Systematic Review on Risk Factors Related to Central Venous Catheter Infection

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Abstract:- **Catheter-related bloodstream infections continue to show high incidence density rates in developing countries. The main objective of the study was to describe the definition, management and risk factors associated with central venous catheter infection. A systematic review of the literature on the definition, management and risk factors associated with central venous catheter infection was carried out using search tools such as PubMed, SciELO, Science Direct, Lilax, Web of Science and Medigraphic. The risk factors for CVC infection with the highest percentage of records correspond to prolonged catheter residence time (26.32%); insertion of the catheter in the femoral vein (21.05%); and number of catheters used, repeated catheterization in the same vein, catheter manipulation and use of multilumen catheter for PN (15.79%). Gram-positive microorganisms (Staphylococcus aureus) and Candida albicans were the most reported in the articles studied. In conclusion, there is a need to conduct more longitudinal studies and to improve risk factor prevention strategies in order to reduce catheter-related infections.**

Keywords:- Central Venous Catheter, Risk Factors, Microorganisms, Management.

I. INTRODUCTION

According to Cruz, Rincón and Mendieta (1), they indicate that the factors for a higher incidence of catheter infection are insertion in the external jugular vein, three-lumen catheters and the service in which there is a greater number of infections is in the Intensive Care Unit due to the fact that the patient has multiple vascular accesses.

In a study carried out in a children's hospital in Mexico, they indicate that there is a greater risk when the catheter is inserted without applying sterile measures, when there is difficulty in its placement, when administering total parenteral nutrition, blood transfusions and when the catheter remains in place for more than 7 days (2).

Tapia, Sanchez and Bustinza (3), mention that in 70 to 90% of the cases colonization occurs via the extraluminal route in a catheter of short permanence of less than 8 days, while the intraluminal route is only involved in 10-50% of the cases; on the contrary, in catheters of long permanence it occurs in 66% via the intraluminal route and 25% via the extraluminal route.

The presence of microorganisms triggers catheter infections that can be local or generalized and cause very severe complications such as endocarditis, meningitis, osteomyelitis and septic shock, for this there are key points for which the infection can develop among them we have: 1. Area of insertion into the skin. The type of catheter. 3. Hematogenous seeding from a distant site. 4. Contaminated solutions. 5. Healing of the catheter with a different technique. 6. Inadequate handling of the device (4).

Of the patients admitted to the health services during their hospital stay, it is estimated that more than 80% need venous access, either peripheral or central for diagnostic and/or therapeutic purposes. Central venous catheters allow: the application of medications, administration of parenteral nutrition, hemodialysis, transfusions, measurement of clinical parameters, among others, and this is possible due to the access to the bloodstream (5).

Studies carried out on the basis of infections associated with Central Venous Catheters in Spain and the United States show a mortality rate of 9.4% to 25% respectively, causing an increase in the length of stay of patients in the hospital, resulting in an increase in the cost of care in health services (6).

In another study, researchers Sandoval, Guevara and Torres (7), conducted a study in a Venezuelan hospital which showed a percentage of Central Venous Catheter Infection of 3 to 8%, leading to 12 to 25% of cases of mortality caused mainly by S. aureus, demonstrating a notable lack of adherence to the techniques of placement and management of the devices.

Locally, an important study by Carrión, Serrano and Quiroz (8), at the Vicente Corral Moscoso Hospital, through a cross-sectional study from March 2012 to March 2013, obtained a sample of 419 patients who required central line placement, 9.78% of whom had bloodstream infection.

A study conducted by systematic review, through a search in Pubmed, Scopus, Cinahl, Web of Science, Lilacs, Bdenf and Cochrane databases, found four studies (11.7%) which showed the effectiveness of educational strategies on care for the prevention of bloodstream infection related to central venous catheter (9).

Another study carried out in Chile also mentions that by training health personnel on catheter handling and care standards, a notable decrease (9.2 to 3.3 per 1000 catheter days) in the incidence of infection at the catheter entry site and in bloodstream infections was evidenced (10).

In a study carried out in Chile on hospital costs by Vergara and Fica (11), they show that infections related to the bloodstream associated with central venous catheters are one of those that cause the highest hospital costs due to longer hospital stay, more antimicrobial consumption and culture controls, resulting in a cost of USD 7286 per event.

From the above we can justify why at present central venous catheter-related bacteremias represent an important problem because it is one of the most serious adverse events and has great repercussions.

Consequently, and since it is a potentially fatal health problem, it is necessary to carry out a bibliographic investigation which will be of great scientific support for professionals in the correct management of patients.

The following questions were posed: What are the risk factors for the development of central venous catheter infection?
- Idea to defend.
- Knowledge of the different microorganisms that cause central venous catheter infection.
- Importance of knowledge about the correct handling of central venous access.

II. THEORETICAL FRAMEWORK

Nursing Knowledge

The nursing profession is a humanistic and social science with its own body of knowledge, its development as a scientific discipline allows the integration of theoretical foundations (Nursing Science) and professional practice (specific domain that differentiates it from other professions). Thus, the nursing professional acts by putting into action the knowledge obtained through scientific principles resulting from research, personal experience and personal skills (12).

Central Venous Catheter

It is defined as any vascular device that allows the infusion of liquids and whose distal tip ends in one of the great vessels such as: pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins and common femoral vein, independent of the insertion site and the type of device used (13).

Classification

Central Venous Catheters are classified based on the duration of the catheter (short, medium and long term), the type of insertion (central or peripheral), location of insertion (jugular, subclavian, femoral, brachial), number of lumens (single, double, triple), among others (6).

Catheter-associated bacteremia

From a clinical point of view, catheter-associated bacteremia (CAB) is diagnosed by a positive peripheral blood culture which must be accompanied by signs and symptoms, together with a positive culture of the catheter tip or retroculture for the same germ and with an antibiogram similar to the peripheral blood culture (14).

