Prevention of Catheter-Related Bloodstream Infections in Patients on Hemodialysis

Prevenção de infecções de corrente sanguínea relacionadas a cateter em pacientes em hemodiálise

Prevención de infecciones del torrente sanguíneo relacionadas al catéter de pacientes en hemodiálisis

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ABSTRACT

Objective: To conduct a systematic review of the literature on the prevention of catheter-related bloodstream infections in patients on hemodialysis. **Methods:** A literature search was performed in Medline, Embase, Scielo, Lilacs, and Cochrane databases for articles published from 1990 to 2008. **Results:** Two hundred ninety- three articles were retrieved. However, only 12 studies were included in this review. **Conclusions**: Findings suggest that health care providers use several infection control measures to prevent bloodstream infections in this patient population.

Keywords: Dialysis; Renal dialysis/complications; Infection; Catheterization, central venous/adverse efects

RESUMO

Objetivo: Realizar uma revisão sistemática sobre medidas padronizadas para prevenção de infecções relacionadas a cateter em pacientes em hemodiálise. **Métodos**: Foi realizada uma revisão sobre a prevenção de infecções em hemodiálise nas bases de dados Medline, Embase, SciElo, Lilacs e Cochrane Library de estudos publicados entre os anos de 1990 e 2008. **Resultados**: Foram encontrados 293 artigos e destes 12 foram incluídos no estudo. **Conclusão**: Foi evidenciada a importância da aplicação de um conjunto de medidas de controle de infecções pelos profissionais da saúde para prevenir a infecção nesta população de pacientes.

Descritores: Diálise; Diálise renal/complicações; Infecções; Cateterismo venoso central/efeitos adversos

RESUMEN

Objetivo: Realizar una revisión sistemática sobre las medidas patronizadas para la prevención de infecciones relacionadas al catéter de pacientes en hemodiálisis. **Métodos**: Fue realizada una revisión sobre la prevención de infecciones en hemodiálisis en las bases de datos Medline, Embase, SciElo, Lilacs y Cochrane Library de estudios publicados entre los años de 1990 al 2008. **Resultados**: Fueron encontrados 293 artículos y de éstos 12 fueron incluidos en el estudio. **Conclusión**: Se evidenció la importancia de la aplicación de un conjunto de medidas de control de infecciones por los profesionales de la salud para prevenir la infección en esta población de pacientes.

Descriptores: Diálisis; Diálisis renal/complicaciones; Infecciones; Cateterización venosa central/efectos adversos

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INTRODUCTION

Fourteen percent of deaths among patients with end-stage kidney disease (ESKD) are due to infections, preceded only by cardiovascular diseases[1].

According to The United States Renal Data System (USRDS), the number of patients receiving hemodialysis in the United States of America (USA) was 328,000 in 2006[2]. Data from Sociedade Brasileira de Nefrologia (Brazilian Society of Nephrology) reported that the number of patients on dialysis treatment in Brazil was 73,605 in 2007 and 90.8% of those patients were receiving hemodialysis[3].

Data from the USA National Healthcare Safety Network demonstrated that bloodstream infection rates in 2006 varied according to the site of vascular access: 0.5% arteriovenous fistula (AVF), 0.9% AV grafts, 4.2% long-term central venous catheter and 27.1% short-term central venous catheter per month, respectively. Most microorganisms detected in the blood culture were considered to be a skin contaminant coagulase-negative *Staphylococcus*. Forty two percent (42%) of *Staphylococcus aureus* were resistant to methicillin and 39% of *Enterococcus* spp were resistant to vancomycin[4].

Patients receiving hemodialysis have high risk for infection due to immunosuppression caused by ESKD, comorbidities, inadequate diet and the need for maintaining the venous access for long periods. In dialysis clinics many patients are submitted to this procedure at the same time, leading to the dissemination of microorganisms through direct or indirect contact with the devices, equipment, contaminated surfaces or the hands of health professionals.

Microbial resistance should be considered because patients on dialysis treatment are often hospitalized and exposed to multi-resistant microorganisms and to broad-spectrum antimicrobial therapy[5-7].

