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An observational study of clinical profile of a patient with acute kidney injury

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Abstract: Introduction: Acute kidney injury is characterised by a sudden and potentially reversible deterioration in renal function, resulting in impaired elimination of nitrogenous waste products and compromised fluid and electrolyte homoeostasis. Variations in the definitions utilised, the demographic under scrutiny, and the healthcare environments can result in notable disparities in the epidemiological data pertaining to acute kidney injury.
Methods: This cross-sectional observational study was approved by the Institutional Ethics Committee in a tertiary-care teaching hospital located in a urban area. All individuals diagnosed with acute renal failure as defined by the RIFLE criteria were incorporated into the study. Individuals who were below the age of 18 were not included in the study. The enquiry comprised a comprehensive account of the patient's medical background, a thorough physical examination, and a systemic evaluation. During the period of hospitalisation, patients were classified based on their RIFLE class, which includes R, I, or F. The classification of RIFLE is determined based on either the glomerular filtration rate (GFR) or urine output. Patients were categorised based on their serum creatinine levels and urine output.
Results: Out of the total of 100 cases of Acute Kidney Injury (AKI), 46% were female patients, whereas 54%) were male patients. The Mean age upon initial presentation was 55.22 $\pm$ 14.91 years. AKI was determined to be primarily caused by sepsis. Among the sample of patients under investigation, 64% of the total, were identified as being associated with sepsis. The study observed a mortality rate of 40%.
Conclusion: Acute Kidney Injury is a prevalent complication observed in patients admitted to the Intensive Care Unit (ICU). The timely identification and management of acute kidney injury (AKI) in critically ill patients have been shown to decrease mortality rates associated with AKI and all-cause mortality.

Keywords: Acute Kidney Injury; RIFLE criteria; Critically ill; Sepsis; Mortality.

1. Introduction

AKI can arise from diverse causes, is predominantly avoidable, and potentially amenable to intervention if detected promptly. Frequently, the failure to promptly and sufficiently identify and address a condition leads to significant adverse consequences. The condition is associated with a significant mortality rate and permanent impairment of renal function [1]. Acute kidney injury (AKI) is linked with a significant rise in both short-term and long-term mortality across all phases. Early detection and treatment can lead to partial or complete reversal of the renal damage caused by AKI [2]. The fluctuating criteria for AKI have led to debates regarding the accurate incidence of this condition. The available literature indicates that the incidence varies between 1% and 31%, depending on the terminology used [3].

In numerous clinical settings, it is now widely recognised that even slight elevations in serum creatinine levels are associated with unfavourable outcomes. The current understanding is that AKI (RRT) encompasses the entire spectrum of the syndrome, ranging from minor changes in renal function indicators to the requirement for renal replacement therapy. Consequently, endeavours have been undertaken to establish standardised criteria for the classification and characteriszation of acute kidney injury. In 2004, the RIFLE

criteria were developed by the Acute Dialysis Quality Initiative (ADQI) group, marking the inception of the aforementioned process. The present system delineates two distinct outcome categories, namely Loss and End-Stage Renal Disease, and further stratifies them into three severity grades, namely Risk, Injury, and Failure, as per the established nomenclature for End-Stage Renal Disease. In 2007, the Acute Kidney Injury Network (AKIN) put forth a revised rendition of the RIFLE criteria, aimed at enhancing the sensitivity of the diagnostic criteria for acute kidney injury (AKI). The definition of AKI has been revised by the KDIGO Acute Kidney Injury Working Group. According to their definition, AKI is characterised by a minimum rise in serum creatinine of 0.3 mg/dL within 48 hours or a 50% increase from baseline within 7 days, or a urine volume of less than 0.5 mL/kg/h for at least 6 hours [7].

The epidemiological statistics of acute kidney injury exhibit significant heterogeneity depending on the definitions employed, the population under investigation, and the clinical settings [8,9]. The incidence of AKI varies between 20% to 50% among critically ill patients who receive treatment in different ICU settings. Additionally, the mortality rates associated with AKI surpass 50% [10,11]. There exist notable dissimilarities in the epidemiological and clinical characteristics of acute kidney injury (AKI) between developed and developing nations. Acute kidney injury (AKI) predominantly impacts elderly patients who are hospitalised in developed nations, whereas it has a higher incidence rate among younger adults and children in less affluent countries. In underdeveloped nations, AKI is commonly attributed to infections and volume depletion, as per sources [12,13].

