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Incidence, Risk Factors, and Outcome of Acute Kidney Injury in Patients Admitted to Intensive Care Unit in a Tertiary Care Hospital

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ABSTRACT

Introduction: Acute Kidney Injury (AKI) is the major cause of morbidity and mortality in hospitalized patients. Knowing the magnitude and outcome of AKI in patients admitted to ICU will help to increase awareness and prepare the resources required in improving care.

Objective: To examine the incidence and outcome of AKI in an intensive care unit in tertiary care hospital, in Tigray, Ethiopia.

Method: Prospective observational type of study was carried out to assess the incidence and outcome of AKI in a tertiary hospital from November 1 to April 1, 2020, G.C.

Results: Of 152 patients admitted to the ICU during the study period 51.3% were males. The most common reasons for admission were the disease of the circulatory system (35%) and all forms of injury and poisoning (15.2%). The most common comorbidities were cardiac disease (41.6%), hypertension (25.7%), and diabetes mellitus (9.9%). Hemodialysis was given for 15.2% of patients and the mortality rate after hemodialysis was high around 85.7% and the overall mortality rate of patients with AKI was 56.5 %. The presence of anemia (AOR= 3.8 95%CI 1.8, 8.03), shock (AOR= 3.2 95%CI 1.5, 6.7), any focus of infection (AOR= 1.8 95%CI 0.8, 4.05) and liver function test derangement (AOR= 3.3 95%CI 1.5, 6.9) significantly affect the occurrence of AKI. Conclusion: The incidence of AKI was high in patients admitted to the ICU, and the development of AKI was associated with poor outcomes and reduced survival.

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Background

Introduction

Acute kidney injury (AKI), previously termed acute renal failure is a common, increasingly encountered complication among patients hospitalized for acute illness. The disorder is generally characterized by an abrupt deterioration in kidney function that disrupts metabolic, electrolyte, and fluid homeostasis over a period of hours to days. The spectrum of AKI is broad, ranging from small changes in the levels of biochemical markers of kidney function to overt kidney failure requiring initiation of renal replacement therapy (RRT) [1].

The etiology of AKI is multifactorial, and kidney function deterioration may fall into three major categories: pre-renal, intrinsic, and post-renal. This categorization offers a simplified perspective on the underlying pathogenic mechanisms related to AKI. Patients in the first category are usually hypovolemic and suffer from hypo-perfusion mainly due to sepsis, other systemic inflammatory conditions, surgery, or trauma. If the underlying disease and hypo perfusion are not resolved, prolonged exposure to pre renal azotemia leads to ischemic cell pre-renal and d acute tubular necrosis, the main cause of intrinsic AKI. Post-renal AKI sets in as a consequence of urinary tract obstruction. Among all causal factors, septic shock is the one most commonly associated with the onset of AKI [2,3].

The risk factors for AKI in ICU patients described in the literature include increasing age, presence of heart failure, liver failure, CKD, anemia, and exposure to nephrotoxic agents like antibiotics, NSAIDS, and contrast materials. Infections, sepsis, shock, need for mechanical ventilation and surgery are well-recognized as high-risk settings for the development of AKI [4]. There have been many studies about the epidemiology and risk factors of AKI in critically ill patients in the different regions of the world. However, little data on the risk factors for development of AKI in critically ill patients are available in our country.

The current definition made by Kidney Disease Improving Global Outcomes (KDIGO) is similar to the AKIN definition but the time frame is extended from 48 h to 7 days [5,6]. AKI (by KDIGO group) is defined as any of the following

- Increase in Serum Creatinine by ≥0.3 mg/dl (≥26.5 μmol/l)

within 48 hours.
- Increase in Serum Creatinine to ≥1.5 times baseline, which is known or presumed to have occurred within the prior 7 days; or
- Urine volume <0.5 ml/kg/h for 6 hours

The incidence of AKI has recently increased in the community and hospital settings. The estimated incidence of acute kidney injury is two to three cases per 1,000 persons [7]. Although care has been improved, AKI is seen in as many as 15% of hospitalized individuals and in about 40% of the patients referred to intensive care. Eighty percent of the intensive care unit (ICU) patients with AKI die, and 13% of the survivors require dialysis [8,9]. These rates have remained virtually unchanged despite the optimization of care, as a consequence of difficult and late diagnosis of AKI, advanced patient age, presence of multiple comorbidities, and patients undergoing a greater number of invasive procedures [9,10]. The current treatment of AKI is mainly supportive. To date, no therapeutic modality has shown efficacy in treating the condition. Although maintenance of volume homeostasis and correction of biochemical abnormality remains the primary goal of treatment, renal replacement therapy is usually indicated for AKI and its complications [6].

