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Original Research Article

Prognostic Factors of Ventilator-Associated Pneumonia in the Department of Anaesthesia and Intensive Care at Treichville University Hospital

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Abstract: ***Introduction*:** The aim of this study was to contribute to improving the management of ventilator-associated pneumonia (VAP) in the Intensive Care Unit of Treichville University Hospital. ***Patients and Methods*:** This was a retrospective descriptive and analytical study conducted in the Department of Anaesthesia and Intensive Care of Treichville University Hospital over a 54-month period, from 1 January 2020 to 30 June 2024. ***Results*:** Fifty-two patients out of 1,250 admissions developed microbiologically confirmed ventilator-associated pneumonia, corresponding to an incidence of 4.16%. The mean age was 41.48 years (range : 2–80 years), with a male-to-female ratio of 1.5. The associated comorbidities were hypertension in 20 patients (38.48%), diabetes mellitus in 9 (17.31%), asthma in 3 (5.76%), HIV infection in 1 (1.92%), and pulmonary tuberculosis in 1 (1.92%). *Klebsiella pneumoniae* was the most frequently isolated pathogen (36.54%), followed by *Pseudomonas aeruginosa* (21.15%). The mean hospital stay was 27.65 days (range: 11–62 days). The mortality rate among patients with VAP was 69%. Factors significantly associated with mortality were age >40 years (P = 0.013), duration of mechanical ventilation >15 days (P = 0.006), late-onset VAP (P = 0.045), and Gram-negative bacterial infections (P = 0.032). ***Conclusion*:** Ventilator-associated pneumonia remains a frequent and serious nosocomial infection, associated with high morbidity and mortality among mechanically ventilated patients.

Keywords: Ventilator-Associated Pneumonia, Mechanical Ventilation, Mortality, Intensive Care.

INTRODUCTION

Ventilator-associated pneumonia (VAP) is defined as a pulmonary infection occurring at least 48 hours after endotracheal intubation and the initiation of mechanical ventilation. It is one of the most common healthcare-associated infections in intensive care units (ICUs), with an incidence ranging from 5% to 67% depending on the study population and diagnostic criteria (Mal, 2003).

VAP is associated with prolonged mechanical ventilation, extended ICU stay, increased healthcare costs, and an attributable mortality estimated at approximately 6% (Timsit *et al*., 2011). Its case-fatality rate ranges from 24% to 50% and may reach 70% in infections caused by multidrug-resistant bacteria (Chastre & Fagon, 2002). However, its independent impact on mortality remains controversial because of the underlying severity of illness in affected patients (Girou *et al*., 2000).

The occurrence and prognosis of VAP are influenced by several factors, including age, comorbidities, severity of the underlying disease, duration of mechanical ventilation, diagnostic challenges, causative pathogens, and the timeliness and appropriateness of antimicrobial therapy (Kollef, 2004 ; Safdar *et al*., 2005; Canadian Critical Care Trials Group, 2006; Kayembe, 2000). In resource-limited settings, these constraints make VAP management particularly challenging (Kayembe, 2000). Consequently, VAP prevention remains a major priority in intensive care and relies on the implementation of evidence-based preventive strategies (Bonten, 2011; French Society of Anaesthesia and Intensive Care [SFAR] & French-Language Intensive Care Society [SRLF], 2009).

Against this background, the present study aimed to identify the prognostic factors associated with poor outcomes in patients with ventilator-associated pneumonia.

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PATIENTS AND METHODS

This was a retrospective descriptive and analytical study conducted in the Department of Anaesthesia and Intensive Care at Treichville University Hospital over a 54-month period, from 1 January 2020 to 30 June 2024.

The study included the medical records of patients who received mechanical ventilation for more than 48 hours during their hospital stay and met the clinical, radiological, and microbiological criteria for ventilator-associated pneumonia (VAP), defined by the presence of :

- Body temperature ≥38.5°C or <36°C
- Purulent respiratory secretions;
- Leukocytosis >12,000/mm³ or leukopenia <4,000/mm³;
- New radiological infiltrates suggestive of pneumonia, with no other obvious infectious source.