Infection at the insertion site

When there is infection, erythema, induration at skin level can be observed along the subcutaneous trajectory of a catheter (15).

Contraindications

The most relative and usual contraindications are coagulopathy and/or thrombocytopenia; however, the values of these contraindications are not clear, with coagulation times being the greatest risk (6).

Risk Factors

The risk factors that trigger bloodstream infection by central venous catheter are: permanence of catheterization, attempts of accesses for the insertion of the central catheter, use of femoral access, great manipulation, use for hyperalimentation, bacterial load of the insertion site, extended hospitalization (16).

In addition, there are certain characteristics in patients who are more susceptible to infection, among them, age, poor nutritional status, trauma, chronic diseases, patients with immunosuppressive and antimicrobial treatment, invasive procedures for diagnostic or therapeutic purposes (17).

Studies have shown that there is a higher risk when inserting the catheter in the jugular vein in relation to those placed in the subclavian vein, and that triple lumen catheters have a higher risk of infection than those with one or two lumens (1).

Complications

Venous thrombosis in upper limbs is one of the complications that occupies about 70-80% causing endothelial inflammation as a consequence of the trauma, when there is involvement of deep vessels the greatest risk is that a pulmonary embolism occurs causing long term consequences (6).

The inappropriate placement of the final end of the catheter has a greater risk of: forming a blood clot inside a blood vessel or in the heart, cardiac arrhythmia, hole in the arteries and veins which can trigger: hydrothorax (excess of liquid in the pleura), pericardial tamponade, leakage of blood, lymph or other liquid, all of this results in the Catheter not being useful, causing pain when solutions are administered through the connector and stenosis (18).

Pneumothorax/hemothorax: the accidental puncture of the pleural membrane allowing air from the atmosphere to enter the pleural cavity is known as pneumothorax. The puncture can be generated by the needle, the dilator, the guide or the catheter, and can be the cause of a pneumothorax, for which signs and symptoms should be evaluated, among them can be dyspnea, tachycardia, hypotension, agitation, dry cough, pleuritic pain or shoulder pain (19).

Hospital Prevalence Studies on CVC Infections

A study carried out in a hospital in Venezuela identified that out of 78 catheter tips, 30 of them were cultured and only 10 were found to be positive with bacterial growth within 24 hours (20). At the Hospital del Niño "Dr. Rodolfo Nieto Padrón", a study of 117 catheter tip cultures was carried out, and 32.5% were found to have bacterial process (21).

General Objective.

To describe the definition, management and risk factors associated with central venous catheter infection.

Specific Objectives

1. To identify the risk factors associated with central venous catheter infection.
2. To identify the types of microorganisms that cause Central Venous Catheter infection.
3. To detail the correct handling of port manipulation and catheter connection.

III. METHODOLOGY

Type of research

A systematic review of the literature was carried out. The recommendations of the PRISMA statement were followed to carry out this process.

Search strategies

In this specific case, the study seeks literature and theoretical review to provide bibliographic content inherent to risk factors associated with central venous catheter infection, identifying relevant aspects such as definition, management and risk factors associated with central venous catheter infection, types of microorganisms, factors that contribute to infection and the correct handling of ports and catheter connection, therefore, the universe of study are the main journals that have published research inherent to the subject such as: : PubMed, SciELO, Science Direct, Lilax, Web of Science and Medigraphic, the same that are consulted through academic search engines.

Inclusion criteria

The selection of articles was made as follows:
- Languages: Spanish and English.
- Year of publication: from 2015 to 2020.
- Original research article.
- Studies of a quantitative or mixed nature.
- Quality of the articles.

Exclusion criteria

We excluded from the study articles that were not of the year of publication sought, thesis type studies (undergraduate, graduate and PhD), monographs and argumentative essays, the impossibility to retrieve the full text of the article and articles repeated from a previous search.
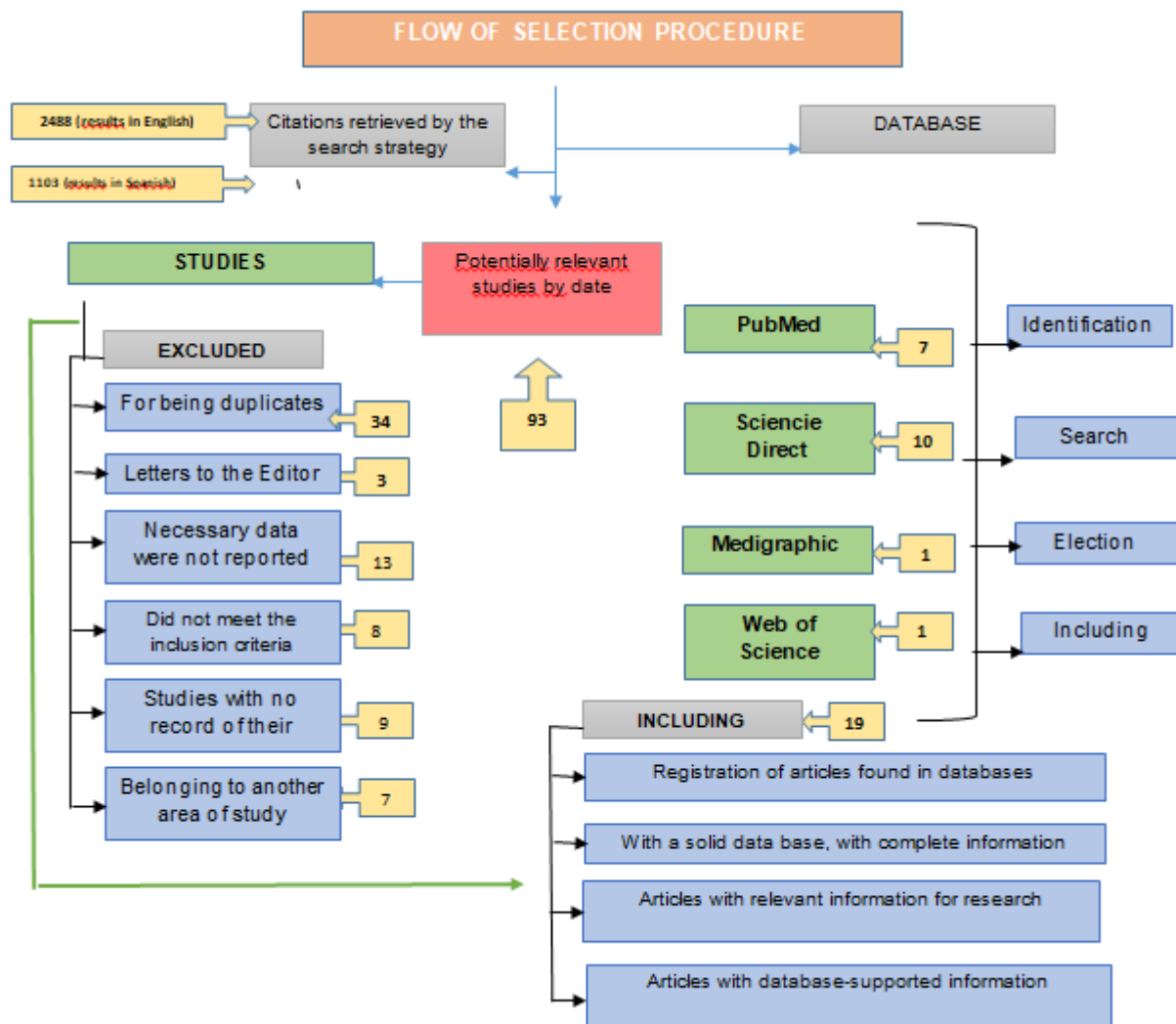
Ethical procedure

