

Presencia de neumotorax como evento adverso relacionado con la atención a la salud

RESUMO | Introdução: El acceso venoso central se define como la colocación de un catéter con su extremo posicionado en la vena cava superior o en la aurícula derecha, teniendo varias funciones en el manejo del paciente en estado crítico. El neumotórax causado durante la inserción del catéter es un incidente que resulta en daño para el paciente, por lo que se considera un evento adverso relacionado con la atención a la salud. Objetivo: Analizar la ocurrencia de neumotórax como eventos adversos relacionados con la atención a la salud después de la inserción de un catéter venoso central. Método: Se trata de un estudio cuantitativo, transversal, analítico. Después de realizar el cálculo de la muestra para la obtención de la muestra, se incluyeron en la investigación los pacientes que se sometieron a la inserción de un catéter venoso central en la institución investigada de abril a septiembre de 2022, la recolección de datos utilizó datos secundarios. Resultados: Se obtuvo una muestra de 103 pacientes, de los cuales 10 (9,7%) de los pacientes presentaron neumotórax relacionado con la inserción de un catéter venoso central. La ocurrencia de neumotórax y el hecho de que el profesional que insertó el catéter fuera residente. La ocurrencia de neumotórax tuvo una asociación significativa ($p < 0,03$) que condujo a una mayor duración de la estancia. Conclusión: Los resultados encontrados demuestran una ocurrencia significativa del evento adverso relacionado con la atención de salud del neumotórax, después de la inserción del Catéter Venoso Central (CVC). Las estrategias dirigidas a la seguridad del paciente son fundamentales y deben ser seguidas constantemente.

Descritores: Catéteres Venosos Centrales; Enfermería; Neumotórax; Evento Adverso.

ABSTRACT | Introduction: Central venous access is defined as the placement of a catheter with its end positioned in the superior vena cava or in the right atrium, having several functions in the management of the patient in critical condition. Pneumothorax caused during catheter insertion is an incident that results in harm to the patient, thus considered an adverse event related to health care. Objective: To analyze the occurrence of pneumothorax as adverse events related to health care after insertion of a central venous catheter. Method: This is a quantitative, cross-sectional, analytical study. After performing the sample calculation to obtain the sample, patients who underwent insertion of a central venous catheter at the researched institution from April to September 2022 were included in the research, data collection used secondary data. Results: A sample of 103 patients was obtained, of which 10 (9.7%) of the patients had pneumothorax related to the insertion of a central venous catheter. The occurrence of pneumothorax and the fact that the professional who inserted the catheter was a resident. The occurrence of pneumothorax had a significant association ($p < 0.03$) leading to increased length of stay. Conclusion: The results found demonstrate a significant occurrence of the adverse event related to pneumothorax health care, after the insertion of the Central Venous Catheter (CVC). Strategies aimed at patient safety are fundamental and must be pursued constantly.

Keywords: Central Venous Catheters; Nursing; Pneumothorax; Adverse Event.

RESUMEN | Introducción: El acceso venoso central se define como la colocación de un catéter con su extremo posicionado en la vena cava superior o en la aurícula derecha, teniendo varias funciones en el manejo del paciente en estado crítico. El neumotórax causado durante la inserción del catéter es un incidente que resulta en daño para el paciente, por lo que se considera un evento adverso relacionado con la atención a la salud. Objetivo: Analizar la ocurrencia de neumotórax como eventos adversos relacionados con la atención a la salud después de la inserción de un catéter venoso central. Método: Se trata de un estudio cuantitativo, transversal, analítico. Después de realizar el cálculo de la muestra para la obtención de la muestra, se incluyeron en la investigación los pacientes que se sometieron a la inserción de un catéter venoso central en la institución investigada de abril a septiembre de 2022, la recolección de datos utilizó datos secundarios. Resultados: Se obtuvo una muestra de 103 pacientes, de los cuales 10 (9,7%) de los pacientes presentaron neumotórax relacionado con la inserción de un catéter venoso central. La ocurrencia de neumotórax y el hecho de que el profesional que insertó el catéter fuera residente. La ocurrencia de neumotórax tuvo una asociación significativa ($p < 0,03$) que condujo a una mayor duración de la estancia. Conclusión: Los resultados encontrados demuestran una ocurrencia significativa del evento adverso relacionado con la atención de salud del neumotórax, después de la inserción del Catéter Venoso Central (CVC). Las estrategias dirigidas a la seguridad del paciente son fundamentales y deben ser seguidas constantemente.

