Risk factors for the development of hospital-acquired pneumonia in polytrauma patients

Fatores de risco para o desenvolvimento de pneumonia hospitalar em pacientes politraumatizados

Factores de riesgo para el desarrollo de neumonía nosocomial en pacientes politraumatizados

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ABSTRACT

Introduction: The literature has been demonstrating that the incidence of Hospital-Acquired Pneumonia is higher in victims of trauma. The objective is to identify the risk factors for the development of Hospital-Acquired Pneumonia in polytrauma patients. **Outline:** Retrospective and longitudinal study, with analysis of 70 medical records of admitted patients in the emergency unit at a tertiary hospital, for a period longer than 48 hours. There were collected from medical records: admission data, data of the trauma, invasive methods and clinical indicators of pneumonia in the hospitalization. **Results:** From the 70 included patients, 15 (21,4%) showed pneumonia until the fifth hospitalization day. When applied the univariate logistic regression, it was observed that the Glasgow Coma Scale to the admission (*p*=0,03), use of endotracheal tube (*p*=0,01) and nasogastric tube (*p*=0,04) associated with the increasing of the risk of hospital-acquired pneumonia. **Implications:** the study demonstrated that level of consciousness, the use of endotracheal tube and the use of the nasogastric tube are predisposing factors for the development of hospital-acquired pneumonia in these patients, being the endotracheal intubation an independent risk factor.

DESCRIPTORS

Pneumonia; Wounds and Injuries; Risk Factors; Cross Infection.

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INTRODUCTION

The infections acquired during the hospitalization period are the more commons causes of complications in critically ill patients.[1]

The Hospital-Acquired Pneumonia (HAP) is one of the most prevalent infections in hospitalized patients, and it develops 48 hours after hospital admission. The Pneumonia Associated to the Mechanical Ventilation (PAV) develops between 48 and 72 hours after the intubation in intubated patients submitted to the mechanical ventilation, with discrepant incidence,[3-4] long permanence times in the Intensive Care Unit (ICU) and in the hospital, increasing the mortality, as well as the hospital costs.[5]

Some authors have been demonstrating that the HAP incidence in trauma-victim patients, to whom the necessity of prehospital intubation has been associated with, emergency intubation, brain injury, spinal cord injury, pulmonary contusion, severity of injury.[5-7]

The mortality augmentation related to the HAP in this population has been motivating some authors to investigate which risk factors are involved in this epidemiology. Nonetheless, the mechanisms are still little-known and divergent.[5-8]

Some studies have been demonstrating that trauma severity, the presence of pulmonary contusion and sternum fracture increase the risk of developing pneumonia.[9-11]

Some authors evaluated the risk factors for increase of the mortality in patients with abdominal trauma, submitted to laparotomy and described that the risk of development of complications is multifactorial, leading to an increase in hospital stay and death.[12]

In the polytrauma patients, the HAP represents a tough diagnosis, the presence of thoracic trauma with the pulmonary contusion increases the odds of developing pneumonia, systemic inflammatory response and death.[13] Besides that, the immediate attendance and preventive intubation are aspects described as fundamentals, minimizing aspirations and other complications.[14]

However, other authors, by analyzing the occurrence of pneumonia in these patients, described that the infection is related not only with the complications due of the trauma, but, also, to the intubation due of the level of consciousness, to the low tissue oxygenation and to the clinical complications recorded immediately after the trauma.[15]

Ahead of occurrence of pneumonia in trauma patients and knowing the mechanisms for the development of the PAV, this study proposed to identify the risk factors for the development of Hospital-Acquired Pneumonia in polytrauma patients.

METHOD

Retrospective study of case-control kind, longitudinal, approved by the Research Ethics Committee of the Hospital of Clinics of the Federal University of Uberlândia (HC-FUU).

Firstly, there were identified, by the number of the medical record, all the patients who were admitted into the emergency unit with diagnosis of polytrauma in the period of July 2015 and December 2015. In the sequence, the medical records were analyzed in the Statistics Section of the HC-FUU.

