Original Article

BREAKDOWN OF COMPLICATIONS RELATED TO THE USE OF CENTRAL VENOUS CATHETERS IN INTENSIVE THERAPY UNITS

DESFECHO DAS COMPLICAÇÕES RELACIONADAS AO USO DE CATETERES VENOSOS CENTRAIS EM UNIDADES DE TERAPIA INTENSIVA

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ABSTRACT: The ICU is a highly complex sector, and among the wide range of interventions performed in the intensive care patient, we highlight the use of the central venous catheter (CVC). Maintaining the CVC requires knowledge and ability to ensure safe and long-lasting vascular access. However, during the permanence time of the device, some complications related to the catheter material, caliber, puncture site, dressing used, type of medication administered and length of stay may occur. Knowing the possible complications that occur with the catheter during its stay and the outcome of these complications favors the health professional in the elaboration of prevention strategies. Therefore, this research aims to elucidate the occurrence of non-elective removal, the main complications and outcomes related to the use of CVC in clients hospitalized in the ICU. This is a descriptive, observational, prospective study with a quantitative approach. The study was carried out in a teaching hospital in Uberaba-MG, from March to August 2016. The population of the study consisted of CVCs inserted in clients hospitalized in the ICUs. As a result, 75 (38.3%) catheters presented complications, being the outcome of 55 (73.3%) non-elective removal when the complication was discovered. The other 121 (61.7%) catheters had the outcome of removal on discharge from the client to the ward 59 (48.7%), death of the client 25 (20.6%), discharge from the client to the ward with the device (Risk benefit) 27 (22.3%) and removal at the physician's discretion 10 (8.2%). The permanence time of the device was 7.65. The greater the number of complications the catheter presented, the greater the chances of catheter loss (63.4). This study emphasizes the importance of conducting other studies that may contribute to the reduction of complications resulting from the use of CVC, and emphasize that complications demand higher expenses for the health system and increase the risk of infection of clients hospitalized in the ICU.

KEYWORDS: Intensive Care Unit. Central Venous Catheters. Device removal.

INTRODUCTION

Advances in health have favored the maintenance of life and therefore, an increase in the demand for beds in the Intensive Care Units (ICU). ICU is a high-complexity sector, in which the monitoring of quality of service provided becomes essential for the safety of the critical patient (COSTA et al., 2010; FERNANDES; PULZI JÚNIOR, FILHO, 2010).

Among the broad range of interventions carried out in the patient admitted to the intensive care, we highlight the use of central venous catheter (CVC). The implementation of the CVC is indicated when the patient needs vasoactive drugs, antibiotics and serum therapy for a long time, hyperosmolar solutions, nutritional support with parenteral nutrition (total or partial parenteral nutrition - TPN, PPN), use of irritating and / or vesicant drugs, hemodialysis, patients impaired peripheral venous network and hemodynamic monitoring (GOMES et al., 2012).

However, during the time of permanence of the device there may be some complications related to the catheter material, gauge, puncture site, curative used, type of drug administered and time of permanence. Infection is a common late complication in hemodialysis catheters (HC) (BATISTA et al., 2014; GROTHE et al., 2010; NEVES JUNIOR et al., 2010; SIQUEIRA et al., 2011; TARDIVO et al., 2008).

Clinical conditions such as thrombocytopenia or coagulopathy are contraindications to the insertion of the CVC due to the risk of prolonged bleeding at the insertion site. For patients with previous central catheters, history of venous thrombosis and / or history of difficulty in the catheter placement, it is prudent to carry out its insertion in the operating room with the aid of scopia, in order to avoid complications. Likewise, it is necessary the performance of the venous doppler before placing the catheter in the customers who have had previous accesses and present upper limb edema or jugular stasis, so to exclude the diagnosis

Received: 19/05/17
Accepted: 20/12/17

of previous thrombosis or venous stenosis (TENORIO et al., 2015).

