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IMPACT OF ACUTE KIDNEY INJURY ON CARDIAC FUNCTION: AN ANALYSIS OF MORTALITY RISK IN CRITICAL CARE PATIENTS.

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ABSTRACT

BACKGROUND: Acute Kidney Injury usually aggravates cardiac vascular complications, therefore aggravating mortality in critically ill patients. Co-morbid conditions such as diabetes mellitus, hypertension, IHD, CCF, CKD, obesity, and old age in the presence of AKI significantly influence cardiac outcomes. **OBJECTIVE:**To evaluate the impact of AKI on cardiac function and predict risk for death by applying specific cardiovascular risk factors. **METHODS:**There were 386 patients diagnosed with AKI, grouped into as 20–40 years, 40–60 years, >60 years and gender male, 58%; female, 42%. The mortality by demographics and co-morbidities has been studied for their associations with cardiac outcomes. **RESULTS:**The mean ages were 43.22 years with SD± 12.61 years, mean creatinine levels were 3.59 mg/dl with SD± 0.61 mg/dl. Mortality was at a peak among the aged people >60 being at 43%, followed by those in middle age groups that were 25% and in young age being 12% but was marked with the occurrence of obesity which was significant. The rates among men were found to be higher at 35% compared to women at 28%. **CONCLUSION:**The study unravels the fact that AKI carries a compounded mortality risk for cardiac function, but a great emphasis was given to the necessity of developing targeted management strategies to address high-risk conditions, especially in older, male, and co morbid AKI patients. Proper monitoring would enable early intervention, thus improving survival in this population.

KEY WORDS: Acute kidney injury, AKI, Mortality, PUMHSW, DM.

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INTRODUCTION

A very frequent clinical problem in the medical wards and intensive care setting is acute kidney injury, with far-reaching implications about patient outcomes, particularly in the context of cardiac function. The complex relationship between the kidneys and cardiovascular system can be essential in maintaining homeostasis, and any disruptions to this delicate balance often precipitate cascading organ dysfunction. AKI is said to be characterized by the abrupt onset of renal dysfunction, which leads to fluid overload, disturbances with electrolytes, and heightened inflammatory responses-all of which have particularly deleterious effects on the cardiac performance[1].The dynamic interplay between AKI and cardiac dysfunction has been abundantly studied and proven to be bi-directionally related to these two pathologies, thus termed the cardio-renal syndrome. Cardiac dysfunction exacerbates renal injury through the mechanisms of decreased renal perfusion and venous congestion, whereas AKI contributes to myocardial stress through systemic inflammation, uremic toxins, and hemodynamic instability[2]. This complex interdependence underlines the need for early detection and management of AKI in critical care settings to reduce its adverse effects on cardiac function.Moreover, AKI has high mortality in critically ill patients, particularly those who are suffering from cardiac disease. Its pathophysiological mechanisms include

acute myocardial dysfunction, diminished myocardial contractility, and acute heart failure. It has been well established that mortality rates in patients affected with AKI escalate exponentially, which is also augmented by an impairment degree as well as the concomitant effect of cardiac dysfunction[3].Thus, understanding the impact of AKI on cardiac function is also vital to maximize patient care and improve survival in ICU.

AKI in patients on general or cardiac intensive care contributes to an increased risk of mortality. It's also aimed at understanding the risk of cardiac mortality with AKI, making this article a reflective case study based on clinical research related to critical care and its systems.

Materials and Methods:

Study Design: This retrospective analysis was performed on critically ill patients diagnosed with Acute Kidney Injury AKI who were admitted to the medical wards and intensive care unit of PMC hospital. The study was aimed at evaluating AKI impact on cardiac function and assessing the risk of mortality based on specific cardiovascular risk factors.

Study Population:A total of 386 patients were enrolled with AKI. Patients for this study were selected based on pre-defined inclusion and exclusion criteria.

Inclusion Criteria: Subjects aged ≥20 years, diagnosed with AKI according to Kidney Disease. Patients who were admitted in the critical care unit during the study period

Exclusion Criteria: Patients with pre-existing end-stage renal disease, pregnant patients, patients having history of kidney transplantation.

