



PNEUMONIA ASSOCIATED WITH MECHANICAL VENTILATION AND USE OF INVASIVE PROCEDURES

PNEUMONIA ASSOCIADA À VENTILAÇÃO MECÂNICA E USO DE PROCEDIMENTOS INVASIVOS NEUMONÍA ASOCIADA A LA VENTILACIÓN MECÁNICA Y USO DE PROCEDIMIENTOS INVASIVOS

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ABSTRACT

Objective: to analyze the correlation between the use of invasive procedures and pneumonia associated to Mechanical Ventilation in an intensive care unit. **Method:** Cross-sectional, retrospective study using data from 40 patients with pneumonia associated to Mechanical ventilation in intensive care units of a university hospital in Curitiba (PR), Brazil. The project was approved by the Research Ethics Committee, under CAAE 02562012.0.0000.0093. **Results:** we identified 23 (57.5%) female patients, average age 63.7 years, 37 (92.5%) of which with duration of more than a week in the ICU, 36 (90%) of them with SVD, 18 (45%) underwent endotracheal intubation and tracheostomy and had spent more than a week in VM and 29 (72.5%) with HAS. There was a positive association between intubation standards and the invasive procedure in patients using central venous catheter and the number of invasive procedures and cardiovascular disease. **Conclusion:** it reinforces the need to review practices and care with central catheters in intubated patients. **Descriptors:** Nursing; Pneumonia; Mechanical Ventilation.

RESUMO

Objetivo: analisar a correlação entre uso de procedimentos invasivos e pneumonia associada à ventilação mecânica em uma Unidade de Terapia Intensiva. **Método:** estudo transversal, retrospectivo, utilizando dados secundários de 40 pacientes com pneumonia associada à ventilação mecânica, em unidades de terapia intensiva de um hospital escola em Curitiba (PR), Brasil. O projeto foi aprovado pelo Comitê de Ética em Pesquisa, sob CAAE 02562012.0.0000.0093. **Resultado:** identificou-se 23 (57,5%) pacientes do sexo feminino, idade média 63,7 anos, 37 (92,5%) com tempo de permanência maior que uma semana na UTI, 36 (90%) com SVD, 18 (45%) submetidos à entubação orotraqueal e traqueostomia com tempo de superior a uma semana em VM e 29 (72,5%) com HAS. Associação positiva entre padrão de entubação e procedimento invasivo nos pacientes em uso de cateter venoso central e número de procedimentos invasivos e doença cardiovascular. **Conclusão:** reforça-se a necessidade de rever práticas e cuidados na com cateter central em pacientes entubados. **Descritores:** Cuidados de Enfermagem; Pneumonia; Ventilação Mecânica.

RESUMEN

Objetivo: analizar la correlación entre el uso de procedimientos invasivos y la neumonía asociada a ventilación mecánica en una unidad de cuidados intensivos. **Método:** estudio transversal, retrospectivo con datos de 40 pacientes con neumonía asociada a ventilación mecánica en las unidades de cuidados intensivos de un hospital universitario de Curitiba (PR), Brasil. El proyecto fue aprobado por el Comité Ético de Investigación, bajo CAAE 02562012.0.0000.0093. **Resultados:** se identificaron 23 (57,5%) pacientes del sexo femenino, edad media 63,7 años, 37 (92,5%) con una duración de más de una semana en la UCI, 36 (90%) se quede con SVD, 18 (45%) fueron sometidos a intubación endotraqueal y traqueotomía habían pasado más de una semana en VM y 29 (72,5%) con HSA. Asociación positiva entre la intubación estándar y procedimiento invasivo en los pacientes utilizando un catéter venoso central y el número de procedimientos invasivos y las enfermedades cardiovasculares. **Conclusión:** se refuerza la necesidad de revisar las prácticas y el cuidado en la ventilación con catéteres centrales en pacientes intubados. **Descriptores:** Enfermería; La Neumonía; Ventilación Mecánica.