The care of the device should not be done only by the nursing staff, but also by all professionals who provide some type of customer service. Maintaining CVC requires knowledge and ability to ensure a safe and lasting vascular access. Knowing possible complications that occur with the catheter during its stay and the outcome of these complications favors health professional in the development of prevention strategies. Thus, this study aimed to analyze the main complications and outcomes related to the use of CVC, identify the occurrence of non-elective removal, and check out which insertion site presented more non-elective removal and complications in clients hospitalized in Intensive Care Units in use of the device in the period of six months.

MATERIAL AND METHODS

This is a descriptive, observational, prospective study, with a quantitative approach. The research was conducted in a teaching hospital in the city of Uberaba-MG, in the General ICU and Coronary ICU, with 10 beds each. The study population consisted of CVCs inserted in clients hospitalized in the ICUs in the period from March to August 2016, comprising 196 catheters. As part of the population, there were catheters punctured in another sector and / or institution and those that were punctured in the ICUs during the period from March to August 2016, being excluded the catheters of customers who were not conscious and oriented, and / or not had responsible family owned to sign the term of assent and informed consent (IC). The Peripherally Inserted Central Catheter (PICC) and the totally implanted catheter "Port-A-Cath®" were excluded from the study due to their low use in ICUs surveyed.

Data collection was conducted during the period from March to August 2016, using the medical records and tracking form of costumer with CVC available in the ICUs and a tool developed by the researchers of the study. Data that were not obtained from the medical records and tracking form of costumer with CVC were sought in daily medical development and in the nursing team notes. The instrument was submitted to face and content validation in the months of November and December 2015, by three judges, who were nurses with doctorates.

Data collection instrument was developed based on the data of the medical records and tracking form of costumer with CVC used in the ICU, the CDC criteria, the manual of the National Health Surveillance Agency (ANVISA), the *Infusion Nurses Society* (INS) and the Standard Operating Procedures (SOP) Manual of the institution under study (BRAZIL, 2013; CDC, 2011; INS, 2013).

Medical records and tracking form of costumer with CVC is an information-recording instrument used by the ICUs of the teaching hospital, which should be completed by the professional nurse. This form contains customer identification data (name, hospital records, birth date, sector, date and time of insertion, unit of insertion) description of the catheter (type and location), maintenance (dressing type and asepsis) and removal (date and reason).

Data collection tool developed by the researchers was composed of: Personal identification of the patient: initials of the name of the customer, hospital records, ICU (adult or coronary), gender (male and female) and date of birth; CVC data: Insertion sector (adult emergency room, operating room, general ICU, coronary ICU, CVC punctured at another institution, medical, surgical, gynecology and obstetrics clinic, hemodynamic and other), type of catheter (single lumen, double lumen and other), insertion site (VJE E, VJE D, VJI D, VJI E, VSD, VSE, VFD, VFE), type of dressing, type of asepsis, checklist carried out when puncturing (yes or no), complications (yes or no), type of complication, type of complication outcome, date of insertion and removal, time of hospitalization (days).

The researcher attended ICUs daily analyzing the tracking form of the patients with CVC, searching for information on the catheter, following, this way, all hospitalizations that occurred in the General and Coronary ICU. The observation was concluded at discharge and / or death of the customer with CVC. The instrument was filled manually, and data collection performed by only one researcher.

Data were entered into an electronic spreadsheet, Microsoft® Excel XP® program, through double enter (typing) and later validated for possible typing errors to be corrected. After the validation procedure, database was imported into the *Statistical Package for the Social Sciences* (SPSS) version 21.0 for analysis. Finally, it was carried out the univariate exploratory analysis of categorical variables, absolute and relative frequency tables, while the quantitative variables were summarized using measures of central tendency (mean, median) and variability (range, standard deviation), as well as the bivariate analysis

in tables such as chi-square, odds ratios and relative risk. In order to analyze the relationship between the number of complications and the occurrence or not of non-elective removal of the catheter it was used the logistic regression with a predictor.

The project was submitted to the Research Ethics Committee (REC) with human beings of UFTM, according to Resolution No. 466, December 12, 2012, receiving Report number 1,312,097 and CAAE number 48713215.0.0000.5154.

