



INTEGRATIVE LITERATURE REVIEW ARTICLE

PNEUMONIA IN PATIENTS HOSPITALIZED FOR TRAUMA UNDER INTENSIVE CARE* PNEUMONIA EM PACIENTES HOSPITALIZADOS POR TRAUMAS SOB TRATAMENTO INTENSIVO*

NEUMONÍA EN PACIENTES HOSPITALIZADOS POR TRAUMA EN TRATAMIENTO INTENSIVO *

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ABSTRACT

Objective: to identify risk factors and ways of preventing pneumonia in patients hospitalized for trauma in Intensive Care Units. **Method:** This is a bibliographic, descriptive, integrative literature review type study of researched articles published in the last ten years in the Virtual Health Library and in the MEDLINE and LILACS databases. They were selected, as descriptors arranged in the Health Sciences Descriptors portal. The descriptive analysis of the results from the data found was carried out. **Results:** It is pointed out that a total of ten articles met the selection criteria. The most relevant prevention measures observed were oral decontamination with 2% chlorhexidine done early, microbiological culture tests, anti-biogram and antibiotic de-escalation/escalation. **Conclusion:** It is concluded that most of the risk factors for the development of pneumonia found in the study were related to consequences of trauma and interventions performed during hospitalization. It is evaluated that the main prevention measures are easy to carry out and low cost.

Descriptors: Pneumonia; Intensive Care Units; Wounds and Injuries; Traumatology; Risk Factors; Prevention and Mitigation.

RESUMO

Objetivo: identificar os fatores de risco e as formas de prevenção da pneumonia em pacientes hospitalizados por trauma em Unidades de Terapia Intensiva. **Método:** trata-se de um estudo bibliográfico, descritivo, tipo revisão integrativa de literatura de artigos pesquisados publicados nos últimos dez anos na Biblioteca Virtual de Saúde e nas bases de dados MEDLINE e LILACS. Selecionaram-se, como descritores dispostos no portal de Descritores das Ciências da Saúde. Realizou-se a análise descritiva dos resultados a partir dos dados encontrados. **Resultados:** aponta-se que um total de dez artigos atendeu aos critérios de seleção. Ressalta-se que as medidas de prevenção mais relevantes observadas foram a descontaminação oral com clorexidina a 2% feita precocemente, a realização de exames de cultura microbiológica, antibiograma e

desescalamento/escalamento de antibióticos. **Conclusão:** conclui-se que a maioria dos fatores de risco para o desenvolvimento da pneumonia encontrados no estudo estava relacionada a consequências do trauma e intervenções realizadas durante a internação. Avalia-se que as principais medidas de prevenção são de fácil execução e baixo custo.

Descritores: Pneumonia; Unidades de Terapia Intensiva; Ferimentos e Lesões; Traumatologia; Fatores de Risco; Prevenção e Mitigação.

RESUMEN

Objetivo: identificar factores de riesgo y formas de prevención de la neumonía en pacientes hospitalizados por trauma en Unidades de Cuidados Intensivos. **Método:** se trata de una revisión bibliográfica, descriptiva, integradora de la literatura de los artículos investigados publicados en los últimos diez años en la Biblioteca Virtual en Salud y en las bases de datos MEDLINE y LILACS. Fueron seleccionados como descriptores disponibles en el portal de Descriptores de Ciencias de la Salud. Se realizó un análisis descriptivo de los resultados a partir de los datos encontrados. **Resultados:** se señala que un total de diez artículos cumplieron los criterios de selección. Cabe destacar que las medidas preventivas más relevantes observadas fueron la descontaminación oral con clorhexidina al 2% realizada precozmente, la realización de pruebas de cultivo microbiológico, antibiograma y desescalamiento / escalado antibiótico. **Conclusión:** se concluye que la mayoría de los factores de riesgo para el desarrollo de neumonía encontrados en el estudio estuvieron relacionados con las consecuencias del trauma y las intervenciones realizadas durante la hospitalización. Se estima que las principales medidas preventivas son fáciles de implementar y de bajo costo.

