ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 6, Issue – 2, March - 2023, Page No. : 458 - 466

Association between etiology of acute kidney disease (AKI) and haemodialysis – A cross sectional study

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How to citation this article: Dr. Ameera Mol, Dr. V. Abdul Jaleel, Dr. Alavi K P, "Association between etiology of acute kidney disease (AKI) and haemodialysis – A cross sectional study", IJMACR- March - 2023, Volume – 6, Issue - 2, P. No. 458 – 466.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: To find the association between etiology of Acute Kidney Injury and Haemodialysis in Acute Kidney Injury (AKI) patients.

Methodology: A Hospital based Cross Sectional Study was conducted among 75inpatients with clinical and / or biochemical evidence of acute kidney injury admitted to a tertiary care hospital in Kerala. A detailed clinical history, physical examination and baseline investigations were done. Patients were followed up during their in hospital stay & outcome was assessed in terms of in-hospital mortality and the need for Maintenance Haemodialysis.

Results: Haemodialysis was required for 10 patients out of which 4 patients died. This had statistical significance and indicated the severity of AKI. Among causes of AKI, infection was the commonest cause which lead to Haemodialysis. Snake bite was the second commonest cause with all of the patients requiring Haemodialysis. One patient each with cardiac cause, HELLP syndrome and hypovolemia required Haemodialysis. There is a statistically significant association between the etiology of AKI and requirement of hemodialysis with P value 0.002.

Conclusion: All patients in our study were admitted and diagnosed to have AKI. The presenting complaints among the AKI patients showed that fever was the commonest complaint, followed by anuria, abdominal pain, fatigue and oliguria.

The causes of AKI showed infection was the most common cause in more than half of the patients, followed by cardiac cause, hypovolemia, obstructive causes, drugs, snake bite, HELLP syndrome, hepatorenal and pancreatitis.

Keywords: AKI, Infection, Haemodialysis

Introduction

Acute kidney injury (AKI) has emerged as one of the leading causes of intensive care unit admissions and mortality. Acute Kidney Injury is characterized by sudden impairment of renal function causing accumulation of urea and nitrogenous wastes along with extracellular volume and electrolyte dysregulation in the body. AKI's duration and severity are risk factors for the emergence of complications, such as a 10-fold rise in the likelihood of developing chronic kidney disease and a 3-fold increase in the likelihood of developing end-stage renal disease.[1,2,3]

Acute kidney damage (AKI) can be brought on by a variety of etiologies, is largely preventable, and may even be treatable if caught early enough. Usually, there are serious negative effects as a result of failing to recognize and treat in a timely and/or adequate manner. It is linked to a high mortality rate and irreversible kidney function loss. [4] AKI is linked to significantly higher short- and long-term mortality at all stages.[5]The kidney damage brought on by AKI can, however, be partially or completely reversed with early discovery and treatment. Because the criteria for defining AKI have changed quickly, there has been considerable dis agreement on the exact occurrence of the condition. Depending on the term employed, the incidence ranges from 1% to 31%, according to the literature that is currently available.[6]

AKI is a substantial contribution to mortality and morbidity, according to two trials: Starting & Ending Supportive Treatment (BEST) for the kidney and Program to Improve Care in Acute Renal Disease (PI CARD). To facilitate an early diagnosis of AKI, the RIFLE classification scheme and the acute kidney injury network (AKIN) classification scheme have been developed. For management to be optimized, accurate and comparable data about the clinical spectrum of AKI are required. Nevertheless, only a small amount of data from India is now available using established criteria.[7,8]

Acute Kidney Injury accounts for 1.5% of general hospital admissions in India, 60% of which had medical reasons. Acute diarrheal illnesses, sepsis, infections (malaria, UTI, pneumonia, viral hepatitis), snake bites, heart failure, diabetes mellitus, use of nephrotoxic drugs, cancer, SLE, hypertension, etc. are the most typical causes of AKI. AKI can also be brought on by signifi cant procedures such exploratory laparotomies and whipple's procedures, among others. AKI has been linked to factors such as advanced age, liver disorders, and under lying concomitant illnesses (DM, HTN, IHD, COPD, cirrhosis).[9]

