Clinical outcome and Predictors of Acute Kidney Injury in Adult Patients Admitted to the Medical Ward of Jimma Medical Center, South West Ethiopia: A prospective Observational Study

Abinet Abebe (✉ abinetabebe.21@gmail.com)

Abinet Abebe, MSc in Clinical Pharmacy, School of Pharmacy, College of Health and Medical Science, Mizan Tepi University, Mizan, Ethiopia

Kabaye Kumela

Kabaye Kumela, Assistant Professor of Clinical Pharmacy, School of Pharmacy, Institute of Health, Jimma University, Jimma, Ethiopia

Dr.Maekel Belay

Dr.Maekel Belay, Internist, Nephrologist, Jimma Medical Center, Jimma, Ethiopia

Bezie Kebede

Bezie Kebede, MSc in Clinical Pharmacy, School of Pharmacy, College of Health and Medical Science, Mizan Tepi University, Mizan, Ethiopia

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Abstract

Background

Acute kidney injury is a major global public health problem occur both in community and hospital settings. It is expensive to manage, prolongs hospitalization and associated with high rates of in-hospital mortality. We aim to evaluate the clinical outcome and predictors of AKI in a single center hospitalized patients.

Method

A hospital based prospective observational study was employed. Patients were recruited using consecutive sampling technique after informed consent was secured from all patients. Data was cleaned, coded and entered in to Epi-data software version 4.4.2 and analyzed with SPSS version 21. Cox regression model was fitted to identify predictors of mortality. Statistical significance was considered at p-value of less than 0.05.

Result

A total of 203 patients were enrolled over five months. Out of this, 121(59.6%) were males and 58(28.6%) aged greater than 60. Most common causes of AKI were; Hypovolemia 99(48.77%), Glomerulonephritis 51 (25.11%), Sepsis 32(15.79%). The overall in hospital mortality was 12.8%. Stage3 AKI (AHR = 9.61, 95%CI: 1.17–28.52, $p = 0.035$), duration of AKI (AHR = 7.04, 95% CI: 1.37–36.08, $p = 0.019$), length of hospital stay (AHR = 0.19, 95% CI: 0.05–0.73 $p = 0.012$) and hyperkalemia (AHR = 3.61, 95% CI: 1.12–11.71, $p = 0.032$) were significantly associated with in hospital mortality.

Conclusion

Acute kidney injury was associated with a significant five month in hospital mortality. Most of causes of AKI are preventable and patients would have been benefited from early identification and treatment of these reversible causes.

Background

Acute kidney injury (AKI) is a complex clinical syndrome arise in response to many etiologies such as hypovolemia, sepsis and nephrotoxins. It is a major global public health problem occur both in the community and hospital settings (1). Once occurred, AKI is expensive to manage, prolongs hospitalization and associated with increased mortality. The in-hospital mortality rate is reported 24% and increased with advanced stage of the disease (2,3). Based on United Kingdom National Institute for Health and Care Excellence (UK-NICE) published report on AKI, early identification and treatment with attention to hydration and medications could avoid up to 42,000 deaths each year (4).

AKI has a gradual and subtle presentation and impose a difficult challenge to healthcare professional (5). The risk increased with exposure to factors that cause or increase susceptibility to the disease. Although there is lack of sufficient data regarding acute kidney injury in case of developing countries, diseases that are considered to be risk factors for AKI in developed world are increasing in prevalence in developing countries. Diabetes is believed to affect 9.4 million people in Africa, with a 6.1% prevalence of diabetic nephropathy in Ethiopia (6-11).

AKI affects over 13 million people and results in 1.7 million deaths each year around the world. Even mild form of AKI is associated with a 50% high risk of death. It also impose a significant burden for society in terms of long-term consequences include; chronic kidney disease (CKD), kidney failure and death (12,22). A single exposure to AKI has a significantly higher risk of morbidity and mortality; with an episode of stage 1 AKI independently associated with an increase in 10-year mortality. The long-term impact of AKI is also extended to health care costs and in UK, it accounts

about 1 % of the total health and social care budget (^{13,14}). A recent study showed that; AKI has been associated with a 58% increased risk of heart failure and 40% increased risk of acute myocardial infarction particularly in patients with pre-existing cardiovascular diseases. Other than CKD and death, AKI is also a risk factor for cardiovascular disease events (^{10,15}).