Descriptores: Neumonía; Unidades de Cuidados Intensivos; Heridas y Traumatismos; Traumatología; Factores de Riesgo; Prevención y Mitigación.

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INTRODUCTION

It is known that after the traumatized patient survives the initial injury, complications may appear during hospitalization that contribute to the increase of morbidity and mortality, considering that the susceptibility to infections in these individuals is significant, representing a threat to recovery. It is understood that pneumonia (PNM) is more common among traumatized patients than in other patients hospitalized in the ICU, regardless of age or health status.¹ Traumatic injuries are found to be the leading cause of death and disability in Americans aged one to 46 years old.² It is understood that the pathophysiology of trauma is complex and involves several aggravating factors. It is considered that the amount of necrosied tissue and ischemia-reperfusion lesions (type of specific lesion that a tissue suffers after a period of ischemia, causing an exacerbated inflammatory response when perfusion occurs)² and an increase in oxidative stress, causing excessive diffusion and permeability of the capillaries, resulting in new injuries and necrotic tissue) weakens the immune system and the individual's resistance to infection, predisposing him/her to the development of the PNM, for example.¹⁻²

The PNM acquired in a hospital environment is defined as that which occurs 48 hours or more after admission.¹ It should be noted that the patients in this unit are exposed to several factors that can cause nosocomial PNM, such as Mechanical Ventilation (MV), which results in a specific type of this pathology, the so-called Mechanical Ventilation Associated Pneumonia (MVAP), which occurs between 48 and 72 hours after performing an Orotracheal Intubation (OTI) or the installation of MV.³⁻⁴

The development of PNM, regardless of its categorization, increases the length of stay in the ICU and hospitalization, raises the costs of health services and treatment and slows down the recovery process.¹

OBJECTIVE

To identify risk factors and ways of preventing pneumonia in patients hospitalized for trauma in Intensive Care Units.

METHOD

It is a bibliographic, descriptive, integrative literature review type study, whose method allows the search, the careful evaluation and the synthesis of available information regarding the subject to be investigated, producing, as a result, a state of knowledge of the subject, the execution of effective interventions in the provision of care and cost reduction, as well as the identification of

potentialities and fragilities about the topic, which may serve as a basis for the formation of future investigations.⁵

The first step was to choose the theme and identify the guiding question: "What are the risk factors for the occurrence of PNM in traumatized patients hospitalized in ICU and what are the measures to prevent it? In the second stage, the inclusion criteria were established: studies whose subject matter included the PNM, trauma and ICU; with free availability and full text; written in English, Spanish and Portuguese; published in the last ten years and carried out on a human basis.

The collection of articles published in the last ten years has been defined in order to contemplate more updated information on the subject, bringing current and innovative conclusions, with greater possibility of practical application, as well as to evaluate the evolution of the subject over the established time. Duplicate articles were excluded between the databases (counted as only one) and those that did not present, in a detailed way, the results regarding the risk factors and forms of prevention of the PNM.

The "pneumonia" AND "intensive care units" AND "injuries and injuries" were selected as descriptors in the Health Sciences Descriptors (DeCS) portal. It is recorded that data collection for this study took place between August 2019 and June 2020, at the Virtual Health Library (VHL), which provide access, among others, to the following databases: Latin American Caribbean Literature on Health Sciences (LILACS) and International Literature on Health Sciences (MEDLINE).

It was later verified that the selected articles were read in full and the results were systematized with the help of professionals with nursing service expertise and Nursing Care teachers for patients in critical situations at the Midwest State University (UNICENTRO). The synthesis and interpretation of the data were based on the results of the critical evaluation of the studies elected after the complete reading. The comparison of these data in relation to theoretical knowledge, identification of conclusions and the implications resulting from the integrative review was carried out in order to draw the necessary information and thus obtain the intended knowledge and conclusions.

