

Safety and effectiveness of disposable tourniquet use on peripheral intravenous catheterization-related contamination rates: a systematic review protocol

Segurança e eficácia do uso de garrotes descartáveis nas taxas de contaminação associadas ao cateterismo intravenoso periférico: um protocolo de revisão sistemática

Seguridad y efectividad del uso de garrotes desechables en las tasas de contaminación relacionadas con el cateterismo intravenoso periférico: un protocolo de revisión sistemática

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ABSTRACT

Background: Peripheral intravenous catheterization constitutes an indispensable resource in care provision, especially for elderly patients. To detect and select an optimal peripheral vessel for catheter insertion, international recommendations advised the use of a tourniquet near the puncture site. Evidence points to the need of implementing disposable tourniquets in clinical settings, since reusable tourniquets can harbor microorganisms that are resistant to conventional antibiotic therapy. However, there are no known studies that synthesized the effectiveness of such devices on peripheral intravenous catheterization-related contamination rates. **Objective:** To identify the best evidence available on the safety and effectiveness of disposable tourniquet use on peripheral intravenous catheterization-related contamination rates. **Review method:** Following the Joanna Briggs Institute's methodology, this review will use specific search strategies for each database/repository to find significant studies. Two independent reviewers will analyze titles/abstracts and compare them based on the outlined inclusion criteria. The included articles will be subjected to methodological quality assessment and data extraction/synthesis. **Conclusion:** The critical analysis of existing data on this topic will contribute to the dissemination of the best available evidence and potentially sustain the need to implement disposable tourniquets in clinical practice.

Keywords: catheterization, peripheral; tourniquet; systematic review protocol.

RESUMO

Introdução: O cateterismo intravenoso periférico constitui um recurso indispensável na prestação de cuidados, especialmente em doentes idosos. Para detectar e selecionar um vaso periférico ideal para a inserção de um cateter, as recomendações internacionais recomendam o uso de um garrote próximo ao local da punção. Existe evidência que sustenta a necessidade de se introduzirem garrotes descartáveis nos contextos clínicos, uma vez que os garrotes reutilizáveis podem estar contaminados por microrganismos resistentes à antibioterapia convencional. Todavia, não existem estudos conhecidos que sintetizem a eficácia

destes dispositivos na redução das taxas de contaminação associadas ao cateterismo intravenoso periférico. **Objetivo:** Identificar a melhor evidência disponível sobre a segurança e a eficácia do uso de garrotes descartáveis nas taxas de contaminação associadas ao cateterismo venoso periférico. **Método de revisão:** Seguindo a metodologia do Joanna Briggs Institute, esta revisão utilizará estratégias de pesquisa específicas para cada base de dados/repositório de modo a encontrar estudos significativos. Dois revisores independentes analisarão os títulos/resumos, confrontando-os com os critérios de inclusão descritos. Os artigos incluídos serão submetidos a avaliação da qualidade metodológica e extração/síntese de dados. **Conclusão:** A análise crítica dos dados existentes sobre este tema contribuirá para a divulgação da melhor evidência disponível e, potencialmente, sustentará a necessidade de implementar garrotes descartáveis na prática clínica.

Palavras-chave: cateterismo intravenoso periférico; garrote; protocolo de revisão sistemática

Introduction

Peripheral intravenous catheterization is one of the most recurrent procedures performed in clinical practice (Marsh, Webster, Mihala, & Rickard, 2017; Rickard et al., 2012; Wallis et al., 2014). However, patients have never been more complex in terms of their vascular access needs (Infusion Nursing Society, 2016), especially the elderly who often present a history of recurrent venipuncture and need of extensive courses of infusion therapy (Infusion Nurses Society, 2016; Royal College of Nursing, 2016).

To promote vascular distension and help health professionals select an optimal peripheral vessel, guidelines recommend the use a tourniquet at a distance of 5-10 centimeters above the chosen puncture site, for a period not exceeding 60 seconds (Infusion Nurses Society, 2016; Royal College of Nursing, 2016).

However, tourniquet contamination, similar to other highly portable medical devices, is a major public health concern, since their extensive reprocessing and reuse between patients may hamper the care provided (Costa, 2017; Hassan, Gonzalez, Hitchins, & Ilev, 2016). Tourniquets have been associated with high contamination rates, often linked with bacterial cultures that are multidrug resistant to conventional antibiotic therapy (Costa, 2017; Costa et al., 2018). Yet, recent studies highlight the existence of a wide gap between health professionals' knowledge and practices in this topic (Aftab, Zia, Zahid, Raheem, Beg, 2015).

Such results were confirmed through a recent scoping review on the potential for contamination of tourniquets during peripheral venipuncture (Oliveira et al., 2018). In this review, several authors from included studies acknowledged the existence of unstandardized professional practices regarding tourniquet use in peripheral intravenous catheterization, constituting a potential risk of infection. Nonetheless, the introduction of disposable tourniquets in some of the included clinical settings constituted a good clinical practice, guaranteeing the quality and safety of procedure (Oliveira et al., 2018).

However, there are no known studies that have critically analyzed the effectiveness of using disposable tourniquets on reducing peripheral intravenous catheterization-related contamination rates.

Systematic review method

This systematic literature review will follow the model recommended by the Joanna Briggs Institute (Tufanaru, Munn, Aromataris, Campbell, & Hopp, 2017) that identifies inclusion and exclusion criteria for Population, Intervention, Comparison, and Outcomes (PICO). As regards the type of participants, this review will consider studies that include patients of all ages, in any clinical setting, who need peripheral intra-venous catheterization.

With regard to the intervention, this review will consider studies that assess the effectiveness of the use of disposable tourniquets in patients requiring peripheral venous catheterization. Studies that compare the effectiveness of disposable tourniquets with other techniques or technologies for vein distension in peripheral vein catheterization will be included in this review.

This review will focus on at least on one the following primary outcomes: tourniquet contamination rates; insertion site contamination rates; and peripheral catheter contamination rates. Additionally, this review will also focus on secondary outcomes such as peripheral venous catheterization-related patient outcomes (e.g., pain or discomfort); provider-reported outcomes (e.g., satisfaction or perceived ease of use); and immediate post-use complications (e.g., hematoma formation, skin injuries, or local sensitive impairment), measured by any reliable instrument, scale or index, as other outcomes described in these studies. The quality of the disposable tourniquet and time required for tourniquet application and vein distension will also be regarded as secondary outcomes.

The review will consider all studies of quantitative evidence, including randomized controlled trials, non-randomized or quasi-experimental, observational, analytical, cohort, case-control, descriptive, cross-sectional, case report or case series studies. In the absence of research studies, other text such as opinion papers and reports will be considered. As there is no known date for the initial use of this type of devices, no time horizon limit will be applied. Moreover, studies in English, Portuguese, French or Spanish will be considered for inclusion in this review. The search strategy will aim to find both published and unpublished studies. An initial limited search of MEDLINE (via PubMed) and CINAHL (via EBSCO) has been undertaken, followed by analysis of the text words in the title and abstract, and of the index terms used to describe the article. This informed the development of a search strategy which will be adapted

to each information source. A full search strategy for MEDLINE (via PubMed) is detailed in Table 1. The reference list of all studies selected for critical appraisal will be screened for additional studies.

Table 1

Example of a search strategy for MEDLINE (via PubMed)

Search	Query
S5	Search (S1 AND S2 AND S3) Filters: English; French; Portuguese; Spanish
S4	Search (S1 AND S2 AND S3)
S3	Search (((((((((((((((contamination[Title/Abstract] OR colonization[Title/Abstract] OR organism[Title/Abstract] OR infect*[Title/Abstract] OR bacter*[Title/Abstract] OR fung*[Title/Abstract] OR virus*[Title/Abstract] OR viral[Title/Abstract] OR pathogen*[Title/Abstract] OR yeast*[Title/Abstract] OR microorganism[Title/Abstract] OR spore[Title/Abstract] OR "colony count"[Title/Abstract] OR colonies[Title/Abstract] OR colony[Title/Abstract] OR "colony forming units"[Title/Abstract] OR "colony forming unit"[Title/Abstract] OR microbial[Title/Abstract] OR fomite[Title/Abstract] OR cross-contamination[Title/Abstract] OR cross-infection[Title/Abstract] OR "Infection+[Mesh] OR "Equipment Contamination+[Mesh] OR "Fomites"[Mesh] OR "Bacteria+[Mesh] OR "Fungi+[Mesh] OR "Viruses+[Mesh])
S2	Search (((((((((((((((tourniquet[Title/Abstract] OR tour-niq*[Title/Abstract] OR "single-use tourniquet"[Title/Abstract] OR "Tourniquets"[Mesh])
S1	Search (((("Catheters"[Mesh]) OR "Cannula"[Mesh]) OR "Vascular Access Devices"[Mesh]) OR (((("peripheral access"[Title/Abstract] OR "peripheral venous catheterization"[Title/Abstract] OR "peripheral venous catheterization"[Title/Abstract] OR "peripheral intravenous access"[Title/Abstract] OR "venous access"[Title/Abstract] OR "peripheral venous access"[Title/Abstract])

The databases to be searched include MEDLINE (via PubMed); CINAHL (via EBSCOHost); Scopus; Cochrane Central Register of Controlled Trials and SciELO. The search for unpublished studies will include: RCAAP – Repositório Científico de Acesso Aberto de Portugal; OpenGrey; and Dissertation Abstracts Online (EThOS).

Assessment of the methodological quality of the studies

Quantitative articles selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using the JBI standardized critical appraisal instruments, namely: the Checklist for Randomized Controlled Trials; Checklist for Quasi-Experimental Studies (non-randomized experimental studies); Checklist for Analytical Cross Sectional Studies; Checklist for Cohort Studies; Checklist for Case Control Studies; Checklist for Case Reports; and Checklist for Case Series (Moola et al., 2017; Tufanaru et al., 2017).

All studies, regardless of their methodological quality, will undergo data extraction and synthesis. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. In the absence of research studies, textual articles selected for retrieval will be assessed by two independent reviewers for authenticity prior to inclusion in the review using the JBI Critical Appraisal Checklist for Text and Opinion Papers (McArthur, Klugárová, Yan, & Florescu, 2015). Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer.

Data extraction

Quantitative data will be extracted from articles included in the review using the standardized data extraction tool from JBI System for the Unified Management, Assessment and Review of Information (JBI-SUMARI). The extracted data will include specific details about the interventions, populations, study methods, and outcomes of significance to the review question and specific objectives. The authors of primary studies will be contacted to provide missing or additional data. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer.

Data synthesis

Quantitative data, wherever possible, will be pooled in a statistical meta-analysis using JBI-SUMARI. The meta-analysis will be performed using the random-effects model to allow

generalization. However, if less than five studies are included in the meta-analysis, it will be performed using the fixed-effects model. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical variables) and weighted mean differences (for continuous variables) and their 95% confidence intervals will be calculated. The I^2 statistic can be used to quantify the amount of dispersion and I^2 values of 25%, 50%, and 75% are interpreted as representing small, moderate and high levels of heterogeneity, respectively. Heterogeneity and inconsistency analyses will be explored based on identified subgroups, including, but not limited to, different quantitative study designs, participants' age or clinical settings. Where statistical pooling is not possible, the findings will be presented in narrative form including tables and figures to aid in data presentation wherever appropriate. In the absence of research studies, textual articles, wherever possible, will be pooled using JBI-SUMARI. This will involve the aggregation or synthesis of conclusions to generate a set of statements that represent that aggregation, through assembling and categorizing these conclusions on the basis of similarity in meaning.

Conclusion

The critical analysis of data regarding the effectiveness of disposable tourniquet use on peripheral intravenous catheterization-related contamination rates will contribute to the dissemination of the best evidence available on the topic. It is expected that this dissemination will be reflected in the definition of guidelines and recommendations on peripheral intravenous catheterization, highlighting the specific contributions of disposable tourniquets in the overall effectiveness, quality and safety of the procedure.

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References

Aftab, H., Zia, B., Zahid, M., Raheem, A., Beg, M. (2015). Knowledge, Attitude, and Practices of Healthcare Personnel Regarding the Transmission of Pathogens via Fomites at a Tertiary Care Hospital in Karachi, Pakistan. *Open Forum Infect Dis.*, 3(1). doi:

10.1093/ofid/ofv208

Costa, P. (2017). *Gestão de material clínico de bolso por enfermeiros: Fatores determinantes e avaliação microbiológica* (Master's dissertation). Escola Superior de Enfermagem de Coimbra, Portugal. Retrieved from <http://web.esenfc.pt/?url=RruTyEuU>

Costa, P., Graveto, J., Santos, C., Fernandes, E., Albano, H., & Osório, N. et al. (2018). Methicillin-resistant *Staphylococcus aureus