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Short-Term Outcome in Patients with Acute Kidney Injury at Sohag University Hospital

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ABSTRACT

Background: Acute kidney injury (AKI) is a common clinical situation with serious complications with long-term and short-term negative consequences as regards morbidity and mortality.

Objective: To determine the short-term outcome of AKI among those patients and to evaluate the relationship between patient characteristics and the outcome of AKI.

Patients and methods: A prospective study that was conducted on 70 Patients diagnosed with AKI using the Kidney Disease–Improving Global Outcomes (KDIGO) criteria based on serum creatinine (increase in serum creatinine by ≥ 0.3 mg/dL within 48h or increase in serum creatinine to ≥1.5 times baseline), which is known or presumed to have occurred within the prior 7 days. They were admitted to Internal Medicine Department, Sohag University Hospital from December 2019 to May 2020. **Results:** There was statistically significant relationship between patient age, history of diabetes, established chronic kidney disease (CKD) and AKI outcomes. Also there was statistically significant relation between AKI outcome and increased s. creatinine level, elevated white blood cells count, decreased hemoglobin level and increased serum potassium level. As regards the staging of AKI, We found statistically significant relationship between AKI outcomes and staging of studied population as stage 3 had worse outcomes. Also we found statistically significant relationship between AKI outcome and ultrasound grading of echogenicity of studied population as increased echogenicity had worse outcome than normal kidneys.

Conclusions: Our study concluded that mortality and morbidity in patients with AKI were increased in advanced age, diabetics, CKD patients, patients with anemia, leucocytosis hyperkalemia and increased serum creatinine.

Keywords: Acute kidney injury, Chronic kidney disease, Sohag University Hospital.

INTRODUCTION

Acute kidney injury (AKI) is one of the most important causes of mortality in hospitalized patients and with aging of the population, the number of those affected with it has increased [(1)]. Epidemiology of AKI is determined by variation in climate, ethnicity, culture, socioeconomic, and development status. Therefore, the epidemiology of AKI differs from country to country, and from center to center within the same country [(2)].

The causes of AKI are different based on various geographical regions and there is a significant difference in its prevalence between developing and developed countries [(3)]. The main AKI causes are ischemia, sepsis, and nephrotoxic drugs. AKI is frequently encountered in the community in smaller urban areas distant from large cities and in rural zones secondary to diarrhea, tropical infectious diseases, animal venoms, use of native medicines, and poor obstetric care among previously healthy young individuals [(4)]. Furthermore, the delayed presentation of AKI patients to health care facilities, lack of resources, late recognition of the disease and absence of reliable statistical data regarding the incidence of AKI all add to the magnitude of the problem in developing countries [(5)]. Failure to detect and treat timely and/or adequately usually leads to significant untoward consequences. It is associated with a high morbidity and permanent loss of kidney function [(6)].

All stages of AKI are associated with significantly high short- and long-term mortality. However, early detection and treatment leads to partial or total reversal of renal damages caused by AKI. For effective planning regarding reduction of mortalities resulting from AKI there is a need for sufficient data regarding the epidemiologic pattern of this disease in our country [(7)]. This study aimed to determine the etiology, short-term outcome and the predictors of AKI among patients admitted to Sohag University Hospital and to evaluate the relationship between patient characteristics and the outcome of AKI.

PATIENTS AND METHODS

A prospective study was conducted on 70 patients diagnosed with AKI using the Kidney Disease – Improving Global Outcomes (KDIGO) criteria based on serum creatinine (increase in serum creatinine by ≥ 0.3 mg/dL within 48h or increase in serum creatinine to ≥1.5 times baseline), which is known or presumed to have occurred within the prior 7 days. They were admitted to Internal Medicine Department, Sohag University Hospital between December 2019 and May 2020.

Staging of AKI was based on serum creatinine: Stage I: 1.5 to 1.9 times base-line or ≥ 0.3 mg/dL increase, stage II: 2.0 to 2.9 times baseline, and stage III: 3.0 times baseline or increase in serum creatinine to ≥ 4.0 mg/dL or initiation of renal replacement therapy.

Exclusion criteria: Patients with kidney transplant, patients below 18 years, and patients with other end organ damage.

