

Intravascular Catheters Management and related Infections (CRBSI)

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Abstract

Background: The use of endovascular catheters is generalized practice nursing the hospital setting. If not well managed, it could expose patients to bloodstream-related infections, in most of the cases, due to the risk factors for intravascular catheter infection are linked to the device itself and can be prevented efficiently.

Objective: A review of the literature was conducted to see and understand the nursing protocol updates in the care of venous and central catheters to prevent the occurrence of CRBSI and the role of nursing education in catheter maintenance in order to reduce the risk of infections.

Method: Literature review was conducted in Pubmed, Cochrane and Nursing Journal using keywords such as: CRBSI, Nursing education, PVC, CVC, prevention. All literature studies that matched the purpose of the study were carefully reviewed.

Conclusions: Catheter related infection is a nosocomial infection which increases the length of hospital stay of the patient and the cost of hospitalization. Prevention of infection is the main task and this is achieved by strictly implementing the appropriate steps during catheter insertion, maintenance and careful observation signs of infection. Education and training of nursing staff plays an important role in reducing the incidence of infection.

Keywords: CRBSI, Nursing education, PVC, CVC, prevention.

Introduction

Catheter-related bloodstream infection (CRBSI) is defined as the presence of bacteremia which originates from an intravenous catheter (Gahlot et.al 2014). CRBSI is one of the most common nosocomial infections associated with the care of the medical team. (Aghadassi et.al 2019). CRBSIs account for around 70% of all health-care associated bloodstream infections (Rickard et.al 2021).

About 90% of hospitalized patients undergo peripheral intravenous therapy (PIV) and 25% of them undergo intravenous therapy with central venous catheters (CAVD) for a variety of indications such as: antibiotic therapy, pain management, chemotherapy, parenteral nutrition administration of fluids or blood products, for dialysis, blood sampling and diagnostic imaging. (American College of Radiology et.al 2018; Deshmukh & Shinde et.al 2014; Ullman, Long, & Rickard et .al 2014; Weinstein & Hagle et.al 2014).

The incidence of CRBSI varies depending on a number of factors such as the type of catheter, the frequency of catheter manipulation, and the patient's condition (e.g., underlying disease and acuity of illness or other concomitant pathologies). (Gahlot et.al 2014).

According to studies, the incidence of local or circulatory infections resulting from the use of peripheral venous catheters is low, most cases are associated with the use of central venous catheters. (Mermel et.al 2017, CDC et.al 2017). According to Gahlot et.al 2014 and Mermel et.al 2017 the relative risk for CRBSI is up to 64 times higher

from central venous catheters than from peripheral venous catheters. However, the number of CRBSI cases from peripheral venous catheters is not negligible. (Tatsuno et. al 2019).

It is well evidenced that infections originating from intravascular catheters cause mortality in approximately 35% of cases and are associated with an increase in morbidity and length of hospital stay, which is associated with an increase in the cost of health care. (Magill et.al 2014, Harron et.al 2016). About 65-70% of CRBSI cases can be prevented by implementing appropriate strategies and protocols by health personnel. (Edward JS et.al 2016, Buetti et.al 2020).

The Centers for Disease Control and Prevention (CDC) has published guidelines for the prevention of CRBSI (CDC et.al 2017), which is the benchmark for all catheter intravascular care recommendations.

Nursing role for peripheral venous catheter (PVC) management

Short-term peripheral venous catheters are widely used in the clinical practice of health care (Mermel et.al 2017) in patients receiving infusion therapy for the administration of fluids, medications and hemoderivatives. (Webster et.al 2015). A direct risk factor for the development of PVC infections is inadequate hand hygiene by health personnel (Loveday et.al 2014) therefore all health practitioners must apply the correct technique for decontamination of the hands before the catheter placement procedure and before and after any contact with the peripheral intravascular catheter. (Zhang et.al 2016).

One reason for the development of CRBSI is the entry of microorganisms from the skin in the area where the catheter is inserted, therefore proper antiseptic is an important component during the placement and maintenance of the site where the catheter is placed (Claire et.al 2021). Based Studies have shown that the use of chlorhexidine gluconate in combination with isopropyl alcohol is recommended as the most effective method for skin asepsis which reduces the risk of infection. (Loveday et al, 2014; Mimos et al, 2015; Gorski et al, 2016).

In hospital settings for catheter fixation, semi-permeable and transparent vests are usually used which allow greater vapor permeability, which increases the rate of evaporation of fluid from the site of insertion, enabling a dry place and reducing the possibility of any infection development. Their transparency allows direct observation of the insertion site (Loveday et.al 2014; Webster et.al 2011, Atay et.al 2020).

Routine replacement of peripheral intravascular catheters is still a topic of debate among various authors (Gonzales et.al 2014)). The Centers for Disease Control and Prevention (CDC et al 2017) recommends that PIVC replacement is not necessary for a period shorter than 72-96 hours and if the catheter is functional can be used for a period longer than 72-96 ore (O'Grady et.al 2011, Gonzales et al. 2014, Helm et.al 2015).

