

ORIGINAL ARTICLE

Ventilator-associated pneumonia in the intermediate care unit

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ABSTRACT

Introduction: ventilator-associated pneumonias cause great concerns to physicians who pose serious diagnostic difficulties that often lead to disproportionate therapeutic decisions that favor the genesis of antimicrobial resistance.

Objective: to characterize pneumonias associated to mechanical ventilation in the Intermediate Care Unit of the “Arnaldo Milián Castro” Hospital.

Methods: an observational, descriptive, cross-sectional study was carried out in the Intermediate Care Unit of the “Arnaldo Milián Castro” Hospital in 2021. The population of patients who developed pneumonia associated with mechanical ventilation (73) was studied. A documentary review guide was used as an instrument for data collection; data were collected from the individual clinical history of patients with ventilator-associated pneumonia, from the admission book and from the Service's infection control register.

Results: the diseases that most frequently led the patient to mechanically assisted ventilation were cerebrovascular diseases, respiratory distress and sepsis. Symptoms became evident in the first nine days of the patient's admission. A greater isolation of Gram-negative germs was obtained, including *Acinetobacter*.

Conclusions: ventilator-associated pneumonias were more frequently observed in male patients over 60 years of age; they were more frequently associated with cerebrovascular diseases and, in most cases, symptoms appeared between four and six days; *Acinetobacter*, *Klebsiella pneumoniae* and *Staphylococcus aureus* were the most frequently isolated germs and half of the patients were discharged dead.

Key words: ventilator-associated pneumonia; respiration; artificial; microbiological test; critical care

RESUMEN

Introducción: las neumonías asociadas a la ventilación causan grandes inquietudes a los médicos que plantean serias dificultades diagnósticas que motivan, a menudo, la

toma de decisiones terapéuticas desproporcionadas que favorecen la génesis de la resistencia antimicrobiana.

Objetivo: caracterizar las neumonías asociadas a la ventilación mecánica en la Unidad de Cuidados Intermedios del Hospital "Arnaldo Milián Castro".

Métodos: se realizó un estudio observacional, descriptivo, transversal en la Sala de Cuidados Intermedios del Hospital "Arnaldo Milián Castro" en el año 2021. Se estudió la población de pacientes que desarrollaron una neumonía asociada a la ventilación mecánica (73). Para la recolección de los datos se utilizó como instrumento una Guía de revisión documental, se recolectaron los datos de la historia clínica individual de los pacientes con neumonía asociada a la ventilación mecánica, del Libro de ingreso y del Registro de control de infecciones del Servicio.

Resultados: las enfermedades que más llevaron al paciente a la ventilación mecánicamente asistida fueron las cerebrovasculares, el distrés respiratorio y la sepsis. Los síntomas se hicieron evidentes en los primeros nueve días de ingreso del paciente. Se obtuvo mayor aislamiento de gérmenes Gram negativo, entre ellos el *Acinetobacter*.

Conclusiones: las neumonías asociadas a la ventilación mecánica fueron observadas con mayor frecuencia en pacientes del sexo masculino, mayores de 60 años; se asociaron con mayor frecuencia a las enfermedades cerebrovasculares y, en su mayoría, los síntomas aparecieron entre cuatro y seis días; el *Acinetobacter*, la *Klebsiella pneumoniae* y el *Staphylococcus aureus* fueron los gérmenes que con mayor frecuencia se aislaron y la mitad de los pacientes egresaron fallecidos.

