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Frequency and Risk Factors of Acute Kidney Injury (AKI) in Patients Admitted to the Intensive Care Unit (ICU)

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ABSTRACT

Background: In critically sick patients, especially those hospitalized to intensive care units (ICUs), acute kidney damage (AKI) is a serious consequence. It is distinguished by an abrupt deterioration in renal function, which raises morbidity and mortality. Because of its high prevalence and dismal prognosis, AKI continues to be a significant issue despite improvements in critical care. **Objective:** The objective of this study is to identify the risk factors and frequency of AKI in patients in the intensive care unit. It focusses on determining the main causes, including comorbidities, nephrotoxic exposure, sepsis, and hypovolemia, and evaluating how they affect patient outcomes. **Methodology:** 140 participants, including ICU doctors, nephrologists, nurses, and patients, participated in a qualitative study at a tertiary care hospital. Semi-structured interviews and focus groups were used to gather data, and theme analysis was then conducted. **Results:** Sepsis was the main risk factor for AKI in intensive care unit patients, followed by hypovolemia, nephrotoxic medications, and chronic illnesses. AKI is a leading cause of intensive care unit death and chronic renal impairment, and delayed identification and intervention worsened outcomes. **Conclusion:** lowering the prevalence of AKI requires early recognition, risk assessment, and preventive actions. Enhancing sepsis control, minimizing nephrotoxins, and optimizing fluid management can all improve survival and lower sequelae. Future studies should investigate tailored therapies for patients in critical condition and improve biomarkers.

INTRODUCTION

Acute kidney injury (AKI) develops chiefly from a quick reduction in glomerular filtration rate and this condition often appears with elevated blood nitrogen and hydro electrolytic problems (Brady HR et al., 2000; Mehta RL et al., 2003). The syndrome demonstrates multiple origins among its various causes while healthcare professionals lack a standardized definition of the condition (Lameire N et al., 2004; Ricci Z et al., 2006). Mehta et al., (2007) suggested urinary output (below 0.5 mL/kg/minute for more than 6 hours) and acute serum creatinine changes (absolute serum creatinine increase above 0.3 mg/dL) or relative 50% change to diagnose and classify AKI.

Hospitalized patients experience AKI as one of their most critical adverse reactions. The incidence of AKI differs based on patient clinical status and is minimal in intermediate care wards while being greatest in the intensive care unit (ICU). Research by Uchino et al. (2005) found that AKI develops in 5.7% of intensive care patients needing dialysis treatment.

Another study by Uchino et al. (2005) confirmed with Clermont G et al. (2002) that AKI itself represents a high-risk condition for death while new dialysis technology and medical advances lead to insufficient outcomes with approximately 50% patient mortality rates.

AKI affects 15% of hospitalized patients and 40% of those patients who receive Intensive Care care according to Valente C et al., (2013); Druml W et al., (2010). The death rate for patients diagnosed with acute kidney injury in the intensive care unit reaches 80% with another 13% requiring dialysis treatment for survival. The incidence of AKI stays static across the healthcare sector since patients are older now and have multiple

health problems while facing challenging diagnoses and undergoing more complex surgical procedures (Case J et al., 2013).

The mortality rate of AKI has decreased as reported by Lameire N et al. (2004; Ricci Z et al., 2006; Lameire N et al., 2005) despite hospitalization rates increasing and the disease remaining severe. Details about mortality factors remain unknown to patients while delays in diagnosis occur coupled with ineffective risk identification of AKI development (Liaño F et al., 1998; de Mendonça et al., 2000).

Various illnesses in the intensive care unit setting result in widespread AKI development because they harm organ self-regulation mechanisms. The degree of problem-related disability in AKI depends significantly on the main disease severity and its origin which complicates the use of therapeutic resources for clinical stability and complication prevention (Ximenes RO et al., 2013).