Other authors with their studies (Webster et.al 2008, Rickard et.al 2012) suggested catheter replacement only in cases of clinical indications. In the Webster study in 2019 there was no clear change in rates of catheter-related bloodstream infection (CRBSI) between clinically indicated or routine replacement of peripheral intravenous

catheters. In a prospective study which randomized clinical study reached the conclusion that the use of saline solution allows a better maintenance of the peripheral venous catheter than the use of heparin. (Perez-Granda et.al 2021).

Nursing role for central venous catheter management

Central venous catheters are mostly used in patients with critical pathology. The placement of central venous catheters is usually the task of doctors but recently specialized nurses play an important role in their insertion (Alexandrou et.al 2011, Kelly et.al 2012).

Knowing that central venous catheters are associated with a higher risk of developing CRBSI, health personnel should avoid their use when not necessary or use central catheters inserted into peripheral veins which are practically easier to place and have a lower risk of developing infection. (Chopra et al. 2021).

When inserting central venous catheters, proper protocol should be applied to avoid infection, numerous studies have shown that the best antiseptic for skin disinfection before insertion of central venous catheter is chlorhexidine gluconate 2% because it has very good properties and more a rapid bactericidal effect (Mimoz et.al 2016, Pages et.al 2016). In the study randomized controlled trials (Masuyana et.al 2021) it was found that antiseptic agents containing 1% CHG-alcohol reduce the risk of developing CRBSI infection more than agents containing 0.5% CHG alcohol or 10% PVI-aqueous.

Routine use of antibacterial drugs is not recommended because it increases the risk of resistant bacterial infections and the risk of conolonization with candida (Ball et.al 2021).

The site where the catheter is inserted has been seen to have an impact on the risk of developing infection, the subclavian vein has a lower risk compared to the femoral and jugular vein (Parianti et.al 2017). In some meta-analyzes where risk comparisons are made for infection between the jugular vein and the femur, it was found that the lowest risk was seen in the jugular vein (Timsit et.al 2013, Parianti et.al 2017) but in other studies it was seen that the risk is similar. (Ge X et.al 2012, Arvaniti et.al 2017). The presence of stitches disrupts the integrity of the skin and this favors the development of an infection. Karpanen in 2019 proposed an innovative system without stitches to reduce this risk but there is still no data on whether this method reduces the risk. Transparent lenses are widely used in the fixation of central venous catheters and their change can be done every 7 days under careful observation of health personnel. (Timsit et.al 2009). A number of studies have shown that the use of a chlorhexidine 2% impregnated disc e.g. bio patch on the skin of the area around the catheter reduces the incidence of catheter related bloodstream infection (Geffers et.al 2016). The use of CHG impregnated sponges and CHG-gel dressings reduces by 60% the risk of infection. (Buetti et.al 2020).

Intravenous (IV) administration sets should be changed at least every 7 days but not more often than 96 hours. (Wollman et.al 2014, Ball et.al 2021) IV tubing for the administration of blood, its products or fat emulsion product administration should be replaced every 24 hours. Additionally, IV tubing used for protocol administration

should be replaced every 6-12 hours. (Ball et.al 2021)

Before any manipulation that the nurse will do in the central venous catheters, whether accessing catheter hubs or needleless connectors, there should be used appropriate antiseptics such as chlorhexidine alcoholic gluconate or 70% alcohol.

A recent meta-analysis including 57 studies and 11 types of impregnations showed that catheter impregnation significantly reduced CR-BSI and colonization. Minocycline-rifampin impregnation appeared to be superior to chlorhexidine-silver sulfadiazine impregnation, which was in turn superior to silver impregnation (Lai et.al 2016).

In cases where the nurse assesses hemodynamic instability, immunosuppression or local signs of infection, the catheter should be removed. (Timsit et.al 2018).

Nursing education, Surveillance and bundles of care

The nurse who cares for patients with central or peripheral venous catheters is responsible for preventing infection. It is therefore necessary to properly educate the nurse on every aspect from the introduction, maintenance and proper observation to reduce the risk of CRBSI. The educational program of the medical team allows it to have the right knowledge and skills by focusing on preventative measures and thus achieve improved results (Marschall et al. 2014).

An observational study of nurses working in hospitals in Japan, where educational programs on catheter care were developed showed a significant reduction in the incidence of CRBSI. The most efficient method of education was found the simulation method compared to the training method with video. (Shimoyama et.al 2017).

Careful observation and surveillance is a key aspect in preventing and managing infections. A key component of the strategy for preventing infections originating from venous catheters is the safe maintenance of the intravascular catheter (CDC et.al 2017).

The care bundles are used for the development of nursing procedures in order to prevent clinical pathologies aiming at improved nursing care and good results for the patient. The intravenous catheter care bundle includes a checklist of care to be taken during catheter insertion, care and maintenance, and removal of the catheter if no longer needed (Marschall et.al 2014).

The care bundles have been shown to increase access to appropriate patient care and enable efficiency in implementing the appropriate steps to prevent CRBSI (Buetti & Tims et.al 2019, Sun et.al 2020).

Conclusions

Catheter related infection is a nosocomial infection which increases the length of hospital stay of the patient and the cost of hospitalization. Prevention of infection is the main task and this is achieved by strictly implementing the appropriate steps during catheter insertion, maintenance and careful observation of infection signs. Education and training of nursing staff plays a role in reducing the incidence of infection.

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