The examination of epidemiological and clinical information at the regional level is essential to understanding the extent of the problem and ensuring that healthcare resources are efficiently distributed, particularly with the implementation of updated criteria for defining and classifying AKI. Furthermore, significant regional disparities exist in the epidemiological patterns of acute kidney injury. There is a scarcity of data regarding the clinical and epidemiological features of patients with AKI utilising contemporary diagnostic criteria in developing countries such as India. Research has shown that the occurrence of acute kidney injury among critically ill patients is a notable indicator of elevated long-term morbidity and mortality. This study was conducted with the aim of comprehensively analysing the clinical and epidemiological features of adult patients who suffered from acute kidney injury (AKI) and were admitted to the medical ICU of a tertiary care facility located in a rural area of Central India.

2. Material and Methods

This study utilised a cross-sectional observational design and was carried out at a semi-urban tertiary-care teaching hospital. The study involved a prospective analysis of 100 patients with acute renal failure who were admitted to tertiary care hospital between April 2021 and October 2022. The study was conducted with the approval of the Institutional Ethics Committee. The study encompassed all individuals who exhibited clinical and biochemical indications of acute renal failure, as per the RIFLE criteria. Exclusion criteria for this study included individuals under the age of 18 with a diagnosis of chronic renal disease. A comprehensive medical assessment was conducted, which included a thorough medical history, a comprehensive physical examination, a systemic evaluation, and the requisite diagnostic tests. The patients were categorised based on the highest RIFLE class attained during their hospitalisation, namely class R, class I, or class F. The RIFLE classification system was established by selecting the more severe of either the glomerular filtration rate criteria or urine output criteria. The RIFLE criteria were employed to classify patients based on the alteration in serum creatinine level and urine output.

3. Results

The research was carried out at tertiary-care teaching hospital, between April 2021 and October 2022. The study focused on patients who were admitted to the Medical Intensive Care Unit and developed Acute Kidney Injury. The objective was to analyse the general presentation, clinical progression, and outcome of the condition.

The study population's demographic and clinical characteristics are presented in Table 1. Out of the total of 100 documented cases of Acute Kidney Injury (AKI), 46 cases (46%) were identified as female, whereas 54 cases (54%) were identified as male. The study found that the average age of individuals at the time

of presentation was 55.22 years, with a standard deviation of 14.91 years. The mean hospitalisation period was 7.91 ± 3.89 days. The average duration of stay in the Medical Intensive Care Unit was 4.98 ± 2.56 days. The average glomerular filtration rate (GFR) upon initial examination was 49.04 ± 19.09. According to the RIFLE classification system, 40% of the patients were categorised as being in Stage R of Acute Kidney Injury. The prevalent co-morbidities observed were Diabetes Mellitus (27%), Chronic Obstructive Pulmonary Disease (16%), Chronic Liver Disease (6%), and Hypertension (11%). Renal replacement therapy (RRT) was administered to 40% of patients in the form of hemodialysis (HD), whereas the remaining 60% of patients did not undergo RRT.

Table 1

Parameter	Patient Characteristics
Age (yrs), Mean ± S.D.	55.22 ± 14.91
Gender (%) Males Females	 54% 46%
Co-Morbid Conditions (n, %) Diabetes Mellitus COPD Chronic Liver Disease Hypertension	 27% 16% 6% 11%
Length of ICU Stay (days), Mean ± S.D.	4.98 ± 2.56
Total Hospital Stay (days), Mean ± S.D.	7.91 ± 3.89
GFR	49.04 ± 19.09
SBP (mm Hg), Mean ± S.D.	121.43 ± 12.57
DBP(mm Hg), Mean ± S.D.	78.84 ± 11.63
Peak S Creatinine (mg/dl), Mean ± S.D.	5.25 ± 2.10
AKI Stage(RIFFLE) Stage R (n, %) Stage I (n, %) Stage F (n, %)	 40% 19% 41%
APACHE II Score, Mean ± S.D.	13.00 ± 5.41
RRT (Hemodialysis) Initiated (n, %)	40%
Need for Mechanical Ventilation (n, %)	23%
No of Deaths (n, %)	40%

Table 2 illustrates the primary clinical indications observed during the initial assessment of individuals diagnosed with Acute Kidney Injury. The predominant clinical manifestations observed in the study population were pyrexia in 71% individuals , reduced urine output (66%), diarrhoea (37%), emesis and nausea (31%), difficulty in breathing (30%), swelling (24%), and changes in cognitive function (23%).

