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Original Article

Predisposing Factors in Acute Kidney Injury Patients Leading to Hemodialysis

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Abstract

Objective: To identify the risk variables of AKI patients needing hemodialysis in a tertiary care hospital in Pakistan.

Methods: A retrospective study of 1100 patients included in the research between January 2017 and December 2018 at Aga Khan University Hospital, of which 347 met the inclusion criteria.

Results: According to the study, sepsis - which affects 30% of patients - emerged as the most important risk factor for needing dialysis. Dialysis was necessary for 0.7% of patients with stage 1 AKI, 7.7% of patients with stage 2 AKI, and 14.2% of patients with stage 3 AKI.

Conclusion: According to the study, sepsis is a key risk factor for AKI requiring hemodialysis, even in cases with less severe form of AKI. These results assist in patient management and follow-up as they highlight the common risk factors that could lead to short and long- term morbidity and mortality of AKI patients. The study also implies that these results might guide focused therapy actions to improve patient outcomes.

Keywords: Acute Kidney Injury, Renal Dialysis, Hemodialysis, Glomerular Function Tests, Nephrotoxic Agents, Chronic Kidney Disease.

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Introduction

Acute kidney injury (AKI) is defined as sudden impairment of renal function characterized by an acute decline in glomerular filtration rate (GFR).[1] The incidence of AKI varies between different regions throughout the world (<1-66%).[2] This can be attributed to a lack of standardized definitions of AKI and due to the variation in resources and healthcare systems between countries.[2] Moreover, it may be a result of a higher number of standardized studies (>90%) originating from developed countries alone.[3]

In recent years it has been possible to compare results from various countries through standardized criteria such as the KDIGO staging system.[4] A couple of consecutive meta-analyses of worldwide epidemiology of AKI involving the KDIGO staging system suggest a prevalence of AKI among high-income countries is around 20% of hospitalized patients, while the epidemiological data from low-middle-income countries was difficult to interpret because of non-uniformity between studies and wide variations in the ability to diagnose and treat AKI.[3] Nonetheless, these studies displayed a collective mortality rate of 23.9% and 13.8% in adults and children, respectively, which is associated with AKI, and an incidence of 7.5% in South Asia.[3,5]

(According to different studies,) The incidence of dialysis-requiring AKI is increasing, affecting around 10% of hospitalized AKI patients6 and predicting higher mortality.[7] Our study explores the characteristics and risk factors predisposing patients to develop dialysis-requiring AKI amid limited data on this condtion.

Studies suggest that various risk factors can predispose an individual to develop AKI. These include chronic kidney disease (CKD) with diabetes mellitus, and cardiovascular diseases.[6] Others include age, hemodynamic instability, exposure to nephrotoxic drugs[6], rhabdomyo-

lysis[8], and sepsis.[9] An increase in AKI incidence has been observed in patients admitted to Intensive Care Units (ICU), which has been associated with poor outcomes such as increased mortality and length of stay, with sepsis and shock being the major cause of AKI.[10] A high mortality rate in patients with COVID-19-associated AKI in ICU' was also seen[11], with some studies suggesting a 7.7-fold increase in odds of in-hospital deaths.[12] In all groups, having more advanced age at the time of presentation for medical AKI, as well as thrombocytopenia, abnormal coagulation, abnormal liver function, hyperkalemia, need for mechanical ventilation, and multi-organ failure, remained predictors of increased death.[13]

Previous literature provides disease-based information regarding the risk factors of AKI. However, we applied a more comprehensive approach, considering all inpatient admissions in our study. Our aim was to identify risk factors in patients with AKI that required subsequent hemodialysis as treatment at a large tertiary care center in a metropolitan city in Pakistan.

Methods

This study is a retrospective study which evaluates all patients admitted at Aga Khan University Hospital (AKUH) from January 2017 to December 2018. Ethics Review Committee (ERC) at the Aga Khan University Hospital approved the study and the data was collected from AKUH. All the patients admitted into the department of medicine were included in the study. Patients with already established chronic kidney disease, end stage renal disease (ESRD), an elevated baseline Creatinine (>1.3mg/dL) and patients on chronic dialysis were excluded from the study.