In accordance with the provisions of article 114 of the Organic Code of the Social Economy of Knowledge, Creativity and Innovation, I acknowledge in favor of the Catholic University a free, non-transferable and non-exclusive license for the non-commercial use of the work, for strictly academic purposes; I also declare that the ideas, concepts, procedures and results of the work described herein are my own and that I have consulted the bibliographical references included in this document.

IV. RESULTS

A comprehensive review of a total of 93 scientific articles from different search engines was carried out in relation to central venous catheter infection; after the exclusion of studies, 19 review studies were obtained and used for the present study (Table 1).

Table 1. Matrix of selected articles.

FLOW OF SELECTION PROCEDURE

2488 (results in English) → Citations retrieved by the search strategy

1103 (results in Spanish)

DATABASE

STUDIES ← Potentially relevant studies by date

EXCLUDED

For being duplicates — 34

Letters to the Editor — 3

Necessary data were not reported — 13

Did not meet the inclusion criteria — 8

Studies with no record of their — 9

Belonging to another area of study — 7

93

PubMed — 7 → Identification

Sciencie Direct — 10 → Search

Medigraphic — 1 → Election

Web of Science — 1 → Including

INCLUDING — 19

Registration of articles found in databases

With a solid data base, with complete information

Articles with relevant information for research

Articles with database-supported information

Studies included:

No. Ref	Title	Author, year, country	Sample	Type of study	Frequency	Risk Factors	Clinical manifestations	Microorganisms	Conclusions	Limitations
23	Cumulative Evidence of Randomized Controlled and Observational Studies on Catheter-Related Infection Risk of Central Venous Catheter Insertion Site in ICU Patients: A Pairwise and Network Meta-Analysis	Kostoula et al, 2017, Grecia	20 articles	systematic review, meta-analysis	Not specified	Insertion in the Femoral vein	Not specified	Not specified	The present meta-analysis for short-term non-tunneled CVCs in the ICU suggests that the subclavian, as well as the internal jugular, might be chosen initially when considering the risk of CRBSI.	Inclusion of crude incidence figures for the measures, the included studies did not provide data on site skin colonization, dressing alterations and that there is a risk of overestimated pooled estimates.

24	Does a Dedicated Lumen for Parenteral Nutrition Administration Reduce the Risk of Catheter-Related Bloodstream Infections? A Systematic Literature Review	Gavin et al, 2018, Australia	1 RCT and 1 prospective study	systematic review	Colonization: dedicated lumen 13%, multilumen group 10.6%.	Use of a multilumen catheter for PN administration, and catheter manipulation	Not specified	The pathogens that cause CR-BSI were described and categorized according to their morphology (i.e. Gram-positive cocci, Gram-positive bacilli categorized according to their morphology (i.e., Gram-positive cocci, Gram-positive bacilli, Gram-negative cocci, Gram-negative bacilli, fungi/yeasts and polymicrobial infection).	this review identifies a significant gap in the literature and provides a strong platform for further research to lead to definitive results.	Insufficient data to establish whether patients receiving PN through a multilumen catheter are at greater risk of developing CR-BSI than those with a dedicated PN lumen.
25	Central venous catheter for hemodialysis : incidence of infection and risk factors	Schwanke et al, 2018, Brazil	69 patients	Prospective cohort study	Incidence of infection of 9.1%.	Hospitalization time of 25 days (7.13 times longer) and catheter insertion in the left femoral vein (10.67 times longer). que en la vena yugular	Suspected infection, The outcome assessed was primary bloodstream infection.	The predominant microorganism isolated in blood culture was Staphylococcus aureus. It is the main causative agent of hemodialysis catheter infections, a fact already identified in several studies in the literature.	The The observation of the actions performed during catheter insertion made it possible to identify the risk factors associated with infection, and the research protocol used may have contributed to the reduction of infection rates. infection and the research protocol used may have contributed to the reduction of infection rates.	The direct observation method can be considered a limitation of this study.
26	Management and Prevention of Central Venous Catheter-Related Infections in the ICU	Buetti, 2019, France	Not specified	Not specified	Not specified	Femoral catheterization in ICU patients in women, repeated catheterization of the same vein,	Not specified	gram-positive (i.e., Staphylococcus aureus) and gram-negative microorganisms	Intravascular catheter-related infections remain one of the leading causes of nosocomial infections, especially in ICUs. It is the most frequent cause of in-hospital bacteremia and is more accessible for prevention if rigorous policies are implemented. It should be one of the main objectives of a quality improvement program.	Not specified

