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CLINICAL STUDY

Acute kidney injury in the elderly hospitalized patients

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Abstract

Objective: We aimed to evaluate acute kidney injury (AKI), occurrence of recovery and risk factors associated with permanent kidney injury and mortality in the elderly individuals. *Design*: Evidence for this study was obtained from retrospective cohort study from our center. *Patients*: A total of 193 patients (>65 years, mean age: 79.99 ± 6.93) with acute kidney injury were enrolled in this study between 2011 and 2012. Patients with kidney failure or renal replacement therapy (RRT) history at admission were excluded. *Intervention*: Main outcome measurements: serum creatinine (SCr), estimated GFR (with CKD-Epi) and complete blood counts were evaluated at baseline and daily basis thereafter. The AKI was defined based on Kidney Disease Improving Global Outcomes (KDIGO) classification. *Results*: Among 193 patients, 43 (22%) patients required RRT. Mortality rate was 18% ($n = 36$) SCr levels were restored within 9.9 ± 6.7days on average (8–39 days). Sixteen patients (12.7%) required RRT after discharge. The mean hospital stay was 10.1 ± 8.6 days (7–41 days). Mortality rate of patients who have no renal recovery was higher (44.8% vs. 4.8%) than renal recovery group ($p < 0.01$). *Conclusion*: The AKI represents a frequent complication in the elderly patients with longer hospital stay and increased mortality and morbidity. Our results show that dialytic support requirement is an independent predictor of permeant kidney injury in the elderly AKI patients. Older age, low diastolic blood pressure, high CRP and low hemoglobin levels were independent risk factors for mortality.

Keywords

Acute kidney injury, dialysis, elderly, mortality, outcome

History

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Introduction

Acute kidney injury (AKI) is a serious event and most often complicates longer hospitalization.[1] AKI is associated with a very high rate of mortality and morbidity.[2–4] Incidence of dialysis requiring AKI increased last years, an average increase of 10% per year.[5] An important factor for increase in AKI is the older age of the population.

Elderly patients have an increased risk for AKI. The BEST Kidney study showed that advanced age was independently associated with increased hospital mortality in patients with AKI.[6] These patients have a lot of comorbid conditions accumulated that can lead to chronic kidney disease (CKD), they are exposed to multiple nephrotoxic medications, they have structural, functional and molecular changes in their kidneys that decrease renal reserve and susceptibility to severe damage.

AKI is largely a disease of the elderly. It was demonstrated that there is 3–8 fold progressive increase in the frequency of AKI in patients older than 60 years.[7] The outcomes for elderly patients who develop dialysis requiring AKI are uniformly poor, reported mortality rates ranging from 31% to 80%.[8]

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In one meta-analysis, patients older than 65 years had significantly worse renal function recovery rates than younger patients (31% of elderly patients did not recover kidney function compared to 26% younger patients).[9] Other studies have also demonstrated that the rates of renal recovery after AKI are lower in the elderly.[10,11]

In our cohort we aimed to investigate the outcomes of AKI in the hospitalized patients; hospital mortality, etiology of AKI, rate of initiating renal replacement therapy (RRT), rate of recovery or no recovery in kidney function of the elderly patients with AKI.

Serum creatinine elevations are used to diagnose AKI according to Kidney Disease Improwing Global Outcomes (KDIGO) criteria for the diagnosis of acute kidney injury[12] (Box 1).

Design

Evidence for this study was obtained from retrospective cohort from our center.

Patients

A total of 193 patients hospitalized (>65 years, mean age: 79.99 ± 6.93) with acute kidney failure were enrolled in this study between 2011 and 2012. Patients with history of kidney failure or renal replacement therapy (RRT) at admission were excluded.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation and discrete variables as frequencies and percentages. One way Anova test, Tukey HDS test, Kruskal–Wallis and Mann–Whitney *U* test were used for comparing the groups. Independent sample *t* tests were applied to evaluate the differences in means between the two groups. Pearson chi square test, Exact test and Fisher–Freeman–Halton tests, were used to compare frequencies between the two groups. Multiple logistic regression analysis was used to identify the independent predictors of worse renal recovery, mortality. Parameters having a p value <0.05 in univariate analysis were included in the model. The mean difference for the continuous variables with its corresponding 95% confidence interval was also included in the model. Statistical analyses were performed using NCSS (Number Cruncher Statistical System) 2007&PASS (Power Analysis and Sample Size) 2008 Statistical Software (Kaysville, UT) version.

Results

We identified a total of 193 hospitalized cohorts due to AKI. Characteristics, laboratory, medications, outcomes and results of the patients are presented in Tables 1–8.