Palabras claves: Catéteres Venosos Centrales; Enfermería; Neumotórax; Evento Adverso.

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Recebido em: 11/12/2022

Aprovado em: 23/01/2023

INTRODUÇÃO

Central Venous Catheters (CVC) are important in the management of critically ill patients in emergency units and Intensive Care Units (ICU). Central venous access is defined as placement of a catheter

with its end positioned in the superior vena cava, in the right atrium, or in a large-caliber vessel. It can be inserted through a peripheral vein or a proximal central vein, the most used being the internal jugular, subclavian and femoral veins.^(1,2)

CVCs have several functions in the management of critically ill patients, both for diagnoses and for specialized treatments, hemodynamic monitoring, administration of parenteral nutrition, administration of chemotherapy, infusion of blood and blood components, and performance of hemodialysis⁽³⁾. With the advancement of modern medicine, a growing number of CVC insertions can be observed; in the United States there are an estimated 15 million insertions each year⁽⁴⁾.

Complications may occur during insertion, the most prevalent and worrying being pneumothorax; which is a trauma that occurs in the pleural cavity, causing air to enter this space located between the parietal and visceral pleura, leading to lung collapse on the affected side⁽⁵⁾. In the face of such an occurrence, an invasive approach is required, commonly using the placement of a chest drain⁽⁶⁾.

Studies have pointed to pneumothorax as one of the main mechanical complications related to CVC insertion⁽⁷⁾⁽¹⁾⁽⁸⁾. Pneumothorax is an incident that results in harm to the patient, thus considered an adverse event related to health care⁽²⁾. Adverse events cause harm to patients, their families and the entire health system and occur due to failures resulting from care processes or structures.⁽⁹⁾ The National Patient Safety Program aims to prevent, monitor and reduce the incidence of adverse events in health care, in order to promote improvements related to patient safety and the quality of health services in Brazil⁽¹⁰⁾.

The nursing team are professionals of paramount importance for the evaluation and management of adverse events, contributing to the reduction and being able to promote improvement in the care processes⁽²⁾. Studies on complications related to CVC insertion are still limiting and little discussed. Knowing the conditions related to the occurrence of pneumothorax as

an adverse event related to health care after CVC insertion is relevant for the debate on this topic and for devising future strategies aimed at patient safety. It is believed that some conditions can influence the appearance of this complication and knowing them is essential. It is essential to prevent, reduce and monitor the incidence of adverse events, as they cause damage to the patient's health, as well as other negative repercussions, such as an increase in hospitalization time, bringing more hospital costs and physical and psychological impact on patients' lives.

The objective of the study was to analyze the occurrence of pneumothorax as an adverse event related to health care after insertion of a central venous catheter.

METHOD

This is a study with a quantitative, cross-sectional, and analytical approach. The study site is a large hospital that provides high and medium complexity care in urgency and emergency, with a focus on traumatology.

For the sample effect size (f_2), it was calculated from the coefficient of determination (r^2) generated in the multiple logistic regression analysis, using the G.Power® 3.1 software. Therefore, a significance level of 0.05, confidence interval of 0.95, sample power of 0.95 and sample effect of 0.17 were adopted. Thus, a minimum estimate of 103 patients was verified in the sample.

Patients of both sexes, victims of trauma, who underwent insertion of a central venous catheter and who underwent X-rays to confirm the placement of the catheter with a report issued by the radiologist were included. Patients with a diagnosis of pneumothorax prior to catheter insertion and with catheter insertion through the femoral vein were excluded.

Data collection was guided by a structured instrument, developed by the

researchers and appreciated by professionals in the area, before its application. With variables to be collected. Characteristics related to the patient (age group and sex); Clinical Data (comorbidities, type of trauma, use of mechanical ventilation at the time of CVC insertion, length of stay); Characteristics of the Central Venous Catheter (catheter type, insertion site, purpose/indication); Characteristics of the professional who inserted the Central Venous Catheter (medical specialty); Sector/Unit where the catheter was inserted; Conduct after insertion of the catheter (Days of permanence of the chest drain).

Data collection took place from April to September 2022, using the described instrument, the medical records of patients who had catheter insertion, were accessed, and analyzed, to obtain the researched information. In the same way, the chest X-ray taken by the patient after insertion of the CVC was evaluated and whether pneumothorax had occurred or not, based on the report issued by the radiologist, in view of the control X-ray after insertion of the catheter.

