ROLES OF HEALTHCARE PROVIDERS IN PREVENTION OF INTRAVASCULAR CATHETER-RELATED INFECTIONS; REVIEW

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Abstract:
An optimal preventative approach should aim to eradicate CRBSI from all sites where patients get treatment. While the task is difficult, programs have shown achievement. However, maintaining eradication necessitates ongoing dedication. The objective of this narrative review was to examine the significance and function of healthcare providers in the prevention of catheter-related bloodstream infection (CRBSI), encompassing physicians, nurses, and all other members of the healthcare team. Effective prevention necessitates the implementation of evidence-based strategies, such as employing strict sterile precautions during catheter insertion, utilizing checklists and maintenance procedures, emphasizing the importance of sterile a catheter access approach and maintaining catheter dressing integrity, and considering the use of preventive antimicrobial agents in certain circumstances.

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Introduction:

In health care, intravascular (IV) catheters are indispensable and widespread. They encompass various types such as peripheral and midline venous catheters, through the skin traversed and nontunneled central venous catheters (CVCs), peripherally inserted central catheters, totally indwelling devices (i.e., ports), and arterial catheters (ACs). Significant progress has been made in preventing infections connected to IV catheters, resulting in a notable 50% decrease in central line-associated bloodstream infections (CLABSIs) and catheter-related bloodstream infection (CRBSI) [1].

Within the United States, there is an annual occurrence of 80,000 bloodstream infections caused by central lines specifically in critical care units. Additionally, it has been estimated that a total of 250,000 instances of CRBSIs occur each year when considering the overall hospital population [2]. Within the intensive care unit (ICU), these infections have been found to individually raise hospital expenses and prolong the duration of hospitalization. However, there is limited evidence to suggest that these infections separately contribute to an increased risk of death [3].

The utilization of these devices exposes a significant number of individuals to the potential danger of catheter-related bloodstream infection. The majority of severe infections are linked to central venous catheters rather than tiny peripheral catheters, especially in intensive care units (ICUs) [4]. Based on statistics from the American Hospital Association's , a computer model estimated that there were around 31 million patient-days in intensive care units (ICUs) in the USA over the last six years. According to statistics from the Centers for Disease Control and Prevention [5], the likelihood of being exposed to these devices every day in the Intensive Care Unit (ICU) was 48%. This translates to about 15 million days per year where central lines are used in ICUs. ICUs in the United States experience an average of 5.3 central line–associated infections of the bloodstream for every 1000 catheter-days. This translates to roughly 16,000 central line–associated bloodstream infections occurring in ICUs each year [5].

Review:

CRBSI, which stands for catheter-related bloodstream infection, is a precise clinical term used in the diagnosis and treatment of patients. It necessitates particular laboratory testing that precisely pinpoints the catheter as the origin of the bloodstream infection. It is not commonly employed for surveillance objectives. Determining whether a bloodstream infection (BSI) is a catheter-related bloodstream infection (CRBSI) can be challenging due to various factors. These include the patient's clinical requirements (where the catheter may not always be removed), the limited use of microbiologic methods (such as quantitative cultures of the blood or differential time to positivity) in many laboratories, and the adherence to procedures by healthcare providers directly involved in patient care [2,5].

CRBSI is influenced by three key factors: 1) the composition of the device, 2) protein adhesions like fibrin and fibronectin that create a protective layer around the catheter, and 3) the inherent virulence factors of the affecting organism, including the extracellular polymer substance (EPS) produced by the attached organisms [6]. Certain catheter materials possess surface imperfections that promote the attachment of specific microbial species, such as S. epidermidis and C. albicans. Catheters composed of these materials are particularly susceptible to microbial colonization and eventual infection. Silastic catheters have a greater likelihood of catheter infections compared to polyurethane catheters due to the development of the fibrin sheath. However, the production of biofilm by C. albicans is more likely to happen on silicone elastomer catheter surfaces compared to polyurethane catheters [7]. Altering the surface characteristics of the biomaterial has been demonstrated to impact the capacity of C. albicans to create biofilm. Moreover, some catheter materials exhibit a higher tendency to promote blood clot formation compared to others, which might increase the likelihood of catheter colonization and infection. This correlation has resulted in a focus on minimizing catheter-related blood clots as an additional method for decreasing catheter-related bloodstream infections (CRBSI) [6,7].

Regrettably, the adoption of evidence-based procedures to prevent central line-associated bloodstream infections (CRBSI) in hospitals across the United States has been less than desirable [2]. During a national survey in March 2005, over 700 U.S. hospitals were examined. The results showed that around 25% of these hospitals did not regularly follow the recommended practices of using maximal sterile barrier precautions during central line insertion or chlorhexidine gluconate as a site disinfectant, as advised in the 2002 guidelines [2,3]. Approximately 15% of hospitals in the United States reported regularly replacing central venous catheters (CVCs) as a preventive measure

against infection, despite data suggesting that this practice is no longer recommended [3].

Guideline recommendations for healthcare providers:

Efficient programs that facilitate the education of healthcare personnel and their ability to deliver, oversee, and assess care are vital for the success of this endeavor. Studies conducted over the past forty years have consistently shown that the risk of infection decreases when aseptic care is standardized. Additionally, it has been found that untrained staff members who insert and maintain intravascular catheters may increase the risk of catheter colonization and catheter-related bloodstream infections (CRBSI) [8]. Specialized intravenous (IV) teams have demonstrated clear and indisputable success in decreasing the occurrence of catheter-related bloodstream infections (CRBSI), related complications, and expenses [8]. In addition, the risk of infection rises when there is a decrease in the number of nursing personnel below a crucial threshold [2,3].

