



## USE OF CENTRAL VENOUS CATHETER IN PATIENTS HOSPITALIZED IN AN INTENSIVE CARE UNIT

*UTILIZAÇÃO DE CATETER VENOSO CENTRAL EM PACIENTES INTERNADOS EM UMA UNIDADE DE TERAPIA INTENSIVA*

*USO DE CATÉTER VENOSO CENTRAL EN PACIENTES INTERNADOS EN UNA UNIDAD DE CUIDADOS INTENSIVOS*

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This is an exploratory, descriptive study with a quantitative approach, which aimed at describing the use of central venous catheters for a short period in an intensive care unit regarding their insertion, maintenance, and removal, and at identifying the profile of patients who received the catheter in the period from June to December 2012, in a private hospital in Fortaleza, CE, Brazil. Data were collected through a questionnaire filled in with information contained in the medical records of the patients and their observation. The types of catheter used were double lumen catheter (76%), single lumen catheter (24%) and the puncture site accesses were in the subclavian vein (64%) and in the jugular vein (36%). Among the reasons for the catheter removal, these were observed: hospital discharge (44%), time of use of catheter (32%). For the maintenance of the catheter the permanent education of the health professional is important, a strategy which qualifies assistance.

**Descriptors:** Catheterization, Central Venous; Nursing Care; Intensive Care Unit.

Objetivou-se descrever a utilização do cateter venoso central de curta permanência em Unidade de Terapia Intensiva quanto à inserção, manutenção e remoção, e identificar o perfil dos pacientes que receberam o cateter de junho a dezembro/2012 em hospital da rede privada de Fortaleza-CE, Brasil. Estudo exploratório, descritivo, com abordagem quantitativa, cujos dados foram coletados por questionário preenchido com informações contidas nos prontuários dos pacientes e observação. Quanto ao tipo de cateter utilizado foram duplo lúmen (76%), lúmen único (24%), puncionado em veia subclávia (64%) e jugular (36%). Entre os motivos para a remoção do cateter destacam-se alta hospitalar (44%), tempo de permanência do cateter (32%). Para a manutenção do cateter é importante a educação permanente dos profissionais, estratégia que qualifica a assistência.

**Descritores:** Cateterismo Venoso Central; Cuidados de Enfermagem; Unidades de Terapia Intensiva.

El objetivo fue describir la utilización del catéter venoso central de corta permanencia en Unidad de Cuidados Intensivos cuanto a la inserción, mantenimiento y remoción, e identificar el perfil de pacientes que recibieron el catéter entre junio y diciembre/2012, en hospital privado de Fortaleza-CE, Brasil. Datos fueron recogidos a través de cuestionario con informaciones contenidas en registros médicos de pacientes y observación. Con respecto al tipo de catéter utilizado y sitio de punción del acceso, 76% fueron catéter de doble lumen, 24% de lumen único, de estos, 64% en vena subclavia, 36% en yugular. Entre las razones para la retirada del catéter, 44% fueron por alta hospitalaria, tiempo de catéter (32%). Para el mantenimiento del catéter, es importante educación continua de profesionales, estrategia que cualifica la atención.

**Descriptorios:** Cateterismo Venoso Central; Atención de Enfermería; Unidades de Terapia Intensiva.

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## INTRODUCTION

The Intensive Care Units (ICU) are specialized areas in the hospitals used for the treatment of patients whose survival is threatened by diseases or conditions that cause instability or malfunction of one or more physiological systems. In order to render adequate assistance to these patients, qualified personnel is necessary, besides technological resources of monitoring, support of vital functions and the use of invasive devices<sup>(1)</sup>.

The invasive monitoring of a patient hospitalized in an ICU is one of the favorable conditions for the establishing of infection. Among the main invasive devices used in an ICU the use of intravascular catheter, especially the venous ones, is pointed out<sup>(2)</sup>.

The central catheters are usually used when there is a limitation in the use of the peripheral ones; when there is the need of endovenous therapy for a long period of time; urgency of administration of toxic or irritating substances as in a prolonged parental nutrition which requires quick dilution in a vein of big caliber; in the fast and safe reposition of fluids and electrolytes, permanent access for the application of medicine in emergencies or in the case of hemodynamic monitoring in critical patients<sup>(3)</sup>.

The Central Venous Catheter (CVC) allows a way of vascular access of a big caliber vein, reaching the superior vena cava when introduced percutaneously through the subclavian or internal jugular veins, or through the profound vein of the forearm, followed by the introduction of a long catheter. It can have multiple lumens, it can be of long or short permanence, requiring an implantation more careful than the peripheral devices, many times surgical, through phlebotomy. Due to such characteristics, the complications are also bigger than the ones related to peripheral devices, mechanical or infectious complications can occur<sup>(4)</sup>.

