International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Acute Kidney Injury in Patients with Traumatic Brain Injury Admitted to the ICU: A Retrospective Study at CHU Hassan II

Dr. Amine Alaoui Mdarhri[1], Dr. Ayoub Khallati[2], Prof. Abdelkarim Shimi[3], Prof. Ali Derkaoui[4], Prof. Ibrahim Bechri[5], Prof. Mohamed Khatouf[6]

[1,2]Resident, Anesthesia And Critical Care
[3,4,5,6]Professor, Anesthesia And Critical Care

Abstract

Objective: This study aims to assess the incidence, risk factors, and prognostic impact of acute kidney injury (AKI) in patients with traumatic brain injury (TBI) admitted to the intensive care unit (ICU).

Methods: We conducted a retrospective, monocentric study over a 12-month period (January to December 2023) in the A1 ICU at CHU Hassan II. Adult patients admitted for isolated TBI were included, with AKI diagnosed using KDIGO criteria. Data were analyzed using SPSS.

Results: Among the 61 patients included, 31 developed AKI, corresponding to an incidence of 50.8%. Risk factors significantly associated with AKI included advanced age, history of hypertension and diabetes, exposure to nephrotoxic agents, and combined use of vasoactive drugs. AKI was associated with a significantly longer ICU stay (14.2 days vs. 6.8 days) and higher mortality (58.1% vs. 6.7%).

Conclusion: AKI is a frequent and serious complication in TBI patients. Early identification of at-risk individuals and preventive strategies are essential to improve prognosis.

Introduction

Acute kidney injury (AKI) is a common and severe complication in intensive care, characterized by a sudden and potentially reversible decline in renal function [1]. It affects 20% to 50% of ICU patients [2], with even higher rates in TBI patients due to a cascade of events including systemic inflammation, hemodynamic instability, and iatrogenic factors [3].

The development of AKI in this population significantly worsens prognosis, increasing mortality, ICU length of stay, and the need for renal replacement therapy [4][5]. Hence, early identification of risk factors and optimization of care is critical [6].

This study aims to describe the incidence, risk factors, and clinical outcomes associated with AKI in TBI patients admitted to a Moroccan ICU.

Materials and Methods

A retrospective, observational, monocentric study was conducted in the A1 ICU of CHU Hassan II, Fez, from January 1 to December 31, 2023.

Inclusion criteria: Patients aged ≥16 years, admitted for isolated TBI, with or without AKI.

Exclusion criteria: History of chronic kidney disease or traumatic renal lesions.

AKI was defined using the KDIGO criteria. Data collected included demographic information, comorbidities, clinical and biological parameters, treatments received, and outcomes. Data analysis was performed using SPSS v26.0. Qualitative variables were compared using the Chi-square or Fisher's exact test, and quantitative variables using the Student's t-test or Mann-Whitney U test. A p-value <0.05 was considered statistically significant.

Results

From a total of 746 ICU admissions, 61 patients met the inclusion criteria. Among them, 31 developed AKI (50.8%).

Demographics:

- Mean age: 42.6 years
- Male predominance: 95% (sex ratio 19:1)
- AKI incidence by age group: 92.3% in patients ≥60 years

Mechanism of trauma:

- Road traffic accidents: 75.4%
- Falls: 13.1%
- Assaults: 11.5%

Comorbidities:

- Diabetes: 83.3% of diabetic patients developed AKI
- Hypertension: 100% of hypertensive patients developed AKI

Glasgow Coma Scale (GCS):

- Median score: 7 (IQR 5–9)
- AKI occurred even in patients with higher GCS scores

ICU Management and Outcomes:

- Mechanical ventilation: 100%
- Surgery: 36.1%; AKI occurred in 87.5% of those undergoing decompressive craniectomy
- Transfusion: 37.7%; 74% of transfused patients developed AKI
- Use of vasoactive drugs and nephrotoxic antibiotics was significantly associated with AKI

Biochemical markers:

- Urea: mean 0.59 g/L; 50.8% had >0.45 g/L
- Creatinine: mean 14 mg/L; 22.95% >12 mg/L
- Sodium: min 137.5 mEq/L, max 145 mEq/L
- Potassium: mean max 4.5 mEq/L; 18% had hyperkalemia

Outcomes:

- ICU stay: 14.2 days in AKI group vs. 6.8 days ($p < 0.01$)
- Mortality: 58.1% in AKI group vs. 6.7% ($p < 0.01$)

Discussion

In this study, we observed a high incidence of acute kidney injury (AKI) in patients with traumatic brain injury (TBI) admitted to the intensive care unit (ICU), with more than half (50.8%) developing renal dysfunction during their ICU stay. This incidence aligns with the upper range reported in the literature,

which varies between 20% and 66% depending on the population, AKI definitions, and clinical context [2][4][7]. Our findings confirm that AKI is a common complication in TBI patients and a significant determinant of ICU morbidity and mortality.