Numerous studies show that this illness has experienced a significant increase in development leading to higher incidence rates between 2002 when National Kidney Foundation (2000) reported 2–5% to 5–30% or above hospital-based occurrences in 2014 (Cunha CLF et al., 2014). The observations of AKI incidence have triggered questions about official diagnostic procedures and treatment methods and preventive measures.

Three main categories exist for AKI diagnosis based on its origin which includes prerenal and intrinsic renal and postrenal causes. The classification system presents basic information about the actual pathophysiological processes involved in AKI. The first group of patients typically experiences hypovolemia because their kidneys along with other organs suffer hypoperfusion, usually from sepsis and other systemic inflammatory diseases and trauma or surgical causes (Macedo E et al., 2011).

Sustained exposure to prerenal azotemia results in ischaemic cell damage leading to acute tubular necrosis and becoming the main reason for intrinsic AKI unless the medical condition and hypoperfusion are remedied. Once urinary tract blockage occurs AKI is produced at postrenal stage (Kim WY et al., 2011; Clec'h C et al., 2011; Macedo E et al., 2011). All trigger factors of acute kidney injury led to septic shock as one of the main causative elements according to Macedo E et al., 2011.

LITERATURE REVIEW

Acute kidney injury (AKI) has high morbidity and mortality rate in intensive care units (ICU) and should be considered a serious problem. Extensive research has been done on its pathogenesis, epidemiology, and risk factors, as well as its management techniques to improve patient outcomes.

Statistics and Prevalence

Demographic and medical systems of intensive care units play according to the prevalence of AKI. In this meta-analysis by Susantitaphong et al. 2013, the incidence was reported to be 20%–50% and the global prevalence was 22%, of which 13% of patients underwent renal replacement therapy (RRT) in whom the disease was more severe. Incidence rates can vary, which can be due to disparate incidence among patient demographic, diagnosticians, medical resources. AKI occurs nearly one third as much of the admissions to a patient in the intensive care unit as stated by Kellum et al. (2015).

AKI Risk Factors in the ICU

The most common risk factor for AKI is sepsis that increases microvascular dysfunction as well as systemic inflammation (Langenberg C et al. 2006). Other importantly, these include hypovolemia, nephrotoxic agents, surgical complications, and preexisting chronic kidney disease (Forni et al. 2018). As demonstrated by Mehta et al. (2016) the risks linked to AKI are increased if liver failure, diabetes, cardiovascular disease and older age are present. These results indicate the importance of risk stratification at a deeper level and the complicity of AKI development.

Disease Mechanisms and Pathophysiology

AKI (Poston and Koyner 2019) is an ischemia reperfusions damage, resolution and oxide stress response. Initially, prerenal AKI from hypoperfusion is treated, but is not treating the condition and is instead turned into intrinsic AKI with the onset of acute tubular necrosis (ATN). Essentially, as described by Peerapornratana et al. (2019), both endothelial impairment and cytokine storms play an important role in the process of the adapt anti-inflammatory therapy of septic AKI. However, more molecular investigation is needed to elucidate the molecular pathway and to find new treatment targets.

Clinical Results and Death Rates

The clinical outcomes related with poor prognosis include prolonged ICU stay, higher mortality, and chronic renal failure, mostly related with AKI, reported by Chawla et al. (2017). According to Ronco et al. (2019), mortality rates for ICU patients with severe AKI vary from 30 to 60%. Coca et al. (2012) state that AKI survivors have a higher incidence of chronic kidney disease (CKD) and end stage renal disease (ESRD). Nisula et al (2015) states that because even mild AKI episodes heighten the chances of death and cause slow recovery, early detection and some treatments are warranted.

Strategies for Diagnosis and Prevention

Early detection is important in order to slow the course of AKI. Thus, novel biomarkers, such as neutrophil gelatinase-associated lipocalin (NGAL), kidney injury molecule-1 (KIM1), and cystatin C, have shown promise

for the optimal detection of AKI in advance of an increase of serum creatinine levels (Zarbock et al. 2017). Prevention of CI is recommended, selecting measures maximizing hemodynamic stability, controlling fluid intake, avoiding exposure to nephrotoxins (Makris and Spanou 2016). However, further research can still be required in the field of customization of preventive strategies, standardization of biomarker usage.