RESULTS

Of the central venous catheters analyzed, 123 were inserted into clients admitted to the General ICU and 73 in the Coronary ICU. Regarding the insertion sector, 45 (23.0%) were inserted in the adult ER, 61 (31.1%) in the surgical room, 45 (23.0%) in the General ICU, 22 (11.2%) in Coronary ICU, 9 (4.6%) punctured at another institution (Emergency Unit and private hospitals of the city), 4 (2.0%) in Medical clinic, 7 (3.6%) in the Surgical Clinic, 2 (1.0%) in Gynecology and Obstetrics and 1 (0.5%) in the unit of hemodynamics.

Regarding the type of the catheter 26 (13.3%) were mono lumen (with 8 (30.7%) intracth®) and 170 (86.7%) double lumen (with 40 (23.5%) hemodialysis catheters - shilley®). All of them were non-tunneled (short stay) and semi-implantable catheters. The relationship type of catheter and the presence or absence of complication was statistically significant (p=0.042). That said, of the 170 double lumens, 61 (35.8%) showed some type of complication, while in the mono lumens, 14 (53.8%) of the 26 showed some complication.

With regard to the local of the insertion 88 (44.9%) of the catheters were punctured through internal jugular vein, 91 (46.4%) through subclavian vein, 16 (8.2%) through femoral vein and 1 (0,5%) through brachial vein (venous dissection). The checklist at the time of the catheter puncture was completed in 48 (24.5%) of the 196 evaluated catheters. Of the 48 catheters inserted with the completion of the checklist, 20 (41.6%) evolved to non-elective removal.

Among the type of asepsis used in dressing changes during the stay of the catheter, 186 (94.9%) used 0.9% saline solution and 0.5% chlorhexidine-alcohol (first the saline solution and right after the chlorhexidine), 4 (2.0%) applied only 0.5% chlorhexidine-alcohol and 6 (3.1%) used more than one type of sterilization in the dressing change (one day chlorhexidine-alcohol was used and in the other, 0.9% saline solution and chlorhexidine-alcohol).

As regards the bandage, sterile gauze bandage and adhesive tape were the most used, 84 (42.9%), followed by the transparent sterile film 12 (6.1%), sterile gauze and transparent sterile film 11 (5.6%), sterile gauze and transparent non-sterile film roll 6 (3.1%), sterile gauze and non-sterile micropore tape 5 (2.6%), sterile gauze and transparent non-sterile row film - transpore 5 (2.6%). 73 (37.2%) used more than one type of coverage during the stay of the catheter (each day one of the coverages previously mentioned were used).

Regarding complications during the permanence of the CVC, 75 (38.3%), there was at least one type of complication during its stay. Among them, 44 (22.4%) showed phlogistic signs, 18 (9.2%) externalized, 7 (3.6%) obstructed, 11 (5.6%) presented suspicion of central venous catheter-related bloodstream infection, 1 (0.5%) had extravasation, 1 (0.5%) bleeding, 1 (0.5%) leaking, 1 (0.5%) infiltration, both the insertion site and 12 (6.1%) no stitches.

They had an average of 7.65 days of permanence and a median of 6.0 days, being the minimum 1 day and the most 30 days.

As for the CVC insertion site that showed more complication during the permanence of the catheter, 31 (41.3%) of the complications occurred in the internal jugular vein, 38 (50.7%) in the subclavian vein, 5 (6,7) in 1 and femoral vein (1.3%) in the brachial vein.

With respect to non-elective removal by insertion site, 23 (42.6%) occurred in the internal jugular vein, 28 (50.0%) in the subclavian vein, 4 (7.4%) in the femoral vein and no non-elective removal in the brachial vein, with no statistically significant relationship between the variables (p = 0.086).

Regarding the outcome of the complications, 196 catheters were analyzed. From these, 121 (61.7%) had no complications and 75 (38.3%) had complications. Of the 121 with no complication, 59 (48.7%) were removed due to the discharge of the costumer to the ward, 10 (8.2%) were removed at the physician's discretion, 25 (20.6%) were removed due to the death of the client and 27 (22.3%) clients were discharged to the ward with the CVC. The justification of the team to refer the client with CVC to the ward is that he was in good condition, with no phlogistic signs and the customer did not have peripheral puncture conditions to completion of treatment in the ward.

