

Incidence of acute kidney injury and its contributing factors among patients of critical care unit.

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Abstract

Acute kidney injury (AKI) is a risk factor for increased mortality in critically ill patients. To assess the incidence and contributing factors of patients who develop AKI in the critical care unit (CCU), a prospective study was undertaken among 100 patients admitted to the CCU of a Medical college & hospital in Kolkata. Incidence of Kidney Injury assessed through record analysis with the help of KIDGO guideline. Contributing factors for AKI were assessed through record analysis with the help of structured Performa. The tool was pre-tested before final data collection. Institutional Ethics committee approval was taken for the study. A non-probability purposive sampling technique was used to select the subjects. Patients who stay more than 48hours in the Critical Care Unit were selected and those with end-stage renal disease, who are aneuric, non-CKD patients with a baseline creatinine concentration of more than 3.4mg/dl for CKD patients who were on maintenance dialysis were excluded from the study. The study result found that the incidence of AKI is 20 %. This study also found a significant association between the incidence of acute kidney injury and its contributing factors like co-morbidity of HTN, cardiovascular disease, chronic kidney disease, chronic liver disease, sepsis, UTI, ventilator support, use of vasopressor agent, baseline creatinine level, and use of nephrotoxic drugs during CCU admission (antibiotics). So, the study results can be used to modify CCU policies.

Keywords: Incidence, AKI, contributing factors, CCU

Introduction

Acute kidney injury (AKI) is a well-known complication that affects critically ill patients in an intensive care unit (ICU) and is associated with increased mortality, morbidity, and length of stay [1]. Acute kidney injury is defined as an absolute increase in serum creatinine more than and equal to 0.3mg/dl, an increase in serum creatinine more than or equal to 1.5 fold from baseline, or a reduction in urine output (documented urine output of less than 0.5ml/kg/h for more than 6 hours). Patient with diabetes mellitus, dehydration, sepsis contributes to the development of Acute Kidney Injury [2]

Signs and symptoms of acute kidney injury are oliguria, total body swelling, hypotension, dehydration, gastrointestinal loss of volume and electrolytes, dark and concentrated urine, sepsis syndrome and fever, exposure to potential nephrotoxins complications, and multiple organ failure. In 2007 John W Zoltan & H Endre [3] proposed the following as AKI diagnostic and classification criteria: acute serum creatinine changes (absolute serum creatinine increase above 0.3 mg/dl or relative 50 % increase from baseline values) or urinary output (below 0.5 ml/kg/minute for more than 6 hours; oliguria).

Currently, the universal policy and the International Society of Nephrology (ISN) policies are concentrated on the elimination of preventable deaths due to AKI in low-income countries by 2025 [4]. For effective planning regarding the reduction of preventable mortalities resulting from AKI, there is a need for sufficient

data regarding the epidemiologic pattern of this disease in each country. Although urine output is an important kidney function parameter that identifies patients at higher risk for adverse outcomes, its pathophysiologic significance in the absence of extremes of oliguria or other surrogates of reduced glomerular filtration rate (GFR) is more controversial. It should be noted that patients who develop AKI by KDIGO urine output criteria, regardless of whether Serum creatinine criteria are present, are at risk for developing fluid overload given the typically high obligate intake of critically ill patients.[5]

In KDIGO guidelines, the recommendations on AKI are based on an exhaustive evidence-based review of the literature and provide guidance for practice for clinicians. Most of the time patients are getting sicker due to acute kidney injury and the mortality and morbidity rate increases in the Critical care units. Actually, the AKI incidence in CCU/ICU patients varies widely depending on the type of CCU/ICU, study population, the period during which the study is conducted, and the criteria. There is little data on contributing factors of AKI in critically ill patients are available in our country. So, the researcher chose the topic with the intention that this study result help to modify the treatment process of patients who are suffering from acute kidney injury in CCU & also helps in the prevention of AKI among CCU admitted patients.