There were used, as inclusion criteria, the following conditions: age higher or equal to 13 years-old, admitted through the emergency unit that showed one or more of the following symptoms: Traumatic Brain Injury (TBI), Spine Trauma (ST), Abdominal Trauma (AT), Thoracic Trauma, who presented or not presented necessity of orotracheal intubation. Extremity traumas, face traumas and other were only included when associated to the ones above descripted and with description of traumatic injury apt of codification by the maps of gravity of the closed trauma (CAIS-85F) penetrating trauma (CAIS-85P).

There were excluded the medical records of patients who dead in the first 48 hours; patients who presented previous hospitalization in other hospital, with clinical diagnosis of pneumonia in the time of the hospital admission; with non-specified injuries or injuries non-apt of codification by the maps CAIS 85-F and CAIS 85-P; immunosuppressed patients; any non-traumatic mechanism of injury, hip and face insulated fractures, upper and lower limbs, superficial skin lesions and incomplete medical records.

The admission data were collected and analyzed through electronic medical record, where were descripted the mechanisms of the trauma, clinical data and adopted conducts in the admission in the emergency room. Data referred to the procedures and to the patient's evolution during the hospitalization were collected in the medical record.

For each traumatized patient admitted in the emergency room of the HC-FUU were utilized the following instruments for classifying the trauma severity: Injury Severity Score (ISS), that describes anatomical points of the lesion and quantifies the total number of areas with lesions. The ISS was calculated by means of the Condensed Abbreviated Injury Scale (CAIS-85), which is subdivided into CAIS-85F for victims of closed trauma and CAIS-85P for victims of perforating trauma, classifying the lesions according to the gravity and sort, in ordinal scale of six points.[16]

There were analyzed: genre, age, use of illicit drugs, tobacco, alcohol, presence of associated diseases, blood transfusion in the first 48 hours of the hospital admission, Glasgow Coma Scale (GCS) at the time of admission, mechanism of the trauma, anatomic points stricken by the trauma, days of hospitalization and in the ICU, death, need of artificial airway and time of using, need of tracheal intubation in the first 48 hours, necessity of tracheostomy, nasogastric tube (NGT) and diagnosis of hospital-acquired pneumonia with or without microbiological criterium. All the data referring to the hospital-performed proceedings were only computed in the case they were performed before of the diagnosis of hospital-acquired pneumonia.

For the pneumonia diagnosing, there were used the criteria of the Center of Diseases Control and Prevention,[17] which include clinical and laboratory criteria. It was considered pneumonia when the patient showed at least the clinical criterion, which includes the clinical signs and the image exam (thorax radiography), and the microbiological criterion was considered only a complementary in the diagnosis. The pneumonia diagnosis was considered precocious when identified until 4 days after the hospitalization and considered tardy after 4 days of hospitalization.

For statistical analysis, it was used the version 15.0 of the software SPSS for Windows. The quantitative variables were submitted to the descriptive analysis through the mean and standard deviation, and, posteriorly, Student's t-test among the groups with and without pneumonia. The qualitative variables were presented by frequency distribution, it was applied the binomial test for comparison of two proportions.

It was used model of the univariate logistic regression with the chi-square test, for to analyze the related factors to the development of hospital-acquired pneumonia and presented the values Odds Ratios (OR) and the respective confidence intervals to 95%. In the sequence, it was used method "forward stepwise" for multivariate logistic regression. For all analysis there were considered statistic meaningful results for the values of $p<0.05$.

RESULTS

In the analyzed period, 276 patients were admitted, 176 were excluded and 70 were included in the sample, as demonstrated in the Figure 1.