The burden of acute kidney injury is high in developing countries with limited resources for the care of these patients once the disease progresses to kidney failure (¹).

The high morbidity and mortality associated with acute kidney injury in Ethiopia is challenging to community. Failure of early recognition of AKI with active monitoring of renal function lead to development of acute renal injury or end stage renal disease (ESRD). Patients with confirmed AKI are treated inappropriately and treatment itself is costly in resource limited settings especially; if progress to ESRD. These challenges are apparent in Ethiopia, where nephrology services are limited. Government run dialysis services in Ethiopia and access to dialysis is limited and some patients referred to private dialysis facilities where treatment is limited by the inability to cover cost of treatment (^{16,17}).

Despite advances in AKI definition considered a major step forward which represents a wide spectrum of patients and focusing attention on opportunities of prevention, renal replacement therapy and supportive measures, there is still high rate of in-hospital mortality. Lack of awareness of the disease and its long term impacts is still high among physicians, allied personnel and the lay public. Therefore, there is limited systematic effort and little resource allocation to inform health-care professionals and the public on the importance of the disease as a preventable and treatable (¹⁸).

In developing countries, late recognition of the disease is even more problematic in both community and hospital settings. Late recognition results in delayed management, where associated morbidity and mortality have worsened. Most of the data on acute kidney injury are derived from high income countries, in low to moderate income countries; the long-term impact of AKI is almost completely unknown (¹⁹).

Limited data is available regarding renal function tests in hospitalized patients, risk factor recognition, outcomes and associated factors of AKI in Ethiopia (^{16,20}). Therefore, the aim of this study was to evaluate clinical outcome and predictors of AKI in medical ward of Jimma medical center, Southwest Ethiopia.

Methods

Study design, Area and Period

A hospital based prospective observational study was conducted at medical ward of Jimma medical center, Southwest Ethiopia. The hospital is located in Jimma town, 350 kilometers Southwest of Addis Ababa; the capital city of Ethiopia. Currently; JMC is the only teaching and referral hospital in southwestern part of Ethiopia. It provides specialized health services through its nine medical and other clinical and diagnostic departments. The internal medicine department of the hospital has over 80 beds for inpatients and has two renal units (³⁹). The study was conducted from April to August, 2019.

Study Population

All adult patients with diagnosis of acute kidney injury were recruited using consecutive sampling technique and followed till discharge or referral to facilities outside the hospital or death. Single population proportion formula was used to determine the sample size. Patients with age ≥ 18 years, patients with confirmed AKI diagnosed by physician and patients who were willing to sign written informed consent were included in the study. On the other hand; patients who can't able to give the required information, hospitalized for less than 48 hours and those patients with underlying

CKD were excluded from the study. The baseline serum creatinine was determined for both hospital and community acquired acute kidney injury based on KIDGO AKI guideline and review of previous literatures. **HA-KI:** - The first documented serum creatinine on admission or patients admitted with normal creatinine levels was used as the baseline for patients with hospital acquired AKI and an increase in creatinine equal to or greater than 0.3 mg/dL when compared with baseline creatinine was used to for patients who develop hospital acquired AKI as described in the KDIGO AKI Guideline⁽¹⁾. **CA-AKI:** - (i) For patients with evidence of renal disease on admission; an increase ≥ 0.3 mg/dL creatinine on admission compared with a prehospital record of creatinine within seven days to three months of hospital admission or (ii) Use of the minimum and or most recent value of admission Scr as a baseline kidney function was used based on review of previous studies ^(40, 41, 42). The clinical assessment (i.e., renal diagnostic imaging or findings suggestive of CKD) was used to differentiate CA-AKI from CKD

Ethical approval and consent to participate

The study meet the ethical and scientific standards outlined in national and international guidelines and approved by institutional review board (IRB) of institute of health, Jimma University research ethics unit (reference number: IHRPGA/574/2019), and a letter of permission was forwarded to the administration of Jimma medical center. Informed consent was secured from all participants and collected data was kept confidential.