Palabras clave: neumonía asociada a ventilación; ventilación artificial; exámenes microbiológicos; cuidados intensivos

INTRODUCTION

Ventilator-associated pneumonia (VAP) is included in what the World Health Organization (WHO) refers to as healthcare-associated infections (HAI) or nosocomial or hospital-acquired infections because they also refer to infections contracted by a patient while being treated in a hospital or other healthcare center and which he/she evidently did not suffer from or incubate at the time of admission.⁽¹⁾ 80% of nosocomial pneumonia episodes occur in patients with artificial airway⁽²⁾ and it is the most frequent nosocomial infection and the main cause of death⁽³⁾ which is an epidemiological problem in Intensive Care Units, with a margin between 10 and 30% in patients with mechanically assisted ventilation (MAV).⁽⁴⁾

VAP is defined as developing at least 48 hours after endotracheal intubation and initiation of MV. It can be classified as early or late onset: early onset occurs within five days of intubation and MV and is usually caused by germs more sensitive to antibiotics and late onset occurs after five days and its most common etiology is infection by multidrug-resistant pathogens.⁽³⁾

Internationally, highly variable mortality figures are reported, ranging from 17 to 30%. It affects between 250,000 and 300,000 patients per year in the United States. An incidence of between five and 50% has been described, with a similar attributable mortality and an increase in hospital stay of between four and 13 days. In addition to the factors related to morbidity and mortality, an increase in associated costs of between 5,000 and 20,000 dollars per diagnosis has been described.⁽⁵⁾ In Cuba, mortality of patients admitted to critical care is between 18 and 23%.⁽⁶⁾

Studies on the subject assure that there are specific risk factors that favor the triggering of the onset and development of VAP, both intrinsic and extrinsic.⁽⁷⁾ Among the risk factors for VAPM are male gender, chronic obstructive pulmonary disease (COPD), age over 70 years, decreased level of consciousness and previous exposure to antibiotics. Others are added such as use in the first 48 hours of neuromuscular relaxants, enteral nutrition, stress ulcer prophylaxis, tracheostomy, transport outside the Intensive Care Unit (ICU) for, e.g., a cranial tomography study or to take him to the operating room, among others, drainage of subglottic secretion, selective digestive decontamination, emergency reintubation, prone position (or ventral decubitus) and renal replacement therapy.^(8,9)

A certain group of microorganisms is usually the beginning and development of a nosocomial infection in the patient: *Escherichia coli*, *Pseudomona aeruginosa*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, some species of the *Enterobacter spp.* genera, *Enterococcus spp.* and *coagulase-negative Staphylococcus*.^(4,10)

In the "Arnaldo Milián Castro" Hospital, the incidence of this disease is similar to that described by other authors in studies carried out in the country^(11,12) because respiratory infections of the pneumonia type are frequently associated with the medical procedure of assisted ventilation in the Intensive Care Unit, of which a high number of cases are reported in which the use of antimicrobial therapy becomes necessary, resulting in an increase in the length of stay, mortality and social and economic costs.⁽¹³⁾

Medical personnel have a hard fight to try to reduce this problem. The application of Biosafety towards the patient is key to reducing mortality in patients connected to a mechanical ventilator in the ICU.⁽¹⁴⁾

Ventilator-associated pneumonias cause great concerns to physicians who pose serious diagnostic difficulties that often motivate disproportionate therapeutic decisions to favor the genesis of antimicrobial resistance, which makes the management of this disease and its results an internationally recognized indicator of quality of care to assess the medical and nursing work in Intensive Care Units.

All of the above motivated the authors to carry out this work with the aim of characterizing VAP in the Intermediate Care Unit of the "Arnaldo Milián Castro" Hospital.

METHODS

An observational, descriptive, cross-sectional, cross-sectional study was carried out in the Intermediate Care Unit of the "Arnaldo Milián Castro" University Clinical-Surgical Provincial Hospital of Santa Clara City, Villa Clara Province, from January to December 2021.

The population of patients who developed pneumonia associated to mechanical ventilation was studied (73).

The following variables were operationalized: age, sex, conditions that led to mechanical ventilation, time of onset of symptoms, microbiological results and status at discharge (alive or dead).

A document review guide was used as an instrument for data collection. Data were collected from the individual medical records of patients with VAP, from the admission book and from the Service's infection control register.