Figure 1 – Population's Flow Diagram.
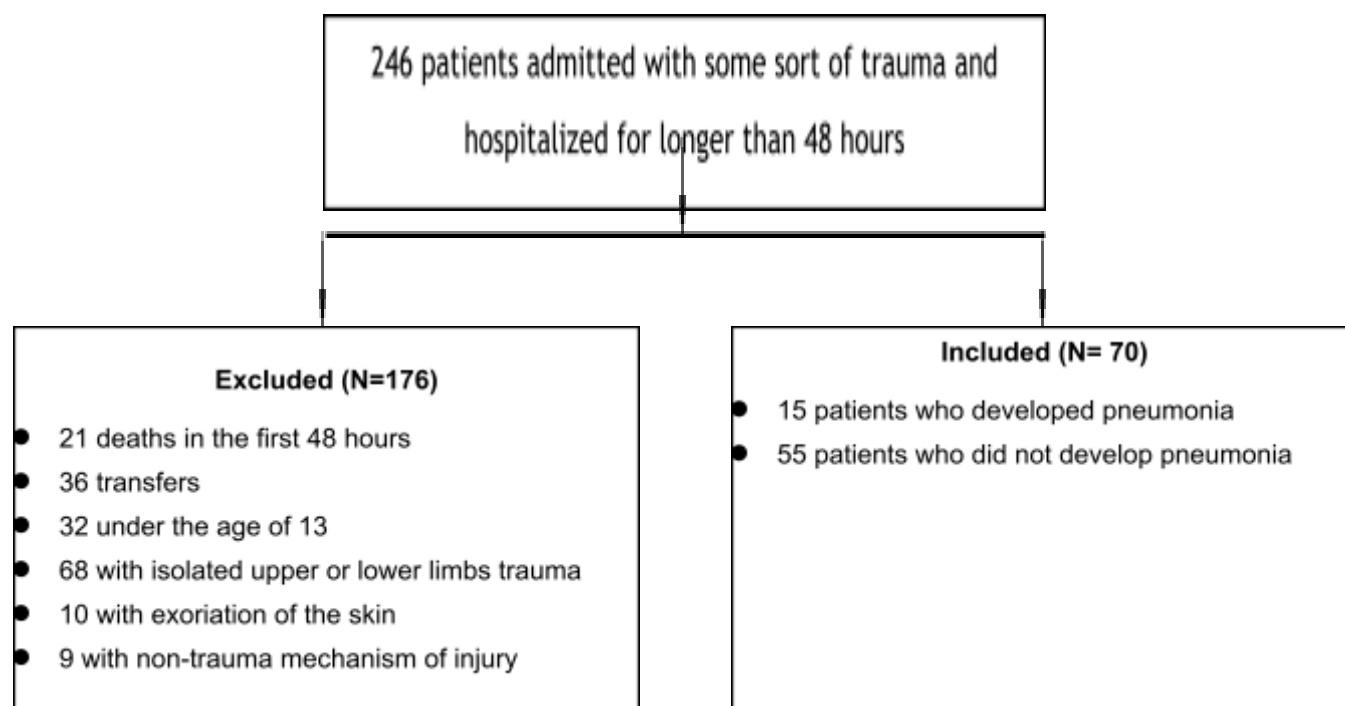
As to the genre, 53 (75%) were men and 17 (24.3%) were women, aged 17 to 97 (40.3±17.6) and median 37 years old. The mean time of hospital internment was of 21.12±18.8 days, with median of 15 days.

The occurrence of hospital pneumonia was of 15 (21.4%), being that all were diagnosed with Pneumonia Associated to the Mechanical Ventilation (PAV). The microbiological criterion was used as diagnosis, being that 11 patients (73.7%) showed positive microbiological criterion.

The tracheal aspiration procedure was used for establishing the pneumonia diagnosis by the microbiological criterion in 15 patients (100%). The mean value of hospital internment time until the diagnosis was of (8,73±8,43) days. The frequency of patients with pneumonia regarding to the hospital internment days is demonstrated in Table 1.

Table 1 – Frequency of patients with pneumonia regarding to the hospital internment days.

Hospital internment time (days)	Number of pneumonia cases	Cumulative Frequency (%)	Classification of pneumonia according to duration
3	4	33.33	Early Pneumonia
4	3	46.67	
5	2	60.00	Late Pneumonia
6	1	66.67	
7	1	73.33	
15	1	80.00	
19	1	86.67	
21	1	93.33	
30	1	100.00	

When comparing the quantitative variables among the patients who presented diagnosis of pneumonia and the ones who did no present, there was significant difference for the variables: GCS in the admission [10.6 (4.0) x 12.9 (3.2)] – (p=0.02), days of hospital internment [42.3 (25) x 15.3 (11.3)] –

(p<0.01), internment days in the UCI [20.9 (14.5) x 5.2 (9.3)] – (p<0.01) and intubation time [15.8 (7.0) x 3.0 (5.1)] – (p<0.01) – (Table 2).

