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EXPOSURES AND SUSCEPTIBILITIES FOR ACUTE KIDNEY INJURY IN PATIENTS ADMITTED IN INTENSIVE CARE UNIT OF A TERTIARY CARE CENTER IN KERALA

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Abstract

Background: Acute kidney injury (AKI), one of the most common syndromes in critically ill patients, has become a health problem worldwide due to its high mortality and morbidity. Risk for AKI is increased by exposure to factors that cause AKI or the presence of factors that increase susceptibility to AKI. The objective of this study is to identify the exposures and susceptibilities of AKI in patients admitted in medical ICU of a tertiary care centre in Kerala. **Materials and Methods:** This descriptive cross-sectional study was conducted among patients with Acute kidney injury diagnosed by KDIGO criteria in medical ICU. **Result:** A total of 125 patients with a diagnosis of AKI as per KDIGO criteria were included in the study. Of these, majority of patients were men (60%). The mean age of the study population was 49.2 ± 18.0 years. The most common clinical presentation was fever and features of dehydration, seen in 60% of the study population. 25 patients had AKI in the past (20%). 15 patients had exposure to nephrotoxic drug intake (12%), followed by 5 patients with history of contrast exposure (4%). The most common prevalent comorbidity was diabetes in 44 patients (35.2%), followed by hypertension in 34 patients (27.2%), Hypotension was present in nearly one fourth of the patients. Of the total study population, 60 (48%) patients were initiated on RRT, 6 (10% of RRT initiated) of whom expired, and the remaining 54 patients (90% of RRT initiated) showed resolving AKI. 12 patients expired with a crude death rate of 9.6%. **Conclusion:** Most common exposures for AKI in the study population was sepsis (44%) followed by leptospirosis (14.4%). The common 'susceptibilities' in the study population were dehydration/ volume depletion, advanced age and diabetes mellitus. So, patients with these susceptibilities and exposures should be looked for early development of AKI so that early diagnosis and treatment can be initiated to prevent morbidity and mortality.

INTRODUCTION

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.[1] Moreover, it may also occur as part of a multiple organ dysfunction syndrome or as a separate event. The term AKI has largely replaced acute renal failure (ARF), recognising the fact that smaller decrements in kidney function that do not result in overt organ failure are of substantial clinical relevance; often associated with increased morbidity and mortality. Most often the aetiology of AKI is multifactorial. More importantly, epidemiological evidence shows that even mild, reversible AKI has important clinical consequences, including increased risk of mortality. [2,3]

Acute kidney injury (AKI); one of the most common syndromes in critically ill patients; has currently become a health problem worldwide as it is associated with high mortality and poor prognosis. About 13 million hospitalised patients suffer from AKI causing about 1.7 million deaths worldwide. In recent years, the incidence of AKI

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has been increasing in low income/middle-income countries, with more than 85% of total mortality.[4,5] The Kidney Disease: Improving Global Outcomes (KDIGO) definition and staging system is the most recent and preferred definition.[6] According to 2012 KDIGO guidelines for risk assessment, AKI is increased by 'exposure' to factors that cause AKI or by the presence of factors that increase 'susceptibility' to AKI.[6] Factors that determine susceptibility of the kidneys to injury include dehydration, certain demographic characteristics and genetic predispositions, acute and chronic comorbidities, and treatments.[7]

It is identified that the interaction between susceptibility and the type and extent of exposure to insults determine the risk of occurrence of AKI and most of the data are available from the developed countries. It is recognized that the epidemiology of AKI in critical care units of developing countries differs from that of the developed countries in many important ways such as age groups affected, use of evidence-based practice protocols & accessibility to cost effective modalities of treatment. Given that in developing countries the costs of renal replacement therapies are prohibitively high, prevention is often the only realistic way to decrease the incidence of AKI.

MATERIALS AND METHODS

This was a descriptive cross-sectional study conducted on patients admitted in ICU (Multi-Disciplinary ICU); Department of General Medicine; Government Medical College; Thrissur, Kerala during 2021 to 2022.