Medical records were used to extract data of the patients using a pre-approved proforma. Collected variables included demographics, comorbid conditions, patient and hospitalization characteristics, laboratory investigations and need for hemodialysis.

Improving Global Outcomes (KDIGO) criteria[14] and Serum Creatinine were used to stage the Acute Kidney Injury of all 347 patients as either AKI-KDIGO stage 1, 2 or 3. Furthermore, GFR was also calculated for each patient via the Cockcroft-Gault equation.[15]

Analysis was done using SPSS version 22. Percentages and frequencies were used to present Qualitative variables, whereas mean ± standard deviation was used to present continuous variables. Chi-square test for categorical and student t test for continuous variables were used to identify risk factors for hemodialysis. For a value to be significant, its p-value needs to be below 0.05.

Results

The characteristics of patients with AKI showed significant variation. Of the 347 patients in the study, 20 had undergone dialysis to treat their AKI. 63.2 years was the mean age of the entire sam-ple, with a gender distribution of 188 males and 159 females. Of these 10 males and 10 females underwent dialysis (Table 1).

Table 1: *Characteristics of AKI patients (n = 347)*

Characteristics	Overall (N = 347)	Dialysis (N = 20)	No Dialysis (N = 327)	P value
Mean age (years)	63.2 ± 16	50.7 ± 16.5	63.9±15.2	<0.001
Gender				0.818
Male	188	10	178	
Female	159	10	149	
Comorbid conditions				
Diabetes	168	9	159	0.820
Hypertension	235	11	224	0.224
Ischemic heart disease	96	5	91	0.989
Malignancy	41	2	39	0.989
Hospitalization factors				
Mortality	29	3	26	0.228
ICU admission	23	2	21	0.633
Length of stay (days)	6.5 ± 7.3	6.1 ± 3.7	6.5 ± 7.5	0.817
Baseline Serum Cr	1.1±0.2	1.2±0.2	1.1 ± 0.2	0.193
Cr on admission	2.6±1.8	6.5±4.6	2.3 ± 1.1	<0.001
GFR on admission	29.7 ± 13.1	12.1 ± 7.4	30.8 ± 12.6	<0.001
BUN on admission	41.9 ± 26.4	71.8 ± 44.1	40.1 ± 23.8	<0.001
Ca on admission	8.6±2.5	8.2±0.8	8.6 ± 2.5	0.453
Phosphate on admission	4.3 ± 2.0	5.7 ± 4.2	4.2 ± 1.8	0.009
AKI-KDIGO Stage				0.004
Stage 1	129	1	128	
Stage 2	180	14	167	
Stage 3	37	5	32	

Hypertensive and diabetic patients were most prevalent in the pool of patients which underwent dialysis, with 11 hypertensive and 9 diabetic patients undergoing the procedure. This was followed by patients with ischemic heart disease and malignancy.

Amongst all patients who had acute kidney injury, the 29 expired, with 3 requiring hemodialysis. Furthermore, 23 patients had ICU admissions and 2 of these underwent

hemodialysis. The baseline creatinine for patients undergoing hemodialysis was not significantly different from the patients who did not require hemodialysis. Hemodialysis was initiated based on volume expansion that cannot be managed with diuretics and hyperkalemia/metabolic acidosis refractory to medical therapy.

Statistically significant characteristics between dialysis and non-dialysis patients include GFR (12.1±7.4 mL/min, p<0.001), admission creatinine (6.5±4.6 mg/dl, p<0.001) and BUN (71.8±44.1 mg/dl, p<0.001). Studies show lower mortality rates for patients starting renal replacement therapy (RRT) with <5 mg/dL creatinine and <70 mg/dL BUN compared to 10 mg/dL creatinine and 150 mg/dL BUN.[16]

A 2008 study demonstrated baseline GFR's importance in determining dialysis-requiring AKI, with CKD patients having a baseline estimated GFR of 15–29 ml/min/1.73 m^2 showing a 29-times in-creased chance of developing dialysis-requiring AKI.[17]

In our study, 1 of 129 stage 1 AKI-KDIGO patients (0.7%), 14 of 180 stage 2 (7.7%), and 5 of 35 stage 3 (13.5%) required dialysis. Stage 3 patients were more likely to develop dialysis-dependent AKI, consistent with Kamaruddin et al.'s findings (OR=4.51; 95% CI: 1.28,15.91).18 According to Garnier et al, risk factors for sepsis include a mean age over 60, diabetes, cardiovascular disease, obesity, CKD, and malignancy[19] which was also consistent with our findings.