AKI is an important contributor to mortality and morbidity and is associated with a high rate of adverse outcomes; mortality rates range between 25 and 80 percent, depending on the cause and the clinical status of the patient. These data highlight the importance of early recognition and appropriate management of AKI in collaboration with nephrologists and other subspecialists [11,1]. Understanding the burden of AKI has been hampered by lack of substantive data or national registry from underdeveloped and developing countries. A minor reduction in renal function may not be apparent clinically but is associated with a grave prognosis [12].

The present study aims to assess the incidence, risk factors, and outcome of patients who develop AKI according to KDIGO definition in our medical adult ICU in ACSH, thus reducing the morbidity and mortality of these patients.

Methods

The study was conducted in a tertiary hospital, in Mekelle, Ethiopia which is located in the northern part of the country at a distance of 780 km from the capital Addis Ababa. The Ayder Referral Hospital serves to an estimated 8 million populations in its catchment areas. The medical ICU has 8 beds, nurses, medical residents and interns working by rotation monthly with 2 assigned specialists. It is equipped with a cardiac monitor, mechanical ventilators, portable X-ray machine, bedside ultrasound, ECG machine, and perfusers. The study was conducted in the medical intensive care unit (MICU) from November 1 to April 1, 2020, G.C.

The study design was prospective observational type of study involving patient evaluation, follow up and progressive chart review was carried out during ICU stay to assess the incidence and outcome of AKI. All adult patients fulfilling the criteria of AKI as per KDIGO, staying in ICU for more than 24 hours were included. But Patients with known renal diseases, or bilateral small shrunken kidneys, on chronic hemodialysis or transplant, and readmission were excluded.

Dependent Variables: were the incidence and outcome of AKI patients

Independent Variables: include age, sex, comorbidity, length of stay, mechanical ventilator use, medication given and presence of infection

Data Collection

All patients who develop AKI after ICU admission during the study consecutively consented, the required data for the study was collected by the principal investigator and trained nurses starting from date of admission to discharge or death of the patient. If the patients develop new conditions (derangements of renal function or decrement in urine output) they were followed closely until they were discharged or died. Baseline renal function was done on admission and repeated at 48hr and if it's normal the RFT was repeated on the 7th day of admission, but the RFT was done at any time based on the clinical condition of the patients. If the patients develop AKI after admission the renal function was done every other day until the patient die or discharged.

Data Analysis

The collected data was checked for completeness before the analysis processes begin. Checked data was coded and entered into Epi-data version 3.1 and then exported to SPSS version 20 for analysis. Descriptive and analytical statistics including bivariate and multivariate analysis were employed. Proportion, percentage, ratios, frequency distribution, measure of central tendency, and measure of dispersion was used for univariate analysis. Bivariate regression analysis was used to examine association between dependent and independent variables. This was done using odds ratio and significance of statistical association was tested using a 95% confidence interval. The results were narrated, summarized using texts, and presented using tables and graphs.

Results

During the study period a total of 152 patients were admitted to the ICU. After excluding forty-two patients with previous renal derangement and staying less than 24 hours, a hundred ten patients were finally analyzed (Figure 1).