Concerning the catheters that presented some kind of complication 75 (38.3%), 55 (73.3%) were removed by the staff through a non-elective way when the complication was observed, and in 20 (26.7%) no action was performed by the professional when the complication was found. However, from these 20 catheters, 05 (25%) remained with the complication until the client was discharged to the ward, with the catheter being removed then; 09 (45%) remained with the complication until the customer's death due to disease worsening; and 06 (30%) the catheter was not removed, the customer was sent to the ward with the complication due to difficulty in peripheral puncture and the risk and benefit of keeping him with the device in not so favorable conditions was evaluated.

When analyzing the relationship between the time of catheter permanence and the total number of complications, it was found that the correlation was not statistically significant, i.e. p = 0.078. However, the binomial logistic regression, having as the outcome the removal or not of the catheter and as predictor the number of complications, revealed that for each additional complication, the chances of catheter removal are 63.4 times greater.

In the period from March to August 2016, 55 (28.1%) CVCs were removed in the General and Coronary ICU. Of these, 37 (30.1%) were in General ICU and 18 (24.7%) in Coronary ICU.

DISCUSSION

The catheters of the study were distributed in two sectors of the HC / UFTM intended for intensive care, being the General ICU destined to hospitalization of all clinics in general and the Coronary ICU for cardiovascular admissions.

The sector with higher rates of CVC insertion was the surgical unit 61 (31.1%), followed by adult emergency room (ER) 45 (23.0%) and the General ICU 45 (23.0%). When we analyzed the complications that have occurred and the sectors where the catheters were inserted, we noted that of the 45 catheters inserted in the Adult ER, 21 (28.0%) presented complications. In the same way, of the 61 catheters inserted in the Surgical Unit, 21 (28.0%) also presented complications. Regarding the ICU, of the 45 catheters, 17 (22.7%) had complications. All of this brings us to reflect these are the main sectors for the clients' admission in the hospital complex (emergency room, operating room and consequently, the ICU). Thus, the protective barriers might not be fully used due to the dynamics of the service that meets many demands at the same time (urgency and emergency care).

Other information found in the study was that 170 (86.7%) catheters were double lumen, which were inserted mostly in the subclavian vein 91 (46.4), what confirms the research conducted by Siqueira, 2010, in which 114 catheters were evaluated, with 62 (54.8%) being double lumen and 58 (50.9%) inserted into the subclavian vein (SIQUEIRA et. al., 2011). However, when we analyzed the insertion site that showed most complications and non-elective removals, the subclavian vein was found as a result. Yet, several studies recommend the subclavian vein as the optimal site of insertion, as it is the path that presents a lower risk of infection, compared with jugular and femoral vein (FRASCA et al, 2010). These two sites are at increased risk of infection due to anatomical proximity to oropharyngeal and physiological secretions, and because of the greater difficulty of catheter fixation (ANDRADE et al, 2011).

A study conducted at the University Hospital of Juiz de Fora showed that the double lumen was the main catheter used 55 (80.9%), and the subclavian vein 37 (54.4%) the main insertion site (ANDRADE et. al., 2011). Of the 61 (35.8%) double lumen catheters that showed some kind of complication, 15 were hemodialysis catheters. Regarding the mono lumen catheters, of the 14 (53.8%) that had complication, seven were intracath®.

A randomized study with 270 catheters inserted in the femoral or subclavian vein of clients admitted to the ICU reported a higher rate of colonization in catheters inserted in the femoral vein (FRASCA et al, 2010). That is similar to our study, since of the 15 hemodialysis catheters that had complications, 10 were inserted into the femoral vein and 5 in internal jugular vein.

