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Etiology and Outcome of Acute Kidney Injury; A Single Centre Study

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ABSTRACT

Acute kidney injury is a syndrome defined by the rapid decline of renal excretory function, commonly identified through the accumulation of nitrogenous waste products. **Objective:** To identify the etiology and outcome of acute kidney injury. **Methods:** The study was carried out from September 2023 to April 2024. 135 patients diagnosed with acute kidney injury, aged 18-75 years were included. To categorize the causes of acute kidney injury into pre-renal, intra-, and post-renal categories, comprehensive histories, clinical evaluations, laboratory tests, and kidney imaging using ultrasound were performed. Outcomes were assessed as full recovery, partial recovery, or failure to recover within three months of diagnosis. Descriptive statistics and SPSS version 23.0 were used for analysis. The chi-square test examined the relationship between age, gender, etiology and outcomes; a p-value<0.05 is considered significant. **Results:** The patients were 41.63 ± 14.55 years old on average. Pre-renal causes were identified in 135 cases, with sepsis 77 (54.8%) being the most common etiology, followed by diuretic overuse 44 (32.6%). Intra-renal causes included acute tubular necrosis 63 (46.7%) and glomerular diseases 48 (35.6%). Post-renal causes were predominantly due to renal stones 68 (50.4%). Full recovery was achieved in 92 (68.1%) cases, partial recovery in 28 (20.7%), and 15 (11.1%) patients failed to recover. **Conclusions:** It was concluded that the maximum number of patients with acute kidney injury fully recovered. Sepsis is the leading pre-renal cause of acute kidney injury, while acute tubular necrosis is the most common intra-renal cause. Renal stones are the primary post-renal cause.

INTRODUCTION

Acute kidney injury (AKI) is a clinical illness marked by a sudden deterioration in kidney function that results in fluid dysregulation, waste product accumulation, and electrolyte abnormalities [1, 2]. It is a frequent serious consequence that hospitalized patients experience, particularly in critical care units [3]. Globally the frequency of AKI varies but in intensive care units (ICUs) many risk factors including sepsis, major surgery and exposure to nephrotoxic medications are associated with increased rates of AKI [4]. AKI is found in 16-20% of hospital admissions as stated by a study from Northern Pakistan [5]. AKI can have a major impact on patient outcomes and is linked to severe morbidity and mortality. A standardized framework for diagnosing and staging AKI is offered by the Kidney Disease Improving Global Outcomes (KDIGO) criteria, which makes it easier to identify and treat the illness consistently. AKI, as per KDIGO, is characterized by a rise in serum creatinine of at least 0.3 mg/dL within 48 hours or at least 1.5 times the baseline within the previous seven days is indicative of AKI [6, 7]. Many factors are causing AKI, however, they can be generally divided into three categories: post-renal, intra-renal, and pre-renal [8, 9]. Reduced renal perfusion causes pre-renal AKI, which is frequently linked to illnesses like sepsis, heart failure, and dehydration. Intra-renal acute kidney injury (AKI) is typically brought on by acute tubular necrosis, glomerulonephritis, or interstitial nephritis directly damaging the kidney parenchyma. Urine flow obstruction, usually from benign

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prostatic hyperplasia, renal calculi, or cancers, is the etiology of post-renal AKI [8, 10]. The underlying cause, severity, and prompt care all affect the AKI prognosis, which varies widely. Patients may experience partial or total recovery from AKI, or they may advance to end-stage renal disease (ESRD) or chronic kidney disease (CKD) [11, 12]. Identifying the etiology of AKI is crucial for the appropriate management and improving patient outcomes. According to a study by Hoste *et al.*, 13.3 million people are impacted by AKI each year and have a high mortality rate of 20–30% in severe cases. The research emphasized the importance of early recognition and management of AKI to enhance outcomes and reduce costs related to healthcare [13]. A study by Zhou et al., (2019) reported that sepsis is a leading cause of AKI accounting for nearly 50% of cases in ICU settings [14]. AKI has been associated with a higher risk of death and was seen in 25% of hospitalized young individuals. Although the AKI burden was similar, low-income and low-middle-income countries exhibited greater mortality rates than high-income countries [15]. The long-term prognosis of AKI survivors was investigated in a study by Silver et al., (2017). According to a study compared to individuals without a history of AKI, patients who recovered from AKI had a higher chance of acquiring CKD and cardiovascular illnesses [16]. Although AKI may be diagnosed and classified using the conventional KDIGO criteria, there remains a substantial need to understand its diverse etiologies and outcomes in different regional and demographic contexts. This study seeks to shed light on the specific causes and effects of AKI in light of the paucity of information available on the Pakistani population. Understanding these factors will help tailor prevention and treatment strategies, improve patient management, and enhance clinical outcomes, addressing a critical knowledge gap in the local healthcare setting.