Box 1. Kidney Disease Improwing Global Outcomes (KDIGO) criteria for the diagnosis of acute kidney injury.

- Stage 1 AKI: 1.5–1.9 times baseline, or ≥0.3 mg/dL (≥26.5 μmol/L) increase in the serum creatinine or urine output <0.5 mL/kp per hour for 6–12 hours
- Stage 2 AKI: 2–2.9 times baseline increase in the serum creatinine or urine output <0.5 mL/kg per hour for ≥12 hours
- Stage 3 AKI: 3 times baseline increase in the serum creatinine, or increase in serum creatinine ≥4 mg/dL (≥353.6 μmol/L) or urine output of <0.3 mL/kg per hour for ≥24 hours, or anuria for ≥12 hours, or initiation renal replacement therapy

The causes of AKI in our elderly patients were: dehydratation ($n=66$), vomiting ($n=24$), diarrhea ($n=25$), cardiorenal (decreased cardiac output) ($n=18$), ATN (nephrotoxic) ($n=22$), sepsis ($n=15$), prostat hyperplasia ($n=17$), prostat carcinoma ($n=10$) bladder carcinoma ($n=12$), hemorrhage ($n=5$) and contrast material ($n=1$).

The comorbid conditions – DM ($p<0.01$), HT ($p<0.05$), and dementia ($p<0.05$) rates – were higher in prerenal groups than others.

Mortality rate of patients who have no renal recovery was higher (44.8% vs. 4.8%) than renal recovery group ($p<0.01$) (Table 5).

There were no association between comorbid conditions (DM, CHF, CAD) and medications (diuretics, antihypertensives, antibiotics) for permanent dialysis ($p>0.05$) (Table 6).

Hemodialysis requirement increased risk factor; odds ratio: 3.21 (%95 CI: 1.37–7.55) for permanent chronic kidney disease.

Patients with mortality have older age (median 83.47) ($p=0.001$), lower diastolic blood pressure ($p=0.026$), higher CRP ($p=0.04$) and lower Hb ($p=0.038$) levels (Table 8).

Discussion

AKI is a growing disease for the elderly patients, with dramatic increases in the incidence over the past decade. AKI is associated with morbidity and mortality. Hospitalized patients with dialysis requiring AKI are older than their counterparts without dialysis requiring AKI. In one meta-analysis, patients older than 65 years had significantly worse renal function recovery rates than younger patients. Some reports have demonstrated that the rates of renal recovery after AKI are lower in the elderly.

The outcomes for the elderly patients who develop dialysis requiring AKI associated with an increased mortality rates ranges from 31% to 80%.[13] In our findings mortality rate of all the patients was 18%. Patients who have no renal recovery

Table 1. Characteristics of patients.

		Groups			
	Total ($n=193$) mean ± SD	Renal mean ± SD	Prerenal mean ± SD	Postrenal mean ± SD	p
Age (year)	79.99 ± 6.93	77.90 ± 6.63	80.19 ± 6.94	80.44 ± 7.07	[a]0.359
BMI	27.29 ± 5.31	32.81 ± 7.56	26.53 ± 4.69	26.25 ± 3.03	[a]0.001*
SBP	115.45 ± 27.59	141.11 ± 34.62	110.76 ± 25.69	122.67 ± 21.11	[b]0.000*
DBP	69.17 ± 14.62	76.67 ± 12.83	66.96 ± 14.21	75.56 ± 14.76	[b]0.001*
Mean hospital stay (day); (Median)	10.11 ± 8.62	10.60 ± 6.93	10.16 ± 9.23	9.44 ± 6.17	[b]0.616
Recovery (day)	9.90 ± 39.19	8.31 ± 8.24	10.59 ± 44.5	7.06 ± 6.77	[b]0.153
	n (%)	*n* (%)	*n* (%)	*n* (%)	*p*
Gender					
female	101	12 (60.0)	84 (57.5)	5 (18.5)	[c]0.001*
male	92	8 (40.0)	62 (42.5)	22 (81.5)	
Mortality					
no	157	18 (90.0)	115 (78.8)	24 (88.9)	[d]0.356
yes	36	2 (10.0)	31 (21.2)	3 (11.1)	

Notes: [a]Oneway ANOVA test.
[b]Kruskal–Wallis test.
[c]Pearson chi square test
[d]Fisher–Freeman–Halton test.
*$p<0.05$.

Table 2. Laboratory parameters.