Data collection and procedures

Data abstraction checklist was developed from review of literatures and National Confidential Enquiry into Patient Outcomes and Death (NCEPOD) AKI data collection tool to collect relevant information from patient chart about diagnosis, comorbidities, medications given, laboratory results and other investigation results. Data abstraction format and questionnaire was pretested to standardized and check suitability before actual data collection.

Statistical analysis

Epi data version 4.4.2 was used to enter, encode and clear data and SPSS version 21 was used for analysis. Descriptive statistics, such as frequency, percentage, mean, median and standard deviation was used to summarize patients' baseline characteristics. Frequency and proportion were used for categorical data, while mean and standard deviation for continuous variables. Crosstabs used for the comparison of proportions of categorical variables. Cox regression model was fitted to determine independent predictors of mortality when the p-value is less than or equal to 0.25 on bivariate analysis. Statistical significance was considered at p-value of less than 0.05 on multivariate analysis.

Outcome measurement

Outcomes of patients with AKI were measured using poor and good outcome parameters. Poor outcomes include; deaths, non-recovery, self-discharge referral and recurrent AKI. Good outcome; patients discharged with complete recovery of renal function at hospital discharge. This was based on evaluating urine output and laboratory abnormality. Patients were followed starting from admission or diagnosis of AKI to discharge or occurrence of the event. The time was recorded from patient's admission or diagnosis of acute kidney injury to occurrence of the event or patients discharge from the hospital.

Operational definitions and Definition of terms

- AKI was defined according to KIDGO (2012) as any of the following: an increase in Scr by ≥ 3 mg/dl (≥ 26.5 micromole/l) within 48 hours; OR increase in Scr 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.

- AKI is staged for according to the following criteria of KIDGO: **Stage1**:- Scr -1.5– 1.9X baseline OR ≥ 3 mg/dl OR UOP < 0.5 ml/kg/h for 6-12hrs. **Stage2**:- Scr-2.0–2.9 times baseline OR UOP < 0.5 ml/kg/h for ≥ 12 hours. **Stage3**:- Scr-3.0 times baseline OR increase in Scr to ≥ 4.0 mg/dl OR UOP < 0.3 ml/kg/h for ≥ 24 hours OR Anuria for ≥ 12 hours (1).
- Clinical outcome: is the condition of the patient at the end of hospital stay.
- Good clinical outcome: admitted patient discharged with improvement in kidney function which is evident by renal function tests and decided by physician
- Poor clinical outcome: in hospital death, self-discharge, referral and non-recovery were considered as poor clinical outcome.
- Recovery– defined as reversal at hospital discharge or return to baseline (43).
 - Late reversal— Reversal after seven days
 - Sustained reversal —Reversal within seven days
- Non-recovery-AKI not returned to premorbid/baseline kidney function
- Referral: Patients referred to other health facility for better management of the condition
- Self-discharge: Patients discharge themselves against medical care
- Comorbidities: - Chronic medical conditions that coexist and affects outcomes
- Duration of AKI- is defined as the number of days AKI was present from the first day the patient met the AKI criteria until they no longer did (44)
- Prolonged length of hospital stay-Hospital stay greater than or equal to seven days (45).

Results

Sociodemographic and Clinical characteristics

A total of 234 AKI patients were enrolled to the study over a period five months, 31 patients were excluded as per the exclusion criteria. Males' accounts 59.6% of all AKI admissions. Patients aged 60 years and above were 28.6%. The rest is summarized in **table 1** below.

Table 1:- Sociodemographic and Clinical characteristics of AKI patients admitted to JMC, April to August, 2019 (n= 203).

Variables	Category	Frequency	Percent (%)
Sex	Male	121	59.6
	Female	82	40.4
Age	18-30	28	13.8
	30-60	117	57.6
	≥60	58	28.6
AKI	CA-AKI	141	69.5
	HA- AKI	62	30.5
Hypertension	Yes	131	64.5
	No	72	35.5
Heart failure	Yes	59	29
	No	144	71
Anemia	Yes	20	10
	No	183	90
Diabetes	Yes	14	6.9
	No	189	93.1
HIV	Yes	10	5
	No	193	95
Chronic liver disease	Yes	4	2
	No	199	98
Smoking	Yes	15	7
	No	188	93
Alcohol consumption	Yes	49	24
	No	154	76

HA AKI-Hospital acquired AKI, CAAKI-Community acquired AKI

Laboratory Values

The result of laboratory values is shown in **table 2** below. Serum electrolyte was assessed for 65.5% of patients. Urinalysis done for 24 % and RBS done for 46% of patients. From 24% of patients with investigation for urinalysis, 8.5%

had hematuria and 6% had proteinuria. CBC was done for 71.4% of patients where, 14% had anemia and 8% had leukocytosis.