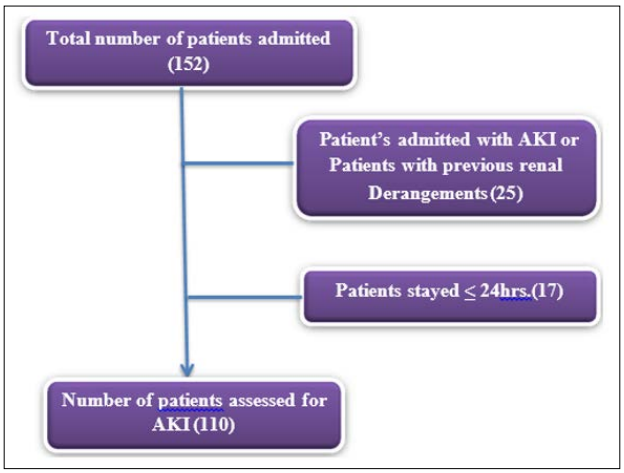

Figure 1: Screening for exclusion criteria and enrollment of patients admitted to ICU for assessing AKI

From those more than half (51.3%) were males, with over 67% (102) of patients were an age less than or equal to 50 years. Among patients admitted to the ICU the majority of them were medical patients 78.3% (119), surgical patients accounts for 20.4% (31) and there were only 1.3% (2) of gynecologic and obstetric patients.

The most common reasons for admission were disease of the circulatory system which accounted for 34.3% (52) followed by all forms of injury and poisoning 15.2 % (23), infectious and parasitic diseases 12.6 % (19) respectively. AMI (17.1%) was the leading cause of admission followed by all forms of injury and CHF each accounting for 15.2% and 10.6% respectively (Table 1). The most common comorbidities were cardiac disease which accounted for 41.6% (42) followed by hypertension 25.7% (26), diabetes mellitus 9.9% (10), and HIV 7.9% (8).

Table 1: Common system affected and reasons for admission to the medical ICU, ACSH

System affected	Frequency	Percentage
Disease of digestive tract	9	6
Pancreatitis	3	2
Generalized peritonitis	3	2
Fulminant hepatitis	3	2
Endocrine and metabolic	5	3.3
DKA	2	1.3
Thyroid storm	2	1.3
Pheochromocytoma		0.7
Infectious and parasitic	19	12.6
Cerebral malaria	1	0.7
Meningitis	3	2
GBS	5	3.3
Tetanus	5	3.3
HIV/AIDS related disease	3	2
Pneumonia	2	1.3
Injury and poisoning	23	15.2
All injury	17	11.3
Poisoning	6	3.9
Disease of nervous system	9	6
Status epilepticus	5	3.3
CVT	2	1.3
Hypoxic brain injury	2	1.3
Miscellaneous	19	12.5

The commonly prescribed drugs after admission to the ICU were antibiotics 24.8% (47) followed by anti-hypertensive 14.3% (27), cardiovascular medicines and diuretics each accounted for 12.2% (23) (Figure 2). The most common focus of infection was chest 87.5% (91) followed by GIT 6.73% (7), kidney 2.9% (3) and CNS 1.9% (2).

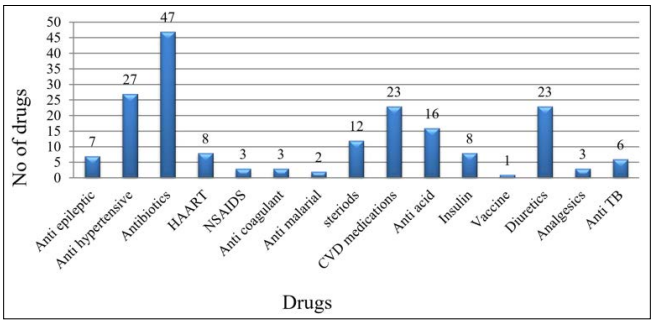

Figure 2: The pattern of drugs given before admission to medical ICU in ACHS

The use of mechanical ventilation was significantly associated with the presence of any focus of infection (P-value 0.000), anemia (p-value 0.002), and surgical intervention (p-value 0.001) and with comorbidities (p value 0.000). Renal replacement therapy in the form of hemodialysis was done for 15.2% (7) of patients with AKI. The mortality rate after hemodialysis for patients with AKI was 85.7% (6).

Comparing patients with AKI and patients without AKI, there were significant differences with regard to liver function test abnormalities (p-value 0.001), presence of anemia (p-value 0.000), shock (p-value 0.002), length of ICU stays (p-value 0.012) and focus of infection (p-value 0.027). The mortality was higher in a patient who developed AKI (56.5 % (26)) with significant p-value (p-value of 0.001) (Table 2).