With regard to the fulfillment of the checklist, it was conducted in 48 (24.5%) of the 196 monitored catheters. Among the 48 catheters that were inserted with the fulfillment of the checklist, 20 (41.6%) evolved to non-elective removal. A study in Thailand showed the reduction of CVC infection rates by applying a bundle for insertion and catheter maintenance measures, with the standardization of changes in the insertion site coverage and greater adherence to hand hygiene, getting good results (APISARNTHANARAK et al., 2010). Research conducted on adult ICU of HCPA evaluated the periods immediately before and after the implementation of the bundles, and it was not observed reduction of CVC infection rates, but there

was a reduction in infection rates related to CVC compared with the intervention period with the same period in the previous year (DALLE et. al., 2012).

Another important aspect when it comes to complications and catheter removals is the dressing used. For CVC there is no consensus on which offers more benefits, but we know that nursing care (handling, observation, dressing change, use of aseptic technique and protection of the catheter end) must be carried out carefully to prevent contamination of the device. There are several materials available on the market for coverage/dressing, such as sterile gauze fixed with micropore tape or adhesive tape, changed every 24 hours, the transparent polyurethane film, changed up to seven days if intact and the Chlorhexidine-impregnated dressing (CDC, 2010; SILVEIRA et. al., 2011).

In a study conducted at the University Hospital of Juiz de Fora, MG, the transparent film was the most common (34-51%) (ANDRADE et. al., 2011). That is different from the ICUs surveyed, in which the most used coverage was the sterile gauze with adhesive tape (84 to 42.9%). However, the CDC recommends that the dressing of the catheter insertion site can be with either sterile gauze and adhesive tape or polyurethane film, preferring the dressing with sterile gauze in clients with bleeding and / or local exudation (CDC, 2010).

Regarding the antisepsis of the insertion site, the measures adopted corroborate the guidelines of the National Health Surveillance Agency (ANVISA) and the CDC, which guide that the antisepsis of the skin at the insertion of the CVC should be only with chlorhexidine-alcohol 0.5%, but the daily dressing should be with saline solution 0.9% and chlorhexidine-alcohol 0.5% (BRAZIL, 2013; CDC, 2010).

We observed in this study that 75 (38.3%) catheters presented any type of complication during its permanence time. Recent studies on critical care have reported an incidence of complications between 1 and 5.5 per 1000 catheters / day, with ICS occurring in approximately 19% of the customers who have the CVC (MINO et. al., 2014).

The main risk factors for the appearance of phlogistic signs in the CVC are the manipulation of the device, complications and breaking barriers during insertion, type of catheter and amount of lumens present, as well as the device's insertion site and the hospital inpatient care unit itself. Catheters with more lumens imply major trauma at the site of insertion and greater manipulation, thus, leading to greater risks of obstruction and infection. The externalization may be related to numerous factors, including the wire that is used for fixing the catheter, style of stitches, the number of 3-way stopcocks that are placed on each route, the number of infusion pumps, positioning of the equipment and even the coverage used. The absence of stitches consequently leads to externalization of the device (CDC, 2010).

To prevent obstruction, before and after administration of any drug, blood or parenteral nutrition, it is essential the washing of the lumen with saline solution (twice more than the primming catheter) (BRAZIL, 2013; CUNHA, 2014; CDC, 2011; INS, 2013; STACCIARIN). In a study conducted in the Teaching Hospital of Goiânia, Goiás, of the 517 reports of adverse events (AE) on hemodialysis, the categories with highest number of reports was related to the CVC (148-28.6%). In the CVC, the AE most witnessed by the professional were the obstruction of the catheter, accidental removal, improper implant, catheter folded or punctured and accidental disconnection of the catheter to the blood line (SOUSA et al., 2013).

The catheter's ICU length of stay was 7.65 days, with a minimum of 1 day and a maximum of 30 days. It differs from some studies, such as Siqueira's, in which the average time of the catheter used was 12.3 days, ranging from 1 to 69 days, with no removal protocol or change being used, with 31.3 % of the catheters remaining for more than 15 days (SIQUEIRA et. al., 2011).