This study aims to find out the etiology and outcomes of AKI in patients at Social Security Hospital, Lahore, using a structured approach based on KDIGO criteria.

METHODS

This cross-sectional analytical study was conducted at Social Security Hospital, Lahore from September 2023 to April 2024. The study enrolled patients aged 18-75 years diagnosed with AKI, excluding those with preexisting kidney disease, chronic renal diseases, or renal transplantation. A non-probability convenient sampling technique was used, with a sample size of 135 determined by the WHO calculator, considering a 95% confidence level, 5% absolute precision, and an estimated true proportion of 9.4% [17]. Administrative permission and ethical approval were taken from the research and ethical committee of Social Security Hospital before starting the study (Ref. No 293/3). All patients provided informed consent confirming their willingness to participate and maintaining confidentiality of their personal information. Data collection involved a complete history, clinical examination, laboratory tests (including serum creatinine and blood CP), and kidney ultrasound imaging. Computed Tomography of the Kidneys, Ureters, and Bladder (CT KUB) and renal biopsy were performed if required. Etiologies of AKI were categorized into pre-renal, intra-renal, and post-renal categories based on clinical, laboratory, and imaging findings. AKI, as per Kidney Disease Improving Global Outcomes (KDIGO), is characterized by a rise in serum creatinine of at least 0.3 mg/dL within 48 hours or at least 1.5 times the baseline within the previous seven days [6, 18]. The management of AKI patients in this study followed a standardized approach based on KDIGO guidelines, with treatments adapted to each primary cause of AKI. The pre-renal AKI cases were treated by fluid replacement to maintain renal perfusion and support kidney function. Renal AKI management included supportive care, dialysis when indicated, and early diagnosis through renal biopsy in select cases to address the root cause. In obstructive AKI cases, prompt removal of the obstruction was carried out to restore renal function however the AKI related to urinary tract infections was managed with appropriate antibiotics to treat infection. This tailored approach ensured alignment with best practices for each AKI category [19]. The outcomes of AKI were categorized as full recovery (serum creatinine returning to normal laboratory reference values within three months), partial recovery (serum creatinine decreasing but not reaching normal levels within three months), and failure to recover (serum creatinine not decreasing or continuing to rise within three months). Data were analyzed by SPSS version 23.0, with continuous variables represented as mean & standard deviation (SD) and categorical variables as frequency/percentage. The association of age, gender and etiology with outcomes was analyzed using the chi-square test, with a p-value of less than 0.05 considered significant.

RESULTS

This study included 135 patients having an average age of 41.63 ± 14.55 years. Gender distribution showed 87 male (64.4%) and 48 female (35.6%). Marital status showed 85 married (63%) and 50 single (37%). Etiological factors were assessed in the study in terms of pre-renal, intra-renal and post-renal. Among pre-renal causes, sepsis was predominant 74 (54.8%), followed by diuretic overuse 44 (32.6%). Intra-renal causes were primarily acute tubular necrosis 63 (46.7%) and glomerular diseases 48 (35.6%). Post-renal causes were mainly due to renal stones 68 (50.4%)(Table 1).

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Table 1: Etiology of AKI in study participants

Causes of AKI	n (%)
Pre-Renal	
Cardiac Diseases	10 (7.4%)
Hypovolemia	7 (5.2%)
Sepsis	74 (54.8%)
Diuretics Overuse	44 (32.6%)
Intra-Renal	
Acute Tubular Necrosis	63 (46.7%)
Glomerular Diseases	48 (35.6%)
Interstitial Diseases	17 (12.6%)
Vascular Diseases	7 (5.2%)
Post-Renal	
Renal Stones	68 (50.4%)
Benign Prostate Hypertrophy	47 (34.8%)
Malignancy	20 (14.8%)

Outcomes of AKI were assessed in terms of full recovery, partial recovery and failure to recover patients. Full recovery was determined in 92(68%) of cases, partial recovery in 28(21%) and failure to recover in 1(11%) (Table 1).

