Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublisher.com/sjams/

OPEN ACCESS

Nephrology

Clinical Profile and Outcomes of Hospital Acquired Acute Kidney Injury in Medical, Surgical and Intensive Care Unit Patients - A Comparative Study from Northeast India

Dr. Takhellambam Brojen[1*], Dr. Ngairangbam Archana[2], Prof. Naorem Sharatkumar[3]

[1]Assistant Professor Department of Nephrology, Regional Institute of Medical Sciences, Manipur, India
[2]Junior Resident, Department of Medicine, Regional Institute of Medical Sciences, Manipur, India
[3]Professor Department of Nephrology, Regional Institute of Medical Sciences, Manipur, India

DOI: 10.36347/sjams.2019.v07i12.69 | **Received:** 20.11.2019 | **Accepted:** 23.12.2019 | **Published:** 30.12.2019

***Corresponding author:** Dr. Takhellambam Brojen

Abstract **Original Research Article**

Background: Acute Kidney Injury (AKI) represents a spectrum of kidney disorders with varying severity, demonstrating notable discrepancies in occurrence and outcomes between developed and developing countries. AKI may develop among the hospitalized patient during the course of hospitalization. This prospective study aims to provide comprehensive insights into Hospital-Acquired Acute Kidney Injury (HAAKI) across medical, surgical, and ICU settings. ***Methods:*** The study enrolled adult patients 18 years- above, of genders who were admitted in medical, surgical, ICU setup with normal kidney function but who developed AKI 48 hours after hospitalization. Statistical analysis involved descriptive statistics, chi-square tests, and distribution analyses to explore various aspects of HAAKI. ***Results:*** The incidence of HAAKI in medical, surgical and ICU units were 0.78%,0.74%and 1.51% respectively. Temporal analysis showed variations in HAAKI onset in different units, with the ICU presenting a higher proportion of severe cases. Pre-renal causes, predominantly drugs played a significant role, while renal causes, including sepsis, exhibited unit-specific variability. Hemodialysis was most frequently used in the ICU (30.6%), and outcomes demonstrated unit-wise variations, with the highest mortality rate in the ICU (33.9%). Cox regression analysis highlighted factors influencing death or survival, including lower hazards in surgical units, increased hazards with malignancy, positive association with neurological diseases, and significantly lower hazards in AKI 1 and AKI 2 cases. ***Conclusions:*** This study sheds light on significant variations in age and sex distribution, primary diseases, and causes of HAAKI across diverse setting in hospitals. These findings emphasize the imperative for unit specific considerations in managing HAAKI cases.

Keywords: Acute Kidney Injury, Hospital-Acquired, Etiology, KDIGO Staging.

INTRODUCTION

Acute kidney injury (AKI) is characterized by elevation of serum creatinine levels to >0.3mg/dl and decreasein urinary output of <0.5ml/hour. [1]. This condition is part of a spectrum of acute kidney disease (AKD), varying in severity from mild and temporary to severe and persistent [2]. AKD may manifest without meeting the rapid onset criterion, such as in cases of gradual kidney dysfunction [1]. Additionally, AKD can persist beyond the resolution of an AKI event, indicating unresolved dysfunction or structural damage to the kidneys.

AKI can manifest as either community-acquired AKI (CAAKI) or hospital-acquired AKI (HAAKI). In developed nations, AKI often affects elderly individuals with existing health conditions, leading to elevated mortality rates and prevalence of HAAKI tends to be more pronounced compared to developing countries. Conversely, in tropical, low, and middle-income countries like India, AKI is characterized by a higher incidence of CAAKI, affecting relatively younger patients without significant underlying health issues [3]. It is often attributed to a single reversible factor such as infection, toxin exposure, volume depletion, or medication. AKI is common in critical care units and significantly contributes to adverse outcomes, with reported mortality rates frequently exceeding 50% [4]. Due to the absence of a nationwide AKI registry, substantial gaps exist in understanding AKI in Indian ICUs. Current information on AKI in critically ill patients in India is primarily derived from various single-center studies [3-10]. Given the geographical and

socioeconomic diversity in the country, regional disparities are anticipated in the epidemiology and outcomes of AKI.

