



## Prevalence of Nosocomial Infections in Traumatic Brain Injury Patients: Identification of Risk Factors and Prevention Measures

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### Abstract:

**Background:** Severe traumatic brain injuries (TBI) pose significant risks for secondary complications, notably nosocomial infections, which increase morbidity, mortality, and healthcare costs. This study aimed to assess the prevalence of nosocomial infections, identify associated risk factors, describe clinical outcomes, and evaluate antibiotic use in TBI patients admitted to the Intensive Care Unit at Hassan II Hospital, Agadir. **Methods:** We conducted a prospective observational study including patients with severe TBI. Data on demographic characteristics, clinical status, medical procedures, infectious complications, antibiotic regimens, and outcomes were collected and analyzed. **Results:** Among the 100 patients included, 93.15% were male, with a mean age of 33.5 years. Respiratory distress and hemodynamic instability were observed in 31.48% and 38.18% of patients, respectively. Mechanical ventilation was required in 73.77% with an average duration of 8.32 days. The prevalence of nosocomial infections was 56.25%, including ventilator-associated pneumonia (63.04%), urinary tract infections (26.56%), meningitis (4.69%), and catheter-related infections (1.56%). Antibiotics were administered to 83.61% of patients, with predominant regimens including third-generation cephalosporins, aminoglycosides, metronidazole, imipenem, and amoxicillin-clavulanate combinations. Septic shock developed in 50.98% of patients, with an overall mortality rate of 25%. **Conclusion:** Nosocomial infections remain a major complication in severe TBI patients, particularly in the context of invasive procedures such as mechanical ventilation and catheter use. Early identification of at-risk patients and implementation of targeted preventive measures and appropriate antibiotic stewardship are essential to improve clinical outcomes.

**Keywords:** Traumatic brain injury ,Nosocomial infections. ,Ventilator-associated pneumonia ,Septic shock. ,Antibiotic therapy ,Intensive care unit , Infection prevention ,Mechanical ventilation

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### I. Introduction:

Severe traumatic brain injury (TBI) represents a major public health concern worldwide due to its high morbidity, mortality, and long-term disability. Beyond the immediate neurological damage caused by the initial trauma, patients with severe TBI are at significant risk of developing secondary complications, among which nosocomial infections are particularly frequent and impactful. These healthcare-associated infections contribute to worsening clinical outcomes by prolonging hospital stays, increasing healthcare costs, and elevating the risk of morbidity and mortality.

Nosocomial infections in TBI patients often arise from invasive medical procedures and devices such as mechanical ventilation, central venous catheters, and urinary catheters. The altered immune status and critical condition of these patients further predispose them to infectious complications. Understanding the epidemiology, risk factors, and clinical impact of nosocomial infections in this vulnerable population is crucial for optimizing care and improving prognosis.

This study aims to evaluate the prevalence and types of nosocomial infections in patients with severe traumatic brain injuries admitted to the Intensive Care Unit at Hassan II Hospital in Agadir, to identify associated risk factors, assess clinical outcomes including mortality and septic shock, and analyze antibiotic

treatment practices. Our findings are intended to support the development of targeted prevention strategies and inform antibiotic stewardship programs to reduce infection-related complications in TBI patients.