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INTRODUCTION

In the intensive care unit (ICU) the nursing care is constantly challenged by infection potentially related to invasive procedures, resulting in increased length of stay, costs and mortality. In the hospital the patient is more exposed to the risk of infection in part related to their clinical condition with a risk directly proportional to the severity of the clinical picture, variety of invasive procedures and hospitalization time.^{1,2}

Nosocomial pneumonia is a major impact in the context of infections and hospital costs, affects approximately 250 000 patients per year, and reaches a billion dollars a year.¹ After the urinary tract infection it remains the second most common cause of nosocomial infection and has significant prevalence in ICUs, usually associated with mechanical ventilation.

Pneumonia is an acute infection in the lungs that produces respiratory signs and symptoms, the main route of microorganisms is in the lower respiratory tract.³ This relates to the aspiration of oropharyngeal secretions, which in the case of patients using tracheal cannula can be including secretion that accumulates above the tube cuff.

When combined with mechanical ventilation (PAV) it occurs in 48-72 hours after insertion of the tracheal tube and establishment of invasive mechanical ventilation (IMV).² In similar mode the PAV is classified as early if it occurs until the fourth day of the use of tracheal cannula and the start of the VM, and as late the one that begins after the fifth day of the use of tracheal tube or tracheostomy and VM.⁴

Some factors may contribute to this clinical as: Patients requiring mechanical ventilation are three times more likely to acquire pneumonia, admission to ICU and poor oral hygiene increase the susceptibility.⁵ Chewing hard food, the tongue movement and speech perform a process of natural mouth cleaning, the use of some drugs causes a decrease in salivary flow and contribute to the increase of the biofilm in the oral cavity, thus contributing to oral colonization by respiratory pathogens.³

Pulmonary infections of patients on mechanical ventilation may be determining factors related to the microflora, systemic aspects and nursing care. In this approach the nursing staff helps to control measures that can be modified to include the duration of the MV, the use of nasogastric and nasoenteral probes, enteral diet, antacids, paralytic agents, preventive antibiotic use, the

Pneumonia associated with mechanical ventilation...

aspiration of gastric contents, transport out of the ICU and to remain in a supine position.⁶

The nurse is responsible for the team of nursing professionals working in the intensive care unit, whose stay is prolonged in these sectors. We are considering some recommendations to reduce VAP, that include educational measures for health professionals, the epidemiological surveillance of nosocomial infections, the interruption in the transmission of microorganisms by appropriate use of hospital equipment, preventing the transmission from one person to another and modification of risk factors for the development of bacterial infections.⁷

Based on this issue, an interest emerged in the profile of patients admitted to the ICU with a diagnosis of VAP using invasive procedures and their association with modifiable measures present in nursing from the elucidation of the following problem: What is the correlation of VAP with different invasive procedures?

Based on these the aim of this study is:

- To analyze the correlation between the use of invasive procedures and ventilator-associated pneumonia in a intensive care unit.

METHOD

A cross-sectional, retrospective study involving patients admitted to the intensive care unit, held in a private hospital school, located in the municipality of Curitiba- PR. This hospital performs high complexity procedures, considered as a reference in the city and the metropolitan area and other hospitals in Paraná and has two ICUs named one and two, with 16 and 8 beds respectively. The ICU one attends to various clinics and to a differentiated complexity of health and number two is destined primarily to the demand of cardiology.

Secondary data was collected from medical records of patients admitted to the two intensive care units of the hospital with a diagnosis of VAP defined by obtaining the etiology classified as probable if the cultural examination of sputum or bronchial secretions (collected by tracheal aspiration) revealed a bacteriological agent. The selection preceded on the traceability of records of active search of the Commission of Hospital Infection Control (CCIH).

Patients of both sexes, aged over 18 years in use of invasive ventilatory device endotracheal or tracheostomy were included, regardless of the caliber or ventilatory device type with diagnosis of VAP. Excluded were

patients admitted in the respective ICUs, with diagnosis of VAP under 18.