On the one hand, the quality of dialysis and thus patients' well being and survival depend on the venous access; on the other hand, this is considered the major risk factor for infection and especially bacteremia in this group of patients[8].

In a study performed at Universidade Federal de São Paulo, 61% of patients with ESKD using central venous catheter presented bacteremia. Risk factors for bacteremia were: catheter insertion in the subclavian vein, duration of catheter use and the hospitalization period. The mortality rate in these patients was 29% and for patients who developed endocarditis it was 55.5%[9].

As this population is exposed to a high infection risk which can be prevented in most cases by health professionals, a systematic review of literature was performed to establish standard measures to prevent catheter associated infections in hemodialysis patients.

EPIDEMIOLOGY

Twenty months of epidemiological surveillance data in the USA demonstrated that the risk for bacteremia was 32 times higher when short-term venous catheter was used, and 19 times higher when long-term venous catheter was used compared to the use of arteriovenous fistula (AVF). Similar data were observed in a study conducted in 11 dialysis centers in Canada[10].

A prospective survey with 35,000 randomized patients between the years of 1996 and 2007 treated in about 300 dialysis units in 12 countries demonstrated a great variation on AVF utilization. AVF use declined in elderly, obese, diabetic and patients with cardiovascular diseases or recurrent cellulitis. Considering the high mortality caused by the use of catheters, the best option for these patients is AV graft. However, in some countries there was an increase in catheter use and a proportional decrease in the use of AV grafts in patients with the characteristics mentioned[11].

Measures to prevent catheter associated infections in hemodialysis patients must be considered taking into account the reduction in the use of central venous catheter (CVC), giving priority to the use of AVF whenever possible. However, in patients with impaired vessels, obesity and diabetes, where access through AVF or graft can be difficult, long-term CVC use is recommended[8].

METHODS

The present study was carried out through a review of the literature encompassing the issue of preventing catheter-associated bloodstream infections in hemodialysis patients. Studies published from 1990 to 2008 have been selected through electronic search in the following databases: *Cochrane Library, Medline, SciELO, Embase, Lilacs,* works presented in congresses, reviews and guidelines. The search strategy used for Medline presented the following steps: "Catheterization, Central Venous" [Mesh] AND "Infection" [Mesh]) AND "Renal Dialysis" [Mesh]) AND "Renal Dialysis/education" [Mesh] AND "Infection Control" [Mesh]. To select articles, two independent reviewers assessed the titles and abstracts of the publications found. All studies in the issue meeting the criteria for review have been included regardless of the language or design. Photocopies of the articles have been obtained and a standard form has been used to extract data.

RESULTS

Two hundred and ninety three articles were found according to the used descriptors, 50 of them were literature reviews. After a previous selection, 12 studies

that met the inclusion criteria were selected according to the assessment of the two independent reviewers. Four of them were systematic reviews, two were prospective cohorts, one was an experimental study, one was a meta-analysis review, three were controlled randomized clinical essays, and another one was a cross-sectional randomized clinical trial. (Chart 1)

It was clear that surveillance is the essential issue for an infection control program and also for improving quality of care. A prospective study carried out in London between 2002 and 2004 with 112 patients (3418 patients per month) demonstrated reduction in bacteremia rate from 6.2% to 2.0% per month, reduction in hospitalizations due to bacteremia from 4.0% to 1.4% per month and also a significant downward trend was seen in bacteremia rates and antibiotic usage after the introduction of a surveillance scheme with patients' risk stratification, definition of denominators, type of access performed by physicians and nurses from the service, team training, preventive measures of infections, dissemination of data and use of results to optimize the actions introduced[10].

The training and education of health professionals, patients and care givers is recommended by the Center for Disease Control and Prevention (CDC) to prevent dialysis infections and must be compatible with the available knowledge from the personnel involved[7]. A study conducted in a university hospital from São Paulo demonstrated 40% reduction in catheter-associated bloodstream infections (CABSI) after the implementation of an educational intervention with staff members[12].