Table 2: Comparison of patients with AKI and without AKI on different clinical parameters

	With AKI(n)	Without AKI(n)	Odd ratio	95% CI	P value
Sex					
Male	25	53	1.190	(0.595 – 2.383)	0.622
Female	21	53			
Need for MV	21	41	1.332	(0.662 - 2.681)	0.425
Shock detected	21	21	3.207	(1.521 – 6.765)	0.002
Surgical intervention	15	29	1.285	(0.607 – 2.720)	0.513
Anemia	23	22	3.818	(1.813 – 8.039)	0.000
Focus of infection	35	67	1.852	(0.846 – 4.057)	0.027
Hypernatremia	11	6	5.238	(1.803 – 15.219)	0.001
Malignancy	3	2	3.628	(0.585 – 22.484)	0.166
LFT	22	23	3.303	(1.578 – 6.935)	0.001
Electrolyte	28	45	2.039	(1.002 – 4.110)	0.061
Comorbidities	25	53	1.146	(0.573 – 2.295)	0.700

Need for RRT	7	0			
Drug given before	28	52	1.556	(0.769 – 3.145)	0.220
Death in the ICU	26	19	5.262.	(2.477 – 11.180)	0.001
Duration of stay(mean)	9.6	7.01	4.952	(2.120 – 10.521)	0.012
Decreased UOP	17	1			0.000

The most common causes of death were multi- organ failure which was documented in 59.6% (28) followed by respiratory failure and increased ICP each accounting for 14.9% (7) cardiac arrest in 6.4% (3) and other 4.2% (2).

Intubation and mechanical ventilation was provided for 40.8% (62) of patients admitted to medical ICU. Males were around 1.5 times more likely to be intubated and putted in mechanical ventilation compared to females. The use of mechanical ventilation was significantly associated with the presence of any focus of infection (P-value 0.000), anemia (p-value 0.002), surgical intervention (p-value 0.001), and comorbidities (p-value 0.000) (Table 3).

Table 3: Demographic and clinical factor of patients compared to the need for mechanical ventilation

	Need for MV		
Gender	**Yes(n)**	**No(n)**	**P-value**
Male	37	41	0.087
Female	25	49	
Address			
Urban	52	73	0.662
Rural	10	17	
Mode of admission			
Surgical	21	10	**0.004**
Transfer from ward	15	23	
Admitted from E-OPD	26	55	
Gynecology and obstetrics	0	2	
Drug given before	26	55	**0.020**
Comorbidities	15	64	**0.000**
Low baseline UOP	1	3	0.515
Presence of infection	56	46	**0.000**
Surgical intervention	27	17	**0.001**
Presence of shock	20	23	0.371
Anemia	27	18	**0.002**
AKI	21	23	0.425
Malignancy	2	3	0.971
LFT abnormalities	17	28	0.627
Electrolyte disorder	33	41	0.356

Discussion

The majority of patients with AKI in this study were young which was similar to results from other parts of Africa unlike in developed countries where elderly are commonly affected [7,12]. This can be explained by the predominantly young overall population demographics of most sub-Saharan countries and also the significantly lower life expectancy. There were more males with AKI than females in this study similar to the pervious report [13].

Medical causes of AKI were the most predominant when the etiology were studied across specialties, which was similar to a study in Nigeria [14]. The incidence of AKI was approaching 19.1% in this study which was comparable to previously published reports which showed an estimated 5–20% of critically ill patients experience an episode of acute renal failure during the course of their illness [15]. But in a study done in 30 Austrian ICUs, the incidence of AKI was only 4.9%, which was lower than this study may be because they define AKI by the need for RRT [16].

This study also showed that patients who have AKI had higher ICU morbidity and mortality. The mortality rate of patients with AKI was 52.2% which is higher than 39.4% reported by Bamgboye et al and 18% reported by Kaballo et al. This may be due to lack of continuous hemodialysis service and cost issues in our set up [17,18].