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All patients in the study were subjected to:

1. **Full history** : Age, sex, smoking, family history of renal disease, therapeutic history, history of hypertension or diabetes
2. **Detailed clinical examination**.
3. **Laboratory Investigations:** S. creatinine, estimated glomerular filtration rate (eGFR) by **MDRD GFR Equation**, complete blood count, blood glucose, blood gases, serum uric acid, urine analysis and serum electrolytes.
4. **Ultrasound imaging of the kidneys** (abdominal ultrasound was done to all patients to detect the site, size, shape, anatomic location and echogenicity grading).
5. Patients received supportive care and dialysis if needed.
6. Daily follow-up for s. creatinine, s. electrolytes and urine output. CVP measurements were done during hospital admission.
7. Follow-up for 3 months after discharge by laboratory investigations including s. creatinine, eGFR, clinical outcome and need for RRT or not.

Ethical consent:

An approval of the study was obtained from Sohag University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the study. This work has been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

Data were analyzed using SPSS version 16.0. Quantitative data were represented as mean, standard deviation, median and range. The following tests were used: Student t-test to compare means of two groups. When the data was not normally, Mann-Whitney test was used. Qualitative data was presented as number and percentage and compared using Chi square test. Sensitivity and specificity were also calculated. Graphs were produced using Excel or SPSS. P value was considered significant if it was equal or less than 0.05.

RESULTS

We found that age of our patients ranged from 29 to 91 with a mean of 61.5 years. 60% (42) of patients were males and 40% (28) were females. Mean weight of our patients was 70 kg **(Table 1).**

Table (1): Age, sex and weight distribution among patients in the study

Variable		Summary statistics
Age/years	Mean ± SD	61.5 ± 15.4
	Median (range)	65 (29:91)
Weight (kg)	Mean ± SD	74.03 ± 20.753
	Median (range)	78 (60:100)
Gender	Females	28(40.00%)
	Males	42(60.00%)

Table (2) showed that there was significant relationship between patient age, history of diabetes and CKD with AKI outcome. But, there was no significant relationship between AKI outcome with patient gender, history of HTN, family history of renal disease or history of nephrotoxic drugs.

Table (2): Relation between AKI outcomes, patient characteristics and risk factors

	Variable	Recovery	Regular dialysis	Death	P value
Age/year	Mean ± SD	57.64±14.65	64.8±12.34	68±17.4	0.044
	Median (range)	61(29:83)	70(38:83)	71.5(38:91)	
Gender	Females	17(43.6%)	4(26.7%)	7(43.8%)	0.493
	Males	22(56.4%)	11(73.3%)	9(56.2%)	
Diabetes mellitus	No	31(79.5%)	10(66.7%)	3(18.8%)	<0.001
	Yes	8(20.5%)	5(33.3%)	13(81.2%)	
Hypertension	No	24(61.5%)	11(73.3%)	11(68.8%)	0.686
	Yes	15(38.5%)	4(26.7%)	5(31.2%)	
Smoking	No	29(74.4%)	12(80%)	15(93.8%)	0.264
	Yes	10(25.6%)	3(20%)	1(6.2%)	
Family history of renal disease	No	36(92.3%)	13(87.5%)	15(93.8%)	0.747
	Yes	3(7.7%)	2(12.5%)	1(6.2%)	
Nephrotoxic drugs	No	36(92.3%)	15(100%)	14(87.5%)	0.394
	Yes	3(7.7%)	0(0%)	2(12.5%)	
CKD	No	22(56.4%)	2(13.3%)	8(50%)	0.016
	Yes	17(43.6%)	13(86.7%)	8(50%)	

As regards the relation between AKI outcomes and investigations of our patients on admission, there was significant relation between AKI outcome and s. creatinine, WBCs, hemoglobin level and serum potassium level. However, there was no significant relation between AKI outcomes and platelets count, serum calcium, serum sodium and ABG results (Table 3).

Table (3): Relation between AKI outcomes and investigations on admission

Variable	Recovery	Regular dialysis	Death	P value
S. Creatinine (mg/dl) Mean ± SD Median	 6.58 ± 1.24 6.8	 8.399 ± 1.58 7.2	 8.82 ± 1.15 9.5	0.041
eGFR (MDRD GFR Equation) (mL/min/1/.73m^2) Mean ± SD Median	 11.73 ± 2.01 9.2	 10.64 ± 2.79 8.3	 9.46 ± 2.25 10.3	0.538
WBCs x 10^9/L Mean ± SD Median	 9.43 ± 2.91 7.5	 12.61 ± 2.46 13	 10.4 ± 2.3 10.4	0.063
HB (g/L) Mean ± SD Median	 10.16 ± 1.73 10	 9.2 ± 1.49 8.9	 8.9 ± 1.55 8.4	0.025
PLT x 10^9/L Mean ± SD Median	 250.7 ± 12.1 222	 269.47 ± 9.86 230	 240.3 ± 6.4 245.5	0.661
Blood glucose (mg/dl) Mean ± SD Median	 144.46 ± 34.47 143	 156.67 ± 36.01 155	 141.8 ± 37.4 132.5	0.443
Na $^+$ (mmol/L) Mean ± SD Median	 131.34 ± 7.11 133	 131.27 ± 8.06 133	 132.69 ± 5.07 134	0.785
K$^+$ (mmol/L) Mean ± SD Median	 3.88 ± 0.82 3.6	 4.15 ± 1.33 4.4	 4.88 ± 1.21 5.25	0.007
Ca^{++} (mmol/L) Mean ± SD Median	 0.97 ± 0.12 0.98	 0.8993 ± 0.12 0.89	 0.93 ± 0.15 0.935	0.177
ABG (PH) Median	7.36 ± 1.18 7.37	7.3 ± 0.08 7.33	7.36 ± 1.84 7.36	0.064