In the statistical analysis, the characterization of the patients' profile was performed using absolute and relative frequencies for categorical variables; mean and standard deviation for continuous variables. Data normality was verified using the Kolmogorov-Smirnov test. The profile distribution according to the prevalence of pneumothorax was tested using Pearson's chi-square and Student's t test. From this exploratory analysis, exploratory variables ($p < 0.20$) were selected for the Multiple Logistic Regression analysis using the conditional Backward method. The significance level adopted was 5% ($p < 0.05$).

The research was approved by the Ethics and Research Committee of the institution, with approval opinion, nº 5,286,577; CAAE 56119622.0.0000.5082. All determinations of Resolution nº 466/2012 of the Ministry of Health, regarding research

with human beings, were respected.

RESULTS

A sample of 103 patients was obtained, descriptions of demographic characteristics are shown in Table 1. Of the 103 patients, ten (9.7%) had pneumothorax related to the insertion of the Central Venous Catheter.

Regarding the type of trauma associated with the occurrence of pneumothorax, it is shown in Table 2. A significant association (p 0.02) was found between musculoskeletal trauma and the non-occurrence of pneumothorax.

As for the characteristics of the professionals who performed the insertion of the Central Venous Catheter and the occurrence of pneumothorax, they are presented in Table 3. A significant association was evidenced between the occurrence of pneumothorax and the fact that the professional who performed the insertion was a resident.

Analyzing the catheter insertion characteristics, the insertion site that had the highest occurrence of pneumothorax was the subclavian vein with 80% (eight) occurrences and 20% (two) in the jugular vein. 92.2% were inserted short-term catheters, and 86.4% for medication infusion purposes. Of the 10 patients who had pneumothorax, 90% were on Mechanical Ventilation (MV), and 68% of the sample was on MV at the time of catheter insertion.

The unit that had the highest insertion of CVC was the Intensive Care Unit, but the sector that had the most occurrence of pneumothorax was the Emergency Room with a percentage of 60% with p>0.02 showing a significant association, the other sectors are presented below in Table 4.

The occurrence of pneumothorax had a significant association (p 0.03) leading to increased length of stay (table 5).

Table 1: Characterization of the demographic profile of trauma victims with CVC insertion. Goiânia-Goiás. 2022 (n = 103).

	Pneumothorax n (%)		Total
	No - 93 (90,3)	Yes - 10 (9,7)	
Age group			
< 18 years old	8 (8,6)	0 (0,0)	8 (7,8)
18 to 39 years old	20 (21,5)	5 (50,0)	25 (24,3)
40 to 59 years old	30 (32,3)	3 (30,0)	33 (32,0)
60 to 79 years old	24 (25,8)	2 (20,0)	26 (25,2)
80 or more	11 (11,8)	0 (0,0)	11 (10,7)
Gender			
Female	25 (26,9)	1 (10,0)	26 (25,2)
Male	68 (73,1)	9 (90,0)	77 (74,8)
Comorbidities			
Chronic disease	33 (35,5)	2 (20,0)	35 (34,0)
Hypertensive	16 (17,2)	1 (10,0)	17 (16,5)
DM	15 (16,1)	1 (10,0)	16 (15,5)
Cardiovascular diseases	12 (12,9)	0 (0,0)	12 (11,7)
Other diseases	17 (18,3)	0 (0,0)	17 (16,5)

Table 2: Characterization of types of traumas according to the involvement of pneumothorax in patients. Goiânia-Goiás. 2022 (n = 103).

Types of traumas	Pneumothorax n (%)		Total	p*
	No - 93 (90,3)	Yes - 10 (9,7)		
Polytrauma	36 (38,7)	6 (60,0)	42 (40,8)	0,19
Falls	27 (29,0)	1 (10,0)	28 (27,2)	0,19
Musculoskeletal trauma	24 (25,8)	0 (0,0)	24 (23,3)	0,02
Motorcycle accident	23 (24,7)	3 (30,0)	26 (25,2)	0,71
Head trauma	21 (22,6)	2 (20,0)	23 (22,3)	0,85
Car Accident	17 (18,3)	4 (40,0)	21 (20,4)	0,10
Burns	6 (6,5)	1 (10,0)	7 (6,8)	0,67
Abdominal trauma	6 (6,5)	0 (0,0)	6 (5,8)	0,48
Interpersonal Violence	5 (5,4)	1 (10,0)	6 (5,8)	0,56
Chest trauma	2 (2,2)	0 (0,0)	2 (1,9)	0,64
Spine trauma	1 (1,1)	1 (10,0)	2 (1,9)	0,05

*Pearson chi-square; n, absolute frequency; %, relative frequency.