Table 2: Laboratory values for AKI patients at JMC, from April-August, 2019 (n=203)

Laboratory value	Time	Mean $\pm$ standard deviation
BUN	Admission	107.97 $\pm$ 91.94 mg/dl
	Discharge	97.49 $\pm$ 81.25 mg/dl
Serum creatinine	Admission	5.31 $\pm$ 3.22mg/dl
	Discharge	4.56 $\pm$ 2.84 mg/dl
Sodium	Admission	132.02 $\pm$ 6.15 mEq/L
	Discharge	135.14 $\pm$ 3.71 mEq/L
Potassium	Admission	5.19 $\pm$ 1.83 mEq/L
	Discharge	4.51 $\pm$ 1.13 mEq/L
Ionized Ca	Admission	1.02 $\pm$ 0.19 mEq/L
	Discharge	1.26 $\pm$ 0.13 mEq/L
Chloride	Admission	109.96 $\pm$ 10.31mEq/L
	Discharge	104.40 $\pm$ 11.74
Hemoglobin	Admission	9.25 $\pm$ 2.46 mg/dl
	Discharge	11.52 $\pm$ 3.14 mg/dl
WBC	Admission	11.22 $\pm$ 6.61x10 ³
	Discharge	10.33 $\pm$ 3.58x10 ³
RBS	Admission	153.71 $\pm$ 35.47 mg/dl
	Discharge	138.33 $\pm$ 26.12 mg/dl

Clinical characteristics of AKI patients are outline in table 3. Most patients (87.2%) had prolonged length of hospital stay. The mean of hospital stay was 10.53 days, and median was 11 days. The mean of AKI duration was 6.59 days. Urine output was assessed only in 146 (71.92%) of patients on admission and from this, 29.4% had oliguric and 70.6% had non-oliguric AKI. The duration of oliguria was 6 $\pm$ 2 days. At discharge, only 113 (64.5%) had urine output assessment. From this; 4 patients (3.53%) were anuric and 8 patients (7.07%) were oliguric. The remaining 101 (89.38%) patients had non oliguric AKI.

Table 3: Clinical characteristics of AKI patients admitted to JMC, April-August, 2019

Variable	Category	Frequency	Percent	No of death (%)
Stage of AKI	Stage 1	69	34	4(1.97)
	Stage 2	48	23.6	7(3.4)
	Stage 3	86	42.4	15(7.4)
Length of hospital stay	<7 days	26	12.8	14(6.89)
	≥7 days	177	87.2	12(5.91)
Duration of AKI	1-2 days	35	17.2	9(4.43)
	3-6 days	52	25.6	5(2.46)
	≥7 days	116	57.2	12(5.91)
Need for RRT	Yes	20	10	11(5.4)
	No	183	90	15(7.4)
Urine output	Oliguric	43	29.4	7(3.44)
	Nonoliguric	103	70.6	4(1.9)

Causes of AKI

The cause of AKI and death from each cause are outlined in **table 4 below**. About half of patients, 106(52%) had pre renal AKI. The other 28(14%) had intrinsic AKI and 9(4.5%) had post renal AKI. The remaining 60(29.5%) had unspecified AKI. The common causes of AKI were hypovolemia include GI loss 49%, glomerulonephritis include nephritic syndrome 25.11%, sepsis 15.79%, and nephrotic syndrome 4.92%.

