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Clinical Profile and Outcome of Acute Kidney Injury in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

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Abstract

Acute kidney injury (AKI) is a major health problem, causing morbidity in 13 million people annually, among which, 85% occur in developing countries. It is therefore one of important issue in Africa where there is resource limitation at large, and appreciation of its pattern can help understand it"s causes, complications and outcome better which are determinants for its early prevention and management. The objective of the study was to evaluate Patterns and outcome of AKI patients who are admitted in Tikur Anbessa specialized hospital (TASH) Adult Emergency Unit, Addis Ababa, Ethiopia. Prospective Cross sectional study was done from August 1, 2018 to May 1, 2019. SPSS software version 25 was used for analysis.

Keywords: Acute kidney injury (AKI) • Adult emergency unit • Complications

Introduction

Binary logistic regression was done for identification of mortality predictors. Patients" laboratory results on admission and discharge were compared by paired samples T-test. Survival time was estimated by Kapan- Meier and log rank test with a 95% CI. A P-value of <0.05 was considered to denote statistical significance.

A total of 144 cases of AKI were included in the study. The mean age of presentation at a younger age of 46.16 ± 16.6, the most common causes of AKI were Sepsis (43.2%), volume depletion (25%), cardio renal syndrome-1(16%) and obstructive uropathy (16%). Uremic encephalopathy, sepsis and hyperkalemia were factors that were identified as mortality predictors in overall AKI patients. AKI patients with sepsis were found to have lower hospital survival than those without sepsis. From the laboratory findings, there was significant difference between creatinine values on admission and discharge.

Acute kidney injury is defined as decline in renal function over hours or days resulting in the accumulation of toxic wastes and the loss of internal homeostasis. Acute kidney injury (AKI) is one of the major health problems, adversely affecting patient morbidity occurring in more than 13 million people every year, 85% of whom accounts for developing countries.

Several studies reviewed risk factors attributed to AKI, in terms of in- hospital mortality, progression to end stage renal disease, accelerating progression of established chronic kidney disease (CKD), and increased cardiovascular risk. Yet there are quite few data addressing the epidemiology and causes of AKI in Low Resource Settings. AKI with its related features accounts for around 3% of admissions in general health-care facilities [1].

In developing countries, the distinction between community acquired and hospital acquired AKI is important because AKI is commonly caused by community-acquired diseases such as dehydration secondary to acute gastroenteritis and malaria which can be easily prevented by community-based interventions like oral hydration [2].

The etiology of AKI is classified into pre-renal, Intrinsic Renal and Post Renal (Figure 1).

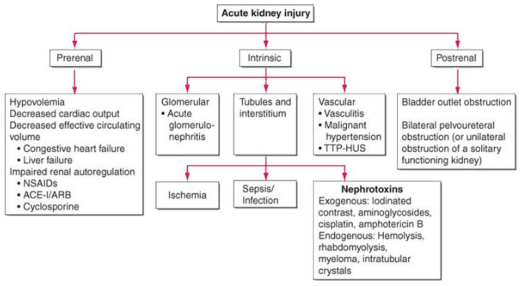

Figure 1. Causes of acute kidney injury.

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Figure 1 illustrates the possible underlying causes of these three types of AKI. It is known that AKI accounts for significant morbidity and mortality in the world, particularly in Africa. Yet there is insufficient data regarding its clinical profile in Emergency unit in tertiary center of Ethiopia.

Therefore, it will be of paramount importance to do a research on AKI which can clearly explain existing burden, common causes and risk factors, complications, practices of Management and outcome.

This can be acquired through acknowledging previous studies; determine the knowledge gap; and then filling the gap and provide guidance by proving options in the way that healthcare professionals work.

AKI is a one of important issue in Africa particularly Ethiopia where there is resource limitation at large and appreciation of its local pattern can help inform policies on its early prevention and management.

This research is going to be helpful in understanding common causes, complications, practice of management and outcome of patients with AKI in our context by filling the knowledge gap on the area.