## **II. Materials and Methods**

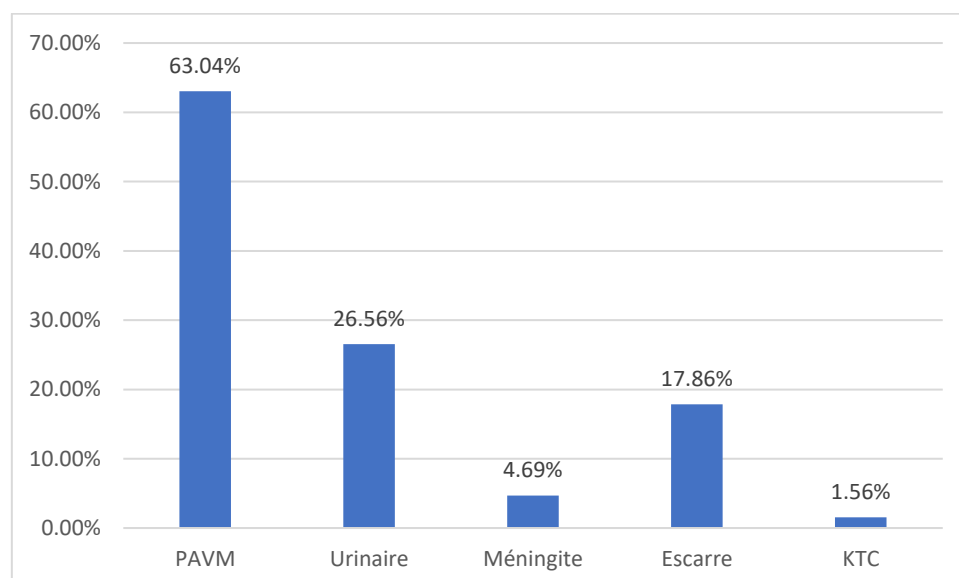
Severe traumatic brain injuries (TBI) represent a public health problem. Beyond the immediate implications of the initial injury, these patients are also exposed to secondary risks, among which nosocomial infections play a prominent role. These infections worsen the patient's condition, prolong hospital stay, and increase medical costs. This study aims to evaluate the incidence, determine the epidemiological profile of nosocomial infections in patients with severe traumatic brain injuries, identify risk factors and prognostic factors in the Intensive Care Unit B at Hassan II Hospital of Agadir, and assess the need for prevention protocols to limit complications in these patients.

## **III. Results:**

Our investigation into the prevalence of nosocomial infections associated with traumatic brain injuries revealed a series of intrinsic patient risk factors. The studied sample had a mean age of 33.50 years, ranging from 6 months to 68 years, showing a wide age range affected by this issue. Additionally, a marked male predominance was observed, with 93.15% of patients being male, suggesting that men might be at higher risk. Clinically, respiratory distress was present in 31.48% of patients, which may influence the infection risk. Hemodynamic instability was also a concern, with 38.18% of patients being unstable. Regarding the nature of the trauma, it was noteworthy that a slight majority (51.61%) suffered from severe polytrauma, while 48.39% had isolated severe traumatic brain injury without associated lesions. Taken together, these data highlight the importance of personalized and reinforced care to prevent nosocomial infections in this specific population.

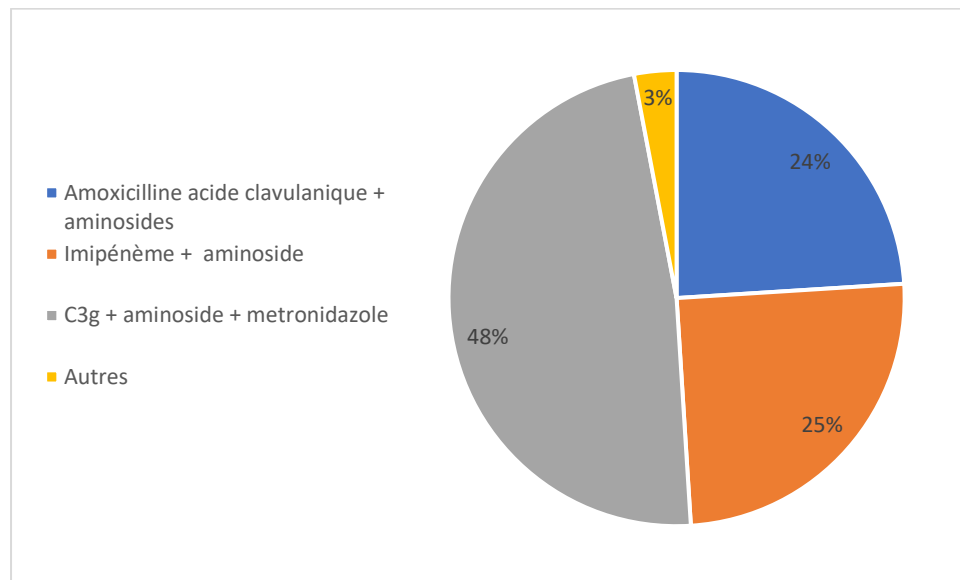
Regarding risk factors associated with procedures and prostheses in patients with traumatic brain injury, significant data concerning interventions and medical devices used were noted. A large number of patients (73.77%) required mechanical ventilation, with an average duration of artificial ventilation of 8.32 days, ranging from 1 to 97 days. Central catheter use was also frequent, observed in 67.80% of patients. Furthermore, nearly half of the patients (80.14%) underwent urinary catheterization. These data emphasize the importance of medical procedures as potential risk factors for nosocomial infections in this patient category.