#	Title	Author/Year/Country	Sample	Study type	Incidence	Risk factors	Clinical manifestation	Pathogens	Conclusion	Limitations
27	Hemodialysis catheter-related infection: rates, risk factors and pathogens	Sahli, 2016, Algeria	94 patients	prospective study	Thirty-four CVC-RI were documented with an incidence of 16.6 per 1000 CVC-days. The incidence of CVC-related bloodstream infection (CVC-RBI) was 10.8 per 1000 CVC-days.	diabetes (P = 0.01) and duration of catheterization (P = 0.01).	Septic shock, mortality was statistically associated with inadequate antibiotic therapy.	The causative microorganisms were: Klebsiella pneumoniae 26.5%, coagulase-negative staphylococci 23.5% and Staphylococcus aureus 23.5%. The microorganisms were multidrug resistant (MDR).	In conclusion, the rate of CVC-RI in hemodialysis is high. Prolonged duration of CVC use and diabetes are important risk factors related to infection in hemodialysis patients. CVC duration should be reduced by creating fistulas. Increased compliance with hygiene measures is needed to decrease the CVC-RI and resistance rate.	Our study has some limitations; we had not tested all 152 procedures for blood infection. Some patients, such as immunosuppressed patients, received prior antibiotic treatment samples; others did not have clinical blood infection and were not tested for blood infection. The rate of CVC-RBI per 1000 CVC-days would be higher if we had performed blood cultures for all CVC procedures.
28	Risk Factors of Central Venous Catheter-Related Bloodstream Infection for Continuous Renal Replacement Therapy in Kidney Intensive Care Unit Patients	Cheng, 2018, China	1,523 patients with CVC, and 57 patients with CRBSI.	retrospective study	The incidence of infection was 3.7%.	Femoral vein catheterization, prolonged catheter dwell time, low CD4+ lymphocytes, and high Acute Physiology and Chronic Health Evaluation (APACHE) II scores were independent factors associated with CRBSI.	The most frequent infectious manifestations were chills (68.4%), fever (100%) and septic shock (49.1%).	The most common pathogens were Gram-negative bacteria, which were observed in 29 cases (50.9%), followed by Gram-negative bacteria (36.8%). The most common pathogens causing CRBSI were Staphylococcus aureus (10 cases) and sewer enterobacteria (10 cases) followed by Staphylococcus epidermidis (9 cases).	The incidence of CRBSI in our renal ICU was 3.7%. Central venous CRBSI for CRRT was associated with femoral vein catheterization, prolonged catheter dwell time, compromised immune function, and high APACHE II scores. Understanding pathogens and risk Factors of central venous CRBSI in the renal ICU can help clinicians prevent and treat CRBSI earlier.	It was a retrospective study, the proportion of femoral vein catheterization in other centers was relatively large and there was no homogeneous type of catheter care.
29	Risk factors for central venous catheter–related bloodstream infections after gastrointestinal surgery	Wu, 2017, China	477 patients	Prospective study	The overall CRBSI rate was 8.0%.	CVC duration (>15 days), emergency surgery and male sex were risk factors for CRBSI.	The diagnosis of CRBSI associated with a CVC was based on the CRBSI criteria established by the Centers for Disease Control and Prevention,	The most common organisms were coagulase-negative staphylococci, followed by Enterobacteriaceae and Candida spp.	The management of CVCs in patients undergoing gastrointestinal surgery mainly from data obtained from ICUs. For example, the following procedures are recommended: hand washing, use of total barrier precautions during CVC	Not specified

									insertion, avoidance of the femoral site if possible, and removal of unnecessary catheters. Further clinical studies in non-ICU surgical patients, such as patients undergoing gastrointestinal surgery, are still needed. Antibiotic choices for initial empiric therapy should be based on previous culture results in this population.	
						ref 4,5				
30	Complications related to the insertion and maintenance of the peripheral access central venous catheter peripheral access	Lacostena-Pérez et al, 2019, España	144 patients	Prospective observational study	The most important complication was suspected infection: 17.36% (incidence rate of 15.2 per 1,000 CVCAP days).	such as multiple catheters, more frequent catheter access, continuous infusions	Inflammation of the vein, infection can occur with phlebitis,	The most frequent germ was Staphylococcus epidermidis (6 cases). The phlebitis had an incidence of 9.03% (7.9 per 1,000 CVCAP days).	The CVCAP, an effective central venous access device due to the minimal incidence of risks during implantation and its advantages over classic central venous catheters, is just another nursing technique.	The major limitation is not having routinely ruled out, by means of ultrasound and even contrast venography, the possibility of phlebitis complicated by the possibility of phlebitis complicated by thrombosis. thrombosis, although the phlebitis patients presented were all asymptomatic. were all asymptomatic. Another limitation is that the study was carried out in a center where the nursing the nursing rotation in the hospitalization wards is frequent, so that the results could frequent, so the results may not necessarily be extrapolated to other settings.s
31	Effectiveness of a package of measures to reduce central venous catheter-associated bacteremia.	Hernández-Aceituno et al, 2019	Not specified	Not specified	The cumulative incidence (CI) and incidence density	In the multivariate analysis, the following were associated with a	Not specified	Not specified	BACVC rates decreased after implementing the insertion package. CVC replacement, 2 or more catheterizations, and parenteral nutrition were	Not specified