Materials & patients

A descriptive survey research design was used for this study. A non-probability purposive sampling technique was used to select the subjects. Patients who stay more than 48 hours in the Critical Care Unit were selected and those with end-stage renal disease, who are aneuric, non-CKD patients with a baseline creatinine concentration of more than 3.4mg/dl CKD patients who were on maintenance dialysis were excluded from the study. Incidence of Kidney Injury assessed through record analysis with the help of KIDGO guideline [6]. Contributing factors for AKI were assessed through record analysis with the help of structured Performa. These developed record analyses Performa were validated by 7 experts and tested for reliability through intra rater reliability with Cohen's Kappa formula and the value was 1. Permission was taken from the Institutional Ethics committee. Informed consent was taken from subjects/subject's relative before data collection. Data collection started after the patient was admitted to the critical care unit. The data collection continued till the patient stayed in the critical care unit or it may be terminated when the patient was discharged, shifted out from the critical care unit, or after death. Data collected during the period of October 2019-February 2020. In this study incidence of acute kidney disease refers to the incidence of acute kidney injury according to KDIGO guidelines among those participants who are admitted to the critical care unit. As per Kidney Disease: Improving Global Outcomes (KDIGO) guideline AKI is defined as anyone criteria like- 1. Increase in Serum Creatinine by more than equal 0.3 mg/dl (more than equal 26.5 micro mol/l) within 48 hours. 2. Urine volume < 0.5 ml/kg/h for longer than 6 hours. Contributing factors refer to some factors responsible for the development of acute kidney injury among patients in this study. The contributing factors are age, sex, history of comorbid conditions such as hypertension,

diabetes mellitus, chronic kidney disease, chronic liver disease, cardiovascular disease, and the patient has undergone surgery during ICU stay, fluid volume status, sepsis, use of a nephrotoxic drug, urinary tract infection, urinary tract obstruction, ventilator support, use of vasopressor, etc.

Frequency and percentage were calculated to describe the demographic variables of the participant and Categorical variables were compared using either the Chi-square or Fisher's exact test when appropriate. Statistical descriptions and tests above were performed using the SPSS version 17.0.1 (SPSS Inc; Chicago, IL, USA). A P- a value of less than 0.05 was considered significant.

Results

From **Table 1** it is evident that the majority (70 %) of CCU admitted patients are from 50-70 years of age group 72 % are male and 30% of admitted patients are smokers. The majority (65 %) of admitted patients have co-morbidity HTN and 60 % have DM and 28 % have sepsis during CCU admission (**Table 2**). 30 % of CCU admitted patients have received antibiotics and 40 % received vasopressor agents (**table 2**). **Table 3** depicts that positive fluid balance is there for the majority (82 %) of the patients and CCU stay is 6-10 days for 62 % of CCU patients. The data presented in fig-1 shows that the AKI incidence rate is 20 %. Data in **Table 4** reflects that the baseline Cr level 0.8-1.2mg/dl for 60 % AKI patients and peak Cr is 1.3-3.4 for 70 % of AKI patients and Urine output < 0.5ml/kg/hr. for longer than 6 hours for 60 % of AKI patients. **Figure 1** shows that AKI incidence is 20 % and AKI incidence is associated with contributing factors like- co-morbidity of HTN, Cardiovascular disease, chronic kidney disease, chronic liver disease, sepsis, UTI, ventilator support, use of vasopressor agent, baseline creatinine level, and use of nephrotoxic drugs like antibiotics during ICU admission (**Table 6**).

Table 1: Frequency and percentage distribution of Socio-demographic characteristics. N =100

Characteristics	Frequency	Percentage
Age in year		
21-30	2	2
31-40	6	6
41-50	18	18
51-60	32	32
61-70	38	38
≥ 70	4	4
Gender		
Male	72	72
Female	28	28
Addiction		
Smoking	30	30
Alcohol	10	10

Smoking & alcohol	12	12
Tobacco	8	8
No addiction	40	40

Table 2: Frequency and percentage distribution of selected illness characteristics. N=100

Illness characteristics	Frequency	Percentage
Co-morbidity		
HTN		
Yes	65	65
No	35	35
DM		
Yes	60	60
No	40	40
Cardiovascular disease		
Yes	18	18
No	82	82
Chronic liver disease		
Yes	10	10
No	90	90
Chronic Kidney disease		
Yes	6	6
No	94	94
Urinary tract obstruction	6	6
Yes	6	6
No	94	94
Undergone any surgery during critical care unit stay	4	4
Yes	4	4
No	96	96
Sepsis		
Yes	28	28
No	72	72
Urinary tract infection		
Yes	14	14
No	86	86
Use of Nephrotoxic drugs		
Antibiotics	30	30
Antihypertensive	8	8
NSAID	13	13
Use of vasopressor		
Yes	40	40
No	60	60