During our study of infectious complications in patients with traumatic brain injuries, several types of infections were identified. Overall, 56.25% of patients experienced at least one infectious complication. Specifically, only 1.56% of patients presented infections related to the central catheter, which is relatively low. Meningitis was diagnosed in 4.69% of patients. Urinary tract infections were more common, affecting 26.56% of patients. A major observation concerns patients under mechanical ventilation: 63.04% of them developed ventilator-associated pneumonia. Finally, complications related to immobility, particularly pressure ulcers, were observed in 17.86% of patients. These results underline the need for increased vigilance and appropriate preventive measures to limit these infectious complications in patients with traumatic brain injuries.



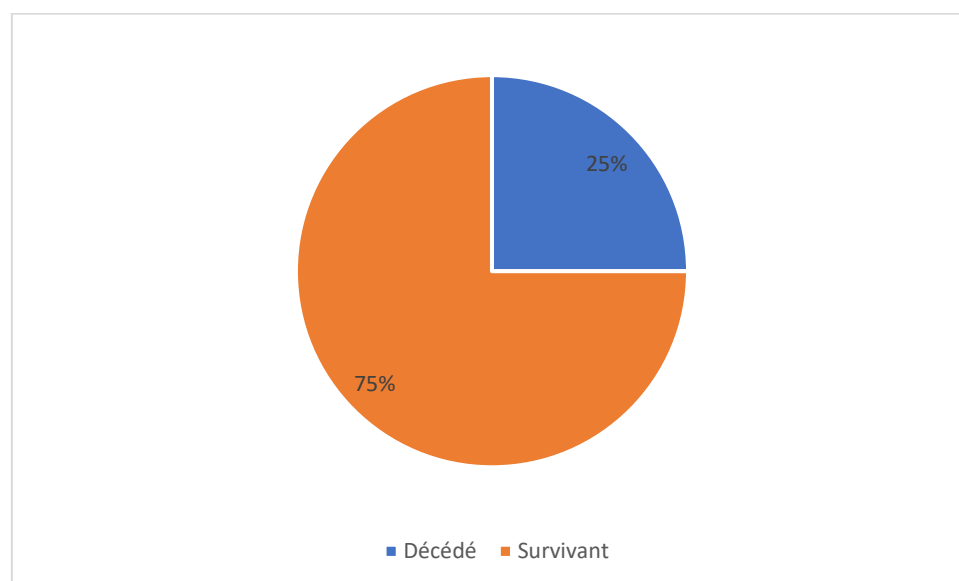
*Figure 1 : Repartition of complications observed*

In the management of infectious complications in patients with traumatic brain injuries, the use of antibiotics was notable. Indeed, a large proportion of patients, 83.61%, received antibiotic treatment. Regarding the types of antibiotics administered: a combination of amoxicillin with clavulanic acid and aminoglycosides was used in 24% of patients. Another combination, imipenem with an aminoglycoside, was prescribed to 25% of patients. The most commonly used regimen included a third-generation cephalosporin (3GC), an aminoglycoside, and metronidazole, covering 48% of patients. Other unspecified types of antibiotics accounted for 3% of prescriptions. These data reflect the diversity of antibiotic regimens used to treat infections in patients with traumatic brain injuries.