RESULTS

It is pointed out that the search with the descriptors and filters applied totaled 54 articles in MEDLINE and 158 articles in the VHL. After an exhaustive selection based on the title and excluding the repeated articles between the bases, 12 and 23 articles were obtained, respectively, culminating in 35 articles in total. It is noteworthy that, after reading, there were only ten left, which directly achieved the objectives and theme of this research (Figures 1 and 2).

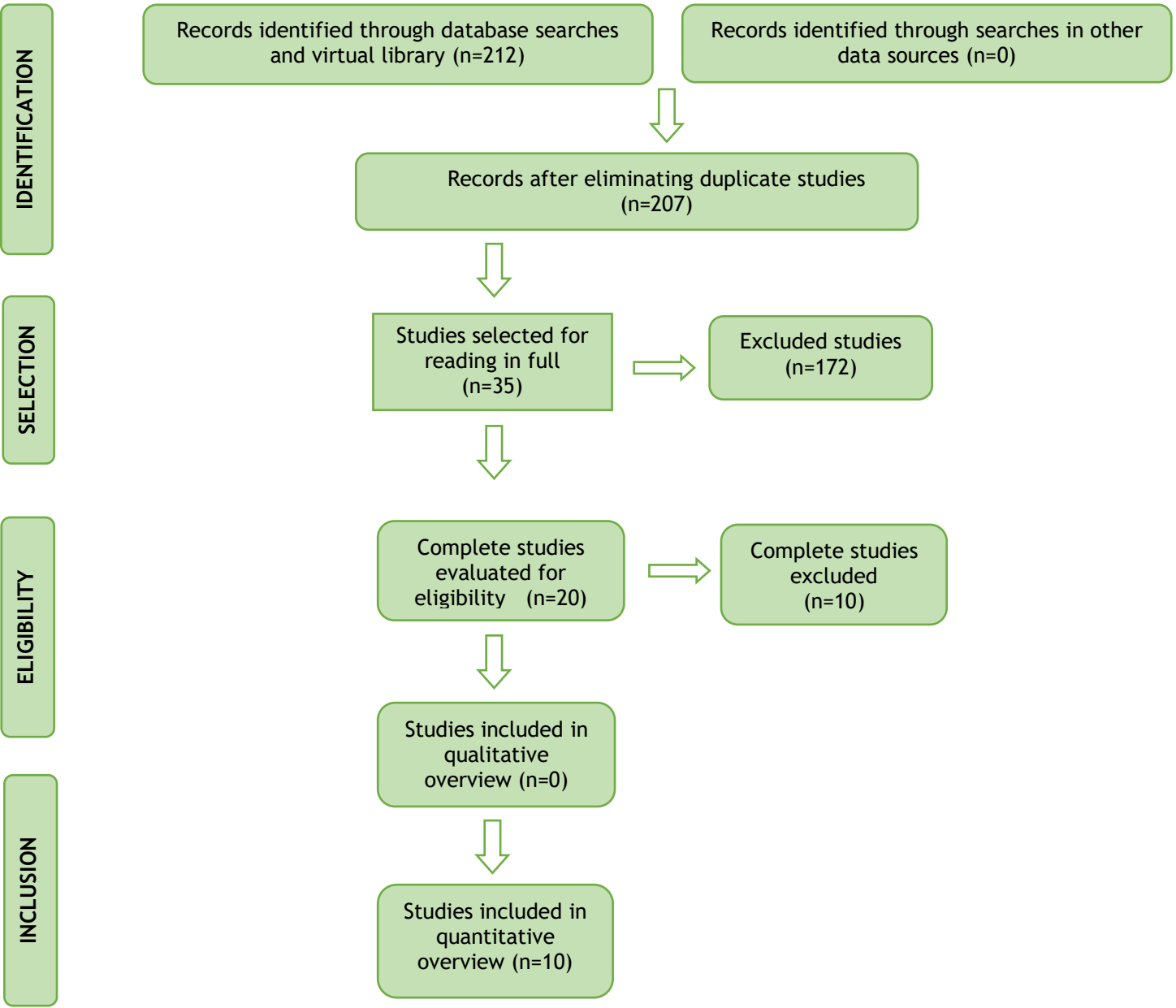


Figure 1. Study Selection Flowchart adapted from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2009). Guarapuava (PR), Brazil, 2019/2020.