In the developing world, HAAKI is frequently under-recognized and underreported [11]. There is significant heterogeneity in the case definitions of AKI in critically ill patients, with some Indian studies utilizing creatinine-based criteria and others adopting RIFLE criteria [6, 7, 9]. To our knowledge, this study is the first from India encompassing a mixed population of patients from multiple medical, surgical and ICUs, utilizing KDIGO criteria for diagnosing AKI.

Aim and objective:

To study the epidemiological characteristics, clinical profiles, and outcomes associated with HAAKI across different patient populations, those in medical, surgical, and ICU patients.

MATERIAL AND METHODS

Study subjects

After getting approval from the institutional ethical committee, a prospective observational study was conducted at the Regional Institute of Medical Sciences, Imphal, spanning from January 2016 to December 2018. Informed consent was taken from all the study subjects or near relatives.Inclusion criteria was patients with age ≥18 years irrespective of gender who were admitted with normal renal function then developed AKI 48 hours after the hospitalization.Exclusion criteria were (a) Patients with AKI at the time of admission, (b) patient developing AKI within 48 hrs of hospitalization,(c) acute on CKD(d) patient taking nephrotoxic drugs prior to hospitalization. All relevant data like age, sex, past illness, primary diseaseand co-morbidities were noted.

Working definitions used in the study

HAAKIwas defined using KDIGO criteria of AKI that any patient who developed AKI after 48 hours of hospitalization.This window period was kept for ruling out subclinical cases of CAAKI [1].Sepsis was defined by the presence of both suspected or confirmed infection and at least two criteria of systemic inflammatory response syndrome, which include: temperature >38°C or <36°C, heart rate >90 beats/min, respiratory rate >20 breaths/min, or arterial carbon dioxide tension <32 mmHg, white blood cell count >12,000/ml or <4000/ml, or >10% immature (band) forms [12].Contrast induced nephropathy was define when serum creatinine > 0.3mg/dl, or > 1.5 times baseline, within 48-72 hours of intravascular administration of a contrast agent.When the patient's systolic arterial pressure was less than 90 mm Hg or the mean arterial pressure was less than 70 mm Hg, with associated tachycardia was levelled as hypotension.[13] Hypovolemia was considered when skin that was cold and clammy with vasoconstriction and collapse of IVC > 50% on ultrasonography [13].If nephrotoxic drugs received by patient a minimum window period two days were kept before defining in increase in serum creatinine values [14]. Baseline serum creatinine was defined as the value of serum creatinine at time of admission [15]. Combined volume loss and sepsis was defined when there was volume loss as well as septicemia in the patient [16]. Length of stay (LOS) indicates number of days since admission to discharge or death or left against medical advice. Full recovery was defined when serum creatinine <1.5md/dl along with urine output improvement at discharge. An increase in urine output and decrease in serum creatinine but >1.5mg/dl at discharge was categorized as partial recovery. No recovery was defined as no increase in urine output and no decrease in creatinine levels at the time patient gets discharge.

HAAKI were divided into AKI stage 1, AKI stage 2, AKI stage 3 based on their serum creatinine values and urine output. [2] They were also divided into anatomical groups: (a) prerenal, (b) renal and (b) post renal group. During the study patients were monitored daily with records of blood investigations and vitals, particularly urine output until discharge or death. Duration in days of onset of disease were recorded from day of hospitalization. The management of the patient were depending on their clinical and laboratory parameters. Disease outcome measured were in terms of the degree of renal recovery and mortality during hospitalization. No follow up was done after the discharge.

Data analysis

Statistical analysis was done using descriptive statistics,Chi-square tests was applied to assess the significance of associations. Median and inter quartile range (IQR) were used to describe the time of HAAKI onset. ROC curve was used to analyze survival in days during hospitalization. $P < 0.05$ considered significant.

RESULTS

There were a total of 20700 admissions in hospital out of which 10299, 6375 and 4096 were in medical, surgical and ICU respectively. The incidence of HAAKI in medical, surgical and ICU unit were 0.78% (N=81), 0.74% (N=35) & 1.51% (N=62) respectively. Out of total 178 patients of HAAKI 104 (58.4%) were male and 74 were female (41.6%). The majority of study population were in the age group of 41-60 years (58.4%) (Table 1). The mean age in the medical, surgical and ICU unit were 52.42±11.99, 51.97±11.63 and 55.97±7.75 respectively.