Inclusion and exclusion criteria
Adult patients (>12 yrs) admitted in ICU satisfying KDIGO diagnostic criteria for AKI were included in the study. Patients who expire within 24 hours of admission in ICU, known renal transplant recipients., known CKD patients and patients with re-admission in ICUs during the study were excluded.

RESULTS

A total of 120 adult patients with a diagnosis of AKI by KDIGO criteria were included in this study. Of these males were more affected [75(60%)] than females (40%). The mean age of the study population was 49.2 ± 18.0 years. Males were having a higher mean age of 50.27 ± 17.4 years when compared to females with a mean age of 47.6 ± 20.4 years.

The most common clinical presentation was fever and features of dehydration, seen in 60% of the study population. 25 patients had AKI in the past (20%). 15 patients had exposure to nephrotoxic drug intake (12%), followed by 5 patients with history of radiation / contrast exposure (4%). History of nephrectomy was present in 2 patients (1.6%)

The most common prevalent comorbidity was diabetes in 44 patients (35.2%), followed by hypertension in 34 patients (27.2%), CAD in 13 patients (10.4%), CVA in 9 patients (7.2%) and CLD in 6 patients (4.8%) [Table 2].

Clinical Examination
Tachycardia was the most common sign in majority of the patients (72%) with a mean pulse rate of 104.8 ±17.6 / min. The blood pressure of 79 patients (63.2%) were within the normal range with a mean systolic blood pressure of 108.38 ±23.65 mm of Hg and a mean diastolic blood pressure of 67±14.7 mm of Hg. Hypotension was present in nearly one fourth of the patients 32 (25.6%)] while 14 patients (11.2%) were found to have hypertension.

Laboratory Findings
There was presence of urine albumin in 55 patients (44%), urine pus cells of more than 4 to 6 per high power field was observed in 50 patients (40%) and urine granular cast was seen in 40 patients (32%).

Low haemoglobin level was seen in 55 patients (44%), Total WBC count was greater than normal levels in more than half of the patients (58.4%) and platelet count was less than 1 lakh in 40 patients (32 %). Hyponatraemia was seen in 75 patients (60%), hypernatremia in 5 patients and rest were within normal range. Hypokalaemia was observed in 36%, and only 16% of the patients had hyperkalaemia surprisingly. The mean serum creatinine was 2.23 at admission, this then increased to 3.91 in 48 hours and then reduced to 1.95 at discharge

The urine output was low at the time of admission in 75 patients (60%), however it reduced even further on day 2 in 95 patients (76%).

Table 1: Medical history

Medical history	Frequency (n)	Percentage (%)
History of Fever	75	60.0
History of Dehydration	75	60.0
History of Nephrotoxic drug intake	15	12.0
History of Radiation/contrast exposure	5	4.0
History of Acute Kidney injury	25	20.0
History of nephrectomy	2	1.6

Table 2: Risk Factors-Exposures- for AKI

Risk Factors for AKI	Frequency (n)	Percentage (%)
Sepsis (Total)	55	44
Urosepsis	36	28.8
Other infection leading to Sepsis	12	9.6
Septic Shock	7	5.6
Leptospirosis	18	14.4
ARDS	12	9.6
Cardiogenic Shock	10	8
CAD	6	4.8
Snake Bite	5	4
DIC	5	4
Pulmonary Embolism	4	3.2
Multi-lobar Consolidation	3	2.4
AKI Due to Contrast Nephropathy	3	2.4
Status Epilepticus	2	1.6
SFI with Hepatorenal Dysfunction/Thrombocytopenia	1	0.8
Acute Gastroenteritis	1	0.8
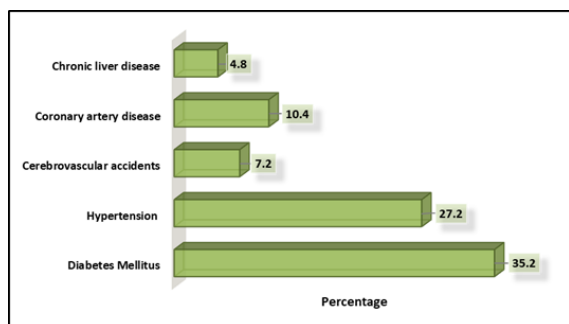
Figure 1: Bar diagram showing comorbidities