					(ID) of BACVC were compared before and after the intervention.	higher risk of CAVCBG: CVC replacement (OR: 11.01; 95% CI: 2.03-59.60, p = 0.005), 2 or more catheterizations (OR: 10.05; 95% CI: 1.77-57.16; p = 0.009) and parenteral nutrition (OR: 23.37; 95% CI: 1.77-57.16; p = 0.009): 4,37-124,91; p < 0,001).			associated with BACVC after implementing the package of measures.	
32	Incidence of central venous catheter-associated infection and related risk factors in patients with total parenteral nutrition in a tertiary hospital. level hospital	Parra-Flores, 2016, México	85 files	Retrospective, observational, comparative and longitudinal study. longitudinal study	19% of patients developed patients developed infection	We found that patients with more days of central catheter use (p = 0.014) 20 days and the fact of being postoperative and with parenteral nutrition (p = 0.05) increase the risk of presenting catheter-associated associated infection, so greater vigilance should be exercised in these patients to prevent this complication. to prevent	The most frequent diagnosis was enterocutaneous fistula.	The most frequently associated microorganisms were: Staphylococcus sp. (44%) and Candida sp. (25%)	We found that patients with more days of central catheter use (p = 0.014) and the fact of being postoperative and with parenteral nutrition (p = 0.05) increase the risk of presenting catheter-associated infection. and the fact of being postoperative and with parenteral nutrition (p = 0.05) increase the risk of presenting catheter-associated infection, so greater vigilance should be taken in these patients to prevent this complication.	Not specified

						this complication. Eighty-one percent of the patients who presented infection were postoperative (p < 0.05). postoperative (p < 0.05).				
33	Central venous catheter-related bacteremia: incidence and risk factors in a hospital in western western Mexico	Lona-Reyes, 2015, México	204 patients	A prospective cohort study was carried out in	The incidence of CVRBC was 6.5 events per 1,000 catheter days.	It was observed that greater catheter manipulation per day was associated with bacteremia (HR 1.14, 95%CI 1.06-1.23).	fever, hypothermia, tachycardia, bradycardia, leukocytosis, leukopenia, erythema or discharge at catheter entry site	The microorganisms identified were Gram-positive cocci (37.5%, n = 6), Gram-negative bacilli (37.5%, n = 6) and Candida albicans (25%, n = 4).	In addition to the maximum precautionary measures when placing or handling the catheter, it is advisable to reduce as much as possible the disconnections between the venoclysis equipment and the CVC. venoclysis equipment and the CVC. Antibiotics have shown a protective effect; however, the risk of favoring the risk of favoring antimicrobial resistance should be considered.	One limitation of this study is the sample size. This may explain the absence of the association between the variables between the variables described as risk factors and the BRCVC
34	Nosocomial bacteremia associated with central in intensive care units in 2 hospitals in Galicia (Spain).	Villamarín-Bello et al, 2016, España	682 patients	a cohort or incidence a cohort or incidence study and subsequently, nested within it, a case-control substudy was and controls	The incidence rates found were 3.21; 2.91 and 5.76 bacteremias per 1,000 days at risk for hospital A for the years ˜ 2009, 2010 and 2011 respectively. These	The risk factors identified were coma (OR = 3.72; 95%CI 1.06-13.02) and the number of catheters (OR = 1.90; 95%CI 1.21-2.97). and the number of catheters (OR = 1.90; 95%CI 1.21-2.97).	CVC-associated bacteremia was considered to be any case that fulfilled any of the criteria established in the PLAMIRMI HGA	In hospital A, the microorganisms most frequently found in cultures were Staphylococcus epidermidis, Acinetobacter baumanii, other Staphylococcus and in the cultures were Staphylococcus epidermidis, Acinetobacter baumanii, other Staphylococcus and Candida albicans. In hospital B, in the 2 cases of bacteremia the microorganisms implicated were Chrysebacterium spp. and other	Rates above the recommended standard are observed in most study periods. Special attention should be paid to patients in coma and with multiple catheters, as they present a higher risk of developing CVC-associated bacteremias.	Not specified

				rates were 2.10; 0 and 4.74 bacteremias per 1,000 days at risk for hospital B for the same years				Staphylococcus.	
35	Needleless connector decontamination for prevention of central venous access device infection: a pilot randomized controlled trial	Rickard et al, 2020, Australia	178 patients	Randomized controlled pilot trial	Not specified	Not specified	Central line-associated bloodstream infection (CLABSI), Primary bloodstream infection	Not specified	Currently, 70% IPA wipes are dominant due to their low cost, availability and rapid drying [2], availability, and quick drying [2] however, the addition of CHG likely increases efficacy, [3, 4] and non-randomized studies support IPA limits to 70%. [5, 6] Pilot RCTs are not designed to test for statistical differences in outcomes or the effect of potential confounders or covariates such as NC/device type or patient factors.	Not specified
36	Effects of a Quality Improvement Program to Reduce Central Venous Catheter-Related Infections in Hemodialysis Patients	Zhenhua et al, 2021, China	122 participants	Not specified	The incidence of central catheter-related bloodstream infection as a primary outcome was 0.8 and 8.8 cases per 1000 catheter days in the PDCA and routine groups, respectively (P<0.00	Asepsia	Not specified	Not specified	This pilot study suggests that the PDCA cycle model can effectively reduce the incidence of central venous catheter-related infections and improve the satisfaction and quality of life of hemodialysis patients.	Not specified

