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ETIOLOGY AND OUTCOME OF ACUTE KIDNEY INJURY IN PATIENTS ADMITTED IN INTENSIVE CARE UNIT IN A TERTIARY CARE HOSPITAL

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Abstract

OBJECTIVE: *To evaluate the etiology and outcomes in AKI patients admitted in intensive care unit at Indus Hospital Karachi.*

METHODOLOGY: *This study was conducted at Indus Hospital, Karachi, it included 18–70 years old patients presented with acute kidney injury in Intensive Care Unit (ICU). The etiological factors evaluated encompassed sepsis, hypovolemic shock, and traumatic injuries. The patient cohort was monitored for various outcomes, including the necessity for dialysis, extended duration of ICU admission, and mortality rates. The data underwent statistical analysis utilizing SPSS software version 26, with a significance threshold established at $p \leq 0.05$.*

RESULTS: *Among 250 AKI patients (mean age 53.08 ± 14.97 years; 54.4% male), sepsis was the most common (41.2%), followed by hypovolemic shock (12.8%) and trauma (1.6%). Hemodialysis was required in 30.4%, remained for a longer period in ICU was 36.8%, and in-hospital mortality was 14.4%. There were significant gender differences for all outcomes ($p < 0.05$).*

CONCLUSION: *This study demonstrated that acute kidney injury in ICU patients is mainly caused by sepsis in a tertiary hospital. Marked disparities attributable to gender were observed concerning the necessity for dialysis, the duration of ICU hospitalization, and in-hospital mortality rates. The prompt recognition and intervention of sepsis-induced acute kidney injury are imperative to enhance clinical outcomes, particularly in critical care environments characterized by limited resources.*

INTRODUCTION

Acute Kidney Injury (AKI) is one of the most frequent and lethal types of kidney damage, ranging from a rapid but recoverable impairment of kidney function to permanent kidney failure [1]. There are many different mechanisms, and it is one of the most common endpoints of morbidity and mortality, especially in the context of the hospitalized and critically ill patient in the intensive care unit (ICU) [2].

AKI may result from a wide range of etiologies, such as dehydration, infections, nephrotoxic meds, contrast exposure during imaging procedures, urinary flow obstruction, systemic diseases such as sepsis. AKI are managed according to their etiology [3]. Based on etiology, AKI is classified into Hospital Acquired AKI and Community Acquired AKI. The prevalence of Hospital Acquired AKI is higher in developed countries while Community Acquired AKI is more prevalent in developing nations. A recent published meta-analysis showed that 8.3% of ambulatory patients developed AKI and the in-hospital AKI incidence had been found to range from 20–31.7% depending on the level of care [4].

Incidence and prevalence of AKI depend on local factors and diseases affecting the population which differ substantially in underdeveloped countries when compared to developed countries [5]. A lot of this is contingent on the health care procedures, nutrition practices, climate scenarios, as well as the awareness base of both the population and health care providers [6]. One study by Zargar et al (1), conducted in an intensive care unit elsewhere in India, reported AKI in 9.7% of admitted patients; 30% of AKI was due to prerenal causes and mortality was10% at 6 weeks and driven by cardiovascular diseases [7].

Sepsis (60.3%) and hypovolemic shock (31.7%) were the most common etiologies for AKI. 28.5% had prolonged ICU admission while In-hospital mortality was reported in 41.3% patients [7]. Magboul et al, also studied etiology and outcomes of AKI in an ICU in Sudan and reported a 39% incidence of AKI. Sepsis (64%) and hypovolemic shock (36%) were the most prevalent etiological factors. 53.7% of patients required Hemodialysis, while In-hospital mortality was reported in 87.8% patients [8].

Sengthavisouk et al, reported in their study that sepsis (27.5%), hypovolemic shock (47.4%) and trauma (11.8%) were the most common etiological factors for AKI. 5.1% of patients required hemodialysis while 44.5% patients had In-hospital mortality [9]. It is evident from literature that AKI is a significant cause of mortality in ICU admitted patients and considerable number of patients eventually become dialysis dependent [7-9].

