



Etiology Based Outcome Analysis in Patients with Acute Kidney Injury Admitted to Medical and Surgical Intensive Care Units: A Retrospective Study in Geriatric Patients

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Abstract:

Introduction: Ageing population is steadily increasing globally with increase in the life expectancy. With ageing, kidney undergoes many structural and functional changes which along with others factors, makes it vulnerable to various insults like dehydration, sepsis and medications. Acute kidney injury (AKI) is defined by KDIGO criteria as any of the following, increase in serum creatinine by 0.3 mg /dl within 48 hours or increase in serum creatinine to 1.5 times of baseline, which is presumed to have occurred within the period of 7 days or urine output of less than 0.5 ml/ kg/ hour for six hours. This study tried to assess the correlation between etiology and in- hospital outcomes of AKI in geriatric patients.

Materials and Methods: This was a retrospective study conducted in geriatric patient population with AKI and admitted in medical and surgical ICUs of a tertiary care hospital. Geriatric is defined by WHO as age above 60 years. Geriatric cases with AKI due to all causes were included in the study. We analyzed the patients based on the type of ICU, cause of AKI and studied the outcomes at discharge from the hospital.

Results and conclusion: Patients' age was not associated with outcomes. Etiology and severity of AKI were predominant determinants of short term mortality in geriatric patients diagnosed with AKI. We found pancreatitis as a major contributor to mortality in medical ICU while cellulitis and sepsis being prominent cause of mortality in surgical ICU.

Key Words: Acute kidney injury, Geriatric AKI, KDIGO AKI mortality.

Introduction

Acute kidney injury (AKI) is a decrease in renal function that occurs suddenly and culminates into retention of nitrogenous and other waste products. Geriatric is defined by United Nations as age 60 years and above¹. According to WHO estimates, in 2020 there were 1 billion people above 60 years of age globally². By 2030, 1 in 6 will be above 60 years of age and by 2050, 2.1 billion people will be above 60 years². 2021 to 2030 is declared by U. N. as a decade of healthy ageing. Ageing affects kidneys due to falling number of functional glomeruli, occurrence of nephrosclerosis, reduction in cortical volume, tubular atrophy and interstitial fibrosis³. Elderly individuals are more likely to have diminished immunity, both innate and adaptive, resulting in increased risk of infections. Often elderly people have comorbidities like hypertension, diabetes mellitus, ischaemic heart disease and osteoarthritis. They consume medications for these ailments which may have a potential to damage kidneys in many ways. Acute kidney injury is not one disease but is a syndrome of medical, surgical and gynaecological disorders, affecting different parts of the renal system. The epidemiology of acute kidney injury is different in developed countries than in developing countries. Its incidence varies between 6.8% to 36% as reported in different studies⁴. One study reports incidence of AKI in elderly as 7%-18% of in-hospital patients and 30%-70% of critically ill patients.

Material and methods:

The study is a retrospective, observational study carried out over February 2015 to January 2016 has been approved by institutional ethical committee. All the patients were above age of 60 years having acute kidney injury as per KDIGO criteria. Good clinical care guidelines were followed as per declaration of Helsinki were followed while this research study was conducted.

Inclusion criteria:

- Critically ill patients above age of 60 years in medical or surgical ICU
- Patients who had given the consent for the study.
- Patients with acute kidney injury as per KDIGO criteria (2012) ⁵
 1. Stage I – rise in serum creatinine by 1.5mg/dl or urine output <0.5ml/kg/hr for 6hours.
 2. Stage II – rise in serum creatinine by 2mg/dl or urine output <0.5ml/kg/hr for 12 hours.
 3. Stage III –rise in serum creatinine by 3mg/dl or 4mg/dl (acute rise of>0.5mg/dl) or urine output <0.3ml/kg/hr for 24hours, or anuria for 12 hours.

Exclusion criteria:

- Patients with diagnosed end stage renal disease.
- ICU or indoor stay less than 48 hours
- Patient who didn't consent for inclusion into the study.

In our study, there were 70 males and 30 females. In this study, it was seen that 35 patients belong to more than 70years of age and 65 patients belonged to 60-65years of age.

Results:

The geriatric patients in medical ICUs had higher occurrence (60%) of acute kidney injury compared to those admitted in surgical ICUs (40%). Though the medical and surgical etiologies were multiple, we could see higher proportion of geriatric patients being diagnosed as having AKI in medical ICUs compared to surgical ICUs. (**Table 1**) The distribution of patients as the cause of AKI showed majority as medical cause (60%) followed by surgical causes (40%) for AKI in geriatric population.

Table 1) Etiology of AKI in geriatric patients.

	No. of patients	Percentage
Medical Causes	60	60.00%
Surgical Causes	40	40.00%
Total	100	100.00%

The distribution of patients as the cause of AKI showed majority as medical cause (60%) followed by surgical causes (40%) for AKI in geriatric population.

