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ORIGINAL ARTICLE

RISK FACTORS AND OUTCOME OF HOSPITAL ACQUIRED ACUTE RENAL FAILURE

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ABSTRACT

Background: Acute renal failure is a frequently encountered problem in hospitalized patients. The etiology of hospital acquired acute renal failure (HAARF) is multi-factorial and it is commonly associated with an increased risk of morbidity and mortality in such patients. The objective of this study was to assess the risk factors and outcomes in patients who developed Hospital Acquired Acute Renal Failure.

Materials & Methods: A cross sectional study was carried out at Medical Unit-II, Nishtar Hospital. Multan, from 01/01/2020 to 30/06/2020. A total of 50 patients were included in the study after identification of clinical features of HAARF on detailed history and clinical examination. Relevant investigations, including renal parameters, serum electrolytes and ultrasonography abdomen were performed. All the data was entered in SPSS and was analyzed using mean ± S.D and frequency (%).

Results: The study included total 56 patients in which 26 (52%) were male patients and 24 (48%) were female patients. Mean age of patients was 56.70 ± 11.70 years. The use of nephrotoxic drugs was the commonest risk factor (40.0%) for developing HAARF, followed by sepsis (28.0%), post-surgical (20.0%), use of radio-active agents (8.0%), and decreased renal perfusion (4.0%). Twenty (40%) patients had complete recovery while partial recovery was noticed in 10 (20%) patients. In 8 (16%) patients, there was no recovery. Death occurred in 12 (24.0%) patients as a result of HAARF. 25 (50%) patients required hemodialysis. The ICU care/ ventilator support was needed in 16 (32%) patients. Multi organ failure was noticed in 16 (32%) patients. Duration of the hospital stay for all 50 patients was more than 14 days.

Conclusion: Nephrotoxic drugs, sepsis, surgery, radio-contrast agents, and reduced renal perfusion are the most important risk factors for hospital acquired acute renal failure. HAARF is also associated with high morbidity and mortality. Ample steps should be taken to provide appropriate medical care in order to prevent adverse outcomes in hospitalized patients.

KEY WORDS: Acute renal failure; chronic kidney disease; oliguria; sepsis; risk factors.

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INTRODUCTION

The development of Acute renal failure (ARF) during hospitalization, commonly known as hospital acquired acute renal failure (HAARF) is a now becoming common and is related to significantly increased duration of hospital stay, healthcare expenditures, elevated risk of developing chronic kidney disease and mortality in both critical and non-critical patients.[1,2] ARF accounts for 5-7% cases of all hospitalized patients and the incidence increases up to 20-50% in ICU patients.[3] ARF is a clinical syndrome characterized by sudden decrease in glomerular filtration rate (GFR), which leads to electrolyte and acid-base imbalance, extra cellular fluid volume disturbance, and accumulation of nitrogenous waste products, and is often accompanied by oliguria. Oliguria is the earliest sign of renal impairment and a diagnostic and management challenge to the nephrologists.[4] Diagnostically, decrease in function of kidney is related to either an absolute elevation in serum creatinine level of 0.3 mg/dl or a percent elevation of 50% in serum creatinine level.[5] Additionally, a diminished

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urine output, comprising of oliguria of less than 0.5 ml/kg/hour for more than 6 hours, also falls in the diagnostic criteria of ARF.[5, 6]

The etiology of HAARF is often multi-factorial. The most common risk factors described in the previous literature were sepsis, gastroenteritis, use of radio-contrast agents, administration of nephro-toxic medications, post-surgical, obstetrical, and decreased renal blood flow.[6,7] The effect of this multi-factorial kidney insult is severe and outcomes are poor in hospitalized patients. According to a study, HAARF patients required more ICU admissions (19.33%), had increased length of hospital stay (mean = 11.8 days), and an increased mortality rate (12.8%).[8]

In spite of the advancements in the management of hospitalized patients, a decrease in renal function is still a commonly occurring condition. So, this study was aimed to identify the risk factors and describe the outcome of patients who developed hospital-acquired acute renal failure. Identification of risk factors and the outcomes in such patients will enable health care providers to reduce the rate of morbidity and mortality occurring during hospital stay.

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out at Medical Unit II, Nishtar Hospital, Multan, from 01/01/2020 to 30/06/2020. The Nephrology services and Dialysis Unit are annexed with Medical Unit II and all the medical related renal problems at Nishtar Hospital are referred to Medical Unit II. Non-probability convenience sampling technique was utilized to gather the data. A total of 50 patients were included in the study.

Inclusion criteria:

- Patients aged 16 years or more, of either gender, admitted at Nishtar Hospital, Multan, who developed hospital-acquired acute renal failure after 24 hours of admission and referred to Nephrology department or Dialysis Unit annexed with Medical Unit II were included in the study.

Exclusion criteria

- Patients with clinical diagnosis of community-acquired acute renal failure (CAARF).
- Patients with clinical diagnosis of acute on chronic renal failure.