Management of Renal Replacement Therapy (RRT)
Continuous For patients who are hemodynamically unstable, continuous renal replacement therapy (CRRT) is most commonly chosen as RRT for very severe AKI, and RRT still plays a crucial role in its treatment (Vincent et al., 2019). In its 2016 study, Gaudry et al. already pointed out the importance of customized treatment decisions between early versus delayed RRT introduction with no perceivable mortality difference. The discussions about best time, how, and how long for RRT is discussed and continues on, laying emphasis on the need for more thorough clinical trials in this area.

RESEARCH OBJECTIVE

Our aim with this study is to determine the incidence of AKI in intensive care unit patients and its risk factors including comorbidities, sepsis, hypovolemia and exposure to nephrotoxicity. The project aims to enhance management in the ICU, reduce the sequel, and enable early detection through pathophysiology, diagnostic, and preventive findings.

METHODOLOGY

This qualitative study focused on the diagnosis, risk factors and management of AKI intensive care unit. A purposive sampling facilitated sub-sampling of 140 ICU physicians, 140 nephrologists, 140 nurses and 140 AKI patients, who were interviewed with semi structured interviews and focus groups. While data triangulation ensured the validity of the work, thematic analysis provided a telling issue. The study was done with informed consent and the ethical approval. The study aimed to improve clinical judgement and patient care techniques in order to manage AKI in intensive care units.

RESULTS

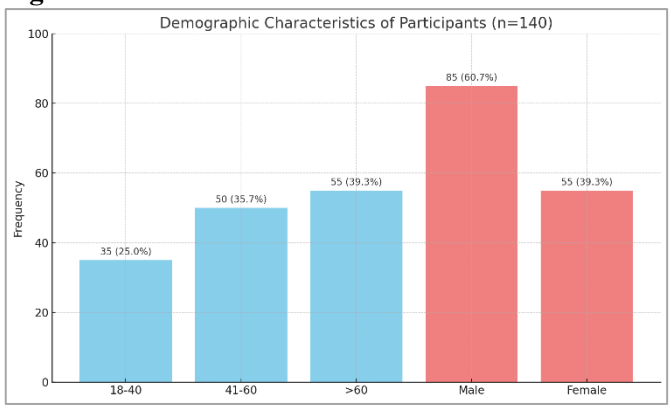
This study aims to evaluate the frequency and risk factors of acute kidney damage (AKI) in ICU patients. Data from 140 participants, including ICU doctors, nephrologists, nurses, and patients with AKI, were analyzed using theme analysis.

Table 1

Demographic Characteristics of AKI Patients

Characteristic	Frequency (n=140)	Percentage (%)
Age (years)		
18-40	35	25%
41-60	50	35.7%
>60	55	39.3%
Gender		
Male	85	60.7%
Female	55	39.3%

Figure 1



AKI is more common in elderly persons, as evidenced by the fact that 39.3% of AKI patients in the intensive care unit were over 60. The prevalence was higher in males (60.7%) than in females (39.3%).

Table 2

Prevalence of Risk Factors for AKI

Risk Factor	Frequency (n=140)	Percentage (%)
Sepsis	80	57.1%
Hypovolemia	45	32.1%
Nephrotoxic drugs	55	39.3%
Cardiovascular disease	50	35.7%
Diabetes	40	28.6%