Moreover, it will be one of the complements forwarded in solving problems regarding practices of management of AKI as it is going to have important implication regarding health promotion for better life.

AKI is one of the common worldwide problems being responsible for an estimated 1.4 million deaths per year [3]. And there are no trustworthy data regarding incidence of AKI in Africa.

According to regional publications, the incidence has been estimated at 150 per million populations [4].

According to a systematic review (2004-2012) of large cohort studies conducted the pooled incidence rates of AKI were 21.6% in adults concluding that 1 in 5 adults worldwide experience AKI during a hospital episode of care [5].

Incidence of AKI in Low income countries is not completely understood the proposed reasons being late presentation of patients to tertiary centers, underreporting, and a reduced capacity to provide intensive care to severely ill patients [2].

Objective of the study

The objective is to evaluate patterns, causes, management practice, predictors of mortality, determinants of survival, complications, outcome of AKI in Tikur Anbessa specialized Hospital (TASH), Addis Ababa, Ethiopia.

Methodology

The study was a prospective cross-sectional study conducted from September, 2018 to May, 2019 in TASH, Addis Ababa, Ethiopia, one of the largest teaching hospitals in Ethiopia which is visited by approximately 370,000- 400,000 patients a year [4]. It is tertiary hospital which approaches patients from all walks of life and all over the country.

All AKI patients with age ≥13 are included except those who opt out and patients with CKD without superimposed AKI. Data was collected then processed and analyzed using SPSS software version 25. Categorical data were compared with chi-squared test. Mortality predictors were analyzed using binary logistic regression.

Laboratory tests on admission and discharge were compared using paired samples T- test. Kaplan- Meier estimator and Log Rank test with a confidence interval of 95% were used to assess survival of AKI patients with sepsis; who underwent dialysis; and those with underlying CKD. Time to discharge of each types of AKI was analyzed using Kaplan-Meier curve. P- Value<0.05 was considered significant [5].

Result

Socio-demographics

There were a total of 144 patients diagnosed to have AKI in TASH EOPD from August, 2018- May, 2019 of which there was a slight predominance of male, 79 (54.9%) and the rest were female.

The mean age of the patients was 46.6 ±16.6 and around 40% of the patients are found in the age group between 30-50 years.

Although patients came from all around Ethiopia, nearly half of them (49.3%) came from Addis Ababa and more than quarter of the patients came from Oromia (27.8%) (Table 1).

Sociodemographic Variable	Sub-variable	Frequency	Percent
Sex	Male	79	54.9
	Female	65	45.1
	Total	144	100
Age	<21	9	6.3
	21-30	20	13.9
	31-40	28	19.4
	41-50	29	20.1
	51-60	28	19.4
	61-70	18	12.5
	>70	12	8.3
	Total	144	100
Region	Addis Ababa	71	49.3
	Oromia	40	27.8
	SNNPR	16	11.1
	Amhara	9	6.3
	Others	6	4.2
	Total	142	98.6
Missing		2	1.4

Table 1. Socio demographic characteristics of patients with AKI, TASH.

Clinical characteristics of AKI

The commonest cause of AKI identified was sepsis (43.8%), the remaining others are summarized in (Table 2).