Authors	Year	Title	Results
Hyllienfmark, Brattstrom, Larsson, Martling, Petersson, Oldner. ¹	2013	High incidence of post-injury pneumonia in intensive care-treated trauma patients	PNM is a common complication among trauma patients treated in the ICU. The reduction of consciousness is an independent risk factor for the development of PNM after injury.
Younan, Delozier, McQuay, Adamski, Violette, Loudon, et al. ²	2019	Among Trauma Patients, Younger Men with Ventilator-Associated Pneumonia Have Worse Outcomes Compared to Older Men—An Exploratory Study	Among the patients traumatized with MVAP, younger men had a longer hospital stay and a greater tendency to stay for longer periods in the ICU.
Walaszek, Kosiarska, Gniadek Kolpa, Wolak, Dobróś, et al. ⁹	2016	The risk factors for hospital-acquired pneumonia in the intensive care unit	The most important risk factors for MVAP related to treatment were reintubation and bronchoscopy. The highest incidence of MVAP was observed in polytrauma patients admitted to the ICU. The duration of mechanical ventilation above 20 days was a significant determining factor for the incidence of MVAP.
Arumugam, Mudali, Strandvik, El-Menyar, Al-Hassani, Al-Than. ³	2018	Risk factors for ventilator-associated pneumonia in trauma patients: a descriptive analysis	In trauma, the risk of developing MVAP is multifactorial. However, the location of the intubation and the presence of thoracic lesion can play an important role in its incidence.

Li,Liu, Xiao, Song, Wang. ⁴	2020	<i>Incidence, risk factors, and outcomes of ventilator-associated pneumonia in traumatic brain injury: a meta-analysis</i>	Patients with traumatic brain injury have a high risk of developing MVAP (36%). Infection increases mortality of individuals with brain trauma, length of stay in ICU and time of use of MV. Smoking, tracheostomy, blood transfusion at admission, infusion of barbiturates and high values of the Injury Severity Score and Abbreviated Injury Scale are risk factors for the development of MVAP.
Coritsidis, Diamond, Rahman, Solodnik, Lawrence, Rhazouani, et al. ¹⁷	2015	<i>Hypertonic saline infusion in traumatic brain injury increases the incidence of pulmonary infection</i>	The use of hypertonic saline solution to treat electrolytic abnormalities has increased the chances of all types of infections, especially pulmonary infections. The solution should be used with caution in patients with TBI.
Zand, Zahed, Mansouri, Dehghanrad; Bahrani, Ghorbani. ²³	2017	<i>The effects of oral rinse with 0.2% and 2% chlorhexidine on oropharyngeal colonization and ventilator associated pneumonia in adults intensive care units</i>	Oral decontamination with 2% chlorhexidine, compared to 0.2% chlorhexidine, proved to be more effective in preventing WFP and reducing oropharyngeal colonization (especially gram-positive).
Hofman, Andruszkow, Kobbe, Poeze, Hildebrand. ⁷	2019	<i>Incidence of post-traumatic pneumonia in poly-traumatized patients: identifying the role of traumatic brain injury and chest trauma</i>	Thoracic trauma alone, and especially its combination with head trauma, represents high risk injuries for the development of PNM, which is the strongest predictor of mortality in post-trauma patients.
Wu, Wu, Zhang, Zhong. ⁸	2019	<i>Risk factors of ventilator-associated pneumonia in critically ill patients</i>	There are a number of risk factors for the occurrence of MVAP. The length of hospital stay and time of use of MVAP were significantly prolonged in patients with decreased level of consciousness.
Patel, Gillespie, Goslar, Sindhwani, Petersen. ⁶	2011	<i>Trauma-associated pneumonia in adult ventilated patients</i>	The clinical pulmonary infection score (CPIS) is not a reliable tool for predicting positive bronchoalveolar lavage. Therefore, BAL should be used as a diagnosis for trauma associated PNM based on clinical reasoning.