Among the complications, the following ones are highlighted: pneumothorax, accidental arterial puncture, cellulites at the site of insertion, phlebitis, septic thrombophlebitis, bacteremia, sepsis, endocarditis and metastatic infections, as osteomyelitis, endophthalmitis, lung abscess, cerebral and arthritis, once it is a bloody technique, invasive, which brings high risk of morbidity e mortality<sup>(5)</sup>.

One of the fundamental strategies for the reduction of the incidence immediate or late complications is the use of strict criteria of indication, strict adherence to the technical steps established in order to provide the vascular access being questioned, including the absolute obedience to the principles of asepsis and antisepsis of a standard surgical procedure, besides the care inherent to the use and maintenance of the catheter, thus providing safety to the patient and the reduction of time of hospitalization<sup>(6)</sup>.

The care of nursing in intensive therapy is complex and challenging, once these professionals are exposed to hard clinical situations, which requires greater attention and control, besides the need of integrated technological innovations, in a consistent, correct, safe and humanized way to the system of care at the bedside<sup>(7)</sup>. That is why there is the need to enhance knowledge on the use of the continuous infusion devices, such as the short permanence central venous catheter, once in the specific case of hospitalized patients at an ICU, is more commonly used, once it is indicated when there is the need of central access for a short period of time, normally from seven to ten days<sup>(8)</sup>.

So, the objective is to describe the use of the short permanence central venous catheter at an Intensive Care Unit regarding the insertion, maintenance and removal, and to identify the profile of the patients who received the catheter from June to December 2012, in a private hospital of Fortaleza, CE, Brazil.

## METHOD

It is a descriptive study, with quantitative approach, made from June to December, 2012, at Intensive Care Unit (ICU), in a private hospital at Fortaleza, CE, Brazil.

Patients with indication for the use of central venous catheter as a way of access for more than 24 hours, for the administration of solutions, medicine and hemoderivatives independently of the pathology of basis, were included in this study. The ones admitted in the unit with central venous access, and the ones who lost the access accidentally, were excluded of this study.

The collected data were registered in an individualized file, with the daily evolution, made by one of the researches from the entrance of the patient in the intensive care unit until the hospital discharge or transference. It was considered as hospital discharge when the patient was taken to another place out of the hospital of origin and transference, when the patient was sent to a unit within the same hospital.

An structured tool was used, with variables related to the characterization of the population (gender, age, reason for hospitalization) and the ones related to the insertion of the catheter (number of lumen, access site, time of permanence, reason for its use, associated complications and reason for removal). Variable is any characteristic which may vary, that is, it is any quality or person, group or situation that varies or acquires different values<sup>(9)</sup>, when dealing with the use of central venous catheter, some independent or dependent variables can favor the risks of infection, an important aspect to be considered in the moment of insertion of the catheter.

The technique of insertion of the catheter, and also the health professional that performed the procedure, were not evaluated. The tool was submitted to the appreciation and approval of the nurses of the units. The data were obtained through a search in the

medical records, as well as the observation of the patient.

Cultures of peripheral blood were made in patients with fever or other signs of infection. The catheters were removed when their use became unnecessary, in the case of obstruction or accidental loss, and submitted to cultures through the semi-quantitative method, where the segment of the tip of the catheter, of approximately 5 centimeters, is carefully transferred in the tube, taken to the laboratory, to the surface of a sheep blood agar plate of 100mm, with heated tweezers. With a slight pressure of the tweezers on the catheter, the catheter was rolled from one side to the other, at least four times, and, if folded, it was rubbed. The plate was incubated for 48 hours at 35.5°C and the colonies shown were identified through standard method. When necessary, after that identification, the biotyping was made until the level of the species, with computerized automatic system of micro biological identification based on calorimetry e turbidimetry (Vitek®), and they are considered positive when they present > 15 Colony Forming Units. In order to obtain diagnosis of infection of the blood stream, the technique in the presence of the catheter was used, without the need of its removal.

The data analysis was made through descriptive statistics, with the use of the program *Statistical Package for the Social Sciences (SPSS)*, version 19.0 for Windows. The data were presented in tables.

This study was approved in the Committee of Ethics in Research of the Universidade Federal do Ceará, Brazil, number 028.04.12. Furthermore, the subjects signed an Informed Consent Form.

## RESULTS

In the period of data collection, 50 punctures were made with central venous catheter. There was no discontinuity of supervision of the patients included in the study, being 60% women and 40% men. Patients with age between 40 and 55 years (50%) and with

pneumopathy (26%) were predominant. The catheters were made of polyurethane (100%), double lumen (76%), inserted in the subclavian vein (64%) and prescribed exclusively for the infusion of fluids and medicine (58%).