The most common cause of admission in AKI patients in this study was cardiovascular disease 34.3% followed by infection and parasitic disease 12.3%. But in the study done by N Mahmood et al in ICU patients the most common cause of admission to the ICU was Diabetes mellitus and Hepatorenal syndrome was the

second, 16.94% (10). The need for hemodialysis was 15.2% in this study which is closed to, in N Mahmood et al study 16.95% (10) and in the study of T B Singh et al the need for hemodialysis was 20.58% in ICU patients which was slightly higher than this study [19,19]. This may be due to the inconsistency in hemodialysis service in our setup and the cost. The indication for hemodialysis was uremic encephalopathy for patients who underwent dialysis in this study which is in contrary to another study. In Saint Paul's Hospital Millennium Medical College the most common indication for dialysis was refractory fluid overload which was done in relatively stable patient in contrast to this study where patients are critically ill in the ICU [20].

The presence of anemia in ICU patients can significantly affect the occurrence of AKI in this study, which was consistent with the study done by Seung Seok Han et al. Because AKI frequently develops in the ischemic conditions, anemia can be one of reasons for a high incidence of AKI in hospital admitted patients. According to the study done by B Khorasani et al, the prevalence of electrolyte abnormalities was directly related to mortality, and hyponatremia was the commonest electrolyte disturbance; which was similar to this study [21,22]. The presence of liver function test abnormalities is significantly associated with the development of AKI in this study; which is similar to the study done by Andreas Drolz et al, this is probably due to ischemia and tissue hypoxia which play a crucial role in the development of AKI and hepatitis [6].

Limitation of the study

This study was a single-center, prospective study of only 6 months' duration. The follow-up up period is too short to know whether the kidneys have recovered or to know the patients' condition after discharge from ICU. Other limitation was relatively smaller sample size.

Conclusion

The incidence of AKI was high in patients admitted to ICU, and the development of AKI was associated with poor outcome and reduced survival. The presence of anemia, shock and any focus of infection, in addition to liver function test derangement significantly affect the occurrence of AKI in this study. The mortality in ICU was significant in patients with AKI, sepsis, shock, anemia, and electrolyte disturbance.

Recommendation

The findings in this study will be very useful in advocating for health care policies that will reduce the burden of AKI. Regular education of the public and health care workers in our hospital should be done in order to encourage early presentation, prompt diagnosis and treatment. Also primary health care givers also need to be regularly educated on how to recognize AKI early and when it becomes expedient for them to refer patients with AKI to higher centers. Also, the government should implement policies that will make renal replacement therapy easily accessible and affordable to those who require it.

Declarations

Ethical Approval and Consent to Participant

Ethical clearance waived from Mekelle University, College of Health Sciences, and Institutional Review Board (IRB). Permission received from the medical director of the hospital before the commencement of the study and informed written consent was also obtained from all eligible participants. The study adhered to relevant guidelines and regulations.

Consent for Publication

Not applicable for this manuscript

Availability of Data and Materials

The data set generated and analyzed during this study is available and can be shared from the corresponding author upon on reasonable request.

Computing Interest

The authors declare that they have no computing interest.

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Authors' Contributions

This work was carried out in collaboration between all authors. Ferew Gemechu contributed to the conception and design of the study, acquired, analyzed and interpreted the data, and drafted and revised the manuscript. Authors Frew Gemechu, Hagazi Tesfay, Haftom Temesegen, and Meskelu Kidu designed, reviewed the data, prepare, and critically revised the manuscript. All authors read and approved the final manuscript.