There are some standard precautions based on strategies to prevent transmission of infections that health professionals must use in patients' care: hand washing before and after the contact, use of gloves, masks, protection glasses and laboratory coats when there is risk of contact with biological material, be careful with sharp-edged and hollow-pointed devices, environmental cleaning, adequate use of materials and equipments and health professionals immunization. When patients present suspicion or confirmation of a more severe infection, additional measures must be taken in addition to those mentioned above[13].

According to national and international recommendations, catheter insertion has to be conducted under sterile conditions and maximum barrier: masks, laboratory coats, gloves and sterile drapes[7-8, 14].

Alcoholic chlorhexidine 2% (drug of choice) or polyvinylpyrrolidone-iodine solution (PVP-I) 10% has to be used for skin antisepsis before catheter insertion and before dressing changes[7, 14]. A randomized study[15] highlighted that use of chlorhexidine before catheter insertion and during dressing changes is associated with less colonization and occurrence of CABSI when compared to the use of alcoholic PVP-I.

Gauze or sterile transparent film are recommended to dress the site of catheter insertion. After bathing or showering it is important to inspect the insertion site, protecting it and replacing the catheter-site dressing when it becomes damp, loosened, or soiled[7-8, 14]. A study[16] demonstrated that mupirocin use in the catheter insertion

Chart 1 – Summary of the studies included

Author, year of publication and country	Design	Participants	Type of intervention
George A, 2006- England	Prospective cohort	112 patients	Surveillance system
Lobo RD, 2005- Brazil	Experimental	75 professionals	Health professional educational program
Guideline CDC, 2001- USA	Systematic review	206 references	Recommendations for dialysis infection prevention
Guideline CDC, 2007- USA	Systematic review	1102 references	Care Recommendations
Guideline CDC, 2002- USA	Systematic review	293 references	Recommendations to prevent catheter-related infections
Mimoz O, 2007- France	Controlled randomized clinical trial	538 catheters	Use of chlorhexidine versus polyvinylpyrrolidone-iodine solution (PVP-I)
Sesso R, 1998- Brazil	Controlled randomized clinical trial	136 patients	Use of mupirocin on catheter insertion
Johnson DW, 2002- Australia	Controlled randomized clinical trial	50 patients	Use of mupirocin on catheter insertion
Roth PE, 2006- Spain	Cross-sectional	375 strains	Mupirocin resistance
Bleyer AJ, 2007- USA	Systematic review	34 studies	Use of antimicrobial lock solutions
Safdar N, 2006- USA	Systematic review with meta-analysis	7 studies	Use of a vancomycin-lock solution to reduce bacteremia.
Ethier J, 2008- multicenter	Prospective cohort	35000 patients	Venous access effectiveness

site reduces significantly the risk of *S aureus* colonization and bacteremia. The same result was obtained in a study carried out in Australia[17]. However, the emergence of resistant strains must be considered as demonstrated in a Spanish study where pandemia of methicillin-resistant *Staphylococcus aureus* was associated to high-level mupirocin resistance[18].

Another prevention strategy is the use of gentamicin, cephalosporin or vancomycin lock solution, taking into account the possibility of the emergence of resistant microorganisms when vancomycin is used[19].

In a meta-analysis, authors demonstrated that in high-risk patients treated with long-term catheters the use of vancomycin lock solution reduces the risk of bacteremia[20].

CDC does not recommend the regular use of antimicrobial lock solution to prevent bloodstream infection. The use is recommended only in special circumstances (e.g. patient with a long-term catheter or patients with clinical data of recurrent infections despite optimal maximal adherence to aseptic technique)[14].

CONCLUSION

Catheter-associated bloodstream infection can be reduced when prevention measures are adequately taken they are: proper choice of insertion site, local antisepsis, personnel appropriate attire, infection surveillance, care and maintenance of the catheter, as well as the use of new technologies.

Taking into account that this is a population at high-risk for infection, the emergence of multi-resistant microorganisms must be considered, and if a severe case occurs, additional prevention measures must be taken to avoid an outbreak in this population.

All personnel involved in the process of catheter insertion, maintenance and removal must be aware of the importance of excellent care for infection prevention.

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