Table 3: Frequency and percentage distribution of selected illness characteristics. N=100

Characteristics	Frequency	Percentage
Fluid volume status		
Positive	82	82
Negative	18	18
Ventilator support		

Invasive	82	82
Non-invasive	18	18
Days of critical care unit stay		
1-5 days	6	6
6-10days	62	62
11-15days	25	25
Above 15 days	7	7

Table 4: Frequency and percentage distribution of creatinine level and urine output during critical care unit stay for AKI patients. N =20

Criteria	Frequency	Percentage
Urine output <0.5ml/kg/hr. for longer than 6 hours		
Yes	12	60%
No	8	40%
Baseline Cr level (mg/dl)		
0.8-1.2	12	60%
1.3-2.8	6	30%
Above 2.8	2	10%
Peak level of creatinine (mg/dl)		
1.3-2.3	8	40%
2.4-3.4	7	35%
3.5-4.5	3	15%
4.6-5.5	2	10%

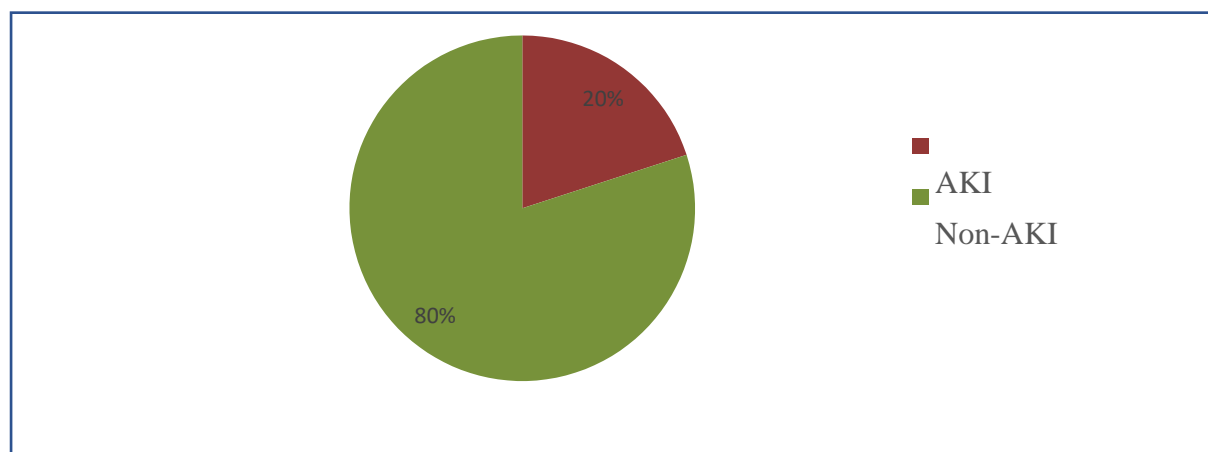


Figure 1: Pie diagram showing percentage of incidence of acute kidney injury among CCU admitted patient.

Table 5: Chi-square computed between incidences of acute kidney injury with selected demographic variables. N=100

Sl No	Demographic characteristics	Occurrence of acute kidney injury		Chi-square value	P Value
		AKI	Non-AKI		
1.	Age			0.467 After Yates correction 0.159	.494 .689
	21-50	4	22		
	51-≥70	16	58		
2.	Gender			0.049	.823
	Male	14	58		
	Female	6	22		
3.	Addiction			1.041	.307
	Present	10	50		

	Absent	10	30		
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Table 6: Chi-square computed between incidences of Acute kidney injury with selected illness characteristics N=100