**Figure 2 :** *Repartition of associations of antibiotics used*

The clinical progression of patients who suffered traumatic brain injuries shows severe complications in some cases. Among all the patients studied, 50.98% developed septic shock, a potentially fatal complication that highlights the severity of their health condition. Furthermore, the mortality rate in our cohort was 25.00%, meaning that one quarter of the patients did not survive their complications and initial health status. The remaining 75.00% survived during the study observation period. These results underscore the need for rapid and effective medical intervention for these patients, as well as the importance of rigorous prevention of nosocomial infections and other complications related to traumatic brain injuries.



**Figure 3 :** *Repartition of patients depending on prognosis*

#### **IV. Discussion**

In our study on the prevalence of nosocomial infections among patients with traumatic brain injuries (TBI), several intrinsic risk factors were identified. The mean age of the studied sample was 33.50 years, with a marked male predominance of 93.15%. Clinically, 31.48% of patients presented respiratory distress, and 38.18% were hemodynamically unstable. Moreover, 51.61% of patients had suffered severe polytrauma, while 48.39% had severe traumatic brain injury without associated lesions.

Existing literature corroborates many of our observations. Hospital-acquired pneumonia is noted as one of the most common nosocomial infections among trauma patients, particularly those with head, thoracic, and abdominal injuries, due to respiratory mechanism alterations caused by these injuries (1). Studies have also shown that male patients and those of advanced age are more likely to develop post-traumatic nosocomial infections, with respiratory distress and hemodynamic instability being significant contributing factors (2,3).

Nosocomial infections, also called healthcare-associated infections, are acquired during healthcare delivery and were not present at admission. These infections significantly increase morbidity and mortality risks in hospitalized patients, nearly doubling these risks and resulting in higher hospitalization costs (4,5).

The male predominance observed in our study aligns with the literature, which indicates that males are often more affected in cases of severe trauma, including traumatic brain injuries. Likewise, our observations regarding respiratory distress and hemodynamic instability reflect the clinical challenges encountered in managing these patients, requiring special attention to minimize the risk of nosocomial infections.

The identification of polytrauma and isolated severe traumatic brain injuries in our sample highlights the diversity of clinical presentations and underscores the importance of personalized evaluation and management to prevent nosocomial infections. Preventive measures should therefore be tailored to patients' demographic and clinical characteristics to effectively reduce the risk of nosocomial infections in this specific population.

In our study, we observed that medical procedures and the use of medical devices such as mechanical ventilation, central catheters, and urinary catheters were common. These procedures and devices can be associated with an increased risk of nosocomial infections, consistent with findings from other studies. We noted that 73.77% of our patients required mechanical ventilation, with an average ventilation duration of 8.32 days. Mechanical ventilation has been identified in the literature as a notable risk factor for nosocomial infections, particularly ventilator-associated pneumonia (VAP) (6,7). In our sample, 67.80% of patients had central catheters. Central catheters can be associated with bloodstream infections (6). Nearly half of our patients (44.07%) underwent urinary catheterization, which is associated with nosocomial urinary tract infections (6,7).

Nosocomial infections can be exacerbated by various factors, including the extent and severity of trauma, age, sex, and other comorbidities, in addition to the medical interventions necessary to manage patients' conditions (1,4). Nosocomial infections may result from pathogen transmission to a susceptible host, especially during invasive procedures, surgeries, or the use of indwelling medical and prosthetic devices (4). Our study highlights the importance of surveillance and proactive management of medical procedures and devices to minimize the risk of nosocomial infections in traumatic brain injury patients. It is crucial to identify patients at high risk of infection to enable early intervention and thus reduce infection-related morbidity (7).

In our study of infectious complications associated with traumatic brain injuries, we found that 56.25% of patients experienced at least one infectious complication. This prevalence aligns with the literature, which recognizes traumatic brain injury victims as being at high risk for infection (8). Infections are common in patients hospitalized after traumatic brain injury and are associated with increased length of stay in intensive care units and hospitals, as well as a higher risk of poor neurological outcomes and mortality (9).

