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INTEGRATIVE REVIEW ARTICLE

PERIPHERAL INTRAVENOUS CATHETER WITH CLOSED INFUSION SYSTEM: AN INTEGRATIVE REVIEW

CATETER INTRAVENOSO PERIFÉRICO COM SISTEMA FECHADO DE INFUSÃO: REVISÃO INTEGRATIVA
CATÉTER INTRAVENOSO PERIFÉRICO CON SISTEMA DE INFUSIÓN CERRADO: UNA REVISIÓN INTEGRADORA

Mitzy Tannia Reichembach Danski[1], Jolline Lind[2], Gabriella Lemes Rodrigues de Oliveira[3]

ABSTRACT

Objective: to analyze the production of knowledge about the use of peripheral intravenous catheter with closed infusion system. *Method:* an integrative review in which was used selection criteria and descriptors controlled from the PICO strategy for the search of articles indexed in Medline, Lilacs and Embase, in the period 2010-2015. The sample consisted of five articles. *Results:* the included studies show that the use of closed infusion system causes reduction in the occurrence of sites related to peripheral intravenous therapy and generates savings for health facilities complications. *Conclusion:* it revealed an insignificant scientific production on the researched topic, finding studies with low level of evidence and lack of national publications, demonstrating the need for deepening the subject in the country through studies with strong methods to survey evidences about the use of devices with closed infusion system. *Descriptors:* Nursing; Peripheral Catheterization; Biomedical Technology; Diffusion of Innovations.

RESUMO

Objetivo: analisar a produção do conhecimento acerca da utilização do cateter intravenoso periférico com sistema fechado de infusão. *Método:* uma revisão integrativa na qual se utilizaram critérios de seleção e descritores controlados a partir da estratégia PICO para a busca de artigos indexados nas bases de dados Medline, Lilacs e Embase, no período de 2010 a 2015. A amostra foi constituída por cinco artigos. *Resultados:* os estudos incluídos mostram que o uso do sistema fechado de infusão ocasiona redução na ocorrência de complicações locais relacionadas à terapia intravenosa periférica e gera economia para os estabelecimentos de saúde. *Conclusão:* evidenciou-se ínfima produção científica acerca da temática pesquisada, encontrando-se estudos com baixo nível de evidência e ausência de publicações nacionais, o que demonstra a necessidade de aprofundamento da temática no país por meio de estudos com métodos fortes para o levantamento de evidências na utilização de dispositivos com sistema fechado de infusão. *Descritores:* Enfermagem; Cateterismo Periférico; Tecnologia Biomédica; Difusão de Inovações.

RESUMEN

Objetivo: analizar la producción de conocimiento acerca del uso de catéteres intravenosos periféricos con el sistema de infusión cerrado. *Método:* una revisión integradora en la cual se utilizaron criterios de selección y los descriptores controlados de la estrategia PICO, para la búsqueda de artículos indexados en Medline, Lilacs y Embase, para el período de 2010-2015. La muestra estuvo constituida por cinco artículos. *Resultados:* los estudios incluidos muestran que el uso del sistema cerrado de infusión provoca reducción en la ocurrencia de complicaciones locales relacionadas con la terapia intravenosa periférica y genera economía para los establecimientos de salud. *Conclusión:* se reveló una pequeña producción científica acerca de la temática investigada, encontrando estudios con bajo nivel de evidencia y la ausencia de publicaciones nacionales, lo que demuestra la necesidad de profundizar el tema en el país a través de estudios con métodos fuertes para la encuesta de evidencias acerca del uso de dispositivos con sistema cerrado de infusión. *Descriptores:* Enfermería; Cateterización Periférica; Tecnología Biomédica; Difusión de las Innovaciones.

[1]Nurse, Professor, Undergraduate/Graduate Nursing/PPGENF, Federal University of Parana/UFPR. Curitiba (PR), Brazil. Email: profa.mitzy@ufpr.br; [2]Nurse, Master's Student, Graduate Nursing Program/PPGENF, Federal University of Parana/UFPR. Curitiba (PR), Brazil. Email: lind.jolline@gmail.com; [3]Nurse, Doctoral Student, Graduate Nursing Program/PPGENF, Federal University of Parana/UFPR. Curitiba (PR), Brazil. Email: gabriella.lemes@yahoo.com.br