Clinical characteristicsa		Frequency N (%)	Male N(%)	Female N(%)	P- Value	Proportion of death (%)
Causes of AKI	Sepsis	65(43.2)	36(55.4)	29(44.6)	0.854	25(56.8)
	Volume depletion	36(25)	19(52.8)	17(47.2)	0.805	12(27.3)
	CRS-1	23((16)	13(56.5)	10(43.5)	0.835	3(6.8)
	OUP	23(16)	11(47.8)	12(52.2)	0.48	9(20.5)
	AGN	8(5.6)	5(63)	3(37)	0.642	3(6.8)
	Hypertensive crisis	7(4.9)	4(57.14)	3(42.86)	0.887	2(4.5)
	Drug	5(3.5)	3(60)	2(40)	0.803	0(0)
	TLS	4(2.8)	1(25)	3(75)	0.229	2(4.5)
	Others	3(2)	3(100)	0(0)	0.194	1(2.3)
	Extra renal OUP	10(25.6)	4(40)	6(60)	0.349	5(38.5)
Causes of underlying CKD	Hypertension	9(23.1)	6(66.7)	3(33.3)	0.462	3(23.08)
	Diabetes	8(20.5)	5(62.5)	3(37.5)	0.655	3(23.08)
	Nephrolithiasis	5(12.8)	5(100)	0(0)	0.039	0(0)
	Others	7(18)	4(57.14)	3(42.86)	0.901	2(15.38)
Complications of AKI	Uremic encephalopathy	32(42.7)	20(13.9)	12(8.3)		23(52.3)
	Anemia	31(41.3)	15(10.4)	16(11.1)		8(18.12)
	Hyperkalemia	22(29.3)	10(6.9)	12(8.3)		11(0.25)
	Fluid overload	11(14.7)	7(63.64)	4(36.36)		6(13.64)
	Uremic gastropathy	11(14.7)	6(54.55)	5(45.45)		3(6.82)
	Uremic pericarditis	3(4.0)	3(100)	0(0)		1(2.27)

Table 2. Clinical characters and proportion of death of patients with AKI, TASH.

aSum is more than 100 % as most patients had more than one cause and complication 39(27.1%) of the patients were found to have preexisting CKD. The main underlying cause of CKD was extra renal OUP which included 1/4th of the cases (25.6%) followed by hypertension (23.1%) and diabetes (20.5%). The mean baseline creatinine was 9.8 ± 6.6. The majority of deaths in AKI on CKD patients were found in those with extra renal OUP most of which are due to cervical ca. (38.5%). The others are listed on table 2 [6].

More than half, 52.8%, of the patients with AKI had complications. Of these, the commonest complication identified was uremic encephalopathy which occurred in 42.1%, followed by anemia (40.8%) and hyperkalemia (28.9%).

A Chi-square test of independence was calculated comparing the frequency of clinical characters in men and women. A significant interaction was found in men with nephrolithiasis as compared with women.

Laboratory values

The patients had complete blood count and renal function test during admission and upon discharge. The mean white cell count is 13,138.8 ± 9558.1 and 11810 ± 6520.7 on admission and discharge respectively. There is, as well decrement of creatinine upon discharge from mean of 5.7±5.4 to 4.9±4.9. The rest are shown on (Table 3).

Laboratory values	Point in time	Mean ± Standard deviation
Urea	Admission	122±76.3
	Discharge	116.2±82.4
Creatinine	Admission	5.7±5.4
	Discharge	4.9±4.9
WBC count	Admission	13138.8±9558.1
	Discharge	11810±6520.7
Hemoglobin	Admission	11.1±3.3
	Discharge	10.8±2.9
Platelet count	Admission	212887.4±127867.3
	Discharge	269042.5±138420.506

Treatment practice and outcome of patients with AKI

More than 3/4th of the patients (82.6%) took drug treatments for the variety of causes of AKI including cardiac, Septic ATN, hypertension and AGN. On the other hand, around half of the patients took fluid treatment for the AKI (Figure 2, Figure 3) (Table 4).

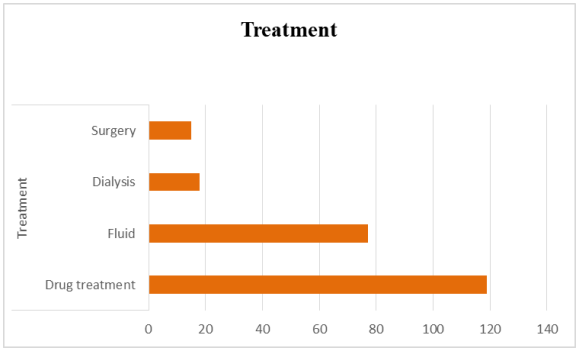

Figure 2. Treatment practice of patients with AKI, TASH.