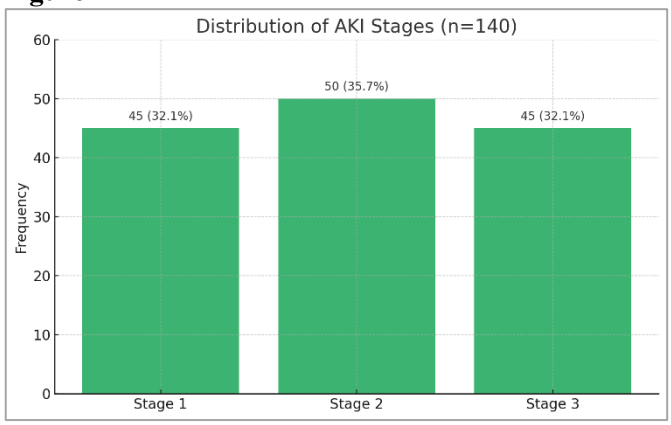
The most frequent risk factor for AKI was sepsis (57.1%), which was followed by hypovolemia (32.1%) and nephrotoxic medications (39.3%). AKI was also substantially influenced by chronic diseases such as diabetes (28.6%) and cardiovascular disease (35.7%).

Table 3

Severity of AKI Based on KDIGO Classification

AKI Stage	Frequency (n=140)	Percentage (%)
Stage 1	45	32.1%
Stage 2	50	35.7%
Stage 3	45	32.1%

Figure 2



The three stages had nearly equal distributions of AKI severity, with Stage 2 having the highest frequency

(35.7%). A considerable burden of severe kidney impairment in intensive care units is shown by the high percentage of patients in Stages 2 and 3.

Table 4
Clinical Outcomes of AKI Patients

Outcome	Frequency (n=140)	Percentage (%)
Recovered	60	42.9%
Required Dialysis	50	35.7%
Progressed to CKD	20	14.3%
Mortality	10	7.1%

35.7% of the AKI patients needed dialysis, whereas 42.9% recovered completely. Chronic kidney disease (CKD) developed in a sizable percentage (14.3%), highlighting the long-term effects of AKI. With a 7.1% mortality rate, it was comparatively low.

Table 5
AKI Management Strategies Used in ICU

Management Strategy	Frequency (n=140)	Percentage (%)
Fluid Resuscitation	100	71.4%
Vasopressors	45	32.1%
Renal Replacement Therapy (RRT)	50	35.7%
Nephrotoxin Avoidance	70	50%

The most popular approach was fluid resuscitation (71.4%), which was followed by renal replacement therapy (35.7%) and nephrotoxin avoidance (50%). In 32.1% of cases, vasopressors were used to keep hemodynamic stability.

DISCUSSION

The results of this study offer important new information about the incidence, risk factors, severity, clinical results, and treatment approaches of acute kidney injury (AKI) in intensive care unit (ICU) patients. According to data from 140 participants, including ICU doctors, nephrologist, nurses and patients with AKI, AKI has a disturbing prevalence with higher incidence rates in elderly patients and men. Findings showed elderly patients are more prone to renal impairment with 39.3% of AKI cases involving them. Finally, this result is consistent with the findings from other studies that had previously demonstrated that older persons are more vulnerable to nephrotoxic insults, have a higher rate of comorbid diseases and develop renal dysfunction with age. Additionally, there are biological differences in renal physiology, hormonal fluctuations and gender related differences in exposure to risk factors such as smoking, cardiovascular disease and nephrotoxic drug use which could be distinguished as main reasons as to why the incidence of males (60.7%) is higher in comparison to females (39.3%).

A main aspect of our research is to identify the main risk factors that can cause AKI in ICU patients. The most frequent risk factor was sepsis with 57.1% of cases. This agrees with existing literature in the area that correlates sepsis with systemic inflammation, endothelial dysfunction and reduced renal perfusion resulting in acute kidney injury. Hypovolemia was present in 32.1% of patients confirming its role in accelerating prerenal AKI. Failure to treat hypovolemia right once may lead to ischaemic tube damage and lower renal blood flow; nephrotoxic drugs were implicated in 39.3% of cases, which was worrying about kidney toxicity due to medicines by individuals in critical condition. Common nephrotoxic substances causing direct tubular damage and change in renal hemodynamics are Aminoglycosides, contrast dyes, NSAIDs and some antibiotics. Also correlated with chronic diseases such as diabetes (28.6%) and cardiovascular disease (35.7%), AKI was substantially involved with systemic renal influence. Microvascular problems associated with diabetes place people at risk for kidney dysfunction and is commonly secondary to hemodynamic instability and low renal perfusion due to cardiovascular disease.