Patients admitted with pneumonia, those who stayed in the intensive care unit for less than 48 hours, and those who did not receive mechanical ventilation were excluded from the study.

The variables analysed included sociodemographic characteristics, clinical findings, therapeutic management, outcomes, and prognostic factors.

Data were analysed using Epi Info™ version 3.5.3. Continuous variables were expressed as means with measures of dispersion. Descriptive statistics were presented in tables and figures, with qualitative variables expressed as frequencies and percentages. Comparisons of proportions were performed using Fisher's exact test. A p-value ≤0.05 was considered statistically significant.

RESULTS

During the study period, 52 of the 1,250 patients admitted developed microbiologically confirmed ventilator-associated pneumonia (VAP), corresponding to an incidence of 4.16%.

Male patients predominated, with 31 cases (60%) compared with 21 females (40%), yielding a male-to-female ratio of 1.5. The mean age was 41.48 ± 18.5 years. The most common comorbidities were hypertension in 22 patients (42.3%), diabetes mellitus in 16 patients (30.7%), and asthma in 8 patients (15.4%).

The isolated pathogens were predominantly Klebsiella pneumoniae (36.54%), followed by Pseudomonas aeruginosa (21.15%) and Acinetobacter baumannii (15.38%).

Comparative analysis showed that age >40 years was significantly associated with mortality (p = 0.013), as was a duration of mechanical ventilation exceeding 15 days (p = 0.006). The type of VAP was also significantly associated with patient outcomes (p = 0.045). Finally, the type of isolated pathogen influenced prognosis, with Gram-negative bacteria being significantly associated with mortality (OR = 21.0; 95% CI : 2.25–195.4 ; p = 0.032).

Table I: Sociodemographic Characteristics and Comorbidities

Characteristics	Frequency (n = 52)	Percentage (%)
Sex		
Masculine	31	60%
Féminine	21	40%
Masculine-to-feminine ratio (H/F) = 1,5		
Mean age (years)	41,48 ± 18,5	
Comorbidities		
Hypertension	22	42,3
Diabetes	16	30,7
Asthma	8	15,4

Table II: Distribution of VAP According to Isolated Pathogens

Isolated Pathogens	Frequency (n)	Percentage (%)
Acinetobacter Baumanii	8	15,38
Acinetobacter SP	3	5,77
Enterobacter Cloacae	1	1,92
Escherichia Coli	2	3,85
Klebsiella Pneumoniae	19	36,54
Levinia SP	1	1,92
Pseudomonas Aeruginosa	11	21,15
Staphylococcus Auerus	7	13,46

Table III: Summary of Univariate Analysis

Age :				
Age > 40 years p=0,013	28	4	2 4	OR : 0,166 IC [0,04-0,62]
Age < 40 years	24	12	12	
Sex :				
Masculine	31	9	22	OR : 1,22 IC [0,37-4,03] p=0,98
Féminine	21	7	14	
Previous pulmonary disease				
Yes	4	0	4	OR : 1,5 IC [1,22-1,83] p=0,40
No	48	16	32	
Duration of mechanical ventilation				
>15 days	17	10	7	OR : 0,144 IC [0,03-0,53] p=0,006
>15 days	35	6	29	
Type of VAP				
Early-onset VAP p=0,045	20	6	14	OR : 1,06 IC [0,31-3,57]
Late-onset VAP	32	10	22	
Pathogens				
Gram-positive bacteria p=0,032	7	6	1	OR : 21 IC [2,25-195,4]
Gram-negative bacteria	45	10	35	

DISCUSSION

The incidence of ventilator-associated pneumonia (VAP) remains difficult to determine accurately because of the heterogeneity of diagnostic definitions and the differences in the populations studied. In our series, the incidence of VAP was 4.16%, calculated using all patients admitted to the intensive care unit as the denominator, regardless of whether they received mechanical ventilation. This finding is similar to that reported by Bouchra R. (2010) at Mohammed VI University Hospital in Marrakech, who found an incidence of 4.24% among 109 patients admitted to the intensive care unit. However, our incidence was lower than that reported by Irié Bi *et al*., (2019), who observed an incidence of 8.23% among 583 mechanically ventilated patients at Bouaké University Hospital. This difference may be explained by variations in the study populations, inclusion criteria, and methods used to calculate incidence.