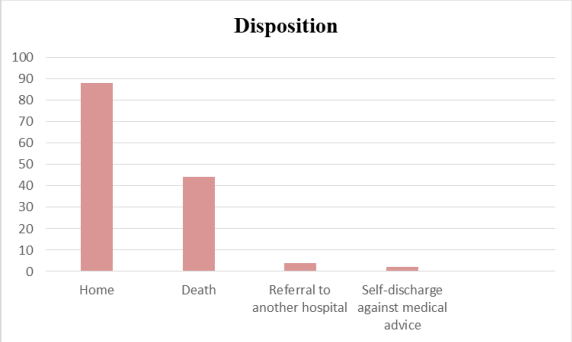

Figure 3. Disposition of patients with AKI, TASH.

Dialysis b					Deathb	
Indications fordialysis		Yes (%)	No (%)	Total (%)	Yes (%)	No (%)
Refractory fluid overload	Yes (%)	4(22.2)	7(5.6)	11(7.7)	6(60)	4(40)
	No (%)	14(77.8)	117(94.4)	131(92.3)	38(29.7)	90(70.3)
Hyperkalemia	Yes (%)	5(27.8)	17(13.7)	22(15.5)	11(55)	9(45)
	No (%)	13(72.2)	107(86.6)	120(84.5)	33(28)	85(72)
Uremic encephalopathy	Yes (%)	13(72.2)	18(14.5)	31(21.8)	23(74.2)	8(25.8)
	No (%)	5(27.8)	106(85.5)	111(78.2)	21(19.6)	86(80.4)

Table 4. Indication for dialysis of AKI patients, TASH.

bSum is more than 100 % as most patients had more than one indication for dialysis.

The commonest indication identified was uremic encephalopathy (72.2%) followed by hyperkalemia (27.8%) and refractory fluid overload (22.2%).

The rest minority underwent surgical management, percutaneous nephrostomy being the commonest surgical procedure. Cervical ca. was the cause in most cases of obstructive uropathy.

Average duration of hospital stay was 7.2 days, the minimum being 2 days and the maximum being 36 days, with a range of 34 days [7]. The average length of stay in each type of AKI is shown the (Table 5).

Types of AKI	Mean hospital LOS±SE
Prerenal	6.50±6.65
Intrinsic renal	7.84±8.18
Post renal	8.39±6.73
Mixed	6.40±4.85

Table 5. Mean hospital LOS in each types of AKI, TASH.

LOS: Length of stay (In days) SE: Standard deviation

More than half of the patients (61.1%) were discharged home. And nearly 1/3rd (30.6%) of the patients died. 4 patients were referred to another centers the reason being lack of bed and two patients self-discharged against medical advice.

Common complications leading to deaths encountered were uremic encephalopathy, fluid overload and hyperkalemia. From the death records, nearly 3/4th (74.2%) had uremic encephalopathy; where as in 60% of deaths, there were complications of fluid overload. And more than half of the deaths (55%) had hyperkalemia. These results are well summarized in table 5 [6].

Predictors of mortality

Binary logistic regression was implemented further to determine the independent predictors of mortality among AKI patients with and without CKD; In overall AKI patients (those AKI regardless of presence or absence of CKD) mortality was significantly correlated with presence of Uremic encephalopathy [OR,0.061; 95 %CI (0.019,0.198); P=<0.001] and hyperkalemia which was marginally significant [OR,0.283; 95 %CI (0.077,1.046); P=0.058]. This, as well as, the finding for factors in AKI patients without underlying CKD is shown in (Table 6).