Figure 2. Main results found in the studies arranged according to the authors, the year of publication and the title. Guarapuava (PR), Brazil, 2019/2020.

It is pointed out that the search strategy of 212 articles made it possible to obtain, as an object of analysis, the ten studies screened and included in the research (Figure 1). It is noticeable, regarding the places of publication, that 30% of the studies were published in the United States of America and 20% in China, while the rest were divided between Sweden, Germany, Poland, Iran and Qatar. It is noted, in relation to the authors, that the majority had a background in Medicine. It is also noted, in relation to the criterion related to language, that all articles were written in English.

DISCUSSION

PNM is the most frequent nosocomial infection in the ICU and in patients with severe lesions. Its clinical suspicion is based on the presence of fever, leukocytosis, purulent secretions and infiltration demonstrated by lung X-rays.⁶ PNM was indicated as the most powerful independent predictor of hospital mortality in polytraumatized patients.⁷

In this sense, the disease can be considered as Hospital Acquired Pneumonia (HAP), so called when it occurs after 48 hours or more from admission, or MVAP, which occurs 48 to 72 hours after OTI.^{1,8} Although the prevalence of MVAP has decreased over the years due to the implementation of

therapeutic strategies and protocols, it remains one of the most common causes of nosocomial infection and death in critically ill patients under intensive care, being a real concern in this service.^{4,8} In addition, MVAP is reported to be responsible for increasing the length of stay of patients in the ICU by about one week, with an additional cost of at least ten thousand dollars per case.¹

Regardless of its categorization, this infection is related to increased morbidity, prolonged use of MV and longer hospital stays, as well as to high health costs.¹ It was demonstrated in an important study that a quarter of all traumatized patients developed the PNM in the first ten days of hospitalization. The profile of these patients was characterized by the smallest age groups, trauma with few penetrating lesions (mostly contusions) and the prevalence of males.¹ This information was reaffirmed in another study², which presented the fact that younger traumatized men, compared to the older ones, have worse outcomes of MVAP, such as a length of stay in prolonged intensive care, for example.²

The PNM in the traumatized patient is considered a unique diagnostic dilemma due to the overlapping conditions to the trauma, such as lung contusion, Acute Respiratory Distress Syndrome (ARDS), acute lung injury and systemic inflammatory response syndrome.⁶ It is also known that the PNM represents a predisposing factor for the development of ARDS and Multiple Organ Failure Syndrome (MOFS).⁷ It is understood that the complications resulting from the trauma predispose the development of the PNM.¹

The vulnerability of traumatized patients is highlighted by the fact that, although the patients are younger and have less associated comorbidities than other ICU patients, they still have an increased risk of presenting the PNM.⁶

An association between the severity of traumatic injury and the development of PNM was suggested in a meta-analysis that evaluated several risk factors for MVAP in patients with traumatic brain injury. It was revealed that patients with high Injury Severity Score (ISS) values, that is, with severe lesions, had a higher risk of being diagnosed with the infection than those with lower scores,⁴ and an important indicator to be evaluated during hospitalization.

The findings of the study were organized into two categories of analysis: Main risk factors for the development of PNM in traumatized patients in ICU and Forms of prevention of PNM in traumatized patients in ICU.

Main risk factors for the development of PNM in traumatized patients in ICU

Trauma is considered a risk factor for the occurrence of infections due to the vulnerability that patients have,¹ because the lowering of the level of consciousness associated with OTI and MV favors the accumulation of secretion in the airways, caused by the loss of the cough reflex, as well as the occurrence of micro-aspirations of secretions that are colonized with bacteria from the oropharynx and gastric content through the orotracheal tube.⁷

It is observed, on the development of MVAP, that the main risk factors found in the studies chosen were traumatic brain injury, smoking, tracheostomy, high ISS and AIS values, spine, face or sternum injuries, blood transfusion at admission or in massive amounts, prolonged stay in ICU and the need to perform invasive procedures in order to promote the maintenance of support systems, which are reintubation and bronchoscopy, as well as a prolonged time of MV use (above 20 days).^{2,4,9}