Pre-renal AKI, acute post-renal obstructive nephropathy, and intrinsic acute kidney disorders are all types of AKI. Pre-renal and post-renal AKI are the results of extra-renal disorders that cause the glomerular filtration rate to decline. Only "intrinsic" AKI indicates real kidney disease (GFR). These pre- and/or post-renal disorders will eventually progress to renal cellular damage and, consequently, intrinsic renal disease if they are not treated. Patients with AKI can range from asymptomatic with transient changes in renal function tests to fatal derangements in circulation, electrolytes & acid base balance. They usually present with nausea, vomiting, fatigue, altered mental status, oliguria/anuria, signs and symptoms of fluid overload. The current method for diagnosing AKI is based on an acute drop in GFR, which is shown by an acute rise in serum creatinine levels and/or a decline in urine production over a specified period of time. 10 AKI has recently been diagnosed using a number of biomarkers, many of which

are still in varying phases of development and confirmation. 11,12 However, it is unclear if using a single or a combination of biomarkers is required to diagnose the complex and multi variate characteristics of AKI.13,14

The data on the incidence and prevalence of AKI worldwide is limited. The available data differs widely across studies on the population in different regions of the world. Early diagnosis of AKI and intervention help in reducing the mortality associated with AKI. This study is done to explore the association between etiology of Acute Kidney Injury and Hemodialysis in Acute Kidney Injury (AKI) patients.

Materials and methods

Ethical approval for the study was obtained from The Ethical Committee of MES Medical College, Perin thal manna with letter No. IEC/MES/11/2020.This Hospital based Cross Sectional Study was conducted among a convenient sample of 75 patients admitted in MES Medical College with clinical/biochemical features of AKI from December 1, 2020 to December 31, 2021. Patients with pre-existing chronic renal failure, acute on CKD Patients aged below 15 years and those without consent were excluded from the study. According to previous study Patel UR et al.[15]Sample size was calculated scientifically by formula $4pq/d^2$.

Where p: prevalence

q: 100-p

d: error

AKI is defined as any of the following as per the KDIGO Criteria 2012 for AKI:

• Increase in Sr. Creatinine by ≥0.3mg/dl (≥26.5µmol/l) within 48 hours;

• Increase in Sr. Creatinine to ≥1.5 times baseline within previous 7 days

• Urine volume< 0.5ml/kg/h for 6 hours

eGFR is calculated using MDRD formula:

175 x (S. Cr) -1.154 x (age)-0.203 x 0.742 [if female]

S. Cr- Serum Creatinine

Data collection

All those adults above 15 years who were diagnosed to have AKI as per the KDIGO criteria for AKI was enrolled after taking informed written consent. A detailed clinical history, physical examination and baseline investigations were done and entered in the predesigned proforma. Those patients who had a high index of clinical suspicion or abnormal baseline investigations underwent specific investigations as per routine hospital protocol for diagnosing the underlying cause. Patients were followed up during their in hospital stay & outcome was assessed in terms of in-hospital mortality and the need for Maintenance Haemodialysis.

Statistical analysis

The data was entered into a Microsoft Excel spreadsheet, and SPSS version 24 was used for data analysis. Calculated descriptive statistics included frequency and percentage. The Fishers exact test was performed to determine whether there was an association between the cause of AKI and hemodialysis. Statistical significance was defined as a P value 0.05.

Results

This study included all in-patients admitted in MES Medical College with clinical/biochemical features of AKI during the period of study satisfying inclusion criteria. In total there were 75 patients in the present study The gender distribution showed that males were predominant in the study population, 39 nos. (52%) and females were 36 nos. (48 %). The mean age of the study population is 62.27 ± 16.3 years, with females having

higher mean age of 62.61 ± 15.4 years when compared to 61.03 ± 17.3 years for males. (Table 1)

Table 1: Age and gender distribution among AKI patients

Age groups (years)	Female (n)	(%)	Male (n)	(%)
21 to 30 years	3	8.3	4	10.3
31 to 40 years	0	0.0	2	5.1
41 to 50 years	2	5.6	1	2.6
51 to 60 years	10	27.8	7	17.9
61 to 70 years	7	19.4	11	28.2
71 to 80 years	10	27.8	12	30.8
81 to 90 years	4	11.1	2	5.1
81 to 90 years	4	11.1	2	5.1

Infection was the most common cause in more than half of the patients (52%), followed by cardiac in 10 patients (13.3%), hypovolemia in 10 patients (13.3%), obstructive uropathy in 6 patients (8%), drug related nephrotoxicity in 5 patients (6.7%), snake bite in 2 patients.