The variables of study include: data on the identification of the service; age; sex; origin of the patient; length of the stay in the ICU; presence of community infection; invasive procedures: urinary catheter (SVD), and enteral tube feeding (SNE, SNG), central venous catheter (CVC), peripherally inserted central catheter (PICC), time and standard of intubation, presence of chronic diseases, aspiration and others.

Data collection occurred between June 2011 to June 30th 2012, guided by na instrument that was developed by the researchers, composed of closed questions. Data records were collected from the clinical records of the selected patients and subsequently organized into a database with the help of the program in spreadsheet format. A data conference was held, and a coding of the database was performed.

We proceeded to the descriptive statistical analysis. The data results of the quantitative variables were described as avarages, median, minimum and maximum values, and standard

deviations. Qualitative variables were described as frequencies and percentages. To evaluate the association between two dichotomous qualitative variables was considered the Fisher exact test. The comparison between two groups with respect to quantitative variables was performed using the nonparametric *Mann-Whitney* test. The significance level of $p < 0.05$ was considered in all analyzes. The procedure was performed with use of the software *Statistica v.8.0*.

The research protocol was approved by the Research Ethics Committee of Universidade Positivo, with protocol No. 777777 and CAAE: 02562012.0.0000.0093 cautiously to abide by the guidelines and rules of Resolution No. 196/1996 of the National Board of Health / Ministry of Health .⁸

It was found that forty ($n = 40$) patients admitted to the intensive care unit had confirmed diagnosis of ventilator-associated pneumonia, average age 63.7 years (median 65.5, standard deviation 18.5). Its characterization as to the service, sex, origin, ICU and the presence of community infection is represented in Table 1.

Table 1. Characteristics of patients with ventilator associated pneumonia. Curitiba / PR, 2012.

Characteristics	n	%
Service		
ICU 1	05	12,5
ICU 2	35	87,5
Gender		
Male	17	42,5
Female	23	57,5
Provenances		
Emergency Care	19	47,5
Internment	13	32,5
Clinical Center	04	10
Surgical Center	04	10
ICU Stay		
Less than or equal to 1 week	03	7,5
Over 1 Week	37	92,5
Community Infection		
Yes	0	0
No	40	100

Of the patients with confirmed diagnosis of ventilator-associated pneumonia, 35 (87.5%) stayed in the ICU 2, with a predominance of 23 (57.5%) that were female. As from the origin of 19 (47.5%) came from the emergency service and most of these, 37 (92.5%) spent

more than a week in ICU. We did not record any community infection in this group of patients.

The occurrence of invasive procedures in patients investigated are shown in Table 2.

Table 2. Occurrence of invasive procedures in patients with diagnosis of ventilator-associated pneumonia, Curitiba / PR, 2012.

Invasive Procedures	n	%
Urinary catheter (SVD)	36	90
Nasogastric Probe	29	72,5
Nasoenteric Probe	22	55
Central venous catheter	27	67,5
Aspiration	40	100
Others.	18	45

It is noteworthy that 40 (100%) underwent aspiration procedures, and 36 (90%) underwent procedures indwelling na urinary

catheter. The investigation of factors related to time, device for MV and presence of chronic disease is shown in Table 3.

Table 3. Factors related to the presence of ventilator-associated pneumonia. Curitiba / PR, 2012.

Risk Factors	n	%
Intubation time		
Less than or equal to 3 days	1	2,5
Less than or equal to 1 weeks	3	7,5
over one week	36	90
Device for MV		
Tracheal and traquestomia	18	45
Tracheal	11	27,5
Tracheostomy	11	27,5
Chronic Disease		
Hypertension	29	72,5
Cardiovascular	16	40
Chronic Obstructive Pulmonary Disease	10	25
Diabetes Mellitus	8	20
Chronic Renal Failure	5	12,5
Cerebrovascular Disease	4	10

We note that 36 (90%) patients remained in VM by more than one weeks time in this condition, and 18 (45%) of these patients were subjected to the use of endotracheal tube followed by tracheostomy, confirming the need for track maintenance of the invasive area for na extended period. Among the diseases with the highest frequency were especially hypertension in 29 (72.5%) and cardiovascular disease in 16 (40%) patients.