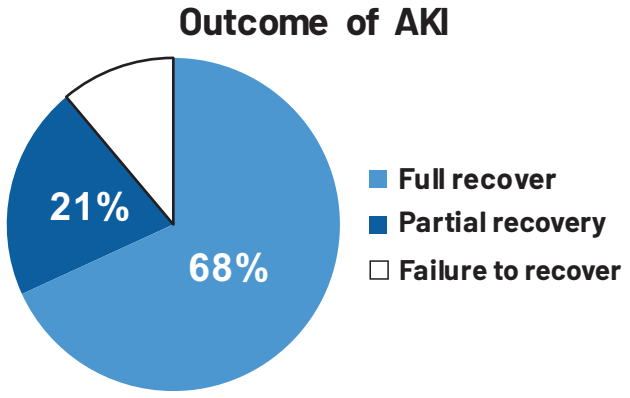

Figure 1: Outcomes of AKI in Terms of Full Recovery, Partial Recovery and Failure to Recover Patients

There is a significant association found between pre-renal & intra-renal causes of AKI and outcomes of AKI ($p<0.005$), however, no significant association was found between post-renal causes of AKI and outcomes of AKI ($p=0.870$). The association between etiological causes of AKI and outcomes of AKI are displayed (Table 2).

Table 2: Relationship Between Etiological Causes and Outcomes of AKI

Etiology of AKI	Outcomes of AKI			p-Value
	Full Recovery n (%)	Partial Recovery n (%)	Failure Recovery n (%)	
Pre-Renal				
Cardiac Diseases	0 (0.0%)	8 (28.6%)	2 (13.3%)	0.000
Hypovolemia	4 (4.3%)	0 (0.0%)	3 (20.0%)	
Sepsis	44 (47.8%)	20 (71.4%)	10 (66.7%)	
Diuretics Overuse	44 (47.8%)	0 (0.0%)	0 (0.0%)	
Intra-Renal				
Acute Tubular Necrosis	45 (48.9%)	15 (53.6%)	3 (20.0%)	0.000
Glomerular Diseases	24 (26.1%)	12 (42.9%)	12 (80.0%)	
Interstitial Diseases	16 (17.4%)	1 (3.6%)	0 (0.0%)	
Vascular Diseases	7 (7.6%)	0 (0.0%)	0 (0.0%)	
Intra-Renal				
Renal Stones	44 (47.8%)	15 (53.6%)	9 (60.0%)	0.870
Benign Prostate Hypertrophy	33 (35.9%)	10 (35.7%)	4 (26.7%)	
Malignancy	15 (16.3%)	3 (10.7%)	2 (13.3%)	

Gender and age-based outcomes of AKI were studied. There is no significant association found between age, gender and outcomes of AKI (Table 3).

Table 3: Association Between Gender, Age and Outcomes of AKI

Variables	Outcomes of AKI			p-value
	Full Recovery	Partial Recovery	Failure Recovery	
Gender				
Male	0 (0.0%)	8 (28.6%)	2 (13.3%)	0.77
Female	28 (58.33%)	11 (22.91%)	9 (18.75%)	
Age				
18-44	53 (66.25%)	16 (20%)	11 (13.75%)	0.73
45-64	33 (70.21%)	11 (23.40%)	3 (6.38%)	
Greater Then 64	6 (75%)	1 (12.5%)	1 (12.5%)	

DISCUSSION

In current study, the mean age (years) of acute kidney injury patients was 41.63 ± 14.55, with 87 (64.4%) male and 48 (35.6%) female. A study done in 2018 found that the mean age of patients having AKI was 49 ± 18.1 years, with 86 (27.8%) patients aged 60 years or older and the majority being men. Another study reported that the mean age of AKI patients was 50 outnumbered by males. In contrast, Srisawat *et al.*, concluded that the average age of AKI patients was 65.1 ± 17.5 and this difference was due to the inclusion of only patients admitted to the intensive care unit (ICU) [20]. The study investigated etiological factors in three categories: pre-renal, intra-renal, and post-renal. Sepsis was the most common (54.8%) pre-renal etiology of AKI among medical cases, whereas acute tubular necrosis was the most common intra-renal etiology factor, and renal stones were present in the majority of cases in post-renal etiology factors. Priyamvada *et al.*, depicted that sepsis was the major cause of AKI [21]. A previous study reported that acute tubular injury was prevalent in renal pathology [22]. According to Hafeez *et al*, the most frequently reported causes of AKI on ICU admission were sepsis (36%), followed by hypovolemia (22%) [23]. Another study discusses the pathophysiology and etiology of acute kidney injury, such as pre-renal factors from hypovolemia, intra-renal causes like glomerular disorders, and post-renal obstructive reasons [9]. AKI outcomes were categorized as fully recovered, partially recovered, and failed to