HELLP syndrome, hepato-renal and pancreatitis accounted for AKI in 1 patient each (1.3%). (Table 2)

Table 2: Distribution of causes of AKI in study participants

Causes of AKI	Frequency	(%)
Infection	39	52.0
Cardiac	10	13.3
Hypovolemia	10	13.3
Obstructive	6	8.0
Drug	5	6.7
Snake bite	2	2.7
HELLP	1	1.3
Hepatorenal	1	1.3
Pancreatitis	1	1.3

Among study participants, hemodialysis was required for 10 patients (13.3%). (Figure 1)

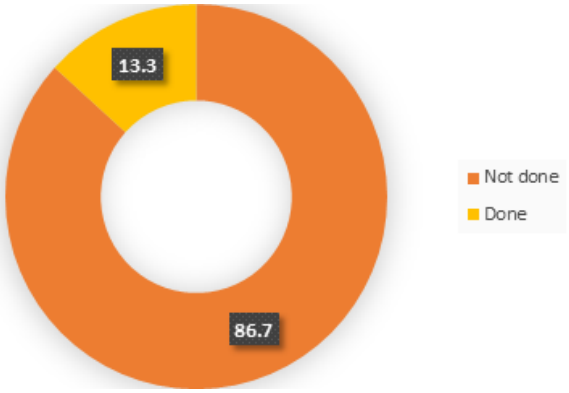

Figure 1: Percentage of patients who required Haemodialysis

Among causes of AKI, infection was the commonest cause which lead to Haemodialysis. Snake bite was the second commonest cause with all of the patients requiring Haemodialysis. One patient each with cardiac cause, HELLP syndrome and hypovolemia required Haemodialysis. There is a statistically significant association between the etiology of AKI and require Ment of hemo dialysis with P value 0.002.

Table 3: Association of Causes of AKI and Haemodialysis

Causes of AKI	Haemodialysis		P value
	Not required (n)	Required (n)	
Infection	34	5	0.002
Snake bite	0	2	
Cardiac	9	1	
HELLP syndrome	0	1	
Hypovolemia	9	1	
Drug related AKI	5	0	
Hepatorenal	1	0	
Obstructive	6	0	
Pancreatitis	1	0	

Test Applied: Fischer's exact test P value <0.05 significant.

Discussion

This study included 75 patients admitted in MES Medical College with clinical/biochemical features of

AKI during the period of study satisfying the inclusion criteria.

The gender distribution among AKI patients in the present study showed that males were predominant with 39 nos. (52%) and females were 36 nos. (48 %). The research population's average age was 62.[27] 16.3 years, with females' mean ages being higher (62.61 15.4 years) than men' (61.03 17.3 years). The age distribution showed that the majority of the patients in both the groups were between the age of 71 to 80 years, with 27.8% and 30.8% in females and males respectively. The lowest in females were in age group between 41 to 50 years (5.6%) and in males between 41 to 50 years (2. 6%). According to the study by Jayannan J et al.[16] on the profile of AKI, 152 individuals were included in the final analysis after being excluded. The subjects' average age was 44.15 years. The majority of the study participants (55.9%) were between the ages of 26 and 50. 51.3% of the study participants were female, and the remaining participants were all male. Another study by Maulita P et al.[17] studied the aetiology, manifestations and outcome of acute kidney disease. 100 cases of acute renal damage admitted to Sir T Hospital Bhavnagar between June 2013 and July 2014 were the subject of a prospective study. Clinical and analytical evidence of high blood urea and serum creatinine were used to make the patients' diagnoses. According to this report, there are 2.7 more men than women. Incidence peaked between the ages of 40 and 65. Similar to this, Dr. Tamanna Manasa et al.[18] carried out a prospective study on acute kidney injury, enrolling fifty patients with clinical and laboratory signs of acute renal injury, including 32 men and 18 females admitted to their hospital with a mean age of 48.01 years. A hospital-based prospective observational study by Prasanta Kumar et al[19]. investigated the aetiology, clinical characteristics, and short-term prognosis of AKI. Acute Kidney Injury Network criteria were used to select 75 AKI patients. The male to female ratio was 1.42:1, and the average age of the patients was 41.09 16.17 years. In other investigations by Shigehiko Uchino et al.[20], Rabbani et al.[21], and Arshad et al.[22], where men predominated over females, a similar pattern was seen.

In our study fever was the commonest complaints in 29 AKI patients (38.7%), followed by anuria in 23 patients (30.7%). Abdominal pain, fatigue, oliguria was seen in 2 patients each (2.7%).