Death					
		COR(95% CI)	P-value	AOR(95% CI)	P-Value
factors in AKI	Fluid Overload	3.55(0.95,13.3)	0.06	1.743(0.28, 10.68)	0.548
	Hyperkalemia	3.15(1.19,8.29)	0.02	5.06(1.291, 19.87)	0.02
	Sepsis	2.46(1.18,5.16)	0.017	3.151(1.23, 8.07)	0.017
	Uremic encephalopathy	11.8(4.6,30)	<0.001	13.71(4.32, 43.5)	<0.001
	Creatinine on admission	0.952(0.893,1.014)	0.128	1.049(0.954,1.154)	0.32
Factors In AKI without underlying CKD	Fluid overload	3.12(0.67,15.32)	0.144	1.189(0.090,15.627)	0.895
	Hyperkalemia	6.32(1.51,26.44)	0.012	0.124(0.017,0.905)	0.039
	Sepsis	2.31(0.96,5.54)	0.062	0.378(0.124,1.152)	0.087
	Uremic encephalopathy	30.93(6.4,149.19)	<0.001	0.033(0.006,0.190)	<0.001
	Creatinine on admission	0.90(0.811, 0.999)	0.047	1.036(0.887,1.211)	0.653

AKI: Acute kidney Injury CKD: Chronic kidney injury COR: Crude odd"s ratio AOR: Adjusted odd"s ratio.

Table 6. Binary logistic regression analyses for correlation between different factors and death in Overall as well as pure AKI (Without underlying CKD), TASH.

A paired-samples t-test was conducted to compare selected laboratory values of patients with AKI upon admission and discharge. There was a significant difference between creatinine values upon admission (M=5.14, SD=4.9) and discharge (M=4.87, SD=4.85) conditions; t (46)=3.243, p=0.002. This result showed that there was

real improvement on creatinine after the patient finished course in the hospital. This result is illustrated in the (Table 7).

Laboratory values on admission and discharge	Mean	SD	SE mean	95%CI of the difference		t	df	Sig.(2-tailed)
				Lower	Upper			
Urea	15.561	52.164	9.369	-3.573	34.695	1.661	30	0.107
Creatinine	1.067	2.256	0.329	0.405	1.73	3.243	46	0.002
WBC	1862.75	7816.859	1235.954	-637.203	4362.703	1.507	39	0.14
Hemoglobin	-0.011 1	2.953	0.479	-1.081	0.86	-0.231	37	0.819

SD: Standard deviation, SE: Standard Error, CI: Confidence interval, df: Degree of freedom

Table 7. Paired-samples T-test for selected laboratory values of patients with AKI, TASH.

Survival of AKI patients

Probability of survival of AKI patients who have sepsis, who underwent dialysis and who had underlying CKD estimated using Kaplan-Meier curves, a lower survival of all AKI patients with sepsis over the hospital stay period was found with marginally significant P-value (Mean survival AKI with sepsis=16.967; SE=3.169 vs. without sepsis=28.105; SE 3.413; P=0.056).

The comparison between AKI patients with CKD, time to death didn‟t not significantly differs from those who haven‟t underlying CKD, for those patients who underwent dialysis, as well, no significance with regards to survival in hospital stay. Finally, time to discharge was assessed between each types of AKI and there was no significant difference found. The illustration is depicted on (Figure 4).

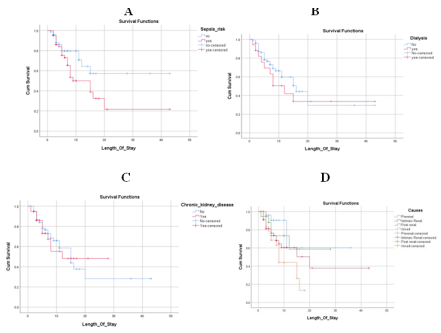

Figure 4. Kaplan-Meier curves A. Time to death in AKI patients with sepsis B. Time to death in AKI patients who underwent dialysis; C. Time to death in AKI patients who had underlying CKD; D. Time to discharge in each types of AKI.

Discussion

This study elucidated the epidemiology, causes, complication practice of management and outcomes of patients with AKI. The presentation of the patients at a younger age coincided with results from Europe, African countries as well as those done in Ethiopia.