Table 4: Causes of AKI and death from each cause, JMC, April-August, 2019

Cause of AKI	Frequency	Percent	Death from each cause of AKI (%)
Hypovolemia	99	48.77	8(3.94%)
Glomerulonephritis include nephritic syndrome	51	25.11	9(4.42%)
Sepsis	32	15.79	4(1.97%)
Nephrotic syndrome	10	4.92	1(0.5%)
BPH	5	2.46	0
Cervical cancer	4	1.97	4(1.97%)
Hydronephrosis	2	0.98	0

Clinical Outcomes of AKI

The outcomes of AKI are shown in **figure 1** above. More than half of patients (53.2%) were improved and discharged with fully recovered renal function. From patients discharged with improved renal function, 13% had sustained reversal and the other had late reversal. The other 27.5 % of patients were discharged with non- recovery AKI. The overall in hospital mortality was 12.8%. The remaining 3 % had recurrent episodes of AKI, 2% referred for further investigation and

treatment and 1.5% self- discharged respectively. Two of the three self-discharged and two of referred patients were in need of RRT.

Bivariate and multivariate cox regression analysis of predictors of mortality

The results for bivariate and multivariate cox regression analysis are outlined in **table 5**. On bivariate analysis, hyperkalemia (HR= 12.1, CI: 5.23-27.99,p=0.000), stage of AKI 3(HR= 12.27,CI: 2.74-49.8, p=0.003), length of hospital stay (HR=0.05,CI: 0.02-0.13,p=0.000), duration of AKI $\geq$ 7 days (HR=4.28,CI: 1.05-18.3,p=0.049) sepsis (HR=8.11,CI: 3.69-17.79,p= 0.000), advanced age (HR= 7.93,CI: 1.05-59.95, p=0.045) and anemia (HR= 9.47,CI: 3.14-28.89,p=0.000) were stastically significant with in hospital mortality.

On multivariate analysis; patients with AKI duration of $\geq$ 7 days had a significantly seven times higher risk of 30 day mortality compared to patients with AKI duration of less than seven days (AHR= 7.046; CI: 1.37-36.08, p=0.019). Patients with stage 3 AKI (AHR= 9.60;CI: 1.175-28.52, p=0.035) and hyperkalemia (AHR= 3.61; CI: 1.17-11.71, p=0.032) had nine times and three times higher rate of 30 day mortality than patients with less sever stage of AKI and patients without hyperkalemia respectively. On the other hand, patients with length of hospital stay greater than or equal to seven days (AHR= 0.19, CI: 0.05- 0.73,p=0.012) had a 81% lower risk of death when compared to patients hospitalized for less than seven days. Patients with need for RRT had a borderline association with mortality (AHR= 2.15, CI: 1.04-4.76,p=0.06). SPSS output for bi variate and multivariate cox regression analysis is shown in **table 5 below**.

Table 5: Bivariate and multivariate cox regression analysis of predictors of mortality(n=26)

Variables	Category	Clinical outcome					
		Survive	Death	HR(95% CI)	P-value	AHR(95%CI)	P-value
		177	26				
Hyperkalemia	No	155	10	Reference		Reference	
	Yes	22	16	12.1 (5.23,27.99)	0.000	3.61(1.12, 11.71)	0.032*
Stage of AKI	Stage1	65	4	Reference		Reference	
	Stage2	41	7	1.30(0.08, 20.88)	0.851	1.7(0.10, 29.04)	0.691
	Stage3	71	15	12.27(2.74,49.8)	0.003	9.6(1.17,28.52)	0.035*
Sepsis	No	153	18	Reference		Reference	
	Yes	24	8	8.11(3.69- 17.79)	0.000	3.12(0.95,10.17)	0.059
Anemia	No	157	18	Reference		Reference	
	Yes	20	8	9.47(3.14,28.89)	0.000	0.40(0.07, 2.109)	0.281
LOHS (days)	<7	9	17	Reference		Reference	
	≥7	168	9	0.05(0.02, 0.13)	0.000	0.19(0.05, 0.73)	0.012*
Dur – AKI(day)	1-2	33	2	Reference		Reference	
	3-6	50	2	0.32(0.04, 2.3)	0.251	1.09(0.12,10.05)	0.935
	≥7	94	22	4.28(1.05, 18.3)	0.049	7.046(1.37,36.08)	0.019*
Need for RRT	No	167	16	Reference		Reference	
	Yes	14	6	12.4(5.04, 30.78)	0.000	2.15(1.04, 4.76)	0.061
Age in years	18-30	24	4	Reference		Reference	
	30-60	108	9	2.35(0.29,18.62)	0.416	1.5(0.17, 12.01)	0.725
	≥60	45	13	7.93(1.05, 59.95)	0.045	3.03(0.35,26.45)	0.316