Outcome

12 patients expired with a crude death rate of 9.6%; 6 of these (50% of the expired) were initiated on RRT. Of the total study population, 60 (48%) patients were initiated on RRT, 6 (10% of RRT initiated) of whom expired, and the remaining 54 patients (90% of RRT initiated) showed resolving AKI. The remaining patients (52%) who were not initiated on RRT showed improvement in renal function tests at the time of discharge from ICU.

Risk factors for AKI in patients admitted in ICU

The most common cause for AKI; categorised as exposures; was sepsis (44.0 %), followed by leptospirosis (14.4%), ARDS in 9.6%, cardiogenic shock in 8%, CAD in 4.8%, snake bite 4%, DIC in 4%, pulmonary embolism in 3.2%, multi-lobar consolidation in 2.4%, contrast induced AKI in 2.4%, status epilepticus in 1.6%, hepatorenal dysfunction in 0.8% and acute gastroenteritis in 0.8%. [Table 6]

DISCUSSION

Demographic Profile

A total of 125 patients who developed AKI during their ICU admission were chosen as the study population. Gender distribution showed that males were affected in higher numbers [75 (60%)] than females. Also, the affected females were less than half [50 (40%)] of the study group. The most common age group was between 61 to 70 years (30.7%) in males and between 51 to 60 years (22%) in females.

The study by M Eswarappa et al,[8] showed majority of the critically ill ICU admitted patients who developed AKI were males in their study. This is similar in other reviewed studies by Shigehiko Uchino et al,[9] Rabbani et al,[10] and Arshad et al,[11] where males were the majority among the AKI patients.

Clinical Profile

The assessment of comorbidities among the study population showed that majority were having diabetes [44 (35.2%)], followed by hypertension in 34 patients (27.2%), CAD in 13 patients (10.4%), CVD in 9 patients (7.2%) and CLD in 6 patients (4.8%).

The study by M Eswarappa et al,[8] showed that diabetes, hypertension and coronary artery disease were the most commonly prevalent comorbidities. The study by Rabbani et al,[10] also showed that presence of comorbidities adversely affected the final outcome of the patients.

The medical history of the study population showed that 75 (60 %) patients presented with fever prior to onset of AKI. 75 (60%) patients also presented with features suggestive of dehydration. 25 (20 %) patients had a previous history of AKI following an acute precipitating event, that resolved completely with normal renal function test at the time of discharge. The study population also showed recent exposure to nephrotoxic drugs in 15 (12%) patients and radiocontrast exposure in 5 (4%) patients. These two-risk factors are now increasingly identified due to new advances in diagnostic and therapeutic field of medicine.

The clinical examination showed tachycardia in majority of the patients (72%) with a mean pulse rate of 104.8 ±17.6 / min. The blood pressure of 79 patients (63.2%) were within normal range. Hypotension was present in nearly one fourth of the patients [32 (25.6%)] while 14 patients (11.2%) were found to have hypertension.

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Investigation Profile

The mean serum creatinine in the study population was 2.23 mg/dl at the time of admission, this then increased to 3.91 mg/dl in 48 hours and then reduced to 1.95 mg/dl at discharge. The urine output was low on admission for 75 patients (60%) however it reduced even further on day 2 in 95 patients (76%). The study by Arshad et al,[11] had similar levels of serum creatinine at the time of admission where serum creatinine on admission was 2.4±1.3 (mg/dl).

The total WBC count was elevated in 58% of the patients and thrombocytopenia was seen in 40 (32%) patients. Also, hypokalaemia was present in 45 (36%) patients with only 20 patients (16%) having hyperkalemia.