Patients aged 16 years or more were included after identification of clinical features of hospital-acquired acute renal failure, on detailed history, detailed clinical examination, investigations such as renal parameters, serum electrolytes and ultrasonography abdomen. Renal parameters and serum electrolytes at the time of admission and after every 24 hours were collected. Renal parameters and serum electrolytes were obtained from central laboratory at Nishtar Hospital, Multan. Ultrasound abdomen with reporting for assessment of kidney size were obtained from Department of Radiology, Nishtar Hospital, Multan. Patients with chronic renal failure on history, clinical examination and ultrasound abdomen were excluded. Written informed consent was obtained from the patient. Risks versus benefits ratio of the study to the patients was calculated and it was found out that the potential risks of the study were minimal while benefits were more. Standard treatment protocols were followed. All the informations were entered in the pre-designed questionnaire.

Statistical Package for Social Science (SPSS) version 26 was utilized to analyze data. Descriptive statistics for numerical data was measured as mean ± Standard Deviation, while categorical data i.e., gender, etiological factors and outcome in terms of complete recovery, partial recovery, no recovery, death, ICU stay/ ventilator support, prolonged hospital stay, need for dialysis were measured as frequencies and percentages.

RESULTS

A total of fifty (50) patients were included in the study. Baseline characteristics are explained in Table 1. The study included 26 (52%) male patients, and 24 (48%) female patients. Mean age of patients was 56.70 ± 11.70 years, with an age range of 16 to 80 years.

Table 1: Baseline parameters of patients with HAARF (N=50)

Parameters	Frequency	Percentage
Age of the patients *(years)	56.70 ± 11.70	
Gender		
Male	26	52.0
Female	24	48.0

HAARF = Hospital-acquired acute renal failure; N = Number of patients included in the study; * = mean ± standard deviation was used to describe the data.

Risk factors for developing HAARF are demonstrated in table 2. The use of nephrotoxic drugs was the commonest risk factor (40.0%) for developing HAARF. Among the nephrotoxic drugs, aminoglycosides were found to be a risk factor for HAARF in 12 patients. Gentamycin was found to be a risk factor for development of HAARF in 7 patients, Vancomycin in 3 patients, Non-steroidal anti-inflammatory drugs (NSAIDs) in 6 patients and Acyclovir in 2 patients.

Sepsis was the second most common risk factor for HAARF (28.0%). The commonest cause for sepsis related HAARF was urinary tract infection (UTI), occurred in 8 patients. Community acquired pneumonia was found as a risk factor for HAARF in 4 patients while in 2 patients, it was soft tissue and skin

infections leading to sepsis and later on to HAARF. Post-operative HAARF developed in 10 (20.0%) patients. The commonest operative procedure after which patient developed HAARF was abdominal surgery and thyroid surgery. Out of these 10 patients, 2 patients had coronary artery bypass grafting (CABG), and were shifted to our Medical unit for management of acute renal failure.

During the study, radio-contrast active agents were found as a risk factor for HAARF in 4 (8.0%) patients. Computed tomography (CT) scan angiography of abdomen was responsible for acute renal failure in 2 patients, while 2 patients developed acute renal failure after coronary angiography. During the study, 2 (4.0%) patients had post myocardial infarction (MI) hypotension and diminished renal perfusion leading to HAARF.

Table 2: Risk factors of HAARF in study participants (N=50)

Risk factors	Frequency	Percentage
Nephrotoxic drugs	20	40.0
Sepsis	14	28.0
Post-surgical	10	20.0
Radio-contrast agent	4	8.0
Diminished renal perfusion	2	4.0

HAARF = Hospital-acquired acute renal failure; N = Number of patients included in the study.

Outcome of the patients with HAARF are described in table 3. In this study, 20 (40%) patients had complete recovery. Partial recovery was noticed in 10 (20%) patients. In 8 (16%) patients, there was no recovery. Death occurred in 12 (24.0%) patients as a result of HAARF.

Table 3: outcomes of HAARF in study participants (N=50)

Outcomes	Frequency	Percentage
Complete recovery	20	40.0
Partial recovery	10	20.0
No recovery	8	16.0
Death	12	24.0

HAARF = Hospital-acquired acute renal failure; N = Number of patients included in the study.

During the study, 25 (50%) patients required hemodialysis. The ICU care/ ventilator support was needed in 16 (32%) patients. Multi organ failure was noticed in 16 (32%) patients. Duration of the hospital stay for all 50 patients was more than14 days.

Table 4: predictors of outcomes in HAARF patients

Parameters	Frequency	Percentage
Need for ICU/ Mechanical ventilation	16	32.0
Need for dialysis	25	50.0
Multi organ failure	16	32.0
Prolonged hospital stay	50	100.0

HAARF = Hospital-acquired acute renal failure; ICU = Intensive care unit.

DISCUSSION

The important causes of HAARF include nephro-toxic drugs, sepsis, surgery, decreased renal blood flow, and radio-contrast agents.[9, 10] Administration of nephrotoxic drugs was the most common cause of HAARF in the present study (40.0%). In a study done by Biradar et al, nephrotoxic drugs were the commonest factor responsible for HAARF.[11] In a study by Singh et al. frequency of drug induced ARF was highest (39.2%) in patients admitted in medical ward.[12] A high percentage (23.25%) was also observed in the study carried out by Goswami et al.[4] Drug-induced HAARF was also common (24.0%) in a prospective study, and it occurred as a result of administration of NSAIDs, Contrast agent, Amphotericin B, and antibiotics including amino glycosides.[13] The similar result was found out in the present study.