HR-hazard ratio, AHR-adjusted hazard ratio, CI-confidence interval, LOHS-length of hospital stay, Dur-AKI- Duration of KI,
 *Stastically significant

Survival graph

The graph for Kaplan–Meier estimated survival for severity of AKI is shown in **Figure 2**. As per KIDGO staging of severity of AKI, stage 3 AKI (AHR 9.6, CI 1.17-28.52, p=0.0035) was significantly associated with in hospital mortality compared with stage 1 and stage 2 AKI. The probability of survival among proportion of patients with stage 3 AKI decrease with time compared to patients with stage 1and stage 2 AKI.

Discussion

This is a single center prospective observational study, investigated a total of 203 AKI patients. From these 203 patients, 69.5% had evidence of renal disease on admission, comparable with reports of community acquire AKI in developing countries; South Africa 72.4% ⁽³¹⁾, Sudan, 82.6% ⁽⁴⁶⁾, review of community acquired AKI in adults in Africa, 70–90% ⁽⁴⁷⁾. Similar with studies done worldwide, there is high proportion of male's with AKI than females in this study, which accounts 59.6 % of all AKI admissions. This is supported by other studies, 58.2% in Singapore⁽⁴⁸⁾, 58.5% in South Africa⁽³¹⁾ and 57% in India⁽⁴⁹⁾. Patients with age 60 years and above were 28.6%. Increase in age and co morbid conditions of elderly are reported to be associated with decrease renal reserve; which is risk for the development of AKI^(25,50).

In hospital mortality

In our study, the overall in-hospital mortality among medical ward admission of patients with AKI was 12.8%, which is lower compared to findings from other studies, 28.4% in India⁽⁵¹⁾; 31.2% in South Africa⁽³¹⁾, 20.3% in Singapore⁽⁴⁸⁾; 36.9% in Cameroon⁽²⁸⁾; 44.4% in Malawi⁽³²⁾, 22.6% in Egypt⁽¹²⁾. The variation compared to these studies might be due to; difference in patients site of admission (i.e ICU vs general medical ward), underlying disease and study populations. This study was done in two renal units of the medical ward; even though large number of critically ill patients were admitted to this ward; due to small number of beds in general ICU setting. On the other hand; this study exclude patients with underlying CKD; an important predictor of in hospital mortality in patients with AKI. The result of this study was comparable with findings from other study in Egypt, 13%⁽³³⁾ and one year study in Sanford-USA 10.8% ⁽³⁶⁾. But there is still difference in duration of study compared to these studies.

In our study; age, sex, comorbidities and causes of AKI have no association with in-hospital mortality similar to findings from India⁽⁵¹⁾; but in other studies; in hospital mortality was significantly associated with cardiovascular disease and older age⁽⁵²⁾, sepsis⁽³¹⁾, female sex⁽⁵³⁾, hypertension and older age⁽⁵⁴⁾.

In our study; stage of AKI (severity) was significantly associated with 30 day in hospital mortality. This might be due to patients delayed admission with advanced stage of the disease and missed attempts to prevent the progression of the disease and its consequences. Findings from this study are consistent with several other studies; in which Stage 3 AKI was associated with mortality; Egypt ⁽³³⁾, India⁽⁵¹⁾, Brazil⁽²⁵⁾. Other study also showed that; even pre stage AKI (pre AKI), defined as a 25–50% increase in peak serum creatinine levels from baseline levels; is associated with increased mortality, longer hospital stay, and increased medical costs. So, clinicians should give emphasis to the clinical significance of pre-AKI ⁽⁵⁵⁾. Stage of AKI is reported to be a predictor for mortality and decreased kidney function, correlate with short term and even longer-term outcomes. So, depending on the stage, the intensity of preventive and therapeutic measures should be performed⁽¹⁾.

In this study; length of hospital stay was significantly associated with in hospital mortality; where patients with prolonged length of hospital stay greater than or equal to seven days had a 81% less risk of death compared to patients hospitalized for less than seven days. This might be due to patient's admission with severe and advanced stage of AKI with complications and died early on hospital admission. This is similar with findings from Nigeria⁽²⁷⁾. But report from other studies in Malawi and Colombia showed prolonged length of hospital stay was predictor of in hospital mortality^(23,32).