The removal of the catheter was motivated by hospital discharge (44%). The culture was negative (80%) and when colonized there was the presence of *Staphylococcus aureus* (10%). The period of permanence of the central venous access varied from 11 to 20 days.

Concerning the evolution post-implantation, 88% of the patients did not present complications. The ones who presented were regarding pneumothorax (6%), local hematoma (4%) and inadequate site of the tip of the catheter (2%). Table 1.

**Table 1** - Characteristics of the sample (n=50), according to the variables of the study. Fortaleza, CE, Brasil, 2012

Variables	n	%
Gender		
Male	20	40.0
Female	30	60.0
Age (years)		
40-55	25	50.0
56-70	15	30.0
71-90	8	16.0
> 90	2	4.0
Reason for hospitalization		
Pneumopathy	13	26.0
Post-operative	12	24.0
Neuropathy	10	20.0
Cardiopathy	8	16.0
Nephropathy	5	10.0
Endocrine disorders	2	4.0
Material of the catheter		
Polyurethane	50	100.0
Number of lumens of the catheter		
Two	38	76.0
One	12	24.0
Puncture site		
Subclavian	32	64.0
Jugular	18	36.0
Reason of the removal		
Hospital discharge	22	44.0
Infection of the exit site	16	32.0
Completion of the therapy	10	20.0
Persistant fever without infectious outbreak	2	4.0
Infections related to the catheters		
Yes	10	20.0
No	40	80.0
Microorganism on the tip of the catheter		
<i>Staphylococcus aureus</i>	5	10.0
<i>Proteus mirabilis</i>	2	4.0
<i>Acinetobacter baumannii</i>	1	2.0
<i>Klebsiella pneumoniae</i>	1	2.0
<i>Pseudomonas aeruginosa</i>	1	2.0
Time of permanence of the catheter (days)		
3-10	10	20.0
11-20	35	70.0
>30	5	10.0
Post-implantation complications		
Yes	6	12.0
No	44	88.0

## DISCUSSÃO

Among the hospitalized patients at the ICU, submitted to the punctures of short permanence central venous access, 60% were female, with average age between 45 and 55 years, confirming a study made in a university hospital on the profile of patients hospitalized in an intensive care unit, whose results showed that the female sex is predominant and the average age ranges from 45 to 60 years, revealing a population of risk for the development of complications, once the clinical conditions, illness and older ages increase the risks of infection<sup>(8)</sup>.

The use of vascular access has therapeutic function and, therefore, must be used with adequate indication, following routines, procedures and assistential protocol defined for representing additional risk to the health of patients<sup>(10)</sup>.

In this study, 64% punctures made for the implantation of the central venous catheter were inserted in the subclavian vein and 36% in the jugular vein. The subclavian vein is recommended as the proper site for the insertion of vascular catheter, due to the smaller probability of occurrence of infection of the blood stream<sup>(11)</sup>.

The site of insertion of the central venous catheter can be an important factor of risk for the development of infection of the blood stream. The catheters inserted in the jugular vein are more likely to have colonization than the ones inserted in the subclavian vein, due to the proximity of secretions from the oropharynx area and to the difficulty of immobilization of the catheter<sup>(10)</sup>.

Among the catheters used, 76% were double lumen and 70% had a time of permanence from 11 to 20 days. The vascular catheters can be made of several materials, have one or more lumens, be impregnated with anti-microbians, antiseptics or heparin. A study point to new strategies in the manufacturing of the catheters: with modification of the surfaces with

hydrated molecules and anti-adherents properties, antibiotic coated balloons, silver impregnated balloons, catheters with heparin and impregnated with silver sulfadiazine, with intra e extra lumen antibiotics, such as minocycline and rifampicin, short permanence (< 2 weeks) related to the reduction of infection and less effective than > 3 weeks<sup>(12)</sup>.

It was observed that 88% of the punctures did not cause any complications to the patients. Works describe that the education of the health team can be the most important measure for the prevention of the complications that have occurred from the use of central venous catheters. There must be attention to the care with washing hands as a primordial measure in the prevention of hospital infections. For such, together with the sensitization of the health professional team, it is necessary to favor adequate conditions for the performance of the procedure<sup>(4)</sup>.

Despite the fact that the central venous puncture is considered by the literature as a safe procedure, it is subject to complications, such as pneumothorax, hemothorax, arterial puncture, arrhythmia, bad positioning of the catheter and infections. A study showed that the rate of complications varied from 0.7 to 30%, so, just a small number of them expose the life to risk; however, it can increase the period and the cost of hospitalization<sup>(13)</sup>.