However, in the statistical analysis we found that the relationship between the catheter permanence time and the total number of complications was not statistically significant ($p = 0.078$), what is consistent with the study of Siqueira that also found that the relationship between the amount of the days of use and infection was not statistically significant ($p = 0.156$), although 19.4% of catheters inserted with more than 14 days had to be removed due to infection (SIQUEIRA et. al., 2011). The overall average of CVC permanence in a survey conducted in Curitiba teaching hospital, PR, was 5.1 days, with a median of 5.5, minimum 1 and maximum of 10 days. The permanence of the catheter for longer than 5 days is indicated by the authors as a risk factor for the development of ICS (PEDROLO; DANSKI; VAYEGO, 2014; PORTO et al, 2010).

As for the reason to the catheter removal (outcome) the results are different from the study by Pedrolo (2014), in which a customer had the CVC removed due to infection suspicion (unconfirmed), two died and five had elective removal of catheter, that is, the device was no longer necessary.

Complications contribute to increased morbidity and mortality in customers using CVC. However, such complications are primarily related to the inappropriate handling of the catheter or the quality of the material it is made of. Thus, in the presence of these events, a non-elective removal of the device must be done and a new catheterization programmed, so that it is possible to continue the intravenous therapy prescribed, hemodialysis or hemodynamic monitoring. All complications should be notified, so that prevention strategies are developed and the security of the client guaranteed (BRAZIL, 2013; CDC, 2011; INS, 2013; MENDONÇA et al, 2011).

CONCLUSIONS

The larger the number of complications the catheter presents, greater the chances of non-elective removal are.

The statistical analysis of the catheter permanence time and the total number of complications was not statistically significant, as well as the statistical analysis between the insertion site and non-elective removal.

The study highlights the importance of conducting further research that can contribute to reduction of complications arising from the use of CVC, and highlight the complications require higher expenses for the health system and increase customers' infection risk ICU. In this sense, it reinforces the importance of the teamwork in order to maintain a patent and lasting central vascular access, with no interruptions and complications. It lists outcomes that can be prevented and sharpens our mind to think of "patient safety" strategies related to central venous catheters.

RESUMO: A UTI é um setor de alta complexidade, dentre a vasta gama de intervenções realizadas no cliente dentro da terapia intensiva destacamos o uso do cateter venoso central (CVC). A manutenção do CVC exige conhecimento e habilidade para garantir um acesso vascular seguro e duradouro. No entanto, durante o tempo de permanência do dispositivo algumas complicações relacionadas ao material do cateter, calibre, local de punção, curativo utilizado, tipo de medicamento administrado e tempo de permanência podem acontecer. Conhecer as possíveis complicações que ocorrem com o cateter durante a sua permanência e o desfecho dessas complicações favorece o profissional de saúde na elaboração de estratégias de prevenção. Diante disso, essa pesquisa tem por objetivo elucidar a ocorrência de retirada não eletiva, as principais complicações e os desfechos relacionados à utilização do CVC nos clientes internados na UTI. Trata-se de um estudo descritivo, observacional, prospectivo, com abordagem quantitativa. A pesquisa foi desenvolvida em um Hospital de ensino de Uberaba-MG no período de março a agosto de 2016. A população do estudo foi constituída por CVC inseridos em clientes internados nas UTI's. Como resultado 75 (38,3%) cateteres apresentaram complicações, onde o desfecho de 55 (73,3%) foi à retirada não eletiva frente à descoberta da complicação. Os outros 121 (61,7%) cateteres tiveram como desfecho a retirada na alta do cliente para enfermaria 59 (48,7%), o óbito do cliente 25 (20,6%), a alta do cliente para enfermaria com o dispositivo (risco benefício) 27 (22,3%) e a retirada a critério médico 10 (8,2%). O tempo de permanência do dispositivo foi de 7,65. Quanto maior foi o número de complicações que o cateter apresentou, maiores foram às chances de perda do cateter (63,4). Este estudo vem destacar a importância da realização de outras pesquisas que possam contribuir para redução de complicações advindas do uso do CVC, e ressaltar que as complicações demandam maiores gastos para o sistema de saúde e aumentam os riscos de infecção dos clientes internados na UTI.

PALAVRAS-CHAVE: Unidade de Terapia Intensiva. Cateteres Venosos Centrais. Remoção de dispositivo.

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