Table 1: Age and Sex Distribution of HAAKI Cases

1. Age	2. Male		3. Female		4. Total	
	5. No.	6. %	7. No.	8. %	9. No.	10. %
11. 21-40 yrs	12. 9	13. 39.1%	14. 14	15. 60.9%	16. 23	17. 12.9%
18. 41-60 yrs	19. 67	20. 64.4%	21. 37	22. 35.6%	23. 104	24. 58.4%
25. >60 yrs	26. 28	27. 54.9%	28. 23	29. 45.1%	30. 51	31. 28.7%
32. Total	33. 104	34. 58.4%	35. 74	36. 41.6%	37. 178	38. 100.0%

HAAKI: Hospital Acquired Acute Kidney injury

The distribution of patients based on their primary diseases across different units in Medical, Surgical, and ICU reveals intriguing insights into the healthcare landscape. Hepato-biliary disease was distributed across all units, with the highest incidence in the medical unit (24.7%). Malignancy was notably more prevalent in the surgical unit, constituting25.7% of cases. Respiratory tract disease is more evenly spread between the medical (18.5%) and ICU (24.2%) units.The statistical analysis, a Chi-square value of 120.6 and p< 0.001, underscores the significance of the association between primary diseases and the units.

The median onset time of HAAKI varies across different units, shedding light on the temporal aspects of this medical condition. In the medical unit, the median onset time was 4.0 days, with an IQR of 3.0 to 5.0 days. Similarly, the surgical unit also reported a median onset time of 4.0 days, within an IQR of 2.0 to 5.0 days. The ICU exhibits a slightly extended median onset time of 4.5 days, with an IQR ranging from 3.0 to 6.0 days (figure-1).

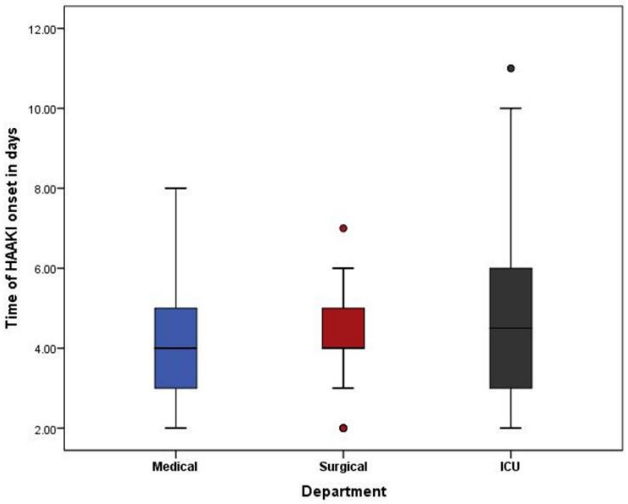

Figure 1: Time of onset of HAAKI in different units

The AKI among patients in different units revealed variations in the severity distribution (Table 2). In the medical and surgical-units, most of the cases were in AKI 1 (54.3%) and (45%) respectively whereas AKI 3 was the most common in I.C.U. The statistical analysis demonstrated a significant association among AKI tagging and the units (chi-square = 27.2, p < 0.001).

Table 2: Distribution of HAAKI according to KDIGO Staging of AKI

KDIGO Staging	Medical Unit n (%)	Surgical Unit n (%)	ICU Unit n (%)
AKI 1	44 (54.3)	16 (45.7)	9 (14.5)
AKI 2	23 (28.4)	11 (31.4)	24 (38.7)
AKI 3	14 (17.3)	8 (22.9)	29 (46.8)
Significance	chi sq=27.2, **p<0.001**		

Pre-renal group was the most common form of HAAKI constituting around 50% (n=90) out of total 178 patients. The incidence of pre-renal AKI in medical, surgical and ICU were 44%, 20% and 26%respectively. Fig 2 shows different causes of HAAKI in different departments. Drugs are the most common causes of HAAKI in medical and surgical units whereas sepsis contributed to a large number of patients in ICU.