There was significant relationship between AKI outcome and KIDGO staging of studied population (Table 4).

Table (4): Relation between AKI outcome and KDIGO staging for AKI in studied population

Variable	Recovery	Regular dialysis	Death	P value
KDIGO Staging For AKI GRADE 2 GRADE3	 13 (33.3%) 26 (66.7%)	 3 (20%) 12 (80%)	 0 (0%) 16 (100%)	0.027

There was significant relationship between AKI outcome and ultrasound grading of echogenicity of studied population (Table 5).

Table (5): Relation between AKI outcome and Ultrasound grading of echogenicity for AKI in studied population

Variable	Recovery	Regular dialysis	Death	P value
Ultrasound grading of echogenicity **NORMAL** **GRADE 1** **GRADE 2/3** **SOLITARY**	 22 (56.4%) 11 (28.2%) 6 (15.4%) 0 (0%)	 2 (13.3%) 7 (46.7%) 6 (40%) 0 (0%)	 8 (50%) 4 (25%) 2 (12.5%) 2 (12.5%)	0.011

Follow up after 3 months:

After 3 months follow up, the data of our patients showed that s. creatinine ranged from 1 to 5.3 and mean 1.9 mg/dl and eGFR ranged from 3 to 87 and mean 40.2.

As regards outcome of studied patients, we found that **39** patients had complete recovery (**36** patients received conservative management from the start and did not receive RRT , one patient received RRT during hospital admission and stopped before discharge and **2** patients received RRT from the start then stopped dialysis within the 1st 3 months after hospital discharge). 15 patients continued on RRT (8 patients from them received RRT from the start and **7** received RRT within the 1st 3 months after hospital discharge). **16** patients died (**5** patients of them from the group who received RRT from the start, **9** patients from the group who received conservative management after hospital discharge and **2** patients from the group who recovered and stopped dialysis within the 1st 3 months after hospital discharge) (Table 6 & 7).

Table (6): Data and outcome of studied populations after 3 months follow up

Variable	Summary statistics
S. Creatinine (mg/dl) Mean ± SD Median	 1.9 ± 0.2 2.6
eGFR (mL/min/1/.73m2) Mean ± SD Median	 40.2 ± 2.5 42
Outcome after 3 mon Recovery Regular dialysis Death	 39 (55.7%) 15 (21.4%) 16 (22.9%)

Table (7): Course and outcome of studied populations after 3 months follow up

Management during hospital admission	Outcome on discharge		Outcomes After 3 Months		Total Outcomes At 3 Months	
Conservative management NO = 50 71.4%	**Recovery**	50/50 (100%)	**Recovery**	36/50 (72%)	**Recovery**	39/70 (55.7%)
			Regular dialysis	5/50 (10%)		
			Death	9/50 (18%)		
RRT (Dialysis) NO = 20 29.6%	**Recovery**	5/20 (25%)	**Recovery**	1/5 (20%)	**Regular dialysis**	15/70 (21.4%)
			Regular dialysis	2/5 (40%)		
			Death	2/5 (40%)		
	Regular dialysis	15/20 (75%)	**Recovery**	2/15 (13.3%)	**Death**	16/70 (22.9%)
			Regular dialysis	8/15 (53.3%)		
			Death	5/15 (33.3%)		