INTRODUCTION

Intravenous Therapy (IT) is experienced daily by nursing practice, especially in the hospital[1], defined as a set of knowledge and techniques for administration of solutions and/or drugs in the circulatory system. It covers the preparation of patients for therapy, choose, obtain and maintain access; different methods of preparation and administration of drugs and solutions; as well as care for the frequency catheter exchange, dressings, devices and infusion solutions.[2]

For the implementation of IT, nurses need of venous access technologies (intravascular catheters)[1], characterized as hard technologies that allow to save and to prolong the lives of seriously ill patients. This is due to the technological evolution of these devices over the past decades, which meant great advances in health.[3]

Intravascular catheters can be classified according to the following: vessel - it occupies (peripheral or central artery); length of stay (temporary or permanent, short or long term); insertion site (subclavian, femoral, jugular, peripheral veins); journey to the vessel (tunneled or non-tunneled/percutaneously); length (long or short); and the presence of particular characteristics (number of lumens, impregnating, and cuffs.[4]

It is known that, in Brazil, the technology used in healthcare, especially in the management of critically ill patients, are below those used in developed countries. As an innovative technology for example, recently launched in the country (2014) and still little used, it has the peripheral intravenous catheter with closed infusion system of this literature review object. It is peripheral intravenous device of high-cost, developed in order to improve venous infusions and ensure less risk to health professionals during the puncture and handling procedure, presenting as more advanced technology compared to other devices with the same purpose available on the market. Widely used internationally, characterized by being of the "over the needle", which has two access ways and can be found in the gauges 18, 20, 22 and 24 gauge (G). It has unique characteristics, such as: siliconized needle designed to improve visualization of blood reflux with septum for blood removal thereof after the triggering of the safety device; making in biomaterial radiopaque Vialon®; stabilization platform; transparent set of extension high pressure; single security device; and two connectors in closed infusion system.[5]

The connectors in closed infusion system prevent contact of sterile solution with the environment at the time of introduction of equipments and professional contact with the blood of the patient, avoiding contamination with biological material. The safety device and the passive needle protection mechanism reduces the blood exposure and accidental puncture injuries.[5]

The stabilization platform meets the recommendations of the Infusion Nurses Society (INS) and the Centers for Disease Control and Prevention (CDC) for stabilizing catheters, allowing for secure attachment and minimizing the risk of accidental displacement.[4,6]

For the implementation of procedures for the intravenous therapy there are regulations that must be met, such that: Regulatory Standard 32 (NR 32) and Collegiate Board Resolution N 45 (RDC 45). NR 32 is to establish the basic guidelines for the implementation of safety and health protection measures for workers' health services, as indicating the use of cutting perforating materials with safety device.[7]

Already the DRC 45 provides for the Good Technical Regulation Use Practices of Parenteral Solutions Health Services. This resolution emphasizes that the use of parenteral solutions with quality, safety and efficacy, requires the fulfillment of minimum requirements to ensure full absence of chemical and biological contamination as well as undesirable interactions and drug incompatibilities.[8]

Specifically in Annex II, the resolution focuses on good preparation practices and administration of parenteral solutions and reinforces the large volume (100 ml or more) should be given in a closed system, which prevents the contact of sterile solution with the environment.[8]

It is noteworthy that the technology in question in this research meets the two above-mentioned regulations, as well as having integrated system with safety device has connectors in closed infusion system.

Peripheral intravenous therapy is an indispensable procedure in the treatment of various diseases, but it is not free from harmful complications to the patient and the professional. It is emphasized that the use of advanced technologies developed in order to improve this practice and minimize these complications are essential.

OBJECTIVE

● To analyze the production of knowledge about the use of peripheral intravenous catheter with closed infusion system.

METHOD

This says respect to an integrative review developed in six phases, namely: definition of the research question, definition of inclusion and exclusion criteria, data search, data analysis and results, interpretation of results and synthesis of revision.[9]

It was based on the research question: "What scientific evidence is found in the publications about the peripheral intravenous catheter with closed infusion system?" There was held search for articles in the databases Medical Literature Analysis and Retrieval System Online (Medline), Latin-American and Caribbean Literature of Health Sciences (LILACS) and Biomedical Database (Embase), in August 2015. The articles were selected with employment rates of subject descriptors and descriptor words of the Health Sciences (DeCS) by interface BIREME and subject descriptors of Medical subject Heading (MeSH) by Medline. For Embase search there were followed criteria and terms of the base.