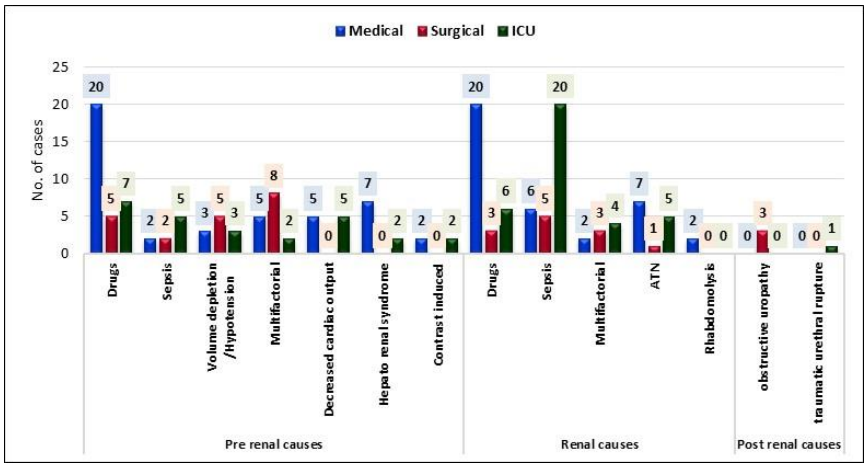

Figure 2: Bar Graph showing distribution of causes in different Units.

Table 3 shows that requirement of RRT were14.8%, 14.3% and 30.6% in medical, surgical and ICU respectively.

Table 3: Hemodialysis Requirement among the patients

Units	Haemodialysis	
	no.	%
Medical Unit	12	14.8
Surgical Unit	5	14.3
ICU Unit	19	30.6
Total	36	22.2

Table 4 shows the outcome of treatment in different units. It shows that mortality was highest in ICU set up. (chi-square = 25.4, $p < 0.001$).

Table4: Outcome of treatment in Different Units

Outcome	Medical Unit n (%)	Surgical Unit n (%)	ICU Unit n (%)
Complete response	45 (55.6)	19 (54.3)	12 (19.4)
Partial response	20 (24.7)	11 (31.4)	22 (35.5)
No recovery	6 (7.4)	1 (2.9)	7 (11.3)
Death	10 (12.3)	4 (11.4)	21 (33.9)
Significance	chi sq=25.4, **p<0.001**		

Cox regression analysis was conducted to explore the relationship between death/survival and several factors, including AKI stage, primary disease, and hospital units. The department of medicine showed no significant association with death (B = -0.13, p = 0.777, HR = 0.88, the surgery department, however, exhibited a significant association (B = -1.23, p = 0.349, HR = 0.29), though lower hazard of death compared to the ICU.Further several primary diseases were analyzed for their association with death. Malignancy demonstrated a significant positive association with death (B = 1.23, p = 0.422, HR = 3.41).Autoimmune disease, cardiovascular disease, diabetes with complications, hepato-biliary disease, respiratory tract disease, and infectious disease showed a significant negative association, indicating a lower hazard of death.Neurological disease exhibited a significant positive association (B = 0.47, p = 0.795, HR = 1.61) and has increased risk of death.AKI staging showed a significant association with death ($p < 0.001$).AKI1 and AKI2 were associated with a significantly lower hazard of death, with AKI1in particular having a large negative coefficient.Renal type AKI3 showed a higher hazard of death in comparison to pre-renal and renal types.