It was found that the relationship between intubation time up to and / or more than one week, and average number of days for different invasive procedures were: (p : 0.913), demonstrating the absence of statistical significance that the non-test parametric *Mann-Whitney test*, $p < 0.05$ gives for this association.

For the statistical test for associations on invasive procedure versus time longer than a week intubation, the results were: the subjected to a nasogastric tube (p : 0.300) procedure, indwelling urinary catheter (p : 1),

central venous catheter (p : 1) nasoenteric probe (p : 1), other procedures (p : 1) and for aspiration and insertion of peripheral venous catheter it was not possible to perform statistical calculation since all of the patients were aspirated and no patient had a Peripherally Inserted Central Catheter (PICC).

The results of the standard intubation ratio versus invasive procedures include: a nasogastric tube (p : 0.242), nasoenteric tube (p : 0.691), central venous catheters (p : 0.003), and other procedures (p : 0.479). For aspiration procedures and indwelling urinary catheter it was not possible to apply the statistical test since all patients were aspirated and because of the small number of cases with indwelling catheters. It is observed that only compared to standard intubation versus central venous catheter it reaches statistical significance.

The association between chronic diseases versus invasive procedures was tested, which is shown in Table 4.

Table 4. Association between chronic disease and invasive procedure related to the presence of ventilator-associated pneumonia. Curitiba, 2012

Occupational chronic	Rank	Number of invasive procedures						p-value*
		n	Average	Median	Minimum	Maximum	Standard deviation	
SAH	No	11	4.5	4	3	8	1,6	0.698
	Yes	29	4.8	5	3	8	1,4	
DM	No	32	4.8	5	3	8	1,4	0,185
	Yes	8	5	4	3	5	0,9	
IRC	No	35	4.7	5	3	8	1,4	0,551
	Yes	5	4.2	4	3	5	0,8	
COPD	No	30	4.8	5	3	8	1,4	0,062
	Yes	10	3.9	4	3	5	0,7	
Cardiovascular	No	24	4.2	4	3	8	1,3	0,012
	Yes	16	5.2	5	3	7	1,1	
Cerebrovascular	No	36	4.5	4	3	8	1,3	0,101
	Yes	4	5.5	5,5	5	6	0,6	

* Non-parametric *Mann-Whitney test*, $p < 0.05$

The 16 patients who had cardiovascular disease, underwent an average of 5.2 invasive procedures. These results reveal that the relationship of chronic disease and invasive procedures, obtained relevance to cardiovascular disease (p : 0.012), with a test which checks statistical significance. Other diseases such as chronic obstructive pulmonary disease (0.062), although showing approximate results in thef non-parametric test ($p < 0.05$), were not considered statistically significant.

DISCUSSION

The study results showed that the characteristics of patients admitted to intensive care with a diagnosis of VAP inflicted more women, with a average age of 63 years. The frequency of infection by gender is contrary to research that give males the greatest number with a prevalence of 60%.^{9,10}

Noting the origin of patients of the emergency care and the permanence of time in the intensive care unit two. The positive relationship between the probability to develop infection appears related to possible risk factors compatible with duration of more than five days of hospitalization.^{11th} The research mentions that VAP is related to adverse effects, including increased length of stay, duration of mechanical ventilation and increased mortality¹² Other studies indicate na approximate risk of 1% to 3% per day of the endotracheal tube;¹³⁻⁴ Also, the time of hospitalization combined with deleterious effects such as immobility among others are factors that contribute to this clinical state¹⁵.