The data were stored in an Excel file and exported to the SPSS v22.0 program for Windows Seven Ultimate for data processing and the creation of tables and graphs. Descriptive statistical techniques were used to summarize quantitative variables and absolute and relative frequencies (in hundreds) were used for qualitative variables.

A commitment was made that the data obtained would be handled with discretion and professionalism, in accordance with the standards set out in the Declaration of Helsinki and respecting the bioethical principles of autonomy, beneficence, nonmaleficence and justice.

RESULTS

Pneumonia associated with mechanical ventilation was observed in 24.5% of the patients seen in the Service during the period analyzed.

Table 1 shows the infection according to age groups and sex. The age group 60 years and older (49, 67.1%) and male sex (45, 61.6%) predominated.

Table 1. Distribution according to age and gender

| Age groups | Masculine | | Feminine | | Total | |
|--------------|-----------|-------------|-----------|-------------|-----------|------------|
| | No. | % | No. | % | No. | % |
| 15 - 29 | 1 | 2.2 | 0 | 0.0 | 1 | 1.4 |
| 30 - 44 | 2 | 4.4 | 2 | 7.1 | 4 | 5.5 |
| 45 - 59 | 11 | 24.4 | 8 | 28.6 | 19 | 26.0 |
| ≥ 60 | 31 | 68.9 | 18 | 64.3 | 49 | 67.1 |
| Total | 45 | 61.6 | 28 | 38.4 | 73 | 100 |

Source: medical records

Of the diseases that led patients to require MAV, cerebrovascular disease (31, 42.5%) was the most frequently observed, followed by sepsis and respiratory distress in patients with COPD, both with 23.3% (Table 2).

Table 2. Disease that led to ventilation

| Affections | Frequency | % |
|-----------------------------|-----------|------------|
| Cerebrovascular diseases | 31 | 42.5 |
| Sepsis | 17 | 23.3 |
| Hypovolemic shock | 4 | 5.5 |
| Respiratory distress (COPD) | 17 | 23.3 |
| Congenital malformations | 3 | 4.1 |
| Exogenous intoxications | 1 | 1.4 |
| Total | 73 | 100 |

Source: medical records

The highest frequency of symptom onset was observed between four and six days of admission (34, 46.6%) and the highest cumulative frequency was in the first nine days of admission (63, 86.3%) -Table 3.

Table 3. Frequency of symptoms according to time of onset

| Time of symptom onset | Absolute frequency | % | Accumulated frequency | % |
|------------------------------|---------------------------|------------|------------------------------|------------|
| 48 a 72 h | 12 | 16.4 | 12 | 16.4 |
| 4 a 6 días | 34 | 46.6 | 46 | 63.0 |
| 7 a 9 días | 17 | 23.3 | 63 | 86.3 |
| ≥ 10 días | 10 | 13.7 | 10 | 13.7 |
| Total | 73 | 100 | 73 | 100 |

Source: medical records

The most frequently observed germs were *Acinetobacter* (22, 23.7%) and *Klebsiella pneumoniae* and *Staphylococcus aureus*, both with 14% (Table 4).

Table 4. Distribution according to the germs isolated in microbiological studies

| Bacteria | No. | % |
|--|------------|----------|
| <i>Acinetobacter</i> | 22 | 23,7 |
| <i>Klebsiella pneumoniae</i> | 13 | 14 |
| <i>Staphylococcus aureus</i> | 13 | 14 |
| <i>Pseudomona aeruginosa</i> | 11 | 11,8 |
| <i>Coagulase negative Staphylococcus</i> | 9 | 9,7 |
| <i>Enterobacter</i> | 4 | 4,3 |

Source: Infection Record

In relation to the condition of the patients at discharge, 36 (49.3%) were discharged alive and 37 (50.7%) died, which shows a high lethality rate of this disease in the Service during the period analyzed.