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recover. The majority of AKI cases (68.1%) were recovered, with 20.7% partially recovered and an 11.1% failure rate reported complete recovery rates between 33% and 90%. Hafeez *et al.*, stated that 69% of patients fully recovered, while others had partial recovery or progressed to chronic kidney disease [22]. A study by Oweis *et al.*, revealed that 59.6% of patients recovered from their acute illness, while 31.2% of individuals died during their hospital stay [3]. The results' generalizability is limited by the use of a non-probability sampling technique and secondly, the data were gathered from a single center.

CONCLUSIONS

It was concluded that this study provides significant insights into the etiology and outcomes of AKI and concluded that the majority of AKI patients were fully recovered and Sepsis is the most prevalent pre-renal cause of AKI, while acute tubular necrosis is the most frequent intra-renal cause. Renal stones are the primary post-renal cause.

Authors Contribution

Conceptualization: MN, SN, MMUR, S
Methodology: MN, MMUR, AJ
Formal analysis: MN, SN, MMUR, S, AJ
Writing review and editing: MN, SN, S, AJ

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Dainton M. Acute Kidney Injury. Renal Nursing: Care and Management of People with Kidney Disease. 2024 Sep: 115-31. doi: 10.1002/9781394178797.ch5.

[2] James MT, Chawla LS, Kimmel PL. Acute Kidney Injury and Chronic Kidney Disease. In chronic Renal Disease. 2020 Jan: 397-409. doi: 10.1016/B978-0-12-815876-0.00026-7.

[3] Oweis AO, Alshelleh SA, Momany SM, Samrah SM, Khassawneh BY, Al Ali MA. Incidence, Risk Factors, and Outcome of Acute Kidney Injury in the Intensive Care Unit: A Single-Center Study from Jordan. Critical Care Research and Practice.2020; 2020(1): 8753764. doi: 10.1155/2020/8753764.

[4] Kahindo CK, Mukuku O, Wembonyama SO, Tsongo ZK. Prevalence and Factors Associated with Acute Kidney Injury in Sub-Saharan African Adults: A Review of the Current Literature. International Journal of Nephrology.2022; 2022(1): 5621665.doi: 10.1155/2022/5621665.

[5] Naqvi R. Epidemiological Trends in Community-Acquired Acute Kidney Injury in Pakistan: 25 Years' Experience from A Tertiary Care Renal Unit. Pakistan Journal of Medical Sciences. 2021 Mar; 37(2): 312. doi: 10.12669/pjms.37.2.3876.

[6] Lameire N. Reflections on the KDIGO Definition of Acute Kidney Injury and Its Integration in the Concept of Acute Diseases and Disorders and Chronic Kidney Diseases. Kidney and Dialysis.2022Feb;2(1):68-79. doi: 10.3390/kidneydial2010008.

[7] El-Khoury JM, Hoenig MP, Jones GR, Lamb EJ, Parikh CR, Tolan NV *et al*. AACC Guidance Document On Laboratory Investigation of Acute Kidney Injury. The Journal of Applied Laboratory Medicine.2021 Sep; 6(5): 1316-37. doi: 10.1093/jalm/jfab020.

[8] Booth GM and Frattali S. Managing Emergencies in the Outpatient Setting: Pearls for Primary Care. Springer Nature.2023Jan.doi:10.1007/978-3-031-15270-2.

[9] Sluman C, Gudka PM, McCormick K. Acute Kidney Injury: Pre-Renal, Intra-Renal and Post-Renal. Renal Medicine and Clinical Pharmacy. 2020 Jul: 23-44. doi: 10.1007/978-3-030-37655-0_3.

[10] Almazmomi MA, Esmat A, Naeem A. Acute Kidney Injury: Definition, Management, and Promising Therapeutic Target. Cureus.2023 Dec; 15(12). doi:10.7759/cureus.51228.