Table 2 – Analysis of the quantitative variables represented by mean and standard deviation.

Variables	Without Pneumonia (n=55) N (%)	With Pneumonia (n=15) N (%)	p Value
Age (years)	35.3 (20.9)	41.5 (18.3)	0.49
Glasgow Coma Scale (points)	12.9 (3.2)	10.6 (4.0)	0.02*
Injury Severity Score (points)	14.7 (7.97)	17.8 (7.8)	0.19
Hospital internment time (days)	15.3 (11.3)	42.3 (25.0)	0.01*
ICU internment time (days)	5.2 (9.3)	20.9 (14.5)	0.01*
Orotracheal tube time (days)	3.0 (5.1)	15.8 (7.0)	0.01*

* p<0.05 Student's t-test.

The qualitative variables are presented in the Table 3, we can observe that patients with TCE, intubation in the first 48 hours of hospital internment and use of NGT developed hospital pneumonia.

Table 3 – Frequency distribution and percentages for the qualitative variables.

Qualitative variables	Without Pneumonia (n=55) N (%)	With Pneumonia (n=15) N (%)	p Value
Male	41 (74)	12 (80)	0.47
Illicit drugs	1 (1.8)	3 (20)	0.06
Coronary disease	2 (3.6)	1 (6.7)	0.08
Systemic Arterial Hypertension	5 (9.1)	2 (13.3)	0.09
Smoking	8 (14.5)	2 (13.3)	0.42
Alcoholism	14 (25.4)	5 (33.3)	0.13
Blood Transfusion (first 48 hours)	15 (27.2)	5 (33.3)	0.58
Blut trauma	37 (67.2)	13 (86.7)	0.18
Craniocerebral trauma	29 (52.7)	11 (73.3)	0.04
Death	7 (12.7)	1 (6.7)	0.41
Tracheal intubation (time <48 hours)	12 (21.8)	11 (73.3)	0.01
Tracheostomy	7 (12.7)	6 (40)	0.09
Nasogastric tube	5 (9.1)	5 (33.3)	0.01

* p<0.05 Student's t-test.

In the Table 4 are presented the variables, confidence intervals of the univariate analysis and of the multivariate analysis and their respective p values. We can observe by the univariate analysis that for each point less in the GCS value at the patient's admission time, it was demonstrated 16% more chance of pneumonia acquiring. The presence of the endotracheal tube increased 1.27 times and the use of NGT during the hospital internment period increased 4.08 times the possibility of acquiring hospital pneumonia. In its turn, in the multivariate analysis, the endotracheal tube presence as independent risk factor (OR=1.28 and p=0.01) for the pneumonia development after the trauma.

Table 4 – Presentation of the odds ratio, confidence interval and the value o p according to the univariate and multivariate analysis.

Variables	Confidence Interval	Univariate Analysis		Multivariate Analysis	
		OR	p	OR	p
Illicit drugs	0.70–24.10	4.30	0.09	3.08	0.07
Smoking	0.10–3.50	0.69	0.66	0.10	0.63
Alcoholism	0.60–6.20	1.95	0.25	0.00	0.21
Blood transfusion	0.30–4.10	1.20	0.75	0.12	0.67
GCS in the admission	0.70–0.90	0.84	0.03	1.23	0.13
ISS	0.90–1.10	1.04	0.19	0.28	0.15
TBI	0.80–19.50	4.01	0.07	0.32	0.06
ST	0.60–2.50	0.90	0.11	0.25	0.93
Thorax trauma	0.30–3.90	1.22	0.13	0.10	0.70
Abdominal trauma	0.08–1.30	0.30	0.73	1.8	0.13
OT	1.10–1.40	1.27	0.01	1.28	0.01
NG Tube	1.00–16.30	4.08	0.04	5.30	0.19

Caption: OR (Odds Ratio), GCS Glasgow Coma Scale, ISS (Injury Severity Score), TBI (Traumatic Brain Injury), ST (Spine Trauma), OT (Orotracheal Tube), NG Tube (Nasogastric Tube).