In our study, we observed specific rates of infections associated with various procedures and medical conditions in patients with traumatic brain injuries. In particular, 1.56% of patients presented infections related to central venous catheters, 4.69% were diagnosed with meningitis, 26.56% had urinary tract infections, 63.04% of mechanically ventilated patients developed ventilator-associated pneumonia, and 17.86% experienced complications related to decubitus, notably pressure ulcers. Compared to existing literature, our rates of catheter-related infections appear relatively low, while the prevalence of meningitis and urinary infections aligns with rates reported in other studies on traumatic brain injury patients (8,9). Notably, the high prevalence of ventilator-associated pneumonia in our sample reflects literature recognizing mechanical ventilation as a major risk factor for infection, particularly ventilator-associated pneumonia (6,7). The prevalence of decubitus-related complications, including pressure ulcers, underscores the importance of proactive patient positioning management and other preventive measures. Our results highlight the need for increased vigilance and tailored preventive approaches to reduce the risk of infectious complications in this vulnerable population, echoing recommendations in the literature for early intervention and careful management of medical devices and care conditions to minimize nosocomial infection risks (7).

In our study of traumatic brain injury patients, we noted a notable use of antibiotics, with 83.61% of patients receiving antibiotic treatment. Regarding the types of antibiotics administered, a combination of

amoxicillin with clavulanic acid and aminoglycosides was used in 24% of patients, imipenem combined with an aminoglycoside in 25% of patients, and a combination of a third-generation cephalosporin (3GC), an aminoglycoside, and metronidazole in 48% of patients, while other unspecified antibiotics accounted for 3% of prescriptions.

The literature suggests that prophylactic antibiotic use can be crucial in reducing infections after major trauma, although its use remains controversial (11). It is often recommended to adapt antibiotic regimens based on specific cases and associated risks, especially in penetrating traumatic brain injuries where infection risk is high (12). One study found that adherence to antibiotic regimen guidelines can influence hospital stay length, highlighting the importance of following established antibiotic management guidelines in trauma patients (13).

Our data reflect diversity in antibiotic regimens used, which could be attributed to variability in clinical cases, infection risks, and hospital protocols. The high prevalence of antibiotic use in our sample underscores the importance of antimicrobial management in the care of traumatic brain injury patients, in alignment with practices observed in the literature. This management includes judicious antibiotic regimen choice, prophylactic administration where indicated, and ongoing monitoring to minimize nosocomial infection risks and combat antibiotic resistance.

Regarding clinical outcomes of patients who suffered traumatic brain injuries, we observed that 50.98% progressed to septic shock and that the mortality rate was 25.00%. These data highlight the severity of complications these patients face. Comparing our results with the literature, it is noted that progression to septic shock is often associated with increased mortality, with significant mortality rates ranging from 64.8% to 72.7% in patients with septic shock (14). Sepsis, particularly septic shock, is recognized as the most severe complication of sepsis, carrying high mortality (15).

The clinical progression of sepsis involves several stages, each associated with different mortality rates. One study aimed to establish the progression and determinants of clinical stages from infection to septic shock, as well as their relation to 7- and 28-day mortality (16). Severe sepsis and septic shock are also recognized as leading causes of death in hospitalized trauma patients, underscoring the importance of rapid and effective medical intervention (17).

Our results reflect these observations and emphasize the need for rapid and effective medical interventions, as well as rigorous prevention of nosocomial infections and other complications related to traumatic brain injuries. The observed 25.00% mortality rate in our cohort aligns with mortality rates associated with sepsis and septic shock in the literature, highlighting the severity of these patients' health conditions and the crucial importance of adequate clinical management to improve outcomes.

## **V. Conclusion**

Management of traumatic brain injuries extends beyond the immediate treatment of the injury itself. Nosocomial infections represent an insidious threat that can hinder patient recovery and further complicate their health status. Through a thorough understanding of the prevalence of these infections, associated risk factors, and adequate preventive measures, it is possible to significantly improve recovery prospects for these patients. As medical science continues to advance, it is imperative for healthcare institutions to stay informed, implement rigorous protocols, and invest in continuous staff training. Every prevented infection marks a step forward toward better patient quality of life and clearly demonstrates caregivers' commitment to excellence in care.

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