						1).			
37	Maintenance antisepsis in reducing the rate of late-onset central venous catheter-related bloodstream infection: A comparison of 0.05% and 1% chlorhexidine	Kikuchi, 2019, Japon	716 patients	prospective observational study	Not specified	microbial infection	Findings of fever, redness, tenderness and exudate during daily inspections of the CVC insertion site.	Not specified	Maintenance antisepsis with 1% chlorhexidine reduced the risk of developing CRBSI 20 days after CVC insertion, indicating the efficacy of 1% chlorhexidine antisepsis. Our data highlight the importance of maintenance antisepsis in reducing the rate of late-stage CRBSI.	Not specified
38	Collateral Damage— The Risks of Central Venous Hemodialysis Catheters	Roper et al, 2020, London	We present a patient with CVT	Not specified	Not specified	Coagulability status, comorbidities, number of previous catheters and history of previous thrombosis.	Our patient developed a CVT in the left brachiocephalic vein as a consequence of left internal jugular THC placement.	Not specified	In conclusion, an increasing number of patients start HD via suboptimal VA, i.e., CVC and THC. Although these methods of obtaining VA are a lifeline, they should be avoided whenever possible to reduce the risk of associated complications. CVTs are an increasingly common complication of HD catheter insertion, which, with proper planning of VA options, could potentially be avoided in many (Table 3).	Not specified
39	Failure of central venous catheter insertion and care bundles in a high central line–associated bloodstream infection rate, high bed occupancy hospital	Karapanou et al, 2020, Grecia	913 CVC insertions	Pre-post quasi-experimental study	The incidence of CLABSI was 8.3 per 1000 catheter-days PRE and 7.6 per 1000 catheter-days POST (incidence rate, 0.92; 95% confidence interval, 0.60-1.40).	ICU hospitalization (x2, p = 0.002), with insertion after previous CVC infection (x2, p <0.001) and with 3 vs. 2-lumen CVC insertion (Fisher's exact test, p = 0.002).	Not specified	Acinetobacter baumannii (10 of 50, 20.0%), followed by coagulase-negative staphylococci (8 of 50, 16.0%) and Klebsiella pneumoniae (6 of 50, 12.0%). In the POST phase, A. baumannii was again the most frequently isolated pathogen (11 of 45, 24.4%), followed by Enterococcus faecium (10 of 45, 22.2%) and coagulase-negative staphylococci (9 of 45, 20.0%).	Despite improved compliance after the intervention, implementation of a modified CVC package failed to decrease the incidence of CLABSI. Higher bundle compliance rates may be necessary for a significant decrease in the incidence of CLABSI, along with the right organizational culture and staffing levels	violations of the insertion package were not recorded, except in the context of the compliance audit

| 40 | Infection at central venous catheter insertion | Nascimento et al, 2015, Brasil | 08 items | integrative review (IR) of the scientific literature | Not specified | Catheter related, with emphasis on the intensive care unit and the care associated with catheter implantation, management and maintenance. | Not specified | Studies show that microorganisms such as methicillin-resistant Sthapylococcus aureus (MRSA) are at the forefront of hospital-acquired infections worldwide. | He demonstrated that it is extremely important to take care when inserting a central venous catheter to prevent a bloodstream infection. | Not specified |
| 41 | Risk factors associated with vascular access sepsis in patients undergoing hemodialysis hemodialysis | Fiterre Lancis et al, 2018, Cuba | 102 patients | Prospective observational prospective analytical | The frequency of vascular access infection was practically 5 times higher (51.6%) in patients with CVC compared to patients with AVF (10.3%) in the period observed. patients with AVF (10.3%) in the observed period. | The use of transient hemodialysis catheters transient catheters for hemodialysis is frequent, with permanent vascular access, higher number of catheters, low hemoglobin and serum albumin level | Not specified | The microbiological isolates corresponded mainly with Staphylococcus aureus, Staphylococcus aureus | The use of a central venous catheter for hemodialysis is an independent risk factor for hemodialysis is an independent risk factor for the development of for the development of infection in patients on hemodialysis. | Limitations of the study are that patients without clinical infection were not subjected to microbiological studies to be taken into account. microbiological studies to take into account possible subclinical possible subclinical infection in immunocompromised patients. |

Table 2. Matrix of selected articles

Of the 19 articles analyzed, the sample sizes of the included reports have a wide range, from 69 to 1,523 patients, and most of the studies correspond to the prospective observational type.

Based on the data presented in Table 2, the results obtained according to the specific objectives are presented below.

Objective Specific 1.- Identify risk factors associated with central venous catheter infection.