Outcome

In this study, about the outcome, 12 patients expired with a crude mortality rate of 9.6% and 60 patients were initiated on RRT (48%). The study by Shigehiko Uchino et al,[9] concluded that the period prevalence of AKI requiring RRT in the ICU was between 5% and 6% and was associated with a high hospital mortality rate. The study by M Eswarappa et al,[8] had similar outcomes of renal replacement therapy (RRT), which was required in 37.2% (n = 186) of patients. About 60% recovered completely with normal renal function tests at the time of discharge.

Risk Factor Profile for AKI

The risk factors for AKI in patients admitted in ICU were studied and identified. The most common cause was sepsis (44.0 %), followed by leptospirosis (14.4%). ARDS in 9.6%, cardiogenic shock in 8%, CAD in 4.8%, snake bite 4%, DIC in 4%, pulmonary embolism in 3.2%, multi-lobar consolidation in 2.4%, contrast induced nephropathy in 2.4%, status epilepticus in 1.6%, hepatorenal dysfunction in 0.8% and acute gastroenteritis in 0.8%.

Reviewed study by Shigehiko Uchino et.al9 concluded that 30% of patients had preadmission renal dysfunction and the most common contributing factor to ARF was septic shock (47.5%; 95% CI, 45.2%-49.5%). They also concluded that independent risk factors for hospital mortality included use of vasopressors, mechanical ventilation; (P<.001), septic shock, cardiogenic shock, and hepatorenal syndrome.

The study by M Eswarappa et,[8] had results similar to the study population with sepsis being the most common cause of AKI, accounting for 38.6% of the patients. 24.4% belonged to risk class, 37.0% to injury class, 35.0% to failure class, 3% to loss and 0.6% to ESRD class of the RIFLE criteria. In the study by P S Priyamvada et al,[12] the predominant aetiologies for AKI were sepsis (22.4%), trauma due to road traffic accidents (21.18%), acute abdomen (perforation, acute pancreatitis, bowel gangrene, intestinal obstruction and cholangitis) (18.64%), and cardiac diseases (10.59%). In this study too sepsis and acute abdomen were the most common causes of AKI. The study conducted by H Gomez et al,[13] and Gujar et.al.14on Sepsis-induced acute kidney injury showed sepsis as the most common risk factor for AKI. Another study by Arshad et al,[11] showed sepsis played a role in almost half of the patients [60 (45%)] who developed AKI. Other factors included diarrhoea [23(17%)], nephrotoxic drug use [25 (19%)] and cardiac pathology [24 (18%)]. It was found that most cases of AKI were due to preventable factors (infections, diarrhoea, and drug toxicity) and concluded that concentrated efforts to eliminate them would be vital in reducing mortality caused by AKI in developing countries.

The study by Rabbani et al,[10] showed that medical causes accounted for 88% of ARF cases and surgical causes accounted for 11% of the ARF cases. Majority of the patients had pre-renal ARF, and 5% had drug related ARF. In the study by Osman et al,[15] the predictors of increased risk of death were identified as advanced age, presence of chronic liver disease, sepsis, and the severity of AKI (as per KDIGO staging) were significant predictors of mortality.

Limitations

First, this was a single-center, single-arm study and was restricted to patients within medical ICU with no patients from trauma and surgical ICU which also has a unique subset of patients with AKI.

CONCLUSION

Most of the patients affected with AKI were males with a male to female ratio of 3:2. The two most common presentations (60% each) were fever and signs of dehydration. The most common comorbidity was diabetes mellitus (35%) followed by hypertension (27%). The most common cause for AKI in the study population was sepsis followed by leptospirosis. As per 2012 KDIGO guidelines it can be concluded that the common 'susceptibilities' in the study population were dehydration/ volume depletion, advanced age and diabetes mellitus. and common 'exposures' were sepsis, leptospirosis and circulatory shock which includes cardiogenic and septic shock.

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