Consider utilizing a chlorhexidine/silver sulfadiazine or minocycline/rifampin-impregnated central venous catheter (CVC) for patients who are likely to have the catheter in place for more than 5 days if, despite successfully implementing a comprehensive approach to lower rates of central line-associated bloodstream infections (CLABSI), the CLABSI rate is not reducing. The all-encompassing method must incorporate a minimum of three elements: providing education to those responsible for inserting and maintaining catheters, implementing maximal sterile barrier precautions, and utilizing a chlorhexidine preparation with alcohol concentration exceeding 0.5% for skin antisepsis during central venous catheter (CVC) insertion [2,3].

Apply a povidone-iodine antiseptic ointment or bacitracin/gramicidin/polymyxin B ointment at the dialysis treatment catheter exit site after the catheter is inserted and at the end of each dialysis session, but only if this ointment is compatible with the material of the hemodialysis catheter according to the manufacturer's recommendation [2,3].

Administer prophylactic antimicrobial lock solution to patients with long-term catheters who have experienced numerous catheter-related bloodstream infections (CRBSI) despite following strict aseptic technique protocols [2,3].

Execute hand hygiene protocols, either by cleansing hands with traditional soap and water or with alcohol-based hand rubs (ABHR). Prior to and following the palpation of catheter insertion sites, as well as prior to and following the insertion, replacement, access, repair, or dressing of an intravascular catheter, it is important to practice hand cleanliness. Avoid palpating the insertion site after applying antiseptic, unless you are maintaining aseptic procedure [9].

Adhering to hand hygiene protocols before inserting or maintaining a catheter, together with employing appropriate aseptic technique during catheter handling, offers defense against infection [3]. Effective hand hygiene can be accomplished by utilizing either an alcohol-based solution or by washing hands with soap and water, ensuring thorough rinsing [9]. Utilizing aseptic technique for the insertion of peripheral catheters does not always need the use of sterile gloves. Instead, a fresh pair of disposable nonsterile gloves can be employed alongside a "no-touch" strategy. Wearing sterile gloves is necessary while inserting central catheters since it is not possible to use a "no-touch" method [3].

Prior to the installation of a peripheral venous catheter, it is necessary to cleanse the skin using an antiseptic solution such as 70% alcohol, tincture of iodine, an iodophor, or chlorhexidine gluconate [10].

Prior to the implantation of central venous catheters and peripheral arterial catheters, and during dressing changes, it is important to cleanse the skin using a chlorhexidine mixture containing at least 0.5% concentration of chlorhexidine and alcohol. If there is a medical reason to avoid using chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as substitute options [10].

Two meticulously conducted studies comparing the chlorhexidine-based antiseptic regimen with either povidone iodine or alcohol for the treatment of an intravascular catheter insertion site have demonstrated reduced rates of catheter colonization or catheter-related bloodstream infections (CRBSI) associated with the use of chlorhexidine preparation [10]. The comparative analysis between chlorhexidine gluconate alcohol and povidone iodine alcohol has not been conducted. No significant changes were seen in central venous catheter (CVC) colonization or catheter-related bloodstream infection (CRBSI) when comparing a 0.5% chlorhexidine tincture with a 10% povidone iodine solution [2,10].

A randomized controlled experiment evaluated studies comparing the risk of catheter-related bloodstream infections (CRBSIs) between transparent dressings and gauze dressings [11]. There was no significant difference in the risk of catheter-related bloodstream infections (CRBSIs)

across the groups. The selection of dressing might vary based on personal preference. When blood is seeping from the catheter insertion site, it is advisable to use gauze dressing. An further systematic review of randomized controlled trials comparing gauze and tape to transparent dressings revealed no notable disparities in CRBSIs, catheter tip colonization, or skin colonization across the different kinds of dressings [11].

Prior to accessing them [IV], it is necessary to disinfect catheter hubs and sample ports. Alcohol, povidone-iodine, and chlorhexidine are efficacious (86, 87) but offer only marginal superiority over saline due to the fact that premoistened cotton wipes physically eliminate the majority of germs from catheter hubs [2,11].

In a single experiment [12], a central hub equipped with an antiseptic chamber filled with iodinated alcohol significantly decreased the likelihood of CRABSI infections (relative risk, 0.2 [CI, 0.1 to 0.7]). This hub is accessible in Europe, however it is not available in the United States. A further experiment evaluated the effectiveness of a sponge soaked with povidone-iodine, enclosed in a plastic shell, and placed around the catheter hubs. The intervention resulted in a significant decrease in the occurrence of CRABSI, reducing it from 24% to 0% ($P < 0.02$) [12].

Conclusion:

In hospital settings, it is important to adhere to guidelines for the prevention of CRABSI. These guidelines are intended for healthcare professionals who implant intravascular catheters and for individuals in charge of monitoring and managing infections in hospital, outpatient, and home healthcare environments. Utilizing comprehensive barrier measures, including the use of sterile gloves, a long-sleeved sterile gown, a mask, a cap, and a wide sterile sheet drape, significantly decreases the occurrence of catheter-related bloodstream infection while inserting a central venous catheter, as compared to the conventional procedure. Furthermore, many precautionary measures have demonstrated significant effectiveness in avoiding CRABSIs.

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