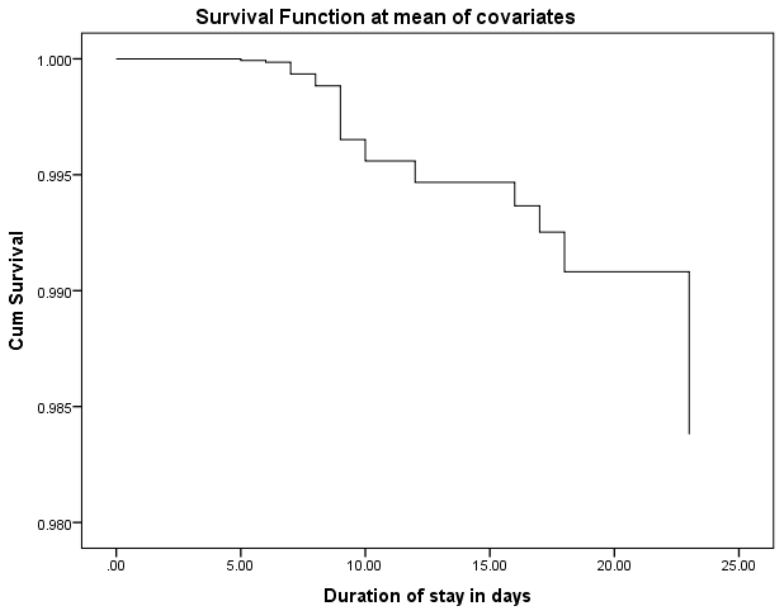

Figure 3: Survival function of mean of covariates.

DISCUSSION

In our study we observed in incidence of HAAKI in medical, surgical and ICU units as 0.78%, 0.74% and 1.51% respectively. It was also observed that male gender was more susceptible in comparison to females (1.4:1) and highest incidence was between the age group of 41-60 years.

Various studies also were consistent with our study (22-24). Male of age group 40-60 are the most responsible and active member in the family moving around for livelihood of the family, interacting with all section of population in society making more vulnerable to character change,exposure to harmful substances and environmental factors. All these factors may predispose these male age group to higher incidence of certain illness requiring hospitalization and increasing risk of HAAKI.

As expected, the primary diseases at the time of admission in different wards were different. Malignancy (27.7%) and respiratory diseases (24.2%) were the most common primary diseases predisposing to HAAKI in surgical and ICU respectively. Whereas hepatobiliary disease was most prevalent in medical unit. This pattern in distribution of primary disease will depend upon the local disease pattern. However, in a study by Singh TB et. al. in North India found a similar pattern (9).

The median time of onset of HAAKI was slightly delayed in ICU in comparison to medical and surgical unit though not significant. It may be because of the fact that patients in ICU are better monitor and managed the fluid and electrolyte as the patient is under closed monitoring. This type of finding was consistent with other studies also. (17-18)

Overall requirement of dialytic support was seen in 22% of study population. Among the different unit requiring dialytic support we found that patients in ICU had higher rate (30.6%) of dialytic requirement. However, in a study in North India by Singh T.B. et. al. found dialytic requirement was more in surgical unit. (9) This variation may be because of fact that initiation of RRT partly depend upon the decision of the treating physician in addition to other well-established indicators of dialysis initiation. Degree of disease severity may also differ depending on the race, geographical distribution, epidemiological characters of population in study. Same disease may respond differently to treatment depending upon these factors.

In this study we found that there was significant variation in KDIGO staging distribution across different units for HAAKI cases ($p<0.001$) particularly ICU patients have higher incidence of AKI-3. Medical and surgical units has more in AKI-1 (54.3%) and (45.7%) respectively. This may be a reflection of the fact that patients in ICU are more sick in comparison to other categories. Many interventions like ventilatory and ionotropic support may worsen the AKI in ICU Presence of co-morbidities also predispose these ICU patients to severe form of AKI.

There was remarkable difference in outcomes among the different units ($p<0.001$) as in previous study, (9). Treatment response was better in medical and surgical units (55.6% and 54,3% respectively) in comparison to ICU (19.4%). Mortality was much higher in ICU in comparison to other units. This finding was consistent with the study in North India by Singh T B et. al. (9) This increased mortality in ICU patients with HAAKI may be contributed by the serious nature of the primary illness as well as other co-morbidities which

often present in ICU patients. Noteworthy was the substantial increase in death risk associated with neurological diseases (HR-4.41, p=0.387) while auto-immune disease showed a lower risk (HR-0.22, p=0.31). As expected, patient with high KDIGO staging had higher risk of death in comparison to other groups (p<0.001).

CONCLUSION

This comprehensive study provides valuable insights into the dynamics of HAAKI across different hospital units particularly using KDIGO definition of AKI. It explores the, demographic patterns, primary disease distributions, time of onset, causative factors and outcomes reveals significant variability in characteristics of HAAKI among the medical, surgical, and ICU ward. Comparisons with existing studies highlight both consistencies and unique aspects in age distribution, etiological patterns, comorbidities, and outcomes. The findings underscore the importance of unit-specific considerations in understanding and managing HAAKI, emphasizing the need for tailored interventions based on distinct clinical trajectories observed in different hospital settings.