Several key risk factors were identified in our cohort. Advanced age, particularly ≥60 years, was strongly associated with the development of AKI. This finding is consistent with previous studies highlighting reduced renal reserve and higher susceptibility to nephrotoxic insults in the elderly [6]. Comorbidities such as diabetes and hypertension were also significantly linked to AKI, which reflects well-documented mechanisms of chronic endothelial and tubular vulnerability in these populations [11][12]. Additionally, the association between AKI and exposure to vasoactive agents, nephrotoxic antibiotics, and contrast media emphasizes the importance of cautious pharmacologic management in neurocritical care.

Interestingly, AKI occurred not only in patients with severe TBI (low GCS) but also among those with moderate or even mild TBI, suggesting that renal impairment in this setting is not solely a function of trauma severity. Other contributors, such as systemic inflammatory responses, hemodynamic instability, and therapeutic interventions (e.g., transfusions and decompressive craniectomy), may play a crucial role. These multifactorial triggers underline the need for a comprehensive, anticipatory approach to renal risk stratification in TBI patients.

The association between AKI and adverse outcomes was marked: patients with AKI had significantly longer ICU stays and nearly nine times the mortality rate of those without. This finding corroborates previous reports that link even mild stages of AKI to worsened prognosis in critical illness [5][13]. The observed mortality rate of 58.1% in the AKI group reflects the severity of organ dysfunction and possibly delayed recognition or limited access to renal replacement therapy in our setting.

From a management perspective, our findings underscore the importance of routine renal monitoring, early identification of high-risk patients, and judicious use of potentially nephrotoxic therapies. Avoiding unnecessary exposure to contrast agents, optimizing hemodynamics, and considering early renal-protective strategies may reduce the incidence and severity of AKI. Moreover, the strong association between transfusion and AKI in our study supports the growing evidence that liberal transfusion thresholds in TBI must be weighed against their potential renal consequences [14].

This study has several limitations. Its retrospective and single-center design limits generalizability. The sample size, although reflective of our local ICU population, is relatively small. Additionally, the lack of long-term renal outcome data prevents assessment of progression to chronic kidney disease. Despite these limitations, our study provides important insights into the frequency, risk profile, and consequences of AKI in a vulnerable population that has not been well-studied in North Africa.

Conclusion

AKI is a common and serious complication among TBI patients admitted to the ICU. Its multifactorial pathogenesis and significant prognostic impact call for targeted prevention strategies and early management. Tailored ICU protocols are essential to reduce AKI incidence and improve outcomes in this vulnerable population.

References:

1. Kellum JA, Lameire N. Diagnosis, evaluation, and management of acute kidney injury: a KDIGO summary. Crit Care. 2013;17(1):204.

2. Hoste EA, Bagshaw SM, Bellomo R, et al. Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study. Intensive Care Med. 2015;41(8):1411–1423.
3. Srisawat N, Kellum JA. Acute kidney injury: definition, epidemiology, and outcome. Curr Opin Crit Care. 2011;17(6):548–555.
4. Murugan R, Kellum JA. Acute kidney injury: what's the prognosis? Nat Rev Nephrol. 2011;7(4):209–217.
5. Bagshaw SM, George C, Bellomo R. Early acute kidney injury and sepsis: a multicentre evaluation. Crit Care. 2008;12(2):R47.
6. Chertow GM, Burdick E, Honour M, Bonventre JV, Bates DW. Acute kidney injury, mortality, length of stay, and costs in hospitalized patients. J Am Soc Nephrol. 2005;16(11):3365–3370.
7. **Lannou, A.** (2020). *Perturbations rénales chez le patient traumatisé crânien : approche physiopathologique*. Disponible en ligne : dumas.ccsd.cnrs.fr.
8. **Shrestha, P., et al.** (2022). *Traumatic Brain Injury and Acute Kidney Injury—Outcomes and Associated Risk Factors*. *Frontiers in Neurology*, 13:1034.
9. **Maxim Challiot**. Epidémiologie des traumatismes crâniens : étude rétrospective réalisée au service d'accueil des urgences du centre hospitalo- universitaire de Guadeloupe de janvier à décembre 2019. Médecine humaine et pathologie. 2020. ffdumas-03797549f
10. **M. B. Nada**, « POUR L'OBTENTION DU DOCTORAT EN MEDECINE ».
11. **Barea-Mendoza JA, Chico-Fernández M, Quintana-Díaz M, Serviá-Goixart L, Fernández-Cuervo A, Bringas-Bollada M, et al.** Traumatic Brain Injury and Acute Kidney Injury—Outcomes and Associated Risk Factors. *J Clin Med.* 2022;11(23):7216. doi:10.3390/jcm11237216.
12. Luo X, Jiang L, Du B, Wen Y, Wang H, Xi X. *A comparison of different diagnostic criteria of acute kidney injury in critically ill patients*. Crit Care. 2014;18(4):R144. This study compares various diagnostic criteria for acute kidney injury (AKI) in critically ill patients.
13. Bagshaw SM, George C, Bellomo R. *A comparison of the RIFLE and AKIN criteria for acute kidney injury in critically ill patients*. Nephrol Dial Transplant. 2008;23(5):1569–1574. This article evaluates the RIFLE and AKIN classification systems for AKI in ICU patients, exploring differences in diagnosis and prognosis.
14. Hoste EA, Bagshaw SM, Bellomo R, et al. *Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study*. Intensive Care Med. 2015;41(8):1411–1423.