SI No	Illness characteristics	Occurrence of acute kidney injury		Chi-square value	P Value	
		AKI	Non-AKI			
1.	Co-morbidity HTN			3.943	.047	
	Present	12	53			
	Absent	8	12			
	Co-morbidity DM				0.260	.609
		Present	13	47		
		Absent	7	33		
	Co-morbidity Cardiovascular disease				35.223	<.00001
		Present	12	6		
		Absent	6	76		
	Co-morbidity Chronic Kidney disease				16.001 with Yates correction is 12.067	.000063 .0005
		Present	5	1		
		Absent	15	79		
Co-morbidity Chronic Liver disease				6.25	.012	
	Present	5	5			
	Absent	15	75			
2.	Urinary tract obstruction			0.709 with Yates correction 0.099	.399 with Yates correction is 0.099	
	Present	2	4			
	Absent	18	76			
3.	Sepsis			21.875	<.00001	
	Present	14	14			
	Absent	6	66			
4.	Fluid volume status			.829	.362	
	Positive	15	67			
	Negative	5	13			
5.	Urinary tract infection			14.036	<.0001	
	Present	8	6			
	Absent	12	74			
6.	Ventilator support			17.344	<.00001	
	Invasive	10	72			
	Non-invasive	10	8			
7.	Use of Nephrotoxic drug			36.011 With Yates correction 32.812	<.00001 .026	
	Antibiotics					
	Present	17	13			
	Absent	3	67			
	Antihypertensive					

	Present	4	4	4.891 With Yates correction 3.065	.079 (with Yates correction)
	Absent	16	76		
	NSAID			16.114 With Yates correction 13.268	.00006 .00027 (with Yates correction)
	Present	8	5		
	Absent	12	75		
8.	Use of Vassopressure			6.510	.010
	Yes	13	27		
	No	7	53		
9.	Days of Critical care unit stay			0.735	.391
	1-10days	12	56		
	11- >15days	8	24		
10.	Baseline Cr level			8.197	.004
	0.8-1.2	12	70		
	1.3-2.8	6	10		
	Above 2.8	2	0		

Discussion

The present study found that the incidence of AKI is 20 % and it is supported by the study H. E. Wang et al [7] study. Samimagham HR et al⁸ study showed that the incidence of AKI is 31.1 %. On the other hand, a review article on Epidemiology of Acute Kidney Injury in the Intensive Care Unit by James Case et al [9] showed that the overall incidence of AKI in the ICU is approximately 20-50 %. The variation of incidence rate may be due to the inconsistency of AKI definition, different study populations & different CCU setups. The incidence of AKI in the present study is similar to Hoste EA et al [10] study which is the 1st multinational epidemiological study in the ICU using the KDIGO criteria.

Our study revealed that there is a significant association between the incidence of acute kidney injury and its contributing factors like co-morbidity of HTN, Cardiovascular disease, chronic kidney disease, chronic liver disease, sepsis, UTI, ventilator support, use of vasopressor agent, baseline creatinine level, and use of nephrotoxic drugs during ICU admission (antibiotics). Our study findings are supported by the study Markos Kashiouris et al [11] where they revealed Acute Kidney Injury is associated with hypertension, sepsis, use of vasopressors/inotropes, higher baseline creatinine level and use of nephrotoxic drugs, etc. Markos Kashiouris et al [12] studies also showed AKI incidence is associated with older age, diabetes, heart failure, systemic inflammatory response syndrome, higher severity of disease scores, high-risk surgery, emergency surgery, use of intra- aortic balloon pump, and longer time in cardiopulmonary bypass pump. This study did not show any association between ages, diabetes, and days of critical care unit stay and there is a lack of published study from where we get the evidence but Maria Moschopoulou et al [12] study revealed that Diabetes mellitus does not affect the incidence of acute kidney injury after cardiac surgery. Regarding age, Xu L et al [12] study concluded that the AKI risk does

not increase with age in older adults, except for those aged 75 and above. In the present study, only 4 subjects are from > 70years of age and maybe that is why this study did not find any relationship between age and incidence of AKI like Xu L et al [13] study.

This study has several strengths and limitations. Firstly, a single laboratory was used, limiting interlaboratory error. Secondly, these studies used most recently & conscientious criteria to define AKI. Regarding, limitations, Firstly, the method of estimating baseline and peak SCr may have overestimated the proportion of patients who were classified with AKI. Secondly, BMI could not consider as a contributing factor as there was a lack of provision for weight measurement.

Conclusion

The incidence of AKI is 20 %. Co-morbidity of HTN, Cardiovascular disease, chronic kidney disease, chronic liver disease, sepsis, UTI, ventilator support, use of vasopressor agent, baseline creatinine level, and use of nephrotoxic drugs during CCU admission (antibiotics) are associated with the incidence of AKI. So, the study results may be used to modify CCU policies to improve CCU care and ultimately reduces medical care costs.

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Declaration: No conflict of interest

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