METHODOLOGY

This descriptive cross-sectional framework was executed within the Department of Nephrology at Indus Hospital, Karachi, subsequent to receiving authorization from the institutional ethics review board. Individuals aged 18 to 70 years of any gender, who were admitted to the ICU with acute AKI, were recruited utilizing a non-probability consecutive sampling method subsequent to obtaining informed consent. Acute kidney injury was defined according to the kidney disease: Improving Global Outcomes (KDIGO) criteria as an increase in serum creatinine of ≥0.3 mg/dL within 48 hours or ≥1.5 times the baseline value within seven days. Exclusion criteria included chronic kidney disease stage greater than 3A, prior renal transplantation, advanced malignancy, end-stage liver disease, repeated intensive care unit admissions during the same hospitalization, and pregnancy or lactation. Upon intensive care unit admission, each patient underwent a thorough clinical evaluation—including assessment of trauma, fluid loss, and vital signs—to determine the etiology of acute kidney injury. Etiological factors were categorized as sepsis (defined as the presence of two or more systemic inflammatory response syndrome [SIRS] criteria with a positive blood culture), hypovolemic shock (base deficit >4 mmol/L along with clinical signs of volume depletion), or trauma occurring within 24 hours prior to admission. Laboratory investigations, including white blood cell count, arterial partial pressure of carbon dioxide ($PaCO_2$), and base deficit, were performed to corroborate clinical findings. All data were documented using a standardized proforma to ensure consistency and minimize bias. Patients were monitored throughout their intensive care unit stay until discharge or in-hospital death to assess key outcomes, namely the requirement for haemodialysis, prolonged intensive care unit stay exceeding 14 days, and in-hospital mortality.

Data will be analyzed using SPSS version 26. Continuous variables will be presented as mean ± standard deviation, while categorical variables will be expressed as frequencies and percentages. The Chi-square test will be used to evaluate the statistical difference, with a p-value ≤ 0.05 considered statistically significant.

RESULTS

The investigation encompassed a cohort of 250 individuals, exhibiting a mean age of 53.08 ± 14.97 years (95% CI: 51.21–54.94). The average serum creatinine concentration upon admission was recorded at 4.20 ± 3.05 mg/dl (95% CI: 3.82–4.58), which subsequently diminished to 3.63 ± 2.29 mg/dl at the time of discharge (95% CI: 3.35–3.92). Within the cohort, 136 participants (54.4%) were identified as male, whereas 114 participants (45.6%) were classified as female. In terms of residential distribution, 146 individuals (58.4%) hailed from urban locales, while 104 individuals (41.6%) originated from rural sectors. Sepsis emerged as the predominant etiology, identified in 103 patients (41.2%), succeeded by hypovolemic shock in 32 patients (12.8%) and trauma in 4 patients (1.6%) (TABLE I).

In this analysis involving 250 patients diagnosed with acute kidney injury (AKI), a gender-specific comparison unveiled statistically significant variations in clinical outcomes. Hemodialysis was necessitated in 49 male patients (36.0%) in contrast to 27 female patients (23.7%), yielding a statistically significant difference (p=0.035; 95% CI: 1.041–3.164). Extended durations of intensive care unit (ICU) admission were significantly more prevalent among female patients, with occurrences recorded in 62 (54.4%) as opposed to 30 male patients (22.1%) (p = 0.0001; 95% CI: 0.137–0.411). Furthermore, in-hospital mortality rates were markedly elevated among male patients, with 29 fatalities (21.3%) compared to a mere 7 (6.1%) among females, a difference that reached statistical significance (p=0.001; 95% CI: 1.740–9.867). These results underscore pronounced gender-based discrepancies in the clinical outcomes of patients afflicted with AKI (TABLE II).