Table 2

Clinical features	**Percentage of Cases**
Fever	71%
Nausea/Vomiting	31%
Loose stools	37%
Oliguria	66%
Polyuria	13%
Odema	24%
Dyspnea	30%
Encephalopathy	30%

Table 3 displays the etiological factors that contribute to the onset of Acute Kidney Injury in the medical Intensive Care Unit. AKI was determined to be primarily caused by sepsis. Among the cohort of 100 patients

that were examined, a total of 64% cases, , were identified as being associated with sepsis. The primary origins of sepsis among our patient population were intricate infections of the urinary and respiratory tracts. Other causative factors attributed to AKI included hypovolemic shock (24%), ingestion of nephrotoxic drugs (4%), renal stone disease (3%), and poisoning (1%).

Table 3

Etiology	**% of Cases**
AGE/ Hypovolumic Shock	24%
Sepsis	64%
Urinary Tract Infections	11%
Respiratory Tract Infections	20%
Ac Pancreatitis	6%
Diabetic Foot with sepsis	3%
Septicemia	11%
Malaria	4%
Others	9%
Drug intake	4%
Poisoning	1%
Renal Stone Disease/Obstructive Uropathy	3%
Multifactorial	3%

Table 4 presents study demonstrates the various complications that arise in individuals diagnosed with Acute Kidney Injury. The prevalent complications documented in the study were Hyperkalemia (26%), Metabolic Acidosis (44%), Encephalopathy (47%), and Oliguria (66%). 23% of patients required mechanical ventilation due to respiratory compromise.

Table 4

Complication	**Percentage of Cases**
Oliguria	66%
Hyperkalemia	26%
Metabolic Acidosis	44%
Encephalopathy	47%
Arrhythmia	3%
Respiratory Distress	23%

Table 5 presents a comparative analysis of the clinical profile, laboratory investigations, and complications observed in both survivor and non-survivor populations. The results of the study indicate that a prolonged hospital stay exceeding seven days and an extended stay in the intensive care unit beyond four days are significantly correlated with a higher mortality rate. The occurrence of complications such as Oliguria and Encephalopathy exhibited a statistically significant correlation with increased mortality rates. The presence of GFR levels below 60 and AKI Stage (RIFFLE) Stage R were found to be significantly correlated with increased mortality rates. The study did not identify any noteworthy correlation between mortality and variables such as age, gender, type of acute kidney injury, and utilisation of renal replacement therapy.

Table 5

Parameters	Survivors	Non – survivors	P-value
Age 21-40 41-60 >60	9 (15%) 31 (52%) 20 (33%)	8 (20%) 24 (60%) 8 (20%)	0.334NS
Sex Male Female	34(57%) 26(43%)	20 (50%) 20(50%)	0.557 NS
Hospital stay ≤7 days >7 days	47 (78%) 13 (22%)	4 (10%) 36 (90%)	<0.01 *
ICU stay <4 days 4-7 days >7 DAYS	42 (70%) 11 (18%) 7(12%)	3 (7%) 20 (50%) 17 (43%)	<0.01 *
APACHE II Score Score ≤10 Score >10	24 (40%) 36 (60%)	11 (28%) 29 (71%)	0.308 NS
Encephalopathy Present Absent	16 (26%) 44 (74%)	32 (78%) 9 (22%)	<0.01 *
Oliguria Present Absent	29(48%) 31(52%)	37 (93%) 3 (7%)	<0.05 *
Sepsis Present Absent	37 (62%) 23 (38%)	27 (68%) 13 (32%)	0.611 NS
Type of AKI Pre Renal Renal Post Renal	10(17%) 47(78%) 3 (5%)	6 (15%) 33 (83%) 6 (15%)	0.377 NS
AKI Stage(Riffle) Stage R (n, %) Stage I (n, %) Stage F (n, %)	38(62%) 11(19.0%) 11 (19.0%)	3 (7%) 7 (18%) 30 (75%)	<0.01 *
GFR ≤60 >60	20(33%) 40 (67%)	34 (85%) 6 (15%)	<0.01 *