Figure 1 shows, in percentage terms, the risk factors associated with central venous catheter infection.
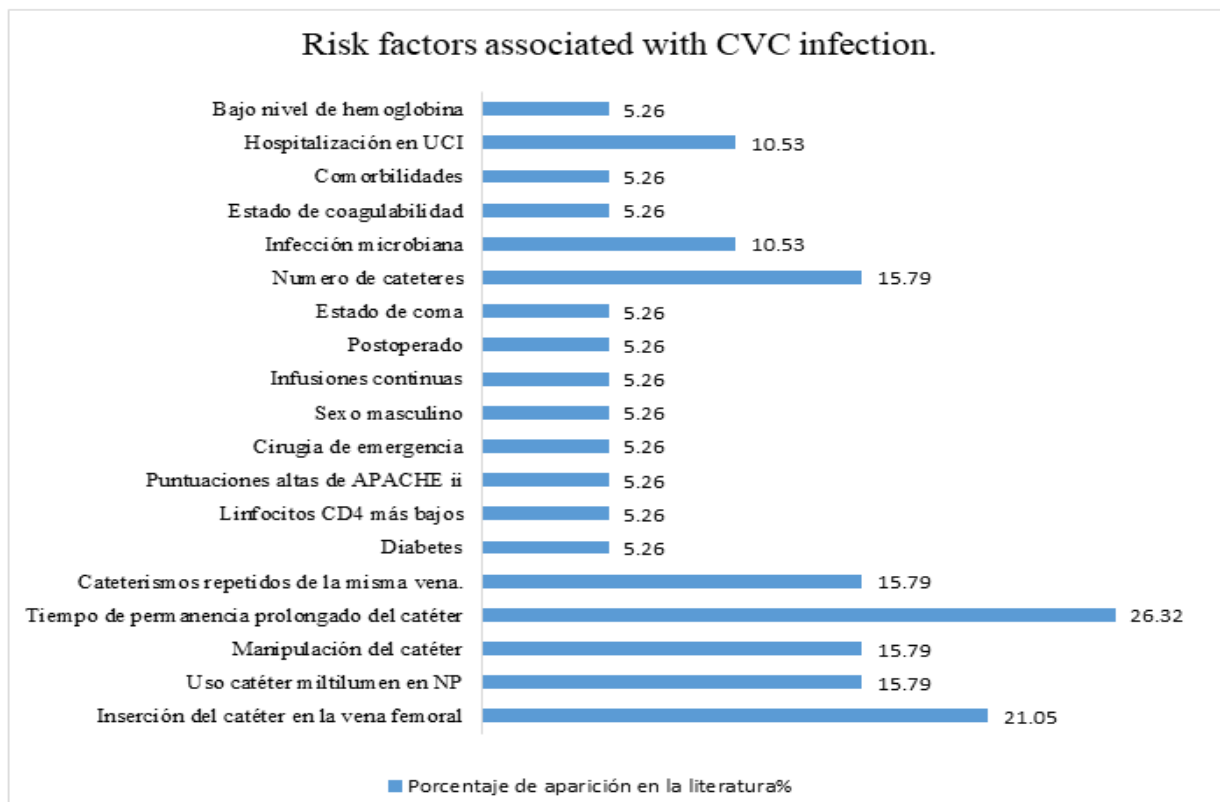
Figure 1: Risk factors associated with CVC infection.

According to the data presented in Figure 4, the risk factors for CVC infection with the highest percentage of records correspond to prolonged catheter residence time (26.32%); insertion of the catheter in the femoral vein (21.05%); and number of catheters used, repeated catheterization in the same vein, catheter manipulation and use of multilumen catheter for PN (15.79%). Hospitalization in the ICU and microbial infection due to asepsis were observed in lower percentages (10.53%). Finally, the factors with a percentage of occurrence of 5.26% correspond to the factors mentioned in only one scientific publication.

Specific Objective 2.- To identify the types of microorganisms that cause Central Venous Catheter infection.

Table 3: microorganisms causing CVC infection

No. Reference	Author, year	Microorganisms
24	Gavin et al, 2018	The pathogens causing CR-BSI were described and categorized according to their morphology (i.e. Gram-positive cocci, Gram-positive bacilli, Gram-negative cocci, Gram-negative bacilli, fungi/yeasts and polymicrobial infection).
25	Schwanke et al, 2018	The predominant microorganism isolated in blood culture was Staphylococcus aureus.
26	Buetti, 2019	Gram-positive (i.e. Staphylococcus aureus) and gram-negative microorganisms
27	Sahli, 2016	Klebsiella pneumoniae, coagulase-negative staphylococci and Staphylococcus aureus. The microorganisms were multidrug resistant (MDR).
28	Cheng, 2018	Staphylococcus aureus and sewer enterobacteria, followed by Staphylococcus epidermidis.
29	Wu, 2017	Coagulase-negative staphylococci, followed by Enterobacteriaceae and Candida spp.
30	Lacostena-Pérez et al, 2019	Staphylococcus epidermidis.
32	Parra-Flores, 2016	Staphylococcus sp. and Candida sp.
33	Lona- Reyes, 2015	Gram-positive cocci, Gram-negative bacilli and Candida albicans.
34	Villamarín-Bello et al, 2016	In hospital A, the microorganisms most frequently found in the cultures were Staphylococcus epidermidis, Acinetobacter baumanii, other Staphylococcus and Candida albicans. In hospital B, in the 2 cases of bacteremia, the microorganisms involved were Chrysebacterium spp. and other Staphylococcus.

39	Karapanou et al, 2020	The most frequently isolated pathogen in the PRE phase was Acinetobacter baumannii, followed by coagulase-negative staphylococci and Klebsiella pneumoniae. In the POST phase, A. baumannii was again the most frequently isolated pathogen, followed by Enterococcus faecium and coagulase-negative staphylococci.
40	Cardoso Nascimento et al, 2015	Staphylococcus aureus
41	Lancis et al, 2018, Cuba	Staphylococcus aureus

Of the microorganisms presented in Table 3, gram-positive microorganisms (Staphylococcus aureus) and Candida albicans were the most reported in the articles studied.

Objective 3. - To detail the correct handling of ports and catheter connection.