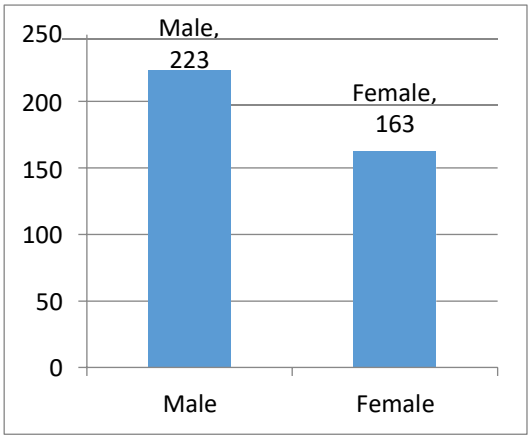
The risk factors considered for this study were: Diabetes Mellitus DM, Hypertension HTN, Ischemic Heart Disease IHD, Congestive Cardiac Failure CCF, Chronic Kidney Disease CKD, Obesity with Body Mass Index >30 kg/m², Age > 60 years.

Data Collection: Patients demographics as; age, gender, medical history, clinical data as; vital signs, laboratory results serum creatinine, blood urea nitrogen, electrolytes, imaging studies, existence of comorbid conditions such as diabetes, hypertension, IHD, CCF, CKD, obesity, and out comes such as; mortality during hospital stay, length of stay and requirement for renal replacement therapy were all recorded on a proforma.

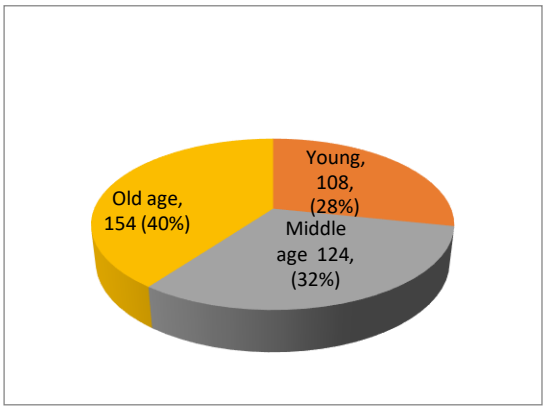
Descriptive statistics was applied to sum up patient demographics, clinical characteristics, and outcomes. Logistic regression analysis was adopted to determine independent risk factors for mortality. Odds ratios OR with 95% confidence intervals CI were calculated for each risk factor. The analysis was stratified according to age groups and gender, to observe the influence of these variables on outcomes.

The study protocol was approved by the ethical committee PUMHSw Nawabshah. Since this was a study of retrospective, it was waived from the requirement of informed consent; however, it maintained patient confidentiality.

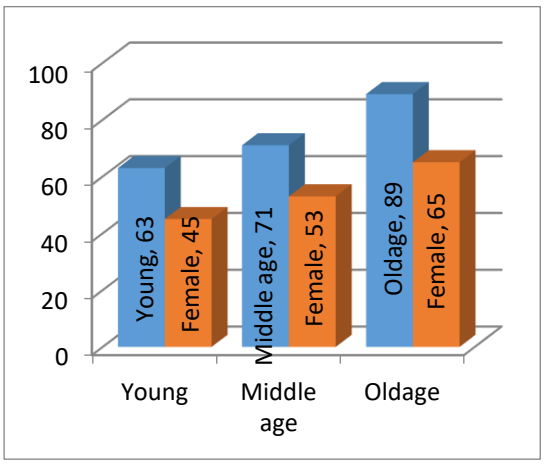
ResultsDemographic Characteristics:



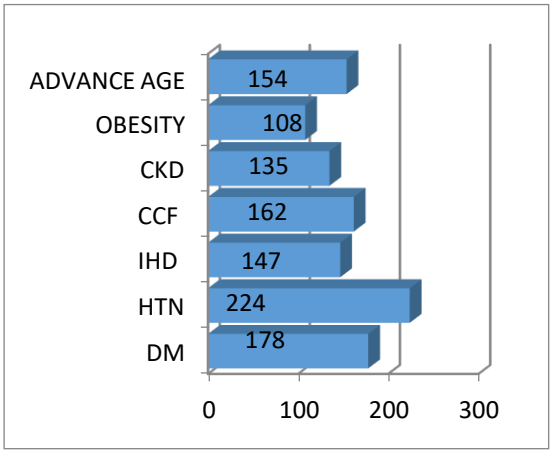
From 386 enrolled AKI patients 223 58% were males and 163 42% were females. We divided age into groups, young age group consisted 108 28% of total subjects in which 63 were males and 45 were females. In middle age group total subjects were 124 32%, from this 71 male and 53 were female. A large number of subjects 154 40% were from the old agegroup, males were 89 and female were 65. The male to female ratio was 1.4:1, showing high prevalence of male subjects in total population as shown below.