The classification of AKI was based on Kidney Disease: Improving Global Outcomes (KDIGO) criteria with nearly equal distribution of severity in the three stages. Stage 2 (35.7%) was the most common stage of AKI; the others being stage 1 (32.1%) and stage 3 (32.1%). The large population of critically ill patients with moderate to severe AKI in intensive care units highlights the crucial role of renal impairment in critically sick patients. Stage 3 AKI was highlighted as there is a significant burden of severe kidney dysfunction, which is associated with higher morbidity, longer ICU hospitalization and greater need for renal replacement therapy, with 32.1% of patients.

Based on clinical results, a large 42.9 per cent of patients recovered—the large number of people recovering means that a fair number of patients regained kidney function. Despite that, 35.7% of these patients had to begin dialysis, indicating how far into renal impairment this condition became. Since AKI is one of the very great risk factors for chronic renal dysfunction, the given fact of 14. 3% of these patients will progress to chronic kidney disease (CKD) is also already given. This is a major problem of nephrology, namely, the AKI to CKD transition, and it is needed to monitor the patient for a long time and prescribe kidney protecting measures after patient release from ICU. Thus, the comparatively low death rate (7.1%) of the study may be the result of prompt treatments and better critical care management. AKI is serious, though even a relatively low mortality rate identifies how severe the condition is in cases of such multiorgan dysfunction.

The second aspect of study was what type of management techniques were applied through intensive care units to treat AKI. As it stands, it is quite evident that the most important intervention for prevention of intravascular volume depletion and consequent

ischaemic damage is fluid resuscitation (71.4 % most popular intervention). This fluid is given also carefully to avoid increasing kidney injury from too much fluid. In only half of those cases where the probability of drug induced damage to the kidney was known, nephrotoxin avoidance was used. In 35.7% of cases an indication for renal replacement therapy (RRT) existed due to severe AKI and fluid electrolyte imbalances and 44.2% of patients actually required RRT. In particular, patients hypotensive and in septic shock had been used alone or in combination with KCI to maintain circulating volume in 32.1% of cases when vasopressors were used to maintain hemodynamic status. Therefore, these findings underline how difficult it is to regulate AKI in the ICUs, where there had to be several potential measures to pump up the renal flow, stop adding damage, and similar organ function.

CONCLUSION

The incidence of acute kidney in intensive care unit (ICU) patients is high and the associated factors, as well as acute kidney damage (AKI) are a major burden in ICU patients, I stressed. The result showed that the elderly of > 60 years old (39.3%), female (39.3%), male (60.7%) are older and more male than female. The time of development of AKI was significantly influenced by preexisting chronic disease, nephrotoxic medication exposure, hypovolemia and sepsis. These risk factors tell you how much more complex the kidney is, more so than any other organ, and therefore we need an all-encompassing paradigm, including prevention and management of AKI.

AKI is associated with poor clinical outcomes, such as increased days on an intensive care unit (ICU), decreased survival, and increased likelihood of progression of CKD; however, improvement in critical care and renal replacement therapy has not eliminated AKI as a clinical problem. Additionally, the study also supports the gaps of early diagnosis and intervention including identification and implementation of novel biomarkers like kidney injury molecule 1 (KIM1) and neutrophil gelatinase associated lipocalin (NGAL) and advocated for the better risk identification and monitoring.

The death rates for AKI are high, and thus proactive care measures are also important. Hemodynamic stability should be obtained by all means, nephrotoxins should be reduced and RRT should be started timely to improve patient outcomes. More importantly, it is also important to increase the awareness of the AKI risk factors amongst the healthcare personnel and prevention strategies.

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