Infection was the most common cause in more than half of the patients (52%), followed by cardiac in 10 patients (13.3%), hypo volemia in 10 patients (13.3%), ob structive uropathy in 6 patients (8%), drug related nep hrotoxi city in 5 patients (6.7%), snake bite in 2 patients. HELLP syndrome, hepato - renal and pan creatitis accounted for AKI in 1 patient each (1.3%). Among infectious causes, UTI was the commonest in 36%, followed by 8 patients with Weil's disease (10.7%), LRTI in 5 patients (6.7%), skin infection in 2 patients (2.7%) and scrotal abscess in 1 patient (1. 3%). According to Shigehiko Uchino et alstudy[20], 30% of patients had renal impairment before to admission. Septic shock was the most frequent cause of ARF (47.5%; 95% CI, 45.2%-49.5%). Use of vasopressors, mechanical ventilation (P .001), septic shock (OR cardio genic), and hepatorenal syndrome were in dependent risk factors for hospital mortality. The findings of the M Eswar Appa et al. [23] study were consistent with those of the current study, with sepsis accounting for 38.6% of patients and being the most frequent cause of AKI. Among the RIFLE criteria, 24.4% belonged to the risk class, 37.0% to the injury class, 35.0% to the failure

class, 3% to the loss class, and 0.6% to the ESRD class. Sepsis was discovered to be present in 52% (79) of the study cases, according to P S Jayannan J et al.16. Sepsis was followed by gastro intestinal loss at 36.2% (55), crush injury at 9.03% (15), snake bite at 3.3% (5), poisoning at 4.6% (7), and acute liver failure at 1.3%. (2). After proper therapy, it was discovered that 62.5% (95) of the research subject's AKI had disappeared.

According to Priyamvada et al.[24], the most common causes of AKI were sepsis (22.4%), trauma from auto accidents (21.18%), acute abdomen (18.64%), cardiac disorders (10.59%), and perforation, acute pancreatitis, intestine gangrene, intestinal blockage, and cholangitis. The most prevalent causes of AKI were sepsis and acute abdomen. A study on "Sepsis-induced acute renal injury" by H. Gomez et al.[25] and G. Gujar et al.[26] revealed sepsis as the most common risk factor. The current investigation also revealed sepsis in about half of the patients with AKI, which is consistent with the work by Arshad et al. Diarrhea, the use of nephrotoxic drugs, and heart pathology were other risks. The majority of cases of AKI were discovered to be caused by avoidable variables (infections, diarrhoea, and drug toxicity), and it was determined that making coordinated efforts to get rid of them would be crucial in lowering the death rate brought on by AKI in developing nations. Similar risk factors for AKI were found by Mercado et al.[27]. According to research by Rabbani et al.[21], medical conditions (88%) and surgical procedures (11%) were the main causes of ARF cases. Pre-renal ARF affected the majority of the patients, whereas drug-related ARF affected 5% of them.

In the present study, most common presenting complaint was fever followed by anuria. Vomiting and oliguria were identified as prevalent presenting symptoms in the Tamanna Manasa et al.[18] investigations. Fever, loss of appetite, jaundice, and loose faeces were further typical symptoms. Malaria, septicemia, drug-induced nephrotoxicity, leptospirosis, snakebite, and acute gastro enteritis were the linked etiological causes. Obstructive uropathy affected two people. They noticed that oliguria and vomiting were frequent clinical manifestations. The most common etiological factor was malaria, and falciparum malaria was more prevalent than vivax malaria. In their study of the aetiology, clinical profile, and short-term prognosis of AKI, Prasanta Kumar et al.19 found that oliguria (25.8%) and fever (40%) were the two most frequent presenting symptoms. Acute gastroenteritis was the second most frequent cause of AKI (17.3%), followed by sepsis (56%) and infection (56%), respectively. In 50% of those with sepsis, pneumonia was the initial diagnosis. A study by Maulita P. et al.[17] on the causes, symptoms, and prognosis of acute kidney injury (AKI) identified the following causes of AKI: malaria, snake bite, septicemia, heart failure, cirrhosis, medication nephrotoxicity, and severe gastro enteritis. There were 8 cases of obstructive uropathy. Oliguria and vomiting were frequent symptoms. Fever, jaundice, loose stools, and peripheral oedema were other clinical characteristics. However in that study, septicaemia was the main factor contributing to acute renal damage.