The common etiologies of acute kidney injury in medical ICU were diarrheal diseases (21.67%), cardio renal syndrome (13.33%), sepsis due to respiratory infections (20%), sepsis due to tropical infections like dengue (15%), drug induces AKI (25%). Sepsis due to various reasons was seen as dominant cause of AKI (56.67%) in these elderly patients. The highest mortality was observed in patients having pancreatitis (66.67%) more than that observed in drug induced AKI (60%). (**Table 2)** The commonest etiology of acute kidney injury was due to a medical cause. Sepsis induced AKI was the commonest etiology accounting for 56.67% cases.

Table 2) Common etiologies for AKI in Medical ICU:

	Total	Percentage	Expired	Mortality %
Acute Gastroenteritis (sepsis)	13	21.67%	3	23.08%
Cardiac Causes	8	13.33%	2	25.00%
Respiratory Cause (sepsis)	12	20.00%	6	50.00%
Tropical Disease (sepsis)	9	15.00%	3	33.33%
Drug induced	15	25.00%	9	60.00%
Pancreatitis	3	5.00%	2	66.67%
Total	60	100.00%	25	41.67%

The commonest etiology of acute kidney injury was due to a medical cause. Sepsis induced AKI was the commonest etiology accounting for 56.67% cases.

In surgical ICU, we found 40% of geriatric patients admitted being diagnosed as AKI due to various causes and in various stages of severity. The common causes of AKI in the surgical ICU were obstructive nephropathy (55%), cellulitis (skin and soft tissue infections 25%), post-operative AKI (major surgical procedures 7.50%) and intestinal obstruction (12.50%). We could observe better outcomes in obstructive nephropathy (mortality 13.64%) compared with skin and soft tissue infections/ cellulitis (mortality 80.0%). (**Table 3**)

Table 3) Common etiologies for AKI in Surgical ICU:

	Total	Percentage	Expired	Mortality %
Obstructive Nephropathy	22	55.00%	3	13.64%
Cellulitis	10	25.00%	8	80.00%
Post-operative (major non-renal surgeries)	3	7.50%	1	33.33%
Intestinal Obstruction	5	12.50%	3	60.00%
Total	40	100.00%	15	37.50%

There is no statistically significant difference in the mortality among patients in different stages and severity of AKI. ($p=0.177$ & $z = 1.349$). Nonetheless, the mortality in patients with stage 3 AKI was observed higher (48.89%) compared with stage 1 AKI (29.41%). (**Table 4**) There is no statistically significant difference in the mortality among patients in different stage and severity of AKI. ($p=0.177$ & $z = 1.349$). Nonetheless, the mortality in patients with stage 3 AKI was observed higher (48.89%) compared with stage 1 AKI (29.41%).

Table No. 4) KDIGO classification of patients at admission and mortality

	No of patient admitted	Death	Mortality%

Stage I	17	5	29.41%
Stage II	38	13	34.21%
Stage III	45	22	48.89%

There is no statistically significant difference in the mortality among patients in different stage and severity of AKI. (p=0.177 & z = 1.349). Nonetheless, the mortality in patients with stage 3 AKI was observed higher (48.89%) compared with stage 1 AKI (29.41%).

We could distribute patients across age and severity of AKI. We categorized patients as having age between 60 to 69 and age more than 70 years. This table indicated no significant association between age and severity of AKI. (p= 0.215) & chi square= 3.072. (**Table 5**) This table indicated no significant association between age and severity of AKI. (p= 0.215) & chi square= 3.072

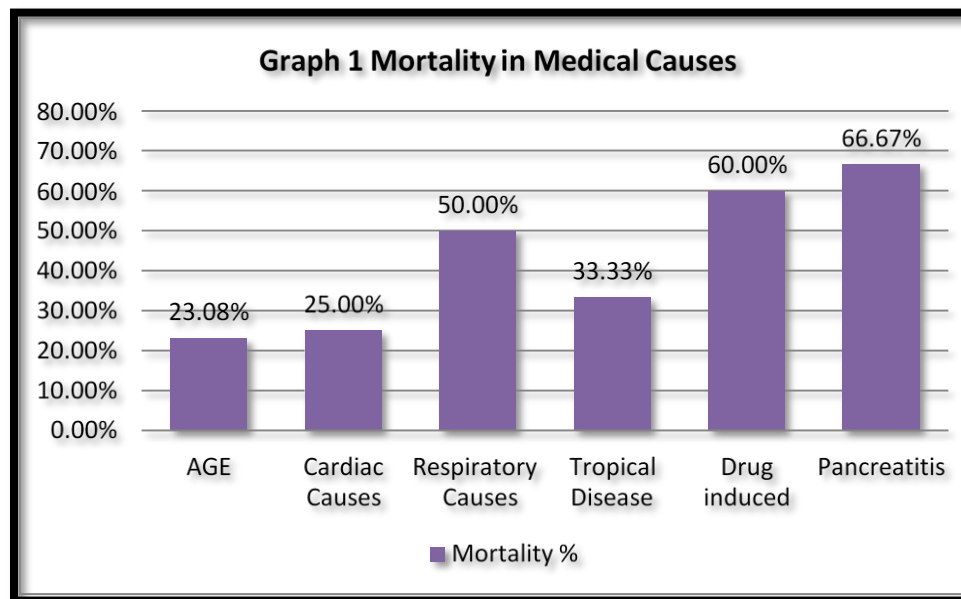
Table 5) Age wise distribution of AKI stages (KDIGO criteria)