Our study showed a predominance of male patients, accounting for 60% of cases, with a male-to-female ratio of 1.5. This finding is consistent with that of Deham (2014), who reported that 67% of patients with VAP were male in a study conducted at Hassan II University Hospital in Fez. This male predominance may be explained by the high frequency of traumatic brain injuries among men, which represent the leading reason for admission to the intensive care unit in our setting.

Regarding age, patients older than 40 years accounted for 53.9% of VAP cases, compared with 46.1% among younger patients. This difference was statistically significant (p = 0.013), indicating an association between older age and poor prognosis. Similar findings were reported by Irié Bi *et al*., (2019), who also identified age as an independent predictor of mortality (p = 0.006). Several authors have further reported that age above 50 years is a poor prognostic factor because of impaired immune defence mechanisms, a higher prevalence of comorbidities, malnutrition, and the decline in physiological reserve associated with ageing (Mal, 2003).

The main reason for admission in our series was coma (78.85%), followed by respiratory distress (11.54%). This observation is comparable to that reported by Imboua (2007), who found altered consciousness in 53.41% of patients admitted to the intensive care unit. The high frequency of coma in our study is probably related to the large number of patients admitted with traumatic brain injuries and severe neurological disorders.

At admission, 40% of patients were already intubated. Endotracheal intubation is a major risk factor for the development of VAP because it facilitates the migration of contaminated oropharyngeal secretions into the lower respiratory tract. Secretions accumulate above

the endotracheal tube cuff and are repeatedly microaspirated, promoting pulmonary colonisation. Furthermore, the endotracheal tube bypasses the natural defence mechanisms of the upper airway, particularly the cough reflex and mucociliary clearance. Bacterial biofilm formation on the surface of the tube and tracheal injury resulting from repeated intubations also contribute to bacterial colonisation and infection (Warner, 2009). In the study by Torres *et al*., (1992), 27.02% of patients were intubated on admission, a lower proportion than that observed in our series.

The timing of VAP onset distinguishes early-onset VAP, occurring within the first five days of mechanical ventilation, from late-onset VAP, developing thereafter. In our study, late-onset VAP accounted for 61.54% of cases. This finding is consistent with that of El Rhazi *et al*., (2007), who reported that 82% of VAP episodes at Hassan II University Hospital in Fez were late-onset. We also found a significant association between late-onset VAP and mortality ($p = 0.045$), with a case-fatality rate of 61.1% among these patients. This increased mortality is probably related to the predominance of multidrug-resistant bacteria in late-onset VAP, as reported in several international studies (Chastre & Fagon, 2002 ; Giantsou *et al*., 2005).

From a microbiological perspective, *Klebsiella pneumoniae* was the most frequently isolated pathogen (36.54%), followed by *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. This distribution is comparable to that reported by Irié Bi *et al*., (2019), who also found *Klebsiella pneumoniae* to be the predominant pathogen (44%), followed by *Pseudomonas aeruginosa* (29%). In contrast, El Rhazi *et al.*, (2007) reported *Pseudomonas aeruginosa* as the predominant organism, accounting for nearly 60% of isolates. These differences most likely reflect variations in the bacterial ecology of individual intensive care units as well as local antimicrobial prescribing policies.

Overall, Gram-negative bacilli accounted for 86.54% of the isolated pathogens in our series. A similar predominance was reported by Bouchra R. (2010), who found that 61.4% of isolates were Gram-negative bacilli. In our study, mortality was significantly higher among patients infected with Gram-negative bacilli ($p = 0.032$). This finding is consistent with that of N'Guessan *et al.,* (2012), who also identified these microorganisms as an independent predictor of poor outcome ($p = 0.02$). However, other studies, including that of Mentec *et al*., (2004), suggest that mortality depends not only on the causative pathogen but also on the patient's severity of illness, the prompt initiation of appropriate antimicrobial therapy, and the overall quality of intensive care management. Conversely, Rello *et al*., (2001) reported significant differences in mortality according to the bacterial species involved.