DISCUSSION

To describe the etiological spectrum and outcome of acute kidney injury (AKI) in ICU admitted patients in a tertiary care hospital in Karachi. Patients were chosen by clinical criteria as defined by kidney disease: KDIGO guidelines, i.e. increase in serum creatinine by ≥0.3 mg/dL within 48 hours or an increase to ≥1.5 times baseline within seven days. This provides consistency and allows for comparison across the international literature. We found that sepsis was the most common aetiological cause of AKI among ICU patients (41.2%), followed by hypovolemic shock (12.8%) and trauma (1.6%). This trend correlates with previous regional and global studies, including Zargar et al. Interestingly, we also found a similar trend when compared to the diagnosis of septic shock mortality by Harshagah et al. [7], who also noted a rise in sepsis (60.3%) and hypovolemia (31.7%) as primary etiologies among Indian populations, and Magboul et al. cominicrops in Sudan that reported similarly [8], Interestingly, Sengthavisouk et al. Higher hypovolemia versus sepsis rates have been described in several studies,[9] which may indicate differences in care-related access and early sepsis detection.

Compared to our study, their reported need for dialysis (5.1%) was markedly lower, which may relate to differences in AKI severity or dialysis availability. In our cohort, gender differences in clinical outcomes were significant. Male patients had a higher hemodialysis requirement and mortality rate, while prolonged ICU admission was more frequent among females. These gender disparities have been inconsistently reported in literature, and may be influenced by biological variation, healthcare-seeking behavior, or underlying comorbidities [10,11]. In this study, the overall in-hospital mortality was 14.4%, which was much lower than the 41.3% reported by Zargar et al. and the 87.8% reported in a study carried out in Sudan [8]. This difference may represent earlier diagnosis or better supportive care in our cohort. Recent investigations emphasize how the outcome of AKI is determined by local health care systems characteristics, such as the accessibility to renal replacement therapies that are available to the population, and the adequacy of sepsis management strategies in the area [12–16]. Strengths of this study were its defined patient population, data collection methodology, and analysis of gender differences, adding valuable data to the literature. However, this comes with several important limitations. Strengths of the study included its single-centre, cross-sectional design, but also limitations such as no long-term outcome data other than vital status post-discharge and no data regarding renal recovery. In addition, SIRS criteria were used for defining sepsis and may have lead to an underestimation of the AKI burden attributable to sepsis, since this criteria is less specific than the more recent SOFA score [17]. Future studies

should also be multicenter and longer term to better determine kidney function, dialysis time and survival. In particular, the identification of NGAL, cystatin C and other newer biomarkers may improve AKI detection and risk stratification for AKI [18–20]. In summary, the results highlight the significant burden of AKI associated with sepsis in the ICU and the importance of early recognition and focused management of sepsis-associated AKI, especially in low-resource settings.

CONCLUSION

This study demonstrated that acute kidney injury in ICU patients is mainly caused by sepsis in a tertiary hospital. Marked disparities attributable to gender were observed concerning the necessity for dialysis, the duration of ICU hospitalization, and in-hospital mortality rates. The prompt recognition and intervention of sepsis-induced acute kidney injury are imperative to enhance clinical outcomes, particularly in critical care environments characterized by limited resources.

Table I: Demographic and Clinical Characteristics of Study Participants (n=250)

Mean ± SD		**95% CI**
Age in years = 53.08 ± 14.97		51.21–54.94
Serum Creatinine Levels at Admission in mg/dl = 4.20 ± 3.05		3.82–4.58
Serum Creatinine Levels at Discharge in mg/dl = 3.63 ± 2.29		3.35–3.92
n (%)		
Gender	Male	136 (54.4)
	Female	114 (45.6)
Residential Status	Urban	146 (58.4)
	Rural	104 (41.6)
Etiology of Acute Kidney Injury		
Sepsis		103 (41.2)
Hypovolemic Shock		32 (12.8)
Trauma		4 (1.6)

Table II: Comparison of Outcomes in AKI Patients with and Without Gender (n=250)

Outcomes Acute Kidney Injury		**Gender**		**95% C. I**	**P-Value**
		Male	**Female**		
Hemodialysis Requirement, n (%)	Yes	49 (36.0)	27 (23.7)	1.041–3.164	0.035*
	No	87 (64.0)	87 (76.3)		
Prolonged ICU Admission, n (%)	Yes	30 (22.1)	62 (54.4)	0.137–0.411	0.0001*
	No	106 (77.9)	52 (45.6)		
In-hospital Mortality, n (%)	Yes	29 (21.3)	7 (6.1)	1.740–9.867	0.001*
	No	107 (78.7)	107 (93.9)		

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