Nevertheless, some complications can be avoided, such as: inadequate site of the tip of the catheter; inadequate function to the torsions in its position; occlusion of the lumen; compression of the clavicle or the first ribs; bleeding at the site of the puncture and occasional hematoma, but such complication did not present major consequences<sup>(14)</sup>. When complications occur it is necessary to evaluate the removal of the central venous catheter. In the study, among the reasons of removal of the catheter were: 44% by hospital discharge, 32% by local infection and 20% were related to the completion of the therapy.

Regarding the average of permanence with the catheter, the period ranged for 7.8 to 8.4 days and 14.3 to 16.6 days. Regarding that matter, some authors report efficacy of these catheters only if used for approximately 10 days; and that, after this period, the infection is predominantly intraluminal. In addition, the bactericidal effect of the devices was restricted to the surface of the catheter and was not extended to the lumens<sup>(15-16)</sup>.

Therefore, the shorter the time of the permanence of the central venous catheter is, the smaller the probability of the development of complications related to it exists, reducing the time of hospital stay of the patient and the costs related to it<sup>(15)</sup>.

There was a prevalence of lack of micro-organisms in cultures on the tips of the catheters, but among the positive cultures, there was the presence of *staphylococcus aureus* (10%), with higher frequency. The negative *staphylococcus coagulase* are the most frequent agents, both of the infection of the blood stream and the one related to the catheter, followed by the *S. aureus* and the gram-negative bacilli<sup>(17)</sup>.

The most commonly isolated micro-organisms in patients with the catheter-related blood stream infection (CRBSI) are negative *Staphylococcus spp. coagulase (NSC)* and *S. aureus*, which can cause colonization on the skin of the patient and on the hands of the health professionals. The more isolated Gram-negative bacilli are *Pseudomonas aeruginosa*, *Acinetobacter spp.* and *Stenotrophomonas maltophilia*. *Candida albicans* and *C. parapsilosis* that appear as the main yeasts of this kind of pathogens of the CRBSIs, once they colonize the hands of the manipulator, are associated to the infusions of glucoses and parenteral nutrition<sup>(5)</sup>.

The infection of the blood stream associated to the insertion and maintenance of the central venous catheter is one of the most serious complications, once it prolongs the hospitalization and increases the cost of medical assistance. In order to characterize that

infection, it is necessary to have evidences of the systemic status, that is, clinical manifestation of infection, in which the vascular access is implied as a possible source. On the other hand, the colonization of the device or the infection of the vascular access involves the significant presence of micro-organisms in the endoluminal portion or external surface of the catheter, in the absence of systemic infection<sup>(12)</sup>.

## CONCLUSION

The use of the central venous catheter became the chosen device in the treatment of hospitalized patients at the Intensive Care Unit, in addition, it allows more safety in the handling of these patients, providing an adequate way for the infusion of solutions and medicine and determination of cardio circulatory parameters.

The care with procedures which involve the vascular access must be a priority of the team who assists the patient, so that, an effective multi and interdisciplinary surveillance provides the prevention and control of possible complications.

It was possible to verify that the indication as to the use of the central venous catheter, in most of the cases, was related to the administration of solutions and medicine in critical patients, and this happens because at Intensive Care Units the infusion of vasoactive predominate requiring an endovenous way compatible with the therapeutical program.

The preferred site for the access puncture was the subclavian vein using double lumen catheter with time of permanence from 11 to 20 days, and the main reason for the removal was hospital discharge. However, one of the reasons of removal of this device occurred due to the presence of flogistic signs. Therefore, all the care provided by the nursing team in the handling of central venous catheters deserve attention, as a way to contribute for the safety of the patient in the hospital environment, once despite the numerous benefits it

provides, the profound venous catheterism represents a potential source of infectious complications.

The results of this study showed that the health professionals, especially the nursing team are outstanding in this context, in order to guarantee the quality of the assistance rendered once in case of non conformity in the handling of these venous access, they interfere in the clinical evolution of the patient, which constitutes a problem of public health, so it needs effective measures of surveillance to prevent the occurrence of such events.

The results of this research are limited, a fact which implies the need of other studies. However, it is considered relevant once it provided reflections from the clinical practice related to the use of the central venous catheter in an ICU, as well as the nursing care based on evidences which can be reevaluated based of scientific principles.

## COLLABORATIONS

Oliveira FJG contributed for the conception of the study, review of the literature, data analysis and initial writing of the manuscript. Siqueira JF contributed for the conception of the article. Ramos IC, Campos FA and Oriá MOB contributed for the initial conception of the study, review of the literature and data analysis. Caetano JÁ contributed for the writing of the article and final approval of the version to be published.

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