditions.

DISCUSSION

The study showed that prevalence of AKI in the ICU patients was 28.2%, and based on RIFLE criteria, there was no significant difference between prevalence of risk, injury and failure in the AKI patients. AKI patients had higher ICU mortality and lower three and six months survival compared to the non-AKI patients. Mechanical ventilation was required more common in AKI patients and rate of vasopressor drugs prescription was higher in these patients.

Prevalence of AKI in the hospitalized patients has been reported 10% in a study done by Cruz DN et al., [9] to 67% in a study done by Hoste EAJ et al., [10]. Discrepancy between these results may be due to different criteria that had been used for definition of AKI and severity of predisposing factors in the patients. In the study by Park [11], prevalence of AKI in ICU patients were (31%), (31%), and (38%) for risk, injury, and failure respectively based on the RIFLE classification, however, we found these prevalence as 35%, 30% and 35% respectively, so it seems that these are similar in this regard. In Park WY et al., and Samimagham HR et al., studies [11,12], there were significant correlation between prevalence of AKI and increasing age of the patients that is consistent with our results that prevalence of AKI was greater in patients older than 65. In a study, Na, K, Cr and BUN were higher, but Hb and Plt were less than in the AKI group. Besides, In Lima RSA et al., study higher BUN and Cr in ICU admited patients with AKI was reported [13], in addition Samimagham HR et al., reported similar results in this regard [12].

The most medical disorders in the patients were HTN, IHD and DM. Furthermore, HTN had correlation with AKI, that has some similarity with the Nisula S et al., study, otherwise Wijewickrama ES et al., in the study on 108 ICU patients showed that age, gender, or presence of co-morbid diseases were not associated with increased risk of AKI [14,15]. Samimagham and Case in their studies showed that multiple trauma was not a risk factor for AKI that is in harmony with our results [12,8], but in Gomes E et al., study, AKI developed in half of traumatic patients that is in conflict with our results [16]. Similar to Yegenaga I et al., results, we found higher rate of vasopressor use in the AKI patients [17].

In our study, mean ICU stay in AKI patients was 11.69±10.83 compared to 8.71±7.21 for non-AKI patients (p=0.02), so in Wijewickrama ES et al., study, ICU Patients with AKI had significantly longer ICU stay [15]. In another study, Bagshaw SM et al., showed higher mortality rate and ICU stay in septic patients [18]. Other important risk factor of mortality and severity of primary disease in ICU patients is the requirement of mechanical ventilation that is consistent with our and Lima RSA et al., result that found higher frequency of mechanical ventilation in AKI patients [13]. In addition, Vieira showed longer duration of mechanical ventilation in AKI patients compared to other patients [19]. In our study, ICU mortality of AKI patients was 38% that was significantly higher than that of other patients (9.38%).

Significant correlation of AKI and hospital mortality has been also reported in several studies such as Samimagham HR et al., Nisula S et al., Lehman L-W et al., [12,14,20], for example Yegenaga found correlation of mortality rate with the severity of renal involvement, as 56%, 68%, 72%, and 100% in risk, injury, failure, and loss categories, however, we found these ICU mortality rate as, 16%, 30.3%, and 53.5% for risk, injury and failure respectively [17]. Schiffl H et al., in a study on 425 ICU patients with AKI who required renal replacement therapy reported survival rate of 35%, 25% and 20% after 1, 5 and 10 years respectively [21]. However in our study, six months survival was 24.9% in severe AKI (failure) patients compared to 69.2% in non AKI patients. Mortality rate in the ICU and six months after discharge in Abosaif study was significantly greater in the failure group compared with other patients [22]. The results of these studies showed a high mortality rate and poor prognosis for severe AKI patients after hospital discharge.

LIMITATION

Our study had some limitations such as small sample size and short term follow up, so we recommended doing similar studies with larger sample size and long time duration follow up and comparison of morbidity and mortality of patients of internal and surgical ICU.

CONCLUSION

The study showed that inpatient mortality and short term survival of the ICU admitted patients had correlation with severity of AKI, based on RIFLE criteria, so proper prophylaxis and treatment methods for prevention of AKI is very important and critical in these patients.

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