		Groups			
	Total ($n = 193$) mean ± SD	Renal mean ± SD	Prerenal mean ± SD	Postrenal mean ± SD	p
Glucose	107.44 ± 43.15 −100	105.10 ± 32.53 −100	110.73 ± 46.07 −103.5	92.11 ± 29.90 −83	[b]0.051
Na	137.75 ± 10.90	132.75 ± 6.36	138.91 ± 11.68	135.22 ± 7.32	[b]0.043*
P	4.78 ± 2.01 −4.5	5.11 ± 2.14 −4.4	4.60 ± 1.93 −4.4	5.47 ± 2.18 −5	[b]0.122
HB	10.96 ± 2.45	11.62 ± 1.85	10.89 ± 2.53	10.86 ± 2.37	[a]0.467
CRP	11.19 ± 10.73 −8.85	7.61 ± 7.29 −6.9	11.83 ± 11.46 −9.37	10.74 ± 8.47 −8.3	[b]0.251
BUN	83.34 ± 47.22 −77	71.20 ± 48.44 −66	83.59 ± 47.21 −77	90.96 ± 46.36 −85	[b]0.134
Potassium	4.63 ± 1.20	4.56 ± 1.14	4.49 ± 1.19	5.44 ± 1.02	[b]0.000**
PTH	153.53 ± 103.24 −131.25	170.64 ± 121.03 −165	141.26 ± 98.86 −128.1	176.32 ± 101.49 −139	[b]0.445
HCT	33.44 ± 7.59	35.02 ± 5.15	33.33 ± 7.99	32.90 ± 6.88	[a]0.598
Creatinine	4.36 ± 3.13 −3.2	5.16 ± 3.43 −3.23	3.72 ± 2.62 −2.89	7.21 ± 3.73 −6.5	[b]0.000**
Calcium	8.31 ± 0.81	8.48 ± 0.48	8.27 ± 0.88	8.37 ± 0.54	[a]0.525
Albumin	2.65 ± 0.63	2.72 ± 0.69	2.63 ± 0.65	2.72 ± 0.46	[b]0.579
Ferritin	363.19 ± 488.56 −217.5	303.58 ± 344.44 −200.11	388.69 ± 534.44 −219	280.87 ± 303.13 −207.5	[b]0.659

Notes: [a]Oneway ANOVA test.
[b]Kruskal–Wallis test.
*$p < 0.05$.
**$p < 0.01$.

Table 3. Medications.

	Renal n (%)	Prerenal n (%)	Postrenal n (%)	p
NSAID	8 (40.0)	44 (30.1)	4 (14.8)	
PPI	5 (25.0)	29 (19.9)	5 (18.5)	
Thiazide	6 (30.0)	33 (22.6)	3 (11.1)	
Spironolactone	0 (0.0)	19 (13.0)	4 (14.8)	
Furosemide	4 (20.0)	30 (20.5)	4 (14.8)	
Anti hypertensive	12 (60.0)	71 (51.4)	9 (66.7)	[a]0.174
CA channel Blockers	4 (20.0)	25 (17.1)	0 (0.0)	
ACEI	4 (20.0)	30 (20.5)	3 (11.1)	
ARB	8 (40.0)	26 (17.8)	6 (22.2)	
Antibiotics	9 (45.0)	8 (5.5)	1 (3.7)	[b]0.000*

Notes: [a]Pearson chi square test.
[b]Fisher–Freeman–Halton test.
*$p < 0.05$.

Table 4. RRT requirement – recovery.

		Groups			
	Total ($n = 193$) n	Renal n (%)	Prerenal n (%)	Postrenal n (%)	p
HD	43	6 (30.0)	26 (17.8)	11 (40.7)	[b]0.022*
Recovery	126	13 (65.0)	97 (66.4)	16 (59.3)	[a]0.771

Notes: [a]Pearson chi square test.
[b]Fisher–Freeman–Halton test.
*$p < 0.05$.

had higher mortality rate (44.8% vs. 4.8%) than the renal recovery group. In our study, deaths were higher recorded probably in connection with higher rate of patients with severe comorbidity.

Table 5. Risk factors for permanent kidney failure.

	Renal recovery		
	Yes	No	[a]p
BMI	27.21 ± 5.48	27.48 ± 5.01	0.828
SBP	116.28 ± 26.26	113.84 ± 30.16	0.571
DBP	69.16 ± 14.90	69.19 ± 14.18	0.990
	n (%)	n (%)	p
Gender			
Female	67 (53.2)	34 (50.7)	[b]0.748
Male	59 (46.8)	33 (49.3)	
HT			
No	98 (80.3)	50 (79.4)	[b]1.000
Yes	24 (19.7)	13 (20.6)	
Mortality			
Yes	6 (4.8)	30 (44.8)	[b]0.001**
No	120 (95.2)	37 (55.2)	

Notes:
[a]Student t-test.
[b]Yates continuity correction.
**$p < 0.01$.