There was used the PICO strategy for articles selection[10], being so selected the descriptors: P - Adult OR Young Adult; I - Catheters OR Catheterization, OR Peripheral Catheterization; C - not applicable; complications thrombophlebitis OR extravasation of diagnostic and therapeutic materials OR infiltration OR infection OR infections related to catheter OR phlebitis. In databases Lilacs and Medline crossed the descriptors groups according to Boolean logic, with 'P' AND 'I' AND 'O', being performed a search for each outcome descriptor - 'O'.

After the search, proceeded the reading of the titles and abstracts of articles found, among which there were selected those that met the inclusion criteria: published between January 2010 and August 2015; in Portuguese, English and Spanish; online available for free; related to nursing; related to peripheral intravenous catheter with closed infusion system. Publications related to central venous catheters that did not meet the proposed theme were excluded; and duplicate articles were counted only once.

The search in LILACS database totaled 63 references, and no studies met the inclusion criteria. Medline yielded 710 publications, two of which were included in this review. In Embase, nine articles, three included in this study.

For data extraction there was performed reading of selected articles in full, with the use of previously tested collection instrument, including: item identification, authors' title, subject, objective, methodology, level of evidence, sample / study population , place / country of study, creation of the intervention and control groups, results and conclusions.

The discussion of strategies and interpretation of results, as well as a summary of the data extracted are presented descriptively.

RESULTS

The final sample was composed of five articles, one 2010, three in 2014 and one in 2015, all in English. Regarding the design of the research, there were identified three randomized clinical trials[12,14,16], a letter to the editor[13] descriptive study.[15] It is noteworthy in Figure 1, the characteristics of each study in relation to the research design, objectives, and database level of evidence.

The themes addressed in the articles presented variability. The letter to the editor refers to a reflection about closed and open systems of infusion[13]; another study behind a descriptive approach to the decision to use catheters with closed system in two health establishments[15]; two studies comparing the closed infusion system with the open system in terms of complication and costs[12,14] and the last study also addresses the occurrence of complications, but within the contrasts infusion reality.[16]

Code, publication year	Research design	Objective	Database	Evidence level
A1, 2014	Randomized clinical trial, open.	Compare the length of stay of peripheral intravenous catheters with closed system and peripheral intravenous infusion catheters with open system.	Medline	2
A2, 2015	Letter to the editor.	Reporting experience about the use of midline catheter, instead of using short peripheral catheter, when the duration of intravenous therapy exceeds six days.	Medline	5
A3, 2010	Controlled randomized clinical trial.	Compare the percentages of complications related to fixation and stabilization; assess the implications and the potential costs of two stabilization systems.	Embase	2
A4, 2014	Observational study.	Assess the security features and costs associated with a new catheter system and its attachment.	Embase	3
A5, 2014	Controlled clinical randomized trial.	Compare the performance of a fenestrated 20 gauge catheter with an 18 gauge non-fenestrated, for the infusion of contrast.	Embase	2

Figure 1. Article code, year of publication, research design, purpose, database and level of evidence.

It is noted that the three trials achieved a considerable and significant number of participants (over 205)[12,14,16], in which the comparison was made with the same peripheral intravenous catheter with a closed infusion system versus an open system catheter and that two studies have no control group [13,15] (Figure 2).

Code, year of publication	Participants	Intervention	Control
A1, 2014	Patients aged greater than or equal to 18 years old that required a peripheral venous catheter for at least 24 hours (n = 1183).	Nexiva® punction (closed intravenous infusion peripheral system catheter). (n = 584).	Punction with Vasocan®. (n=599).
A2, 2015	Adult patients in need of intravenous antibiotics for long periods (n = 130).	During the first 12 months of the study, 142 midline catheters were placed by means of ultrasound-guided puncture.	Does not apply.
A3, 2010	Adults admitted to clinical and surgical units (n = 302).	Punction with Nexiva® Bandage 3M Tegaderm® (n = 150).	Punction with Introcan®, with stabilization StatLock® and transparent dressing (n=152).
A4, 2011	Adults admitted to two different hospitals (n = 18463).	Punction with Nexiva® Bandage 3M Tegaderm®.	Does not apply.
A5, 2014	Adult patients need CT examination, through the infusion of contrast media (n = 205).	Punction with Nexiva Diffusics®, 20 gauge (n=103).	Punction with Jelco®, 18 gauge (n=102).