Sepsis was a common cause of HAARF in the present study, accounting for 28.0% cases. In a study by Singh et al. sepsis was the most common cause of ARF in patients admitted to surgical unit and ICU (34.0% and 35.2% respectively).[12] Sepsis was also found to be the dominant cause of ARF (64.24%) in a study.[6] In another study, sepsis was the commonest cause (37.0%).[13] In study, sepsis was a main causative factor of HAARF, accounting for 18.2% cases.[14] Among sepsis, pneumonia and urosepsis were the commonest causes in the study by Iram et al.[6] In the present study, the commonest cause for sepsis related HAARF was urinary tract infection (UTI), occurred in 8 patients. Pneumonia was found as a risk factor for HAARF in 4 patients while in 2 patients, it was soft tissue and skin infections leading to sepsis and later on to HAARF.

Post-surgical HAARF was the third most commonly encountered condition in the present study (20.0%). Post-operative wound infection was found to be the causative factor of HAARF in 20.0% cases in a study by Goswami et al.[4] In case-series study, 6.54% of the cases had post-operative ARF.[15] While in a study

by Iram et al. post-surgical ARF occurred in 9.56% cases.[6]

Radio-contrast agents are also a major cause of HAARF, accounting for 8.0% of the cases in the present study. In a study by Tso et al. contrast induced ARF occurred in 21.2% patients.[2] Goswami et al. reported the contrast induced nephropathy in 4.18% patients.[4] While, 11.2% cases had contrast induced ARF in a study by Cheng et al.[16] HAARF associated with hypovolemia and diminished renal perfusion was found out in 4.0% cases in the current study. In a study by Singh et al, hypovolemia induced HAARF occurred in 17.8%, 9.2%, and 14.7% cases in medical ward, surgical ward, and ICU, respectively.[12] Goswami et al. reported that 28.83% patients, who had volume depletion and hypo perfusion, suffered from acute renal failure.[4]

Regarding the outcomes in the present case-series study, 40.0% patients had complete recovery. Partial recovery was noticed in 20.0% patients. In 16.0% patients, there was no recovery. Death occurred in 12 (24.0%) patients as a result of HAARF. The findings are comparable to the findings of the prospective study by Iram et al. In their study, mortality was observed in 4.35% patients, 66.96% had complete recovery, while 28.69% progressed to chronic kidney disease.[6] Singh et al. reported the death in 45% cases while 55% patients had partial or complete recovery of renal function.[13] Death was seen in 47.0% cases and complete recovery in 53.0% cases in a study by Ahmad et al.[15] In-hospital mortality was observed in 51.58% patients with HAARF in a retrospective cohort study by Hsu et al.[17]

The patients with AKI had a substantially higher mortality rate (42.9%) in a study carried out by Alex et al. among HIV positive patients. In the same study, renal recovery was complete in 66.7% of the 30 survivors, partial in 13.3%, and no recovery in 20.0% of the survivors.[18] Li et al. reported the 28-day mortality rate to be 25.7% in patients with HAARF.[19] study reported that the mortality rate was 44.5% in patients with acute kidney injury, which increased corresponding to the AKI stage (stage 1, 4.9%; stage 2, 28.3%; and stage 3 66.8%).[20] In a comparative study by Lu et al. HAARF patients had substantially higher death rate juxtaposed to community acquired ARF patients with COVID-19 ($p < 0.014$).[21]

This study had certain limitations. Firstly, no follow-up was carried out. Hence, outcomes were not determined after hospital discharge. Secondly, the study consisted of data from a single center of a government hospital, making it difficult to generalize it to the patients in the private settings. Lastly, more accurate and significant results could have been obtained if a larger sample size was taken in the study.

This study, designed at Medical Unit II, Nishtar Hospital Multan identified old age, co morbid conditions, use of nephrotoxic drugs, sepsis and surgery as risk factor for HAARF. We also noticed that patients with HAARF had significant morbidity and mortality. The present study also shows that spectrum of hospital acquired acute renal failure is quite similar to that of advanced Western countries.

CONCLUSION

Nephrotoxic drugs, sepsis, surgery, radio-contrast agents, and reduced renal perfusion are the most important risk factors for hospital acquired acute renal failure. HAARF is also associated with high morbidity and mortality. Ample steps should be taken to provide appropriate medical care in order to prevent adverse outcomes in hospitalized patients. The limitations of study were sample size as it was done on 50 patients only, and no hypothesis was tested, so in future study should be done on larger sample size so that it can be generalized for population.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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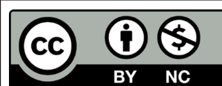
AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MS, HAK
Acquisition, Analysis or Interpretation of Data:	MS, HAK, MI, US, YA, MZN
Manuscript Writing & Approval:	MS, HAK, MI, US, YA, MZN

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.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