Table 3: Categorization of the profile of professionals in the insertion of CVC and the occurrence of pneumothorax. Goiânia-Goiás. 2022 (n = 103).

Professionals in CVC insertion	Pneumothorax n (%)		Total	p*
	No - 93 (90,3)	Yes - 10 (9,7)		
No Specialty Registered	49 (52,7)	2 (20,0)	51 (49,5)	0,04
Resident	13 (14,0)	4 (40,0)	17 (16,5)	0,03
Anesthetist	10 (10,8)	1 (10,0)	11 (10,7)	0,94

DISCUSSION

The results found demonstrate a significant occurrence of the adverse event related to pneumothorax health care, after the insertion of the Central Venous Catheter (CVC). As for related factors, there is a significant association between pneumothorax and the fact that the professional who performed the insertion was a resident and the catheter was inserted in an emergency situation in the emergency room. The highest occurrence occurred when inserted into the subclavian vein and in patients who were on mechanical ventilation. The occurrence of pneumothorax increases the length of stay of trauma victims.

There are few publications on the occurrence of pneumothorax after insertion of a central catheter in the literature, and the existing ones show this as the most predominant mechanical complication and especially when punctured in emergency situations in the emergency room.⁽¹¹⁾⁽⁷⁾ Evidence, in line with the findings of this research.

In a hospital unit in Washington, a study was carried out that analyzed complications related to CVC between two groups, a group of physicians who underwent training through realistic simulation of CVC insertion and the other group that did not. Noting that those who received the training had fewer complications compared to those who did not. Showing the need to implement continuous training to perform CVC insertion, which may be able to reduce this complication⁽¹²⁾.

A strategy presented in the literature to minimize the occurrence of pneumothorax is the Safe Insertion of Centrally Inserted Centrally (SIC) protocol, a method that uses seven basic steps for safe insertion of the catheter, namely: Pre-procedural evaluation; Choice of vein by ultrasound exami-

General surgeon	6 (6,5)	2 (20,0)	8 (7,8)	0,12
Medical specialty: Intensivist	5 (5,4)	0 (0,0)	5 (4,9)	0,45
General practitioner	4 (4,3)	0 (0,0)	4 (3,9)	0,50
Nephrologist	3 (3,2)	0 (0,0)	3 (2,9)	0,56
Pediatrician	2 (2,2)	1 (10,0)	3 (2,9)	0,16
Orthopedist	1 (1,1)	0 (0,0)	1 (1,0)	0,74

*Pearson chi-square; n, absolute frequency; %, relative frequency.

Table 4: Insertion of the Central Venous Catheter and the occurrence of pneumothorax according to the hospitalization sector. Goiânia-Goiás. 2022 (n = 103).

Sector/Inpatient Unit	Pneumothorax n (%)		Total	p*
	No - 93 (90,3)	Yes - 10 (9,7)		
Adult ICU	42 (45,2)	2 (20,0)	44 (42,7)	0,12
Emergency Room	23 (24,7)	6 (60,0)	29 (28,2)	0,02
Surgery Center	14 (15,1)	2 (20,0)	16 (15,5)	0,69
Adult hospitalization	9 (9,7)	0 (0,0)	9 (8,7)	0,30
Pediatric Hospitalization	2 (2,2)	0 (0,0)	2 (1,9)	0,64
Pediatric ICU	1 (1,1)	0 (0,0)	1 (1,0)	0,74

*Pearson chi-square; n, absolute frequency; %, relative frequency.

Table 5: Association of pneumothorax with length of hospital stay and mean and standard deviation of days of chest tube use. Goiânia-Goiás. 2022 (n = 103).