Table 4: microorganisms causing CVC infection

No. Reference	Author, year	Management
24	Gavin et al, 2018, Australia	Any time a lumen or intravenous administration equipment connection is accessed or manipulated, it is imperative to perform hand hygiene immediately prior to the procedure; wear gloves; and use an aseptic non-contact technique with adequate scrubbing and drying time and a pulsatile washing technique.
25	Schwanke et al, 2018, Brazil	It is of utmost importance to identify risk factors for infection in order to guide the development and adoption of protocols. These measures help to reduce infection rates and, consequently, can ensure the quality of care for patients requiring hemodialysis.
26	Buetti, 2019, France	Avoidance of unnecessary intravascular catheters, sterile barrier precautions, skin antisepsis, patient bathing with chlorhexidine, etc.
27	Sahli, 2016, Algeria	Promotion of clear clinical guidelines and continuing education of staff is needed to improve practice. Hand hygiene needs to be improved, but attention should be paid to the use of protective clothing: mask and sterile gown. The application of aseptic techniques during the insertion, care and handling of intravascular catheters is known to be effective precautions against CVC-R.
29	Wu, 2017, China	The following procedures are recommended: hand washing, use of full barrier precautions during CVC insertion, avoidance of the femoral site if possible, and removal of unnecessary catheters. Further clinical studies in non-ICU surgical patients, such as patients undergoing gastrointestinal surgery, are still needed. Antibiotic choices for initial empiric therapy should be based on previous culture results in this population.
33	Lona- Reyes, 2015, México	Finally, it is suggested that disconnections between the infusion line and the CVC be reduced as much as possible. Strategies to achieve this include administering drugs with as few doses as possible, indicating infusions of solutions for 24 h and the use of continuous infusion pumps. Although antibiotics have a protective effect for CRVC, their indication is not recommended until the impact on antimicrobial resistance is assessed.
35	Rickard et al, 2020, Australia	NC needleless connector decontamination is a high-volume, high-value practice that urgently needs high-quality evidence to prevent CLABSI.
37	Kikuchi, 2019, Japon	Combined measures have been recommended to prevent infections at the catheter insertion site. These recommendations focus primarily on the insertion procedure and include measures such as washing hands before the insertion procedure, using maximum barrier precautions during insertion, cleaning the skin with chlorhexidine, avoiding the femoral vein, and removing an unnecessary catheter.
39	Karapanou et al, 2020, Grecia	We suggest that care packages are more than checklists of actions and that their success depends, at least in part, on the context. Requirements in terms of organizational culture and staffing are likely to be critical to the successful implementation of the care package.
40	Cardoso Nascimento et al, 2015, Brasil	It was evidenced through the studies analyzed that in the intensive care environment there is a need to use invasive procedures such as the Central Venous Catheter for life support. However, these should be used with care by professionals, respecting asepsis techniques, maintenance time and other care to avoid contamination of the patient by the device. He also concluded that surveillance is an essential component in an infection control program, as well as a fundamental action to improve the quality of nursing care.

V. DISCUSSION

The present documentary research focused on analyzing the results of 19 current scientific papers regarding the main risk factors associated with central venous catheter infection.

Regarding the risk factors, prolonged catheter stay time was the factor with the highest percentage of incidence found. According to Schwanke et al (25), the mean hospital stay of hemodialysis patients was 25 days, and those who remained hospitalized for more than 60 days had a 7.13 times higher risk of developing infection than those who remained hospitalized for less time, according to the authors this may be related to the complexity of the patients, since most of them had Acute Respiratory Failure (ARF) possibly derived from other factors, which required longer treatment. On the other hand, Wu et al (29) analyzed that CVC durations of 1 to 15 days were associated with a lower risk of bloodstream infection than CVC durations> 15 days, similar to the results obtained by the authors.

Regarding femoral vein catheter insertion, according to Wu et al (29) central venous catheter related bloodstream infection (CRBSI) is closely related to the catheter site, and that the femoral vein was the most common catheterization site for CRBSI, and the cause of femoral vein for CRBSI is believed to be bacterial colonization of the perineal skin. Kostoula et al (23) state that, in the ICU setting, when considering the risk of CRBSI, the subclavian is no longer the undisputed site of choice in ICU patients; the internal jugular may also be chosen initially. The subclavian retains its rank of first choice when the risk of colonization is considered and is not otherwise contraindicated, and the excessive risk of femoral CRBSI remains debatable.

Referring to risk factors such as number of catheters, repeated catheterization in the same vein, catheter manipulation and multilumen catheter use in parenteral nutrition (PN), Gavin et al (24) in their paper cites that multiple concurrent devices may put patients at risk for infection, venous thromboembolism and falls. In addition, Lacostena-Pérez el at (30) indicates that the aggressiveness of some of the usual drugs such as vasoactive amines, antibiotics, antiarrhythmics such as amiodarone, etc., often require the insertion of more than one noncentral peripheral venous catheter, and this increases the risk of phlebitis, extravasation and complications.

On the other hand, among the microorganisms most frequently identified in the articles studied were gram-positive microorganisms (Staphylococcus aureus) and Candida albicans. According to Schwanke et al (25), Staphylococcus aureus is the main causative agent of hemodialysis catheter infections; likewise, Buetti (26) maintains that this microorganism is frequently responsible for CRBSI.

Cardoso et al (40) argues that microorganisms such as methicillin-resistant Staphylococcus aureus (MRSA) are at the forefront of hospital infections worldwide, therefore, the control of patient stay, patient contact, along with the lack of adherence to standard precautionary measures remain a risk factor for colonization by microorganisms resident in the hospital environment in health professionals, especially nurses who deal in the different stages of health care (40).

Finally, among the recommendations found in the literature, it is important to respect aseptic techniques such as hand hygiene immediately before the procedure (24,27,29,37), the use of protective clothing such as gloves, mask and sterile gown (27).

One of the major limitations of the present work can be attributed to the scarcity of updated information at the Latin American level; therefore, the body of work analyzed corresponds, for the most part, to research based on data from European countries. Nevertheless, these studies can be considered as a strong reference in terms of methodology and criteria for developing this type of research at both the local and regional levels.

VI. CONCLUSIONS

After a review of the literature consisting of 19 scientific articles, it is concluded that bloodstream infections are an important cause of morbidity and mortality, and those related to central venous catheters are considered primary diseases. Knowledge regarding the risk factors of infection associated with CVC will help in the implementation of protocols regarding the proper management at the time of CVC implementation and thus ensure a good condition of life of the patient.

Since the greatest risk of infection is related to asepsis, it is essential to respect asepsis techniques, maintenance time and other care to avoid contamination of the patient by the device.

Therefore, the bibliographic study carried out in the present work is considered relevant, since it intends to make the nursing staff apply the nursing care process, with the aim of improving the quality of patient care and timely care related to the pathology to reduce the risk of potential complications and reduce the mortality rate.

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