The incidence of comorbid conditions that increase for AKI dramatically increases with age. More seen comorbid conditions were HT (54%), DM (32%), CHF (26%), CAD (12%) and SVA (11%) in our cohorts. The important role of prostatic disease in causing AKI is highlighted by the fact that 35% of AKI cases in patients aged 80–89 years were accounted for this cause in one study.[6] In our patients, obstructive AKI due to prostatic disease was lower than (14%) the study by Uchino et al. Prerenal AKI in some series accounts nearly one-third of AKI causes.[14] Elderly patients are more prone to the development of volume depletion and dehydration. In our cohort, prerenal AKI rate was higher (60%) than other series.

Table 6. Risk factors for permanent renal failure.

		Recovery		
		No *n* (%)	Yes *n* (%)	*p*
Hemodialysis	No	40 (59.7)	110 (87.3)	[a]0.001**
	Yes	27 (40.3)	16 (12.7)	
Diuretic use	No	41 (61.2)	79 (62.7)	[b]0.837
	Yes	26 (38.8)	47 (37.3)	
Antihypertensive drugs	No	38 (56.7)	63 (50.0)	[b]0.374
	Yes	29 (43.3)	63 (50.0)	
Antibiotics use	No	60 (89.6)	115 (91.3)	[a]0.896
	Yes	7 (10.4)	11 (8.7)	
Dementia	No	57 (85.1)	107 (84.9)	[a]1.000
	Yes	10 (14.9)	19 (15.1)	
Diabetes mellitus	No	42 (62.7)	89 (70.6)	[a]0.260
	Yes	25 (37.3)	37 (29.4)	
CHF	No	46 (68.7)	96 (76.2)	[a]0.338
	Yes	21 (31.3)	30 (23.8)	
CAD	No	59 (88.1)	110 (87.3)	[a]1.000
	Yes	8 (11.9)	16 (12.7)	

Notes: [a]Yates continuity correction.
[b]Pearson chi-square.

Table 7. Risk factors for mortality.

	Mortality ($n = 36$)	No mortality ($n = 157$)	
	Mean ± SD	Mean ± SD	[a]*p*
Age (year)	83.47 ± 7.51	79.19 ± 6.56	[c]0.001**
BMI	25.65 ± 4.29	27.55 ± 5.44	0.254
SBP (mmHg)	107.24 ± 25.37	117.30 ± 27.81	0.054
DBP (mmHg)	64.15 ± 13.70	70.31 ± 14.63	0.026*
Hemodialysis treatment	15 (41.7%)	28 (17.8%)	0.004**
No HD	21 (58%)	129 (82%	
	n (%)	*n* (%)	*p*
Gender			
Female	17 (47.2%)	84 (53.5%)	[b]0.496
Male	19 (52.8%)	73 (46.5%)	

Notes: [a]Student *t*-test.
[b]Pearson chi-square.
[c]Yates continuity correction.
**$p < 0.01$.

Table 8. Analysis risk factors for mortality.

			%95 CI	
	p	ODDS	Lower	Upper
Hemodialysis	0.111	2.238	0.83	6.03
Lower blood pressure	0.049*	2.602	1.00	6.74
CRP >5	0.043*	3.706	1.04	13.21
HB (<12)	0.038*	3.077	1.07	8.87

*$p < 0.05$.

The contribution of each nephrotoxic medication to the development of AKI was studied. During the course of the study, pharmacological treatments were modified according to the clinical status and renal function of the patient. As a matter of fact, polypharmacy was very common among our patients including angiotensin converting enzyme inhibitors/angiotensin receptor blockers (40%), NSAIDs (29%) PPI (20%) and aminoglycosides (9%), that are known to be associated with nephrotoxic effects.[15–17] However, it was not possible to determine individual contribution of these medications due to the multiplicity of combinations.

Patients with AKI may recover completely, require permanent RRT, partially recover, or may die of their acute ilness.[18] Recent data have demonstrated that older age is associated with a greater risk of non-recovery of renal function back to baseline and survivors are often left with CKD.[2,9,19,20]

In our study, after multivariable adjustment, there was no association between comorbid conditions (DM, CHF, CAD) and medications (diuretics, antihypertensives, antibiotics) for permanent dialysis only hemodialysis requirement remained as an independent predictor, for permeant kidney disease or non-recovery. Older age, low diastolic blood pressure, high CRP and low hemoglobin levels were independent risk factors for mortality.

Conclusion

In conclusion, AKI is mostly frequent in the elderly hospitalized patients associated with increased length of hospital stay, mortality and morbidity. Our findings suggest that hemodialysis requiring AKI is an independent predictor for the development of permanent kidney failure; and older age, low diastolic blood pressure, high CRP and low hemoglobin levels were independent risk factors for mortality

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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