Graph showing the age distribution.



Graph showing male and female distribution
Regarding risk factors the most common risk factor was Hypertension seen in 224 58% subjects, followed by diabetes mellitus 178 46%, CCF162 42%, advanced age 154 40%, IHD 147 38%, CKD 135 35% and Obesity as 108 28% respectively as shown below.



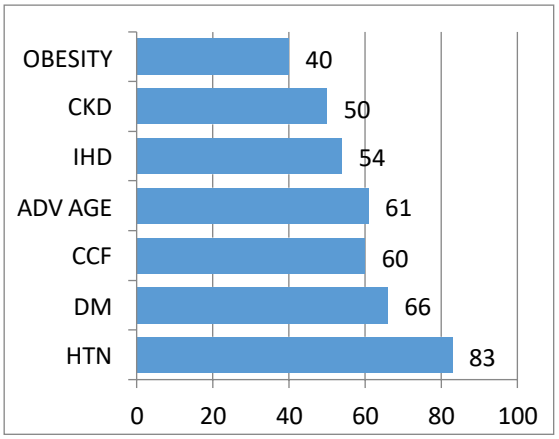
Graph showing risk factors

Gender Differences in Mortality

Mortality was elevated in males at 39% as opposed to the 31% among females. Male subjects with chronic kidney disease and hypertension have experienced cardiovascular mortality risk that is significantly higher than that among their female counterparts.

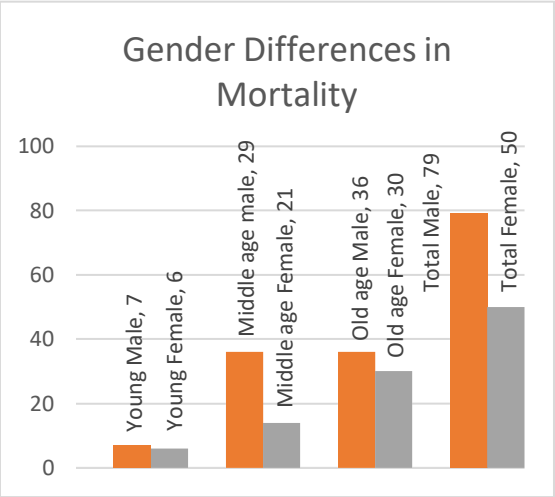
Multivariate Analysis

Logistic regression analysis identified age greater than 60 years, hypertension, and CCF as the top independent predictors of cardiovascular mortality $p < 0.01$. CKD and IHD also had a substantial linkage with heightened mortality risk $p < 0.05$. The associations between obesity and diabetes with mortality were generally lower in strength but, nonetheless, statistically significant.



Graph showing number of deaths related to different risk factors

Out of 386 AKI subjects 129 33.4% died, in young age group total subjects died were 1310.08%, out of them 07 5.88% were males and 6 4.20% were females. In middle age group total death was 50 38.76%, out of these 29 22.61% were male and 21 18% were females. Most of deaths 66 51.16% occurred inoldage group, male subjects were 36 16.15% and females were 30 21.33% respectively. As shown below



Graph showing mortality in different age groups

DISCUSSION

We noted cardiovascular mortality rate to be at 33.4% which aligns with reports indicating that AKI increases short term mortality. AKI can almost triple the risk of cardiovascular events and mortality especially in ICU. In the critical care literature, the 30 days mortality in AKI patients can range from 20-50% depending on the severity of AKI, age and comorbidities. Our data depicts the age gradient, while its highest mortality rate is witnessed in people above 60 years, 51.16%. The middle-aged people of 40-60 years have an even higher mortality level compared to young adults of 20-40 years: 38.76% and 10.08%, respectively. This trend is consistent globally where older age is strongly associated with higher AKI mortality[4].

Research suggests that age-related decline in kidney function and higher prevalence of comorbidities, for example, hypertension and diabetes, increases mortality in older adults. Studies from both the US and Europe indicated a similar trend where mortality from AKI is still higher in elderly subjects more due to susceptibility to cardiovascular stress, poor immune response, and increased comorbidities[4].

The study results conducted by Hussain et al. and Hsu, R. K., et al. 52% have shown that for an AKI case, in more than 50% mortality patients in comparison there were cases who belonged to the elder population; i.e., age greater than or equal to 60[5,6]. These are the similar demography factors exposed in this study which support our conclusions.