VAP is recognised as one of the major complications of mechanical ventilation because of its substantial impact on morbidity, particularly through prolongation of both mechanical ventilation and intensive care unit stay. In our study, the mean duration of mechanical ventilation among patients with VAP was 17.96 days (range : 10–32 days), while the mean hospital stay was 27.65 days (range : 11–62 days). These findings are consistent with those reported by Chastre and Fagon (2002), who demonstrated that VAP prolongs mechanical ventilation by an average of 7 to 9 days. Similarly, several studies have confirmed that VAP significantly increases the length of intensive care unit stay, thereby increasing healthcare costs and the risk of additional healthcare-associated infections (Mal, 2003).

In our series, mortality was significantly higher among patients who required mechanical ventilation for more than 15 days ($p = 0.006$). This finding confirms that prolonged mechanical ventilation is both a major risk factor for the development of VAP and an indicator of disease severity. Indeed, the longer mechanical ventilation is maintained, the greater the risk of bacterial colonisation of the lower respiratory tract, favouring infections caused by multidrug-resistant organisms and resulting in poorer clinical outcomes (Hunter, 2012 ; Mietto *et al*., 2013).

Regarding therapeutic management, combination antibiotic therapy was administered to 88.46% of patients, whereas antibiotic monotherapy was used in only 9.62% of cases. This proportion is higher than that reported by Bouchra R. (2010), who found a rate of 57.8% for combination therapy in patients treated at Mohammed VI University Hospital in Marrakech. This difference may be explained by the greater severity of illness in our study population, the high prevalence of Gram-negative bacilli, and the need to initiate broad-spectrum empirical therapy as soon as VAP is suspected. Current international guidelines recommend empirical antibiotic therapy tailored to the local microbiological epidemiology to maximise the likelihood of adequate initial antimicrobial coverage, particularly in patients with late-onset or severe VAP (Niederman *et al*., 2005 ; Papazian *et al*., 2003).

The attributable mortality of ventilator-associated pneumonia (VAP) generally ranges from 20% to 50%, but may reach much higher levels when infections are caused by multidrug-resistant Gram-negative bacilli, particularly *Pseudomonas aeruginosa* and *Acinetobacter baumannii* (Irié Bi *et al*., 2019). In our study, the mortality rate was 69%, reflecting the severity of illness of the patients managed in our intensive care unit. This finding is comparable to that reported by N'Guessan *et al*., (2012), who observed a 70% mortality rate in an intensive care unit in Abidjan.

Furthermore, Chastre and Fagon (2002) demonstrated that infections caused by *Pseudomonas*

aeruginosa remain associated with high mortality despite the early administration of appropriate antimicrobial therapy, with attributable mortality reaching up to 30%. This high fatality rate is related to the organism's virulence, its ability to develop multidrug resistance, and the severity of the underlying conditions affecting these patients.

The high mortality observed in our series may therefore be explained by several concomitant factors, including the severity of the underlying diseases leading to intensive care admission, the high frequency of late-onset VAP, the predominance of Gram-negative bacilli, the emergence of multidrug-resistant organisms, and the challenges associated with initiating appropriate empirical antibiotic therapy in our setting. These findings highlight the importance of strengthening infection prevention and control measures, improving microbiological surveillance strategies, and optimising antimicrobial therapy according to local susceptibility patterns in order to reduce the morbidity and mortality associated with VAP.

CONCLUSION

Ventilator-associated pneumonia remains a frequent and serious complication in intensive care, associated with high mortality. Gram-negative bacilli, particularly *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, were the predominant pathogens. VAP prolongs the duration of mechanical ventilation, intensive care unit stay, and overall morbidity. The main prognostic factors identified were older age, late-onset VAP, Gram-negative bacterial infection, and prolonged mechanical ventilation. Effective implementation of evidence-based preventive measures can significantly reduce the incidence of VAP and contribute to a long-term reduction in antibiotic consumption.

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