In the present study, among 75 total AKI patients 10 patients had hypovolemia (13.3%), this also included patients with blood loss (bleeding per vagina and bleeding per rectum) and fluid loss due to diarrhoea in 5 patients (6.7%). The present study showed serum creatinine in 38 patients between 1.4 to 3 mg/dl (50.7%), 30 patients between 2 to 4 mg/dl (40%) and 7 patients between 4 to 8 mg/dl (9.3%). The urea levels in 45

patients were between 27 to 70 mg/dl (60%). The urea creatinine ratio of 19 patients were<20:1 ratio (25.3%) and 56 patients with ratio> 20:1 (74.7%). The potassium levels was within normal range in 56 patients (74.7%), hypokalaemia in 13 patients (17.3%) and hyperkalaemia (8%) in 6 patients. In the study by Arshad et al.[22]patients had serum creatinine at the time of admission between 2.4 ± 1.3 (mg/dl). According to Rabbani et al. [21], the patients' baseline creatinine levels were 1.9 +/- 1.8 mg/ dl, and 27% of them already had chronic renal disease. Creatinine increased on average by 7.18 +/- 3.8 mg/ dL. The mean blood creatinine and urea levels at admission were 2.37 0.90 and 92.44 39.67 mg/dl, respectively, in the study by Prasanta Kumar et al.[19]. After being admitted to the hospital, the serum creatinine gradually increased to 2.96 1.18 and 3.26 1.56 mg/dl at 24 and 48 hours, respectively. 73.3 percent of the cases were non-oliguric. In our study Haemodialysis was required for 10 patients (13.3%) and in total 4 patients died (5.3%). The comparison of Haemodialysis to patient's death showed that out of 10 patients who required Haemodialysis 4 died. The association of causes of AKI and Haemodialysis showed that infection was the commonest cause which lead to Haemodialysis.

Snake bite was the second commonest cause with all of the patients requiring Haemodialysis. One patient each with cardiac cause, HELLP syndrome and hypovolemia required Haemodialysis. This was statistically significant. The association of causes of AKI showed infection as the most common cause for death while 1 patient each from cardiac cause and hypovolemia also died. However, this association was not statistically significant. According to Jayannan J et al.[16], of the remaining study participants, 27.6% required Haemodialysis for recovery, 3.3% continued to have AKI, 3.9% advanced to CKD, and 2.6% passed away. The final three categories were thought to be subpar effects of AKI. Those with systemic hypertension (30.9%) and people with diabetes mellitus (28.1%) in this study had poor outcomes. In univariate regression analysis, sepsis and gastrointestinal loss both contributed to the poor outcome of AKI, whereas in multi variate regression analysis, gastro intestinal loss alone contributed to the poor outcome of AKI. According to the Maulita P et al.[17] study, out of 100 instances, 93% of patients survived and 7% passed away. 17% of patients got hemodialysis, while 83% of patients were receiving conservative care. 51 patients out of 100 instances had a condition that increased their risk of developing AKI. Moreover, there were greater deaths among this group. The most prevalent comorbid conditions were DM, HTN, and IHD. In the study conducted by Dr Tamanna Manasa et al.[18]no patients underwent Haemodialysis while90% of patients survived. According to Prasanta Kumar et al.[19], hemodialysis was required in 24% of cases. Hospital stays on average lasted 8.16 days. Mortality in hospitals was 24%. On discharge, 92.9% of survivors had fully recovered their kidney function. Mortality was influenced with sepsis, the necessity for dialysis, urea levels over 100 mg/dl, and peak serum creatinine levels over 3 mg/dl (P 0.01). According to this study, sepsis in particular was the most common cause of AKI. One-fourth of the patients needed hemodiafiltration. A considerably increased mortality was linked to sepsis, the requirement for dialysis, and excessive creatinine. According to Shige hiko Uchino et al.[20], a high hospital mortality rate was linked to a period prevalence of ARF needing RRT in the ICU of between 5% and 6%. In the research by M Eswar Appa et al. 37.2% of patients (n = 186) required renal replacement

therapy (RRT).

60% of patients experienced full recovery and restored renal function. Last but not least, extensive retrospective data from the UPHS-AKI cohort of 6119 patients discovered sepsis-causing infection to be a separate predictor of mortality in AKI.[28]

Conclusion

- Fever was the commonest complaint followed by anuria, abdominal pain, fatigue and oliguria.
- Infection was the most common cause of AKI in the present study in more than half of the patients, followed by cardiac cause, hypovolemia, obstructive causes, drug induced nephrotoxicity, snake bite, HELLP syndrome, hepato-renal and pancreatitis.
- The commonest type of infection was UTI followed by Weil's disease, LRTI, skin infection and abscess.
- Haemodialysis was required for 10 patients out of which 4 patients died and remaining had complete resolution.
- The association of causes of AKI and haemodialysis showed that infection was the highest cause which lead to haemodialysis. Snake bite was the second commonest cause with all of the patients requiring haemodialysis. One patient each with cardiac cause, HELLP syndrome and hypovolemia underwent haemodialysis.
- The association of causes of AKI and death showed infection as the most common cause for death, followed by cardiac cause and hypovolemia with 1 death each, however not statistically significant.

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