AGE GROUP	Stage	Stage	Stage	Stage	Stage	Stage
	I	Percentage	II	Percentage	III	Percentage
60-69 year age group	8	47.06%	27	71.05%	30	66.67%
More than 70 years	9	52.94%	11	28.95%	15	33.33%
Total No. of patients above 60	17	100.00%	38	100.00%	45	100.00%

This table indicated no significant association between age and severity of AKI. (p= 0.215) & chi square= 3.072

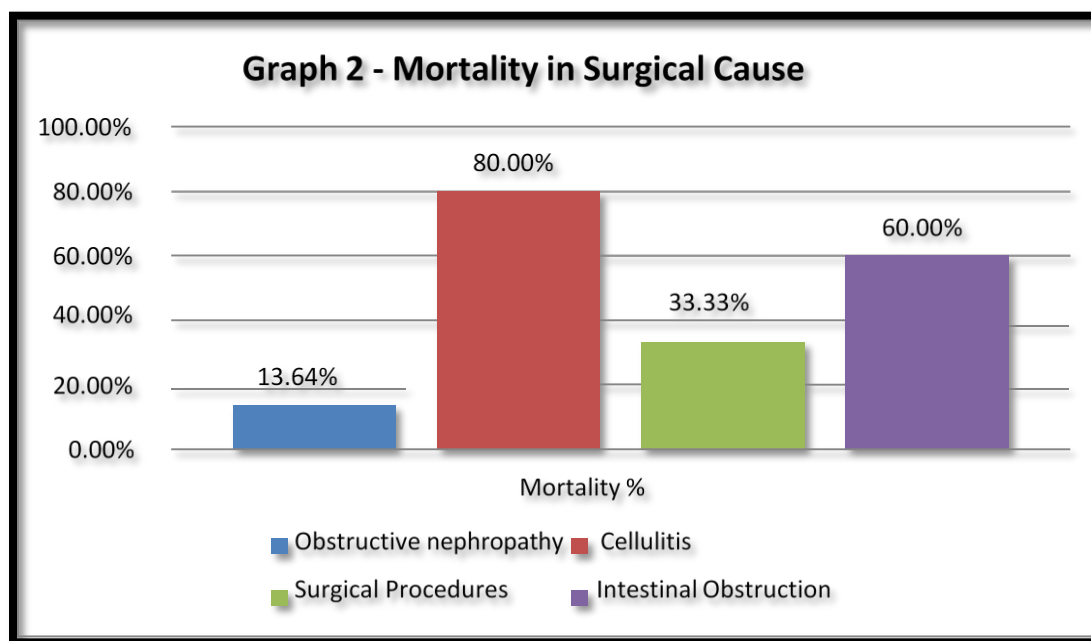
This table showed the mortality in medical ICU with acute kidney injury. Acute pancreatitis as a cause of AKI was associated with higher mortality (66.67%) compared to other causes of AKI in study population. Z=0.519, P=0.60). The underlying focus of sepsis was predominantly respiratory (50%) followed by intestinal (diarrheal disease 23.08%), and tropical diseases (33.33%). But, highest mortality was observed in patients having pancreatitis (66.67%). (**Graph 1**)

Graph 1) This table showed the mortality in medical ICU in patients with AKI. Acute pancreatitis as a cause of acute kidney injury was associated with higher mortality (66.67%) compared to other causes of AKI in study population. $Z=0.519$, $P=0.60$)



This graph shows the percentages of patients in surgical ICU with acute kidney injury. In this graph obstructive nephropathy was the commonest cause of acute kidney injury. This graph shows percentage of mortality in patients with acute kidney injury. Mortality due to cellulitis was significantly more. (p value = 0.02) and z score = (3.664). (**Graph 2**)

Graph 2) This graph showed the various causes of acute kidney injury in geriatric patients admitted in surgical ICU. In this graph obstructive nephropathy was the commonest cause of acute kidney injury.