The use of MV has been found to be effective in promoting hyperventilation, decreasing intracranial pressure values in brain trauma patients, but it also favors bacterial colonization and lung infection, with *Staphylococcus aureus* and *Haemophilus influenza* standing out as the microorganisms most frequently observed in the respiratory samples of a group of intensive care patients of a French hospital.¹⁰

As other risk factors for PNM in traumatized patients hospitalized in the ICU, thoracic trauma and, again, brain injury (TBI) are highlighted.⁷ TBI is often associated with prolonged ICU stay, high incidence of disability¹¹ e taxas de mortalidade acima de 40%, sendo ele o trauma primário ou provocado por fatores secundários, como hipóxia, hipotensão, anemia, hipoglicemia ou hiperglicemia e processos inflamatórios generalizados.⁷ It is added that some characteristic signs of TBI, such as dysphagia, hemiplegia and hemiparesis, significantly increase the accumulation of secretion in the airways, either by the impaired ability to swallow or by immobility.¹²⁻³

Thoracic trauma is related to a longer duration of MV use and intensive hospitalization, usually because it causes direct bruising in the lungs, increasing more than three times the risk of PNM development.⁷ When these two traumas are associated, it is observed that the picture becomes more serious, causing, besides the pulmonary dysfunction, an increase in the risk of aspiration and the reduction of the defense mechanisms.⁷

It is known that traumatized patients often require the use of invasive devices for their feeding during hospitalization, such as the Nasogastric Probe (NGP). It has been pointed out that the NGP interferes with oral microbiota, causing oropharyngeal colonization and gastric reflux,¹⁴ which

increases the chances of the aspirational PNM, as well as harming the cough reflex and swallowing.¹⁵⁻¹⁶

The last risk factor shown was the use of hypertonic saline solution to treat electrolytic abnormalities, which caused a significant increase in the chances of occurrence of all types of infections, more specifically, pulmonary infections, due to the situation of hypernatremia.¹⁷ This is a condition commonly observed in hospitalized patients, affecting more than 9% of critically ill individuals and increasing their morbidity and mortality. It is associated with a decrease in the cardiac contractility of the left ventricle, with losses in the use of glucose and gluconeogenesis, as well as with hyperventilation, renal dysfunction and a drop in phagocytic activity of the immune system cells, predisposing these patients to infections and other comorbidities.¹⁸⁻⁹

Formas de prevenção da PNM em pacientes traumatizados em UTI

The management of PNM in traumatized patients in the ICU was based, according to the studies, on the use of antibiotic therapy associated with culture tests to avoid microbial resistance, aiming at an adequate and effective treatment, as well as the use of diagnostic methods associated with the clinic, such as bronchoalveolar lavage,^{6,8} technique used to isolate a segment of the lung, thus identifying specific infections in the lower airways, done through infusion and subsequent aspiration of fluid in the airway of interest by a flexible bronchoscope.²⁰

It is noted that some common preventive measures of MVAP would be the early stimulation of movement, daily interruption of sedation and early evaluation for extubation, however, these determinations end up not being fully applicable due to injuries associated with trauma, such as internal abdominal hemorrhages, severe thoracic trauma and other damage to organs.⁴ A differentiated view (focused on prevention) of the scores used as indicators of MVAP predisposition, the ISS and Abbreviated Injury Scale (AIS) is required, based on them, the care provided, aiming at reducing the risk of incidence of the complication in question⁴.