4. Discussion

Acute kidney injury is a prevalent manifestation in hospitalised patients, particularly those who are admitted to the intensive care unit with severe illness. It is imperative to investigate the occurrence and medical attributes of individuals with AKI across different populations, in light of recent modifications to the standards and advancements in diagnostic and therapeutic methodologies. Having up-to-date and sufficient epidemiological data is crucial in optimising the utilisation of healthcare resources within a given region. Recent studies conducted on acute kidney injury (AKI) in patients admitted to the intensive care unit (ICU) have indicated that the prevalence of this condition differs significantly across various demographics and subgroups of patients [8,10,14]. The majority of the participants in our research, comprising 55% of the sample, fell within the age range of 41 to 60 years. Consistent with prior research conducted in developing nations, findings indicate that AKI is commonly identified at a younger age in these regions compared to developed nations, where it is more frequently observed among the elderly population [15,16]. The aetiology of AKI exhibits a wide range and diverse pattern. The study revealed that intrinsic renal disorders were the leading cause of AKI, accounting for 69.8% of cases, followed by pre-renal causes at 24%, and post-renal causes at 5%. The leading aetiology of acute kidney injury (AKI) was sepsis, accounting for 64% of cases. Sepsis can be attributed to various aetiologies such as respiratory tract infections, urinary tract infections, septicaemia, severe malaria, and other related ailments. AKI was found to have additional significant aetiologies, including

acute gastroenteritis, drug use, renal stone disease, and poisoning. In a multicenter study conducted across 54 hospitals in 23 countries, acute renal failure in critically ill patients was found to have septic shock as the primary diagnosis in 47.5% of cases. The study conducted by Eswarappa et al. retrospectively analysed a cohort of 500 critically ill patients from India who had acute kidney injury. The findings indicated that sepsis was responsible for 38.6% of the cases, thereby emerging as the predominant cause of AKI. Despite the decline in sepsis as a cause of AKI in industrialised nations, sepsis remains a significant factor contributing to AKI in developing countries.

There exists a notable variation in the documented mortality rates among patients with acute kidney injury (AKI) in intensive care unit (ICU) contexts, as certain investigations suggest a fatality rate exceeding 50%. The interplay of various factors such as the research population, socioeconomic status, aetiology of acute kidney injury, and the available hospital management resources are all significant in determining the outcome of the condition. In a multicenter study conducted by Uchino et al. (2005), involving 29,269 critically ill patients with acute kidney injury, the overall hospital mortality rate was reported to be 60.5%. Korula et al. [18] reported an observational study on the incidence, prognostic factors, and outcomes of acute kidney injury in ICU patients in South India, revealing a 28-day mortality rate of 49.5%. In accordance with a retrospective analysis of patients in intensive care units who required renal replacement therapy for acute kidney injuries, the reported mortality rate was 49% [19]. The study recorded a mortality rate of 37%, with a total of 37 patients diagnosed with AKI having passed away. The mortality rate was found to be higher among patients who experienced AKI related to sepsis (42.18%, n=27 out of 64) in comparison to those who did not have sepsis (36.11%, n=13 out of 36). The present study reveals that RIFFLE stage F AKI was the predominant type, comprising 41% of the overall patient population. Furthermore, this type exhibited a fatality rate of 73.17%, with 30 patients succumbing to the condition. Several clinical parameters were compared between survivors and non-survivors to determine the factors that had a significant impact on mortality. These factors included the duration of hospitalisation, length of stay in the intensive care unit, presence of oliguria and encephalopathy, baseline glomerular filtration rate, and RIFLE stage. The presence of oliguria was deemed to be a noteworthy prognosticator of mortality. Out of the total of 70 patients, oliguria was observed in 66 individuals. Among these patients, 37 (56.06%) did not survive while 29 (43.94%) survived. The mortality rate among non-oliguric patients (n=34) was 8.8%, with only three patients succumbing to the illness.

Acute kidney injury is a prevalent medical condition that often afflicts critically ill patients and contributes to the economic burden on healthcare resources, particularly in regions with restricted resources such as developing countries like India. Early diagnosis and timely treatment are crucial in preventing mortality and long-term illness.

The present investigation exhibited certain limitations. The present study was solely focused on the clinical characteristics of AKI and did not involve a comparative analysis between ICU patients with AKI and those who did not develop AKI, as it was an observational study. Our investigation solely focused on the clinical profile of patients with AKI who were admitted to the hospital. The study did not include the requirement for maintenance Rapid Response Team (RRT) or extended patient monitoring to assess the development of any persistent issues. A potential limitation of the study is its relatively reduced sample size. Further investigation with extended follow-up may be necessary to ascertain the developing epidemiological and clinical characteristics of individuals experiencing acute kidney injury within a particular region.

5. Conclusion

Acute Kidney Injury is a noteworthy clinical concern that commonly impacts critically ill patients, particularly those in the medical intensive care unit. Currently, sepsis and volume depletion are the predominant aetiologies of acute kidney injury (AKI). At present, it is considered a self-sufficient indicator of mortality. Early identification and proper management, including renal replacement therapy as necessary, are essential in reducing both all-cause and AKI-related mortality in critically ill patients.

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