REFERENCES

1. KDIGO AKI Work Group. KDIGO clinical practice guideline for acute kidney injury. Kidney Int. Suppl. 2012; 2, 1–138.
2. Chu, R. et al. Assessment of KDIGO definitions in patients with histopathologic evidence of acute renal disease. Clin. J. Am. Soc. Nephrol.2014; 9, 1175–1182.
3. Gurjar M, Baronia AK, Azim A, Prasad N, Jain S, Singh RK, et al. Septic acute kidney injury in critically ill Indian patients. Indian J Crit Care Med. 2013;17:49–52.
4. Mahajan S, Tiwari S, Bharani R, Bhowmik D, Ravi S, Agarwal SK, et al. Spectrum of acute renal failure and factors predicting its outcome in an Intensive Care Unit in India. Ren Fail. 2006;28:119–24.
5. Sural S, Sharma RK, Singhal MK, Kher V, Gupta A, Arora P, et al. Acute renal failure in an Intensive Care Unit in India – Prognostic factors and outcome. J Nephrol. 1999;12:390–4.
6. Eswarappa M, Gireesh MS, Ravi V, Kumar D, Dev G. Spectrum of acute kidney injury in critically ill patients: A single center study from South India. Indian J Nephrol. 2014;24:280–5.
7. Korula S, Balakrishnan S, Sundar S, Paul V, Balagopal A. Acute kidney injury-incidence, prognostic factors, and outcome of patients in an Intensive Care Unit in a tertiary center: A prospective observational study. Indian J Crit Care Med. 2016;20:332–6.
8. Avasthi G, Sandhu JS, Mohindra K. Acute renal failure in medical and surgical Intensive Care Units – A one year prospective study. Ren Fail. 2003;25:105–13.
9. Singh TB, Rathore SS, Choudhury TA, Shukla VK, Singh DK, Prakash J, et al. Hospital-acquired acute kidney injury in medical, surgical, and Intensive Care Unit: A comparative study. Indian J Nephrol. 2013;23:24–9.
10. Prakash J, Murthy AS, Vohra R, Rajak M, Mathur SK. Acute renal failure in the Intensive Care Unit. J Assoc Physicians India. 2006;54:784–8.
11. Kher V, Srisawat N, Noiri E, Benghanem Gharbi M, Shetty MS, Yang L et al. Acute Disease Quality Initiative (ADQI) Consensus Group. Prevention and Therapy of Acute Kidney Injury in the Developing World. Kidney Int Rep. 2017 Apr 26;2(4):544–58.
12. Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA, Schein RM, Sibbald WJ. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. The ACCP/SCCM Consensus Conference Committee. American College of Chest Physicians/Society of Critical Care Medicine. Chest. 1992 Jun;101(6):1644-55.
13. Vincent JL, De Backer D. Circulatory Shock. N Engl J Med. 2013 Oct 31;369(18):1726–34.
14. Jha V, Malhotra HS, Sakhuja V, Chugh KS. Spectrum of hospital-acquired acute renal failure in the developing countries--Chandigarh study. Q J Med. 1992 Jul;83(303):497-505.
15. Koulouridis I, Price LL, Madias NE, Jaber BL. Hospital-acquired acute kidney injury and hospital readmission: a cohort study. Am J Kidney Dis. 2015 Feb;65(2):275-82.
16. Kohli HS, Bhaskaran MC, Muthukumar T, Thennarasu K, Sud K, Jha V, Gupta KL, Sakhuja V. Treatment-related acute renal failure in the elderly: a hospital-based prospective study. Nephrol Dial Transplant. 2000 Feb;15(2):212-7.
17. Patel UR, Pasari AS, Balwani MR, Bhawane A, Tolani PR, Acharya S. Clinical profile of acute kidney injury in a tertiary care center in the Tropical Region. J Integr Nephrol Androl 2018; 5:130-3.
18. Goswami S, Vohra R, Raju BM, Bharani R and Pahwa N. Clinical profile and outcome of hospital acquired acute kidney injury versus community acquired acute kidney injury- a prospective study from central india. International Journal of Innovative Research and Review 2016; Vol. 4 (3) July-September, pp.31-39.