The findings for the occurrence of invasive procedures suggest a high frequency of use by these patients, for aspiration followed by indwelling catheters in investigated patients. In intensive care patients require more care and handling, are subjected to various forms of instrumentation, especially tracheostomy, mechanical ventilation, aspiration of bronchial secretion, central catheterization and of urinary tract among others, and these procedures weaken the physiological and immunological barriers of the body and are considered a risk factor for infection.²

The technique of aspiration in order to maintain patency of the airway and promotion of effective gas exchange improves oxygenation and pulmonary function in patients using na endotracheal tube, is a procedure widely used in the ICU independent of having VM or not.¹⁶ Also is emphasized that the presence of the tube increases the production of secretions, thus making vacuuming a key procedure to the positive prognosis of MV patients.¹⁷ The alert that aspiration of bacteria primarily oropharyngeal and / or gastric reflux is most important route of infection is a measure designed to meet the CDC recommendation for the care of plaque that grows on teeth.^{18th}

The presence of urinary catheter is an important factor for ICU-acquired infection and na eight times greater probability factor.¹⁹ The presence of the catheter in the urethra removes the intrinsic defense mechanisms of the host such as urination and efficient emptying of the bladder and puts in evidence that urinary tract infections represent 8-35% of infections in the ICU.^{11th} These findings confirm the strong correction of urinary catheter urinary infection and not necessarily with VAP. There were difficulties in identifying studies that did VAP correction procedures versus indwelling urinary catheter.

In our study the risk factors related to infection with pneumonia on mechanical ventilation are congruent to stay longer than a week and combined use of endotracheal tube intubation and tracheostomy, and a higher frequency of patients with chronic hypertensive disease followed by other cardiovascular disorders. Research shows that the average time of onset of pneumonia was 5.4 days after intubation, while tracheostomy in this same study showed an independent factor for the presence of pneumonia and VM and use of antimicrobials for the absence of VAP.^{20th}

By the 5th day of VM, the risk of developing pneumonia increases 3.3% per day and after that the risk begins to regress, reaching 1.3% on the 15th day of VM.²¹ This reflects the higher risk for developing pneumonia until the 5th day of use of endotracheal tube, unlike tracheostomy requiring antimicrobials. However, in this study the correlation time of intubation and invasive procedures showed no statistical significance.

The central venous catheter is widely used especially in intensive care units, for allowing the continued and prolonged administration of intravenous fluids (drugs, parenteral nutrition, blood products, etc.), hemodynamic monitoring such as central venous pressure and pulmonary artery pressure, part of the hemodialysis process, besides being an alternative to difficult peripheral access.²² In the current study the pattern of prolonged intubation correlation with invasive procedures for central venous catheter was statistically significant

It consists of high onsite manipulation in the treatment in intensive care, there are several complications related to inadequate insertion practices, manipulation and maintenance of CVC, thereby increasing the risk for infections. Such infections are directly related to morbidity and mortality, length of stay and cost of hospitalization of critically ill patients.^{23rd}

Another high statistically positive correlation was found between chronic cardiovascular disease and the number of invasive procedures. Cardiovascular diseases are cited as a risk factor for the development of ventilator-associated pneumonia.³ And this association is due in large part to these individuals often have compromised immune alterations due to disease or medications with decreased salivary flow due to procedures such as therapeutic dehydration, among others.³

CONCLUSION

The epidemiologic and demographic profile and the use of ventilatory strategies for patients undergoing MV vary widely between different institutions. We emphasize particularly the characterization of the factors that predispose nosocomial infections in intensive care units linked to the realization of several invasive procedures, particularly for patients with cardiovascular disease.

Reported evidence of correlation between the standard intubating and patients undergoing central venous catheter procedure with confirmed diagnosis of ventilator-associated pneumonia, reinforce the need to review practices and care in handling them. Prevention of complications relating to handling of invasive procedures in these places deserves a special attention to recycling of knowledge of staff engaged in intensive care. This way it underscores the importance of conducting further prospective studies.

The findings of this study contribute to create the basis for further work on infection control in intensive care, reaffirming the importance of an education program on proper handling of invasive procedures used in the ICU with the participation of health professionals. Moreover, it adds knowledge about the rates of hospital infections and emphasizes the importance related to the associated outcomes, such as the threat posed to patients.

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Nascimento MEB do, Schier DCL, Farias SF de et al.

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Submission: 2014/01/27

Accepted: 2014/09/17

Publishing: 2014/10/15

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