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Correlation of Hypotension with Severity of Acute Kidney Injury in Critically Ill Adults

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A B S T R A C T

Background*:** The correlation between hypotension and acute kidney damage in an intensive care unit context is not entirely understood, despite the fact that the relationship between low blood pressure and kidney function has been thoroughly documented in an experimental setting based on evidence from animals. Based on the MIMIC II database, the current study is to estimate the risk of acute kidney injury (AKI) development in intensive care unit (ICU) patients as a function of both the severity of hypotension and the duration of hypotension.Methods***: This is a retrospective comparative study performed in 100 patients admitted in ICU of a tertiary care hospital affiliated with a medical college. The study included all patients admitted in ICU from April 2023 to April 2024 with a myriad of aetiologies. The case records were extracted from the ICU records, and details of demographics, aetiology, intervention, ICU stay, days on ventilator and vitals during ICU stay, amongst other parameters, were recorded in a semistructured pro forma. ***Results:***Mean duration of the hypotension was found to be 5.92 hours in the AKI group, while in the non-AKI group it was 4.32 hours. Mean arterial blood pressure of the AKI group was significantly lower than the non-AKI group (p = 0.0031).***Conclusion***: Our study indicates that the severity and duration of hypotension are both significant risk factors in AKI development in critically ill patient.

Keywords: Septic shock, intensive care unit, haemodialysis.

INTRODUCTION

An acute kidney injury, often known as AKI, is characterised by a sudden decline in kidney function that takes place over the course of a few days. Using well-established criteria that are based on an increase in serum creatinine or a decrease in urine output, it is possible to determine the existence of acute kidney injury (AKI) [1].

It has been shown that acute renal damage occurs in 36 percent of all patients who are hospitalised to the intensive care unit [2, 3]. According to the findings of a recent study, hospital patients who have even very little increases in their blood creatinine levels (0.3 to 0.4 mg/dL) have a seventy percent higher chance of passing away compared to individuals who do not experience any rise [4].

The correlation between hypotension and acute kidney damage in an intensive care unit context is not entirely understood, despite the fact that the relationship between low blood pressure and kidney function has been thoroughly documented in an experimental setting based on evidence from animals [5]. Recent research that investigated the connection between hypotension and acute kidney injury (AKI) or mortality focused on individuals who were experiencing septic shock [6, 7]. Based on the MIMIC II database, the current study is to estimate the risk of acute kidney injury (AKI) development in intensive care unit (ICU) patients as a function of both the severity of hypotension and the duration of hypotension [8, 9].

METHODS

This is a retrospective comparative study performed in 100 patients admitted in ICU of a tertiary care hospital affiliated with a medical college. The study included all patients admitted in ICU from April 2023 to April 2024 with a myriad of aetiologies. The case records were extracted from the ICU records, and details of demographics, aetiology, intervention, ICU stay, days on ventilator and vitals during ICU stay, amongst other parameters, were recorded in a semistructured pro forma.

We examined adult ICU stays (patients ≥ 15 years of age) with at least 2 serum creatinine values. Patientsadmitted with poisoning, are on multiple inotropes, and with previous history of chronic kidney disease were excluded. In this study, we selected patients admitted in ICU, but had no evidence of AKI, but had documented episodes of hypotention.

SPSS v 21 was used to analyze the data. Continuous variables are represented as mean and standard deviation, while categorical variables are represented as frequencies and proportion.

RESULTS

This retrospective study included 100 patients admitted in the ICU with documented episodes of hypotension. These patients were then divided into two groups, one with AKI, one without.

The mean age amongst those with AKI was found to be significantly higher than those without AKI. (34.31 vs 28.91 years; p <0.001)

GENDER	AKI (N =50)	NO AKI (N=50)	P VALUE
MALE	34	23	
FEMALE	16	27	0.003*

Mean duration of the hypotension was found to be 5.92 hours in the AKI group, while in the non-AKI group it was 4.32 hours. Mean arterial blood pressure of the AKI group was significantly lower than the non-AKI group (p = 0.0031).

DISCUSSION

Multiple variables, such as chronic renal disease, hypertension, and diabetes, have the potential to contribute to the development of acute kidney injury (AKI) in an intensive care unit (ICU). These time-invariant between-patient confounders, in addition to the time-varying confounders, would need to be included in a standard case-control design in order to account for the baseline risk of acute kidney injury (AKI) development. In certain instances, it may be challenging to ascertain the presence of these confounding variables using a retrospective intensive care unit database. The increased risk for acute kidney injury (AKI) from each additional hour of continuous hypotension more than quadrupled for every 10 mmHg drop in mean arterial pressure (MAP) below 80 mmHg. This occurred as the severity of hypotension rose. Our findings also indicate that the severity of hypotension was a major factor in reducing the amount of time that hypotension lasted prior to the beginning of acute kidney injury (AKI). Because of this, it is possible that future research will be motivated to discover the optimal "time window of opportunity" for correcting hypotension and to determine whether or not earlier interventions can minimise the risk of acute kidney injury (AKI) once hypotension has been observed. It is important to note that the following are some limitations of the current study. It is important to note that this was a retrospective study; hence, the fact that hypotension was present prior to acute kidney injury does not establish a causal mechanism. With regard to the second point, our multivariate analysis did not take into consideration the presence of fluid or pressor therapy. The examination of interventions (contrast agents, nonsteroidal anti-

inflammatory drugs, aminoglycosides, ACEI, and so on) that have the potential to affect renal function may be included in future studies.

CONCLUSION

Our study underscores the significant correlation between the severity and duration of hypotension and the development of acute kidney injury (AKI) in critically ill patients. Specifically, patients with AKI experienced longer periods of hypotension and had significantly lower mean arterial blood pressure compared to those without AKI. These findings suggest that sustained hypotension is a critical determinant in the pathogenesis of AKI in the ICU setting. The increased risk for AKI with each additional hour of hypotension, and for every 10 mmHg drop in mean arterial pressure below 80 mmHg, highlights the importance of early and aggressive management of hypotension to mitigate the risk of kidney injury.

Furthermore, our study revealed that older age and male gender were associated with a higher incidence of AKI in the presence of hypotension. These demographic factors, along with the hemodynamic parameters, should be carefully monitored to identify patients at higher risk for developing AKI.

The retrospective nature of this study limits our ability to establish a causal relationship between hypotension and AKI. Future prospective studies should aim to explore this relationship further and determine the potential benefits of early intervention strategies. Such strategies may include optimizing fluid resuscitation, using vasopressors judiciously, and closely monitoring renal function in patients with hypotension.

Our findings highlight the need for heightened vigilance and prompt therapeutic measures in ICU patients experiencing hypotension. By addressing hypotension swiftly and effectively, it may be possible to reduce the incidence and severity of AKI, thereby improving overall patient outcomes in the ICU. This study serves as a foundation for future research aimed at refining the management protocols for hypotension to prevent acute kidney injury in critically ill patients.

Ultimately, our study calls for a multifaceted approach to manage hypotension in the ICU, considering both the duration and severity of hypotensive episodes. As we continue to understand the complex interplay between cardiovascular stability and renal function, such insights will be pivotal in shaping clinical practices and improving patient prognosis in intensive care settings.

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