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References

1. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P (2004) Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care 8: 4.
2. Poch E, Riviello ED, Christopher K (2008) Acute renal failure in the intensive care unit. Med Clin (Barc) 130: 141-8.
3. Liaño F, Pascual J, Gámez C, Gallego A, Bajo MA, et al. (1996) Epidemiology of acute renal failure: A prospective, multicenter, community-based study. Kidney Int 50: 811-8.
4. Bellomo R, Ronco C, Mehta RL, Asfar P, Boisramé-Helms J, et al. (2017) Acute kidney injury in the ICU: from injury to recovery: reports from the 5th Paris International Conference. Ann Intensive Care 7: 1-40.
5. Pimienta L, Pino R, Villaveces M (2018) Prevalence of catheter-related haemodialysis infections in Hospital Universitario San Rafael, Bogotá, Colombia 5: 17-25.
6. Kellum JA, Lameire N, Aspelin P, Barsoum RS, Burdmann EA, et al. (2012) Kidney disease: Improving global outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury. Kidney Int Suppl 2: 1-138.
7. Li PKT, Burdmann EA, Mehta RL, Riella M, Feehally J, et al. (2013) Acute kidney injury: Global health alert. J Nephropathol 2: 90-7.
8. Rewa O, Bagshaw SM (2014) Acute kidney injury-epidemiology, outcomes and economics. Nat Rev Nephrol 10(4):193-207.
9. Hashemian SM, Jamaati H, Bidgoli BF, Farrokhi FR, Malekmohammad M, et al. (2016) Outcome of acute kidney injury in critical care unit, based on AKI network. Tanaffos 15: 89-95.
10. Murugan R, Kellum JA (2011) Acute kidney injury: What's the prognosis? Nat Rev Nephrol 7: 209-17.

11. Barrantes F, Feng Y, Ivanov O, Yalamanchili HB, Patel J, et al. (2009) Acute kidney injury predicts outcomes of non-critically ill patients. Mayo Clin Proc 84: 410-6.
12. Xuan BHN, Mai H Le, Thi TXN, Thi MTH, Nguyen HN, et al. (2010) Swarming hornet attacks: Shock and acute kidney injury-a large case series from Vietnam. Nephrol Dial Transplant 25: 1146-50.
13. Kibreab Gidey, Abraha Hailu A (2018) Pattern and Outcome of Medical Intensivve Care Unit Admission to Ayder Càmprehensive Specialised Hospitalised Hospital in Tigray, Etiopia. Ethiop Med J 56: 31-6.
14. Oluseyi A, Ayodeji A, Ayodeji F (2016) Aetiologies and Short-term Outcomes of Acute Kidney Injury in a Tertiary Centre in Southwest Nigeria. Ethiop J Health Sci 26: 37-44.
15. Medve L, Antek C, Paloczi B, Kocsi S, Gartner B, et al. (2011) Epidemiology of acute kidney injury in Hungarian intensive care units: A multicenter, prospective, observational study. BMC Nephrol 12: 1.
16. Bagshaw SM, George C, Dinu I, Bellomo R (2008) A multi-centre evaluation of the RIFLE criteria for early acute kidney injury in critically ill patients. Nephrol Dial Transplant 23: 1203-10.
17. Odutayo A, Adhikari NKJ, Barton J, Burns KEA, Friedrich JO, et al. (2012) Epidemiology of acute kidney injury in Canadian critical care units: A prospective cohort study. Can J Anesth 59: 934-42.
17. Mahmood N, Rahman MF, Rahman MM, Shahid SH, Siddiqui MMA (2017) Acute Kidney Injury in Patients of Intensive Care Unit. Anwer Khan Mod Med Coll J 8: 38-44.
18. Shukla VS, Singh RG, Rathore SS, Usha (2013) Outcome of malaria-associated acute kidney injury: A prospective study from a single center. Ren Fail 35: 801-5.
19. Masoodi I, Alharth F, Irshad S, Mastan A, Alzaidi A, Sirwal I (2019) Hemodialysis catheter-related infections: Results of a tertiary care center study in Saudi Arabia. Int J Med Sci Public Heal 8: 1.
20. Han SS, Baek SH, Ahn SY, Chin HJ, Na KY, Chae DW, et al. (2015) Anemia is a risk factor for acute kidney injury and long-term mortality in critically ill patients. Tohoku J Exp Med 237: 287-95.
21. Edet Effa E, Ohem Okpa H, Mbu PN, Epoke EJ, Otokpa DE (2015) Acute Kidney Injury in Hospitalized patients at the University of Calabar Teaching Hospital: An aetiological and outcome study. IOSR J Dent Med Sci Ver VII [Internet] 14: 2279-861. Available from: www.iosrjournals.org.