Figure 2. Article code, year of publication, participants, intervention and control.

The results and conclusions of the studies indicate that the use of peripheral intravenous catheter with closed infusion system generates savings for health facilities[12,14], reduction of accidents with sharp piercing equipment[12,15] and local complications related to peripheral intravenous therapy[12,14] (Figure 3).

Code, year of publication	Results and conclusions
A1, 2014	Patients were similar in both groups in terms of gender, race, hypertension, obesity, diabetes and mortality; the only significant difference was the morbid obesity (p = 0.006). In addition, no differences were observed between the groups in terms of presence of surgical wounds and drains, urinary catheters, repeated punctures, length of the catheter, frequency the insertion site (hand/forearm), use of the right arm versus left, or vein punctured (Basilica/average/cephalic-cubital vein). The catheters with open system were inserted with fewer attempts due to previous experience of nurses with this system. For that catheters remained in place for more than 24 hours, the mean hospitalization time was 144.5 h to the catheters with closed infusion system. There have been 70 cases of phlebitis in the group that used the closed system (12%, 31 cases/1000 catheter-days), compared to 101 cases in a group that used open system (16.9%, 45 cases/1000 catheter-days). The use of closed-system led to a reduction in the rate of phlebitis of 29% (p = 0.004) and infiltration (24%). Furthermore, no accidents with a bladed cutting material in both groups, proving that both closed systems like the open are passive safety devices. The study demonstrated superiority of closed system use on the open sea.
A2, 2015	Although peripheral intravenous catheters of new generation, as with closed system of infusion can reduce the rate of local complications associated with the use of peripheral intravenous catheter short, one should consider the use of other types of catheters, such as catheters and middle line peripherally inserted Central, assessing the type and duration of intravenous therapy.
A3, 2010	Most catheters inserted were 20 gauge, followed by 22 caliber gauge; the minority was 18 gauge. The duration of the participation of each subject in the study went up to 96 hours. There were no significant differences between the groups with respect to gender, age and medical diagnosis. The median age of the sample was 63 years, and 58% were female. The average residence time of stabilization system since its implementation until his retirement was of 31 hours for the experimental group (closed system) and 32 hours for the control (open system). The risk of complications related to fixation of catheters has been reduced by 26% in the experimental group compared with the control group. The probability of developing complications during the first 48 hours is of 23% for the experimental group and 29% for the control group, and during the 96 hours the probability increases to 38% in the experimental group and 48% for the control group. The cost of stabilization and fixation system in the experimental group resulted in a cost savings of $ 1.91 for peripheral catheter insertion. There were no statistically significant differences between groups for infiltration rates; the rates of this complication within 48 to 96 hours were 12% to 20% for the experimental group and 15% to 24% for the control group. No case of phlebitis mechanics was reported in both groups. The highest level of success on the first try for the catheter with a closed system and low exposure to biological material contributed to the higher level of satisfaction of nursing staff. The experimental group was ranked as more favorable than the control group. The preference of the nursing staff, combined with the similar performance in preventing complications, as well as the cost savings, provide strong evidence to conclude that the catheter from the experimental group with a bandage specifically designed for this is a sensible alternative to the stabilization of peripheral catheters.
A4, 2011	Clinical results for both periods (before and after the intervention) were virtually equivalent, demonstrating that a system is not inferior to the other on the development of catheter-related complications. However, the catheter system with integrated stabilization platform (peripheral catheter with closed system of infusion) performed less expensive and safer due to a passive safety mechanism. Problems with high-pressure injection in the Radiology Department of study were resolved through the use of the new catheter system.
A5, 2014	There was no significant difference for the variables age, sex, body mass index, contrast and volume between the two study groups. Maximum pressure was higher with 20 g (230.5 ± 27.6 psi) than in 18 gauge (215.6 ± 32.8 psi) (p < 0.001). Fenestrated 20 gauge catheters are similar to those of 18 gauge fenestrated not as regards rates of infusion of contrast and can be entered in most individuals whose veins are considered inadequate for a 18 gauge catheter.

Figure 3. Article code, year of publication, results and conclusions.

DISCUSSION

When searching for articles that discuss about the use of peripheral intravenous catheters with closed infusion system, we observed how few are said about the production technology, which corresponds to a limitation.

Complications of peripheral intravenous therapy may be related to the catheter in the vein of time. Routine replacement of devices versus replacement as clinically indicated has been the subject of controversy and uncertainty among the guidelines. Over the years, the length of stay increased from 48 to 72 hours and, more recently, for 96 hours, however, these recommendations are mainly based on previous studies (1975, 1987 and 1998) that did not take into account the recent changes the manufacturing technology of peripheral catheters.[12]

Recently, studies tested the routine replacement policy versus catheter removal when clinically indicated; the average length of stay was of 99 hours when the recommendation was replaced as clinically indicated, and 70 hours when routine replacement.[17] The two clinical trials included in this review, which evaluated the residence time of the inserted catheters, show the average time of the total sample 31.5 to 206.4 hours.[12,14] By analyzing only the closed system catheters, clinical trial that demonstrated this technology remains a longer time to open system with catheters without the development of complications, 144 hours.[12] Other studies emphasize and show that the replacement catheter by clinical indication is a safe strategy[18,19] and reduces costs for the institutions.[18]

It is reiterated that the characteristics of the peripheral catheter, the way this is stabilized and what devices are used in this stabilization and fixation must be considered, as they relate to the success of the catheter time and the occurrence of complications, in addition to having implications for nursing practice.[14] In this sense, INS recommends stabilizing the catheter to preserve its integrity, guiding the products used during this procedure should be evaluated for effectiveness, catheter stopping power, durability, ease usage and costs.[6]

The peripheral intravenous catheter of closed infusion system follows these recommendations, still relying on other peculiar characteristics, such that: safety device and needleless connectors. All of these items are considered recent innovations.[5]

Studies point to the above benefits to professionals who handle this technology, with regard to safety and minimization of accidents involving biological material and cutting perforating due to the presence of closed and security device system.[12,14-5] One study reports reduced exposure to blood in 98% during peripheral venipuncture, reducing the potential for contamination of the professionals handling this catheter.[14]

The same study noted catheter displacement reduced by 84% because of its stabilizing platform, minimizing risks of local complications that lead to catheter removal and new punctures and consequently reducing costs of health facilities.[14] Another international clinical trial included in this review showed statistically significant reduced risk of phlebitis in 29% and the relative risk for catheter-related infection in 20%.[12] In relation to costs, studies show $ 1 economy , 91-2.57 by using peripheral intravenous catheter with a closed system.[14,15]

Opposing the other studies, one of the articles reinforces the CDC's recommendation about the use of midline catheters or central venous catheter peripherally inserted instead of peripheral short catheters, when the duration of intravenous therapy is provided for longer than six days. In this study, the mean residence time of the midline catheter was 21.6 days (range one to 128 days). Regarding the development of complications, it refers to thrombosis catheter in 12 patients (7%), with all episodes attributed to the use of drugs that were not suitable for infusion into a peripheral vein (vancomycin, acyclovir, ampicillin and mannitol). Only one case of local infection was detected in a patient diagnosed with cancer.[13]

Another article also addressed the challenge of introducing new products in health facilities. This process usually produces frustration and anxiety to patients. As an alternative to these challenges, it highlights the importance of involving all stakeholders in the assessment and implementation of new technology.[15]

CONCLUSION

The introduction of new technologies in health facilities requires professionals with constant technical and scientific training, because the control of the technology makes they are able to ensure the use of a safe and an effective way, allowing for a harmless and a quality care.

Although peripheral intravenous catheter with closed present several benefits system, there is the absence of national studies about

the subject, as elucidated in this review. In few clinical trials it appears that found on the researched subject, demonstrating the need for studies with designs that can assist in providing strong evidence for reduction strategies of local complications related to peripheral intravenous therapy, in addition to expanding the knowledge of a device that meets the recommendations of the INS and national regulations.

In addition, recommendations for the replacement of peripheral venous access devices should be reassessed and should be set according to the type of the technology used. The studies included in this review indicate a significant reduction of the costs of intravenous therapy, no increased risk of developing complications, through the use of peripheral intravenous catheter with closed infusion system.

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Corresponding Address

Jolline Lind
Universidade Federal do Paraná
Departamento de Enfermagem
Grupo de Pesquisa Tecnologia e Inovação em Saúde
Av. Lothario Meissner, 632 / Campus Botânico
Bloco Didático II / 3° andar
CEP 80210-170 – Curitiba (PR), Brazil