	Pneumothorax n (%)		Total	p*
	No - 93 (90,3)	Yes - 10 (9,7)		
	Mean ± SD			
Drain days		7,57 ± 4,12	7,57 ± 4,12	N/A
Length of stay (days)	34,58 ± 32,11	52,40 ± 31,92	36,31 ± 32,38	0,03

*Student's t test; n, absolute frequency; %, relative frequency; na, not applicable; SD, standard deviation.

nation; Appropriate aseptic technique; Ultrasound guided insertion; Intra-procedural assessment of catheter tip location; Adequate protection of the exit site to reduce bleeding; Adequate fixation of the exit location; Use of sutureless devices and proper dressing in place⁽¹³⁾.

A study points out that the use of the SIC protocol leads to a decrease in mechanical complications, showing that in the ultrasound-guided puncture stage, the professional is able to observe whether pleural trauma has occurred through the catheter, thus

making it an effective method bringing innovation and technology in performing CVC insertion contributing to the reduction of adverse events related to the insertion technique, in addition to providing safety and quality of care offered⁽¹⁴⁾.

Patients using mechanical ventilation showed higher rates of pneumothorax after catheter insertion, a fact that can be explained by the high positive end-expiratory pressure (PEEP), which causes controlled pulmonary hyperinflation, which differs when the patient is in physiological PEEP

, thus allowing greater contact with the pleura at the time of insertion of the catheter⁽¹⁵⁾⁽¹⁶⁾. Subclavian vein insertion with continuous mechanical ventilation has a significant association compared with patients who have subclavian insertion in brief apnea⁽¹⁷⁾.

A retrospective study carried out in an emergency room showed that pneumothorax was observed in four cases with insertion in the right subclavian vein and three cases in the left subclavian vein, showing that these insertion sites are the ones that most cause pneumothorax due to the anatomical region being close to the pleura. In addition, as it is in the emergency unit that requires agility and overload for the professional who performs the procedure, this complication results⁽¹⁸⁾.

Studies show that for the safe insertion of the CVC, there is ultrasound support that collaborates with patient safety; bringing several benefits such as: single puncture, reducing the risk of pneumothorax, nerve, artery and vein injuries, facilitating and speeding up the catheter positioning confirmation process and showing such complications early, eliminating the use of radiography for evaluation; However, these studies show the effectiveness of ultrasound in the diagnosis and early management of pneumothorax related to CVC insertion⁽⁶⁾⁽⁸⁾.

The use of the Peripherally Inserted Central Catheter (PICC), which is a long-lasting, peripherally punctured centrally located catheter in the superior or inferior vena cava, can be an excellent strategy, as the occurrence of this adverse event does not exist because it treat a peripheral puncture⁽¹⁹⁾. The PICC compared to the CVC is safer and more effective because in addition to reducing the risk of mechanical complications, it also reduces the rates of bloodstream infections.⁽¹⁷⁾.

The nurse is one of the professionals qualified to insert the PICC as

long as he/she is qualified to insert it, and this procedure can be guided by ultrasound and also make use of te-



Pneumothorax is an incident that results in harm to the patient, thus considered an adverse event related to health care. Adverse events cause harm to patients, their families and the entire health system and occur due to failures resulting from care processes or structures.



chniques for handling subcutaneous anesthetics⁽²⁰⁾. The management of adverse events is one of the global con-

cerns of patient safety, fitting it as a multidisciplinary competence⁽¹⁰⁾. The nursing team has an important role in the management of adverse events related to the insertion of a central venous catheter and the insertion of the PICC, giving them continuous attention and intervening in inappropriate conducts in the management of these devices; the nurse assists in the creation of care protocols to contribute to the reduction of adverse events and the improvement of patient safety⁽²¹⁾.

As limitations of the present study, the lack of information because it is secondary data from the medical records. And the characteristics pertinent to the type of study design.

CONCLUSION

The results found demonstrate a significant occurrence of the adverse event related to pneumothorax health care, after the insertion of the Central Venous Catheter (CVC). As for related factors, there is a significant association between pneumothorax and the fact that the professional who performed the insertion was a resident and the catheter was inserted in an emergency in the emergency room. The highest occurrence occurred when inserted into the subclavian vein and in patients who were on mechanical ventilation. The occurrence of pneumothorax increases the length of stay of trauma victims.

From this reality found, proposing training for professionals with less training time and less technical skill is paramount, as well as the use of resources to facilitate and guide the insertion of the catheter, as in the case of ultrasound. Thinking strategically about the peripherally inserted central catheter as a first option could be a fantastic initiative to reduce such an adverse event. Strategies aimed at patient safety are fundamental and must be pursued constantly.

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