DISCUSSION

The current study found that associated comorbidities in our patients presented with AKI were as following: 26 patients were diabetic, 24 were hypertensive, 14 were smokers, 6 patients had family history of renal diseases and 5 patients had history of nephrotoxic drugs. Among these associated comorbidities there was statistically significant relationship between AKI outcome, patient age, history of diabetes and established CKD as outcome worsens with advanced age, established CKD and diabetic patients. On the other side, there was no significant relationship between AKI outcome with patient gender, history of HTN, family history of renal disease or history of nephrotoxic drugs. These findings are comparable with **Kashiouris *et al.*** [8] who reported that increased risk of AKI in hospitalized patients occurs with older age, diabetes, higher s. creatinine, hypertension, use of nephrotoxic drugs and high risk surgery. Moreover, these results are comparable with those of **Finlay *et al.*** [9] who found that the risk factors for higher incidence of AKI were age older than 75 years (90.9%), hypertension (65.8%), diabetes mellitus (33%), CKD (46.2%) and use of nephrotoxic drugs (90.9%). This is important issue as the identification of risk factors is considered a predicting risk of mortality and helps to prevent worse outcome of AKI**.**

As regards the etiology of AKI in studied population, it was found that 22 patients had history of anorexia and poor oral intake, 40 patients had history of gastroenteritis, 2 patients had history of DKA, 2 patients had history of contrast, 2 patients had history of postpartum hemorrhage and 2 patients had chemotherapy. We know that there is wide range of other etiologies of AKI that were not included in our study because of limited number of studied cases. **Goswami *et al.*** [10] showed that the causes of hospital-acquired AKI were poor fluid intake (34.8%), volume depletion and gastroenteritis (28.8%), drugs (23.2%), DKA (8.37%) and radiocontrast agents (4.2%). While, **Liaño *et al.*** [11] reported that decreased renal perfusion and ischemic ATN remained the most common cause of AKI in the UK.

As regards the relation between AKI outcome and investigation of studied patients, there was statistically significant relation between AKI outcome and WBCs, hemoglobin level and serum potassium level, as outcome worsens in patients who had leucocytosis, anemia and hyperkalemia. Similarly, **Silva Júnior *et al.*** [12] found that the risk factors for death among hospitalized patients with AKI were sepsis, hyperkalemia, and anemia. While, **Kebar *et al.*** [13] found that serum potassium was not statistically significantly associated with the outcome of AKI.

In the current study, we found that studied population were classified (according to KDIGO Clinical Practice Guidelines 3 stages) into; 54 patient were stage 3 and 16 patient were stage 2. Also we found a significant relationship between AKI outcome and KIDGO staging. As patients with stage 3 AKI were associated with a higher mortality rate and a higher risk of non-recovery of renal function (P = 0.027). Similarly, **Chang *et al.*** [14] found that mortality rate was progressive and significant on the basis of the AKI staging. Additionally, **Truche *et al.*** [15] found that the rate of renal recovery was significantly different between the AKI stages (65.62%, 62.74% and 45.60% for the AKI stages 1, 2 and 3 respectively).

As regard outcome on discharge date of studied patients, we found that 55 patients had complete recovery, 15 patients continued on dialysis (RRT) and none of patients died. On follow up after 3 months; 39 patients had complete recovery, 15 patients continued on dialysis (RRT) and 16 of patients died. The low percentage of hospital mortality could be explained by that we did not include critically ill patients and those who needed intensive care. Similarly **Al Okaly *et al.*** [16] found that the number of patients receiving RRT was 30 (47.6%) with significantly higher RRT levels among patients with history of CKD (69% vs. 29.4% among non-CKD patients). Also it is well known that need for RRT was an independent predictor of poor outcomes (P = 0.000) among patients experienced AKI in intensive care setting. In addition, **De Corte *et al.*** [17] found that the rate of major renal adverse events among patients experienced AKI in critical care setting receiving RRT was 87.5%.

As regards imaging, abdominal ultrasound was done to all studied population and we found that 32 patient had normal ultrasound, 22 patients were echogenic grade I, 14 patients were echogenic grade II/III and 2 patients had solitary kidney. We found significant relationship between AKI outcome and ultrasound grading of echogenicity of studied population. These results are comparable to **Samimagham *et al.*** [18] who found that high echogenicity grade was an independent risk factor for increasing mortality rate. In case of **Peres *et al.*** [19], there was increased risk of AKI complications among patients with high echogenicity grade on admission.

CONCLUSION

Our study concluded that mortality and morbidity in patients with AKI increased in advanced age, diabetes, CKD, anemia, leucocytosis hyperkalemia and increased serum creatinine.

RECOMMENDATIONS

Conduction of further studies of AKI on wide scale of patients and in long periods is needed. Regular education of the public and health care workers should be done in order to get early diagnosis and treatment of AKI.

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Conflict of Interest: Nil.

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