[11] Vijayan A, Abdel-Rahman EM, Liu KD, Goldstein SL, Agarwal A, Okusa MD. Recovery After Critical Illness and Acute Kidney Injury. Clinical Journal of the American Society of Nephrology. 2021 Oct; 16(10): 1601-9. doi: 10.2215/CJN.19601220.

[12] Pan HC, Chen HY, Teng NC, Yeh FY, Huang TM, See CY *et al*. Recovery Dynamics and Prognosis After Dialysis for Acute Kidney Injury. journal of the American Medical Association Network Open.2024 Mar; 7(3): e240351-. doi: 10.1001/jamanetworkopen.2024.0351.

[13] Hoste EA, Kellum JA, Selby NM, Zarbock A, Palevsky PM, Bagshaw SM *et al*. Global Epidemiology and Outcomes of Acute Kidney Injury. Nature Reviews Nephrology. 2018 Oct; 14(10): 607-25. doi: 10.1038/s41581-018-0052-0.

[14] Zhou J, Bai Y, Wang X, Yang J, Fu P, Cai D *et al*. A Simple Risk Score for Prediction of Sepsis Associated-Acute Kidney Injury in Critically Ill Patients. Journal of Nephrology. 2019 Dec; 32: 947-56. doi: 10.1007/s40620-019-00625-y.

[15] Meena J, Mathew G, Kumar J, Chanchlani R. Incidence of Acute Kidney Injury in Hospitalized Children: A Meta-Analysis. Pediatrics.2023 Feb; 151(2). doi: 10.1542/peds.2022-058823.

[16] Silver SA, Beaubien-Souligny W, Shah PS, Harel S, Blum D, Kishibe T *et al*. The Prevalence of Acute Kidney Injury in Patients Hospitalized with COVID-19

DOI: https://doi.org/10.54393/pjhs.v5i10.1981

Infection: A Systematic Review and Meta-Analysis. Kidney Medicine. 2021 Jan; 3(1): 83-98. doi: 10.1016/j.xkme.2020.11.008.

[17] Vikrant S, Gupta D, Singh M. Epidemiology and Outcome of Acute Kidney Injury from A Tertiary Care Hospital in India. Saudi Journal of Kidney Diseases and Transplantation.2018 Jul; 29(4): 956-66. doi: 10.4103/1319-2442.239633.

[18] Mehta RL, Burdmann EA, Cerdá J, Feehally J, Finkelstein F, García-García G *et al*. Recognition and Management of Acute Kidney Injury in the International Society of Nephrology 0by25 Global Snapshot: A Multinational Cross-Sectional Study. The Lancet.2016 May; 387(10032): 2017-25. doi: 10.1016/S0140-6736(16)30240-9.

[19] Kellum JA, Lameire N, Aspelin P, Barsoum RS, Burdmann EA, Goldstein SL *et al*. Kidney Disease: Improving Global Outcomes (KDIGO) Acute Kidney Injury Work Group. KDIGO Clinical Practice Guideline for Acute Kidney Injury. Kidney International Supplements. 2012 Mar; 2(1): 1-38.

[20] Srisawat N, Kulvichit W, Mahamitra N, Hurst C, Praditpornsilpa K, Lumlertgul N *et al*. The Epidemiology and Characteristics of Acute Kidney Injury in the Southeast Asia Intensive Care Unit: A Prospective Multicenter Study. Nephrology Dialysis Transplantation.2020 Oct; 35(10): 1729-38. doi: 10.1093/ndt/gfz087.

[21] Priyamvada PS, Jayasurya R, Shankar V, Parameswaran S. Epidemiology and Outcomes of Acute Kidney Injury in Critically Ill: Experience from A Tertiary Care Center. Indian Journal of Nephrology. 2018 Nov; 28(6): 413-20. doi: 10.4103/ijn.IJN_191_17.

[22] Kellum JA, Romagnani P, Ashuntantang G, Ronco C, Zarbock A, Anders HJ. Acute Kidney Injury. Nature Reviews Disease Primers.2021Jul;7(1):1-7.doi: 10.1038/s41572-021-00284-z.

[23] Abd ElHafeez S, Tripepi G, Quinn R, Naga Y, Abdelmonem S, AbdelHady M *et al*. Risk, Predictors, and Outcomes of Acute Kidney Injury in Patients Admitted to Intensive Care Units in Egypt. Scientific Reports. 2017 Dec; 7(1): 17163. doi: 10.1038/s41598-017-17264-7.