Table 2: *Risk Factors for dialysis in acute kidney injury (n = 347)*

Characteristics	Overall (N = 347)	Dialysis (N = 20)	No Dialysis (N = 327)	P value
Sepsis	41	6	35	0.021
Diarrhea	30	2	28	0.687
Nephrotoxic drugs	89	5	84	0.989
Contrast used recently	32	0	32	0.237
Trauma	11	0	11	0.989
Cardiac surgery	63	3	60	0.999
Non-cardiac surgery	83	4	79	0.793
Smoking	49	2	47	0.444

Discussion

Six patients required hemodialysis due to sepsis; which emerged as the most common risk factor among those we looked at for acute kidney damage (AKI) in our study (Table 2). This result is con-sistent with the previous studies' findings that sepsis is a significant risk factor for AKI requiring dialysis.[20,21] Sepsis' clinical importance in the pathophysiology of AKI is shown by its persistently high occurrence.

Our study is notable for its thorough examination of risk variables, which identified nephrotoxic medications as the cause of kidney impairment in five patients who required dialysis. Following closely behind with (four and three instances each), respectively, was non-cardiac and cardiac sur-gery. However, these three factors were deemed insignificant in our study, and sepsis was the sole significant risk factor. These findings highlight the complex nature of AKI development, even if sepsis continues to be a significant contributor. When determining the likelihood of AKI and put-ting preventative measures in place, doctors must consider these risk factors.

The results of our study also shed light on the geographical variation in AKI risk factors. In contrast to other South Asian statistics, we saw notably less intensive care unit (ICU) admissions, suggesting potential variations in patient demographics and healthcare environments/practices.

It is important to accept our study's limits while acknowledging the significance of our findings. Our findings might be constrained by our single-center, retrospective approach, and convenience sampling. A multi-center strategy would increase the representation and external validity of the population being studied. To reduce selection bias and enhance the application of findings to a wider context, future research should also consider more rigorous sample techniques, such as random or stratified sampling.

The fact that sepsis has been identified as a main risk factor highlights the need for early detection and vigorous sepsis care to avoid AKI. Our findings further emphasize the value of early renal recovery techniques and attentive monitoring to reduce both short-term and long-term problems.[22] Our study's findings that AKI is complex highlight the demand for individualized risk assessments and therapies based on distinct patient profiles. Future studies should investigate novel approaches to managing and preventing AKI while considering the many risk variables at play.

Conclusion

Our study sheds valuable information on the field of acute kidney injury (AKI) necessitating he-modialysis and reveals the complex nature of this disorder. In line with earlier studies, we discovered sepsis to be the most important risk factor for AKI requiring dialysis. Nephrotoxic medications and surgical procedures have also become known as notable causes of AKI needing hemodialysis, however in our center that was not the case. Our study's geographic variation—which showed fewer ICU admissions than previous South Asian data—

underscores the significance of taking local demography and healthcare environments into account when addressing AKI risk factors. Our re-search highlights how crucial early sepsis detection and effective sepsis care are in preventing AKI. The importance of early renal recovery treatments and diligent follow-up monitoring is also emphasized to reduce short- and long-term consequences brought on by this incapacitating illness, as this will assist physicians in highlighting the risk factors.

The drawbacks of our single-center, retrospective investigation, including potential bias in selection, must be acknowledged. To improve this, future research should consider multi-center designs and more exacting sampling techniques. In summary, our study adds to the growing body of knowledge on AKI, particularly its link to sepsis and nephrotoxic drugs, and offers important added information for both academics and physicians. Finally, given the wide range of risk factors implicated, our findings highlight the necessity for customized risk assessments and treatments in the management of AKI.

Conflict of Interest: *None*

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