An evidence-based guideline for the management of adults with MVAP, HAP and PNM associated with health care by the American Thoracic Society (ATS) and American Society of Infectious Diseases (ASID) was updated in 2016.²¹ It is important to note that the main objectives of this guideline are related to the use of adequate antibiotics in correct doses and antimicrobial decolonization, based on the performance of microbiological cultures and the clinical response of the patient, as well as reducing the duration of therapy to the shortest possible time.²¹

It is clarified, however, that only the presence of a guideline is not enough for its guidelines to be put into practice, and there are barriers to its implementation, such as, for example, the

individual characteristics of each institution, be they structural, organizational or referring to the body of professionals.²² However, it is evaluated that the implementation of the guideline determined by ASID/ATS, in a customized way and according to the specific guidelines and protocols of the hospital to be undertaken, is the most effective way to achieve a achieved adherence.²²

Oral decontamination with chlorhexidine 2% of the patients hospitalized in the ICU was shown to be effective in reducing MVAP and in reducing oropharyngeal colonization, mainly by gram-positive microorganisms.²³

As another effective measure to avoid this pulmonary infection, it is indicated the performance of oral care with chlorhexidine gluconate in the first two hours of admission or OTI in the ICU, as well as the use of medical record and electronic record, which aim to systematize and organize the care provided to patients.³ It was found that these practices promoted the reduction of the PNM in intubated patients, decreased the length of hospital stay and the general costs in health services and promoted an improvement in the documentation and care of patients in the ICU, regardless of the use of the MV.

It is considered extremely important, besides the indicated prevention measures, since the colonization of the respiratory tract of ICU patients is complex, that antibiotic therapy, microbiological culture and de-escalation of antibiotics be instituted, in order to avoid the perpetuation of the life of multi-resistant and super-bacterial microorganisms, to reduce the toxicity and costs of the treatment and to hinder the emergence of resistance to antibiotics.²⁴ De-escalation is defined as a strategy whose purpose is to interrupt the use of the antibiotic or to switch to another one with smaller spectrum coverage. It is stated that the escalation occurs when the addition of a new antimicrobial or the change to another one with higher spectrum coverage is performed.²⁵

It was noticed, according to a study²⁶ that evaluated the importance of the nurse in the execution of the bundle for the prevention of MVAP in ICU, that the elevation of the headboard, oral hygiene, daily evaluation of the readiness for the extubation procedure and daily interruption of the sedation were seen as effective in the prevalent bundles. However, the daily adherence and practice of the recommendations by the multi-professional team are necessary for the results to be achieved.²⁷ It is emphasized that the nurse is one of the most important components to achieve an effective prevention of nosocomial infections such as PNM, because he has direct and continuous contact with the patient through the assistance,²⁶ highlighting the importance of care and

assistance actions that are prescribed exclusively by nurses, thus seeking the benefit of the patient.

The following factors were mentioned: ineffective prevention measures, frequent change of professionals, inefficient or non-existent training, lack of knowledge about the incidence and impact of MVAP, and lack of financial and structural resources.²⁸ The indispensability of permanent education and the constant qualification of the health team are stressed.

In addition, the importance of the presence of the pharmaceutical professional in relation to the control of hospital infection rates and in practices related to the correct and rational use of antimicrobials is highlighted^{22,29} and the dental professional³⁰ in the ICU, highlighting the relevance of working together and the harmony with the multidisciplinary team²² in order to achieve the improvement of the service provided and the subsequent discharge of the patient with the minimum possible side effects and comorbidities.

It is evaluated that this study achieved the proposed objectives, however, it is important to stress that integrative revision, like any type of study, has advantages and limitations. Among the limitations, it is warned that attention should be paid when carrying out the conclusions reached on the findings, in order not to extrapolate, therefore, the method was rigorously followed and discussions on the presentation of the results were promoted.

CONCLUSION

It is concluded in the ten articles evaluated that the main risk factors identified for PNM were trauma, especially cerebral and thoracic trauma, severity of injury, ISS, use of NGP and MV, prolonged length of stay in the ICU, use of hypertonic saline solution, reintubation and bronchoscopy. Oral decontamination with 2% chlorhexidine and the use of early chlorhexidine gluconate, as well as microbiological culture tests, antibiogram and antibiotic escalation in an appropriate manner were frequently cited as preventive measures of the complication.

CONTRIBUTIONS

It is informed that all authors also contributed in the conception, analysis and interpretation of the research, in the writing and critical review with intellectual contribution and in the approval of the final version.

CONFLICT OF INTERESTS

Nothing to declare.

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