DISCUSSION

Of the 297 patients who received AMV, 73 (24.5%) acquired VAP, a finding that coincides with that of other authors^(14,15) who report that the true incidence of VAP varies according to the definition and the population evaluated, and that it is estimated to occur in up to 27% of patients on mechanical ventilation (MV), among whom the frequency fluctuates between 20% and 50%.

A predominance of patients over 60 years of age was evidenced, similar to that reported by other authors^(3,16) who, likewise, report the elderly patient as the most affected. With respect to sex, other authors^(17,18) report a predominance of the male sex, which is in agreement with this study.

The predominance of cerebrovascular diseases in the study is attributable to the fact that most patients with cerebrovascular diseases suffer severe or moderate coma accompanied by respiratory failure that leads them to receive mechanical ventilation due to prolonged bed rest, stress, change in their normal oropharyngeal flora and the predominance of gram-negative germs, which increases the risk of suffering nosocomial diseases, in this case VAP.

In the literature reviewed there are studies that agree with this cause;^(18,19) however, it contrasts with the findings of other researchers^(3,9) who identified surgical causes as the most common reason for admission.

When evaluating the time of onset of symptoms, it was found that the greatest number of patients presented VAP between four and six days after the onset of VAM but, in general, the greatest number was in the first nine days; in this study, fewer patients contracted VAP after 10 days on assisted ventilation (these were younger and less immunocompromised patients). Although there was a progressive decrease in VAP after 6 days, this could be related to the use of broad-spectrum antimicrobials such as cephalosporins, aminoglycosides and quinolones, which are mainly renally excreted. Other investigators⁽²⁰⁾ found a predominance of patients with a ventilation time of more than 10 days, which is due to the fact that, in general, the patients admitted presented a very deteriorated state of health.

The high incidence of infection in the first week could be associated with inadequate instrumentation and endotracheal suctioning technique, as well as manipulation after instrumentation, in which bacterial translocation occurs; the high percentage is worrisome because although it is not frequent, this could generate the entry of bacteria into the bloodstream because these patients are immunocompromised.

The frequency of intubated and tracheostomized patients in Intensive Care Units obliges the nursing staff to achieve and maintain high levels in the performance of the endotracheal suctioning technique, as well as the precautions and applications that should be known and observed in its application.

Other researchers⁽²⁰⁾ agree with the present research by stating that *Acinetobacter* predominated in the microbiological results of their studies, followed by *Klebsiella pneumoniae* and *Staphylococcus aureus*. This work differs, in part, with the order of frequency of germs in the research of other authors⁽²¹⁾ in which the most prevalent pathogen was *Staphylococcus aureus*, followed by *Klebsiella pneumoniae* and *Acinetobacter*. This shows that the microbiological map of each institution is different, making it necessary to prevent VAP and treat them correctly, with an efficient antibiotic policy to avoid antimicrobial resistance.

When analyzing mortality, we found varied values when reviewing the literature. Mortality in this study does not coincide with that achieved by another investigation⁽²²⁾ in which only 36% of patients were discharged; while another study⁽²³⁾ reports a mortality of 52.2%, closer to that found in the present investigation. Another study⁽²⁴⁾ reported a mortality of 64.5%. A mortality higher than 50% may be related to the patient's state of deterioration and survival prognosis⁽¹⁹⁾.

CONCLUSIONS

The study shows that VAP is more frequently observed in male patients over 60 years of age, that this disease is more frequently associated with cerebrovascular diseases, that most symptoms appear between four and six days after the onset of VMA, that *Acinetobacter*, *Klebsiella pneumoniae* and *Staphylococcus aureus* are the germs most frequently isolated in these patients and that this disease has a high lethality rate in the Service.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHORS' CONTRIBUTION

YMR: conceptualization, data curation, formal analysis, research, methodology, visualization, writing the original draft, writing (review and editing).

AGB and BCPT: data curation.

GGL: formal analysis, supervision, writing the original draft, writing (reviewing and editing).

ARLD: data curation, writing original draft, writing (reviewing and editing).

LMM: formal analysis, research.