Although patients coming from different corners of the country, more than half of the patients came from Addis Ababa and Oromia, this coincides with another literature done in St. Paul hospital which is found in the same area where TASH is found. This can be explained by the Geographical proximity of the patients living in Addis Ababa and Oromiya to TASH.

In line with the study done in sub-Saharan country, ATN was the leading cause of AKI in this study, followed by gastrointestinal loss (diarrhea or vomiting), cardiac and obstructive uropathy. In contrast, recent local literature from Saint Paul ‟s Hospital Millennium Medical College showed that the predominant causes were hypovolemia, acute glomerulonephritis and pregnancy related causes.

Sepsis related AKI was top cause for on the list in this study. This went in harmony with the study done across Australia which showed that nearly 1/3rd of patients with AKI had sepsis However, the study done in Uganda showed considerably lower number of septic related AKI cases which was 16.3%.

This study showed that CRS-1 is still one of the major causes of AKI which was also strengthened by a systematic review and meta-analysis. Yet, there is a difference regarding dominant cause of CRS-1 which in this study is acute heart failure in contrast to single-center retrospective study done in USA which showed that acute coronary syndrome to be the dominant cause of CRS-1. This dissimilarity can be explained by the higher incidence of valvular heart disease in Ethiopia as compared to western setup.

OUP was also found to be one of the major causes of AKI which corresponds to reports from other African countries. And the major causes of OUP were women with cervical ca. which is still consistent with other developing countries.

AGN accounted for 5.6% of all AKI cases admitted to the hospital with higher mortality of 37.7% as compared to other causes and this closely correlated with the report from Pakistan which showed 4.19% which also unfolded that the morbidity was higher in comparison with other causes.

Counter to the data from Capetown which demonstrated that exogenous nephrotoxins accounted for more than 1/3rd (37.4%) of AKI patients, this study showed that they were one of the rare causes of AKI

In this study, more than half of the patients with AKI were discharged and nearly 1/3rd died, both findings being consistent with other local literatures done recently in tertiary hospital.

The top indication for dialysis was uremic encephalopathy followed by Hyperkalemia. In contrast, other literatures from Africa in general and Ethiopia in particular showed that it was rather the refractory fluid overload which is the commonest indication for dialysis followed by uremic symptoms and signs.

This study showed uremic encephalopathy, hyperkalemia and sepsis significantly predicted mortality for patients with AKI.

According to a study done on Sudanese patients was analyzed with binary logistic regression to identify independent predictors of mortality among AKI patients; Mortality significantly associated with the increase in patients‟ age, presence of chronic liver disease, and the severity of AKI as per the KDIGO staging.

Those AKI patients with underlying CKD had not shown to have decreased in-hospital survival. This corresponds with other studies including the one which was done by waikar and associates which even showed that there was lower in-hospital mortality of AKI patients with underlying CKD as compared with patients without CKD who develop AKI.

Conclusion

As sepsis was the dominant cause of AKI as well as mortality predictor and cause of lower hospital survival, early initiation of antibiotics in the Emergency unit would be beneficial in order to improve the in hospital outcome of patients with AKI.

Limitations of the Study

The research, however, is subject to some limitations:

In CKD patients it was difficult to find whether hypertension and diabetes were causes or complications. Additionally, there was also another challenge in finding creatinine and urea of some patients due to unavailability of reagents. Additionally, the term „drug treatment‟ used in the study was too non-specific which encompassed all the medications used to treat sepsis, CRS- 1, Hypertension, AGN, TLS and others. So, it made it difficult to analyze each medication types. Moreover, it should have been better if AKI was staged in order to entertain differences among each stage with regards to different parameters.

Authors' Contributions

The authors have all contributed either to the conception of the work; the acquisition, analysis, or interpretation of data; drafting and revising; final approval of the version to be published; and agreed to be accountable for all aspects of the work.

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