Duration of AKI had a stastically significant association with mortality in which; patients with AKI duration of greater than seven days had a seven times higher risk of mortality compared with patients with AKI duration of three to six days or less. This is similar to findings from other studies where; AKI duration of greater > 2 weeks predicts mortality^(33,56).

Therefore; AKI duration should be used as an additional parameter for the prediction of in hospital mortality in critically ill patients and both KIDGO staging of AKI and AKI duration are strong predictor of mortality compared to KIDGO stage of AKI alone⁽⁵⁷⁾. Persistent AKI was associated with worse clinical outcomes include increased ICU length of stay, time on the ventilator and days with cardiovascular failure. This showed the importance of identifying those patients and appropriate interventions⁽⁵⁸⁾.

In this study it was found that; patients with hyperkalemia had a significantly associated higher risk of mortality compared with patients without hyperkalemia. This was similar from findings of other studies⁽⁵¹⁾. Another study showed that; the in-hospital mortality rate of patients with hyperkalemia was 30.7%. The study revealed that; acute kidney injury (AKI) in patients with normal baseline renal function was a strong predictor of mortality, compared with AKI superimposed on CKD⁽⁵⁹⁾. A study on predictors of hyperkalemia and death in patients with cardiac and renal diseases showed that; Compared to patients with normokalemia, those with hyperkalemia had a higher percentage of death. Hyperkalemic event, severity of renal disease and age were predictors of all-cause mortality⁽⁶⁰⁾.

The result of this study identified that; need for RRT, which is predictor on bivariate analysis; had nearly significant association with in hospital mortality on multivariate analysis. Despite RRT was considered in 5% of patients and the other 5% were in need of dialysis, none of the patients were dialyzed due to various reasons include; referral to other institutions, self-discharged due to cost issues, patients late admission with advanced stage disease and complications lead patients to death before initiate dialysis. This is consistent with findings from systematic review of AKI outcomes in sub-Saharan Africa which stated; acute kidney injury is severe in sub-Saharan Africa where, 70% of patients need dialysis and only 33% received; increase overall mortality rate from 33–86% ^(29,34). Need for RRT is also revealed as predictor of mortality in other studies^(25,33). The variation with these studies might be due to; some patients admitted late with advanced stage disease and die before initiating RRT; other patients self-discharged due to cost issues and also referred to other institutions for further investigation and management.

Limitations of the study

This study has several limitations. First, urine output assessment was done in around 70% of patients only, which might detect more cases and important to monitor outcomes. Second, patients with underlying CKD were excluded; because most patients have no routine renal function tests and difficult to know the baseline renal function. Furthermore, no outcome monitoring was performed beyond the period of hospitalization. Therefore, important information, including the incidence of CKD after AKI, mortality rate, and ESRD and other non-renal outcomes are unknown.

Conclusion

The study revealed that; about half of patients had improved renal function at hospital discharge. Twelve percent were died within 30 days of hospital admission. Severity of AKI, hyperkalemia duration of AKI and short length of hospital stay were predictors of 30 day mortality. Most of causes of AKI are preventable and patients would have been benefited from early identification and treatment of these reversible causes.

Abbreviations

AKI —Acute kidney injury

BUN — Blood urea nitrogen

CKD —Chronic kidney disease

ESRD —End-stage renal disease

JMC —Jimma Medical Center

LOHS— Length of hospital stay

RRT —Renal replacement therapy

SCR – Serum creatinine

UK United Kingdom

UOP –Urine output

Declarations

Ethical approval and consent to participate

The institutional review board of Jimma University, institute of health, research ethics unit approved the study (reference number (IHRPGA/574/2019), and a letter of permission was forwarded to the administration of Jimma medical center. Informed consent was secured from all participants and the collected data was kept confidential.

Consent for publication “Not applicable”

Availability of data and materials. The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request

Competing interests.” The authors declare that they have no competing interests”

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Figures

Figure 1

Clinical outcomes of AKI patients admitted to JMC, April to August, 2019

Figure 2

Kaplan–Meier estimated survival for severity of AKI. Long-rank test $p=0.035$