Hypertension remains the most prominent risk factor for AKI mortality due to its impact on the cardiovascular and renal system. Hypertension accelerates deterioration in the kidneys, thus putting the patient at higher risks of acquiring AKI and a chance of mortality. Global studies, like the Journal of the American Society of Nephrology, hypothesize that hypertension in AKI patients attains 60-70% due primarily to the geriatric population. This is nearly close to our outcome 64.34%, so hypertension remains a risk towards mortality[7].

Diabetic mellitus is another well-documented risk factor for AKI mortality as it accelerates kidney damage and increases cardiovascular complications[8]. International studies like the International Society of Nephrology often report prevalence of diabetes among AKI mortality at around 40-60% which more or less correlates with our finding that stands at 51.16%. So our findings are not different from the international data on diabetes and AKI mortality.

A South Asian study in Lahore based on deceased AKI patients showed that 49% had diabetes and was close to our result at 51.16%, suggesting a regional trend, whereby diabetes is a strong predictor of mortality from AKI in South Asia, similar to international findings[9].

The increase of CCF risk of AKI due to poor perfusion and low cardiac output, which will decrease kidney functions. Studies often observe that CCF affects 40-50% of the AKI patients' death[10]. This is approximately similar to our findings. Aging is also a huge determinant of AKI outcome, studies indicate that elderly age is often associated with mortality in 45-55% of cases which is approximately similar with your finding of 47.29%.

In Pakistan, CCF was present in approximately 45% cases of AKI mortalities, which aligns with findings of 46.51%. Hence, supporting the fact that just like hypertension, CCF are also significant risk factor for mortalities in AKI patients in national settings[11].

Other known risk factors of AKI mortality include diabetes, accelerating damage to the kidneys and increasing cardiovascular complications. International studies by reports from the International Society of Nephrology studies report that prevalence in diabetes in

AKI mortality is about 40-60%[7] that is largely similar to your result 51.16%. So our findings are thereby replicated within global data on diabetes and AKI mortality.

In most cases, the mortality rate due to AKI in Pakistan and other South Asian countries is equal to that experienced in the studies conducted locally[12], primarily due to reasons of healthcare access not being very high and the proactive management of cardiovascular disease on a relatively lower level[13].

In the present study, HTN, IHD and CKD were two major risk factors that were very critical in nature. The diseases affect both kidney and heart functions. So, AKI patients become more susceptible to the diseases[14]. International studies, especially on a high-risk basis, reported that the prevalence of IHD mortality was about 40-45%[15]. The outcome of this study matches with your findings.

It was also observed that in 42% of deaths due to AKI, IHD was found[16]. These figures have been cross-referenced with yours at 41.86%. This figure further supports the claim that there does indeed exist a large dependency of IHD on AKI death rates worldwide.

CKD is reportedly the same around the world, between 35-45% in deaths resulting from AKI, in the studies documented within the American Journal of Kidney Diseases[17]. South Asia endures significantly more in CKD significantly in the mortality of AKI because of the restricted use of CKD management in the early stages of kidney disease[18].

Obesity has emerged to be the fastest-rising risk factor across the globe, and in this present study accounts for 31.01% of AKI mortalities. From the direct perspective, obesity influences AKI mortality through alterations in blood pressure, diabetes, and cardiovascular performances[19]. On the other hand, epidemiology prevalence shows the evidence that 25-35% of AKI mortality cases result from obesity with the higher region of high rates of obesity[20]. Thus, our findings place them in the world trends, although the rates might vary on regional health practices.

Obesity results indicated that this accounted for 30% of AKI-related deaths, which almost matched 31.01% in your study; hence, obesity remains a constant impact on outcomes due to AKI in Pakistan[21].

Other risk factors such as hypertension, diabetes mellitus, age, and cardiac comorbidities were also present and similar findings to published international studies for such an incidence[22]. A comparison of findings from this study with other researchers conducted within the region and internationally would present an uninterrupted sequence, though actual differences would be determined by access to healthcare services, diseases by prevalence in each region, and socio-economic factors that determine the outcome of patients among different populations[23].

Conclusion: The findings bear a close resemblance with national and international trends regarding AKI mortality rates, age-related risk of mortality, and the prevalence of hypertension, DM, CCF, IHD, CKD, and obesity as mortality-related risk factors in AKI patients. These consistencies among the studi es highlight common underlying risk factors and demographic vulnerabilities across these regions globally and within Pakistan, pointing to similar patterns of disease progression.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE:written and verbal consent was taken from subjects and next of kin.

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AUTHORS' CONTRIBUTIONS:

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST: No competing interest declared

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