Discussion:

The present study was hospital based observational study in which patient data collected over one year from February 2015 to Jan 2016 at a tertiary care hospital from western Maharashtra was analysed. A total of 100 patients above 60 years of age were enrolled into the study. AKI is characterised by a sudden decline in GFR resulting in retention of metabolic waste, dysregulated water, electrolyte and acid base homeostasis⁶. Mean age of elderly AKI was 67 years. Two other studies mention mean age of elderly AKI to be 70.5 years and 72 years⁷. Male to female ratio in our group was 70: 30. It was cited as 48:30 in a study conducted in Tunisia⁸. 73% of our patients had at least one or more comorbid conditions like hypertension, diabetes mellitus, heart failure, osteoarthritis or nutritional deficiencies. In a study by Pascal et al there were 256 patients between age of 65 to 79 years with 103 patients above 80 years⁹. In our study there were 65 patients in age group of 60-69 years and 35 patients had age more than 70 yrs. Medical aetiology accounted for 60% of cases of AKI while surgical cause was seen in 40% Medical to surgical ethology ratio was 80:20 in one Eastern Indian study^{9,10}. Amongst medical causes, sepsis or infection was the most common cause of AKI (56.67% of medical cause AKI). Sepsis was secondary to either acute gastroenteritis or respiratory infections or tropical infections. 15% of medical ethology cases were attributed to AKI secondary to tropical diseases like malaria, dengue rickettsia disease or leptospirosis. Renal involvement in dengue can manifest as AKI, haematuria or haemolytic uremic syndrome^{11,12}. Various studies find AKI in 13.8 to 30.7% of dengue patients^{9,11, 12} Mortality

varied from 23.08% in acute gastroenteritis causing AKI to 50% in respiratory origin sepsis related AKI. 13 patients developed acute kidney injury due to gastroenteritis with associated sepsis and dehydration. 12 patients developed AKI due to respiratory cause and associated sepsis, 8 due to tropical illness and 3 developed AKI due to pancreatitis. In all, 56.67% of patients had sepsis related AKI and formed the largest group. Next common aetiology was found to be drug induced AKI (25% of medical aetiology). High in-hospital mortality was observed in drug induced AKI (60%), next only to pancreatitis in which it was 66.67%. Medications can damage kidneys through different mechanisms. Drugs associated with hemodynamically mediated AKI are ACE inhibitors and ARB drugs responsible for inhibition of efferent arteriolar vasoconstriction and reduction in GFR. Drugs like NSAIDs inhibit production of vasodilator prostaglandins with afferent arteriolar vasoconstriction which also results in drop in GFR¹³. Likewise, aminoglycosides may cause acute tubular injury.^{13,14} NSAIDs and other drugs damaging the kidneys is a cause of AKI at all ages but risk is increased in the elderly¹⁵. Cardio renal syndrome (CRS I) occurs in elderly individuals with acute heart failure and is responsible for adverse outcome¹⁶ In this study, cardiac causes leading to cardio renal syndrome was seen in 8 cases (13.13%) with a mortality of 25%. Obstructive nephropathy was the most frequent aetiology in surgical ICU (22 out of 40 patients) accounting for 55% of surgical cause AKI with a mortality of 13.64%. Next common aetiology in surgical ICU was cellulitis and sepsis leading to AKI, which made 25% of surgical cases and they had highest mortality of 80%. A study published in 2020 mentioned obstructive nephropathy as a cause of AKI in 5-10% AKI and 22% in elderly AKI¹⁷.

The outcomes of AKI in geriatric population were not governed by the age itself but by the cause and severity of AKI. We presumed treating this subset of patients with AKI in a timely manner could fetch better outcomes. Age is a non-modifiable variable but the underlying cause of AKI could be a modifiable variable in many of the patients in geriatric age group.

Conclusion:

In geriatric population, AKI was observed predominantly in medical ICU than in surgical ICU. Mortality was related to specific etiology of AKI rather than the age of the patient. There was no correlation between age and severity of AKI in geriatric patients admitted either to medical or surgical ICU.

Limitations:

- As the study was time bound and included only elderly population the only small number of people were taken into study. Moreover, there was no control group without AKI.
- Few patients whose etiology for acute kidney injury was not known and needed renal biopsy and were not willing for it were not taken into the study.
- Few patients who were not willing for dialysis were also not taken in this study.

Recommendation:

- The investigators recommend the need for larger scale case controlled study to explore causes, presentations and management of geriatric AKI with a focus on assessing short and long term outcomes. This could be an opportunity to explore the utility of novel biomarkers of AKI in geriatric population.

Societal Relevance:

- Geriatric AKI is a large neglected area in medicine and nephrology. This data may sensitize families and people involved in geriatric care in ICUs to be vigilant for occurrence of AKI and possible newer ways to treat or prevent worsening renal parameters.

Conflict of interest – None

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