DISCUSSION

The goal of this study was to evaluate the predisposing factors for the developing of HAP in trauma-victim patients. In this sense, the results demonstrated that the level of consciousness evaluated through the GCS-at the time of the admission, the use of NGT and the use of endotracheal tube represent risk factors in this patients' population.

In this study, the pneumonia occurrence was of 21%, showing an incidence similar to the found in the literature, that presents variations between 9% and 27% for UCI-interned patients.[3-4] For these authors, one possible explanation to that variations in the HAP incidence are the used diagnosis criteria, as well as the sort of patient. Other factors that possibly can be associated between the offered care to these patients, mainly by the Hospital Infection Control Service in the definition and application of antibiotic therapy, as well as the actuation of multidisciplinary team that, concomitantly, can directly influence in the control of possible complications and or infections that can seizure these individuals during the hospital internment period.[18-19]

In a recent systematical revision, the authors demonstrated that, in the last three decades, changes in the treatment of trauma victims like the use of protocols of blood transfusion, approach and advanced surgical techniques, control of fluid challenge and coagulopathy diminished the mortality and complications in this patients' population.[19]

On the other hand, other authors suggested that some determining factors for the mortality in trauma victims are the deep suppression of the immune system and commitment of the level of the level of consciousness, leading to the need of tracheal intubation and ventilatory support, augmenting, thereby, the incidence of PAV and of the during of UCI and hospital internment.[12,20]

In the present study, all the patients who developed pneumonia were UCI interned at the time of diagnosis, where are stratified by severity indexes and have differentiated accompany, with skilled and multi-professional and, even so, the mean quantity of days until the pneumonia diagnosis was of 8.7 days, where all the patients were using the endotracheal tube.

The presence of endotracheal tube was considered independent risk factor for the development of HAP, as pointed out by the multivariate analysis, that is, independent of any other variable, and is in accordance with previous studies which demonstrated that the invasive devices, as the endotracheal tube, relate in a

constant form with the risk of respiratory infections and are, also, the ones lesser influenced by other factors.[21]

In most part of the patients who developed PAV, the intubation occurred in a precocious way, that is, in the first 48 hours, as a form of preventing hypoxemia, protect the respiratory tract and avoid bronchoaspiration. However, it was observed that 73.3% of the patients developed pneumonia. This result can be associated to the fact that, despite the early intubation commonly be necessaire as a way of protection of respiratory tract, the presence of the endotracheal tube leads to the necessity of sedation, which alters the natural mechanisms of pulmonary protection, as the mucociliary clearance, the cough effectiveness, besides allowing the microaspiration of subglottic secretions that are found around the cuff, predisposing to the appearance of pulmonary infections.[22-23]

By analyzing the GCS of the patients, it had been observed that were found lesser values in the patients who developed pneumonia. This result corroborates with other paper where it had been demonstrated that the low levels of conscientiousness compromised the protection of the respiratory tract, may causing bronchoaspiration and consequently pneumonia.[18] In addition to these factors, the immobility in the bed and the hypoventilation can lead to atelecatasis formation, denoting, in this way, that the reduction on conscientiousness level and other alterations consequence of it can potentialize the pneumonia development.[18,24]

Another literature-demonstrated important aspect to the development of HAP is trauma severity. In this research, it was evaluated by means of the ISS, which presented lesser values when compared to other studies, without significant association to the development of HAP. Although there were already demonstrated that the incidence of pneumonia seen to increase with trauma severity, the prevalence of pneumonia in this sample occurred even with low ISS values, supporting that secondary factors, developed

after the trauma, can be involved on its development.[19,25]

In accordance with the literature, the hospital internment time find in this study was higher in the population that developed HAP. Studies describe that long hospital internment periods contribute for a higher incidence of hospital infections,[26] however, in this study, the clinical and radiological signs of pneumonia occurred with mean time of 8 days, what possible enlarged the hospital internment time of this patients as consequence of the development of infection and the treatment need.

Another found of this study, through the univariate analysis, was that the presence of NGT represented a 4 times chance for the development of HAP. Possibly it is related to the fact that the presence of the NGT alters the function of the gastroesophageal sphincter, increasing the reflux and oropharyngeal colonization, as well as the risk maxillary sinusitis, which can lead to bacterial migration and development of infection.[26] On the other hand, the maintenance if the critical patient's nutritional status and the precocious beginning of enteral feeding are important and can preserve the gastrointestinal epithelium and prevent bacterial colonization.[27]

For mechanically ventilated patients, the guidelines recommend the semi-seated position with headboard elevated by 30° to 45° and maintaining the ideal cuff pressure, narrowing, in this way, the oropharyngeal colonization and the pulmonary aspiration of gastric secretions.[27-28]

CONCLUSION

This study demonstrated that, in polytrauma patients, the predisposing factors for the pneumonia development were lower values in the Glasgow Coma Scale, us of Nasogastric Tube and the use of Endotracheal Tube, being this last one, risk factor for development of infection.

RESUMO

Introdução: A literatura tem demonstrado que a incidência de Pneumonia Adquirida no Hospital é maior em pacientes vítimas de trauma. O objetivo é identificar os fatores de risco para o desenvolvimento de Pneumonia Adquirida no Hospital em pacientes politraumatizados. **Delineamento:** Estudo longitudinal retrospectivo, com análise de 70 prontuários de pacientes admitidos no pronto socorro de um hospital terciário, por um período maior do que 48 horas. Foram coletados dos prontuários: dados da admissão, do trauma, métodos invasivos e sinais clínicos de pneumonia na internação. **Resultados:** Dos 70 pacientes incluídos, 15 (21,4%) apresentaram pneumonia até o quinto dia de internação. Quando aplicado modelo de regressão logística univariada, observou-se que a Escala de Coma de Glasgow à admissão (p=0,03), uso do tubo endotraqueal (p=0,01) e sonda nasogástrica (p=0,04) se associaram com o aumento do risco de pneumonia hospitalar. Já na análise multivariada apenas o tubo endotraqueal foi associado com o aumento do risco para desenvolver a pneumonia. **Implicações:** O estudo demonstrou que nestes pacientes, o nível de consciência, o uso de sonda nasogástrica e tubo endotraqueal, são fatores predisponentes para o desenvolvimento de pneumonia, sendo a intubação endotraqueal um fator de risco independente.

DESCRITORES
Pneumonia; Ferimentos e Lesões; Fatores de Risco; Infecção Hospitalar.

RESUMEN

Introducción: La literatura ha demostrado que la incidencia de neumonía adquirida en el hospital es mayor en pacientes traumatizados. El objetivo es identificar factores de riesgo para el desarrollo de neumonía adquirida en el hospital en pacientes politraumatizados. **Delineación:** Estudio longitudinal retrospectivo, con análisis de 70 historias clínicas de pacientes ingresados en el servicio de urgencias de un hospital terciario, por un período superior a 48 horas. Se obtuvieron de los registros médicos: datos de ingreso, trauma, métodos invasivos y signos clínicos de neumonía al ingreso. **Resultados:** De los 70 pacientes incluidos, 15 (21,4%) tenían neumonía al quinto día de hospitalización. Al aplicar un modelo de regresión logística univariante, se observó que la Escala de coma de Glasgow al ingreso (p=0,03), uso de sonda endotraqueal (p=0,01) y sonda nasogástrica (p=0,04) asociado con un mayor riesgo de neumonía nosocomial. En el análisis multivariado, solo el tubo endotraqueal se asoció con un mayor riesgo de desarrollar neumonía. **Implicaciones:** El estudio demostró que en estos pacientes, el nivel de conciencia, el uso de sonda nasogástrica y sonda endotraqueal, son factores predisponentes para el desarrollo de neumonía, siendo la intubación endotraqueal un factor de riesgo independiente.

DESCRIPTORES
Neumonía; Heridas y Traumatismos; Factores de Riesgo; Infección Hospitalaria.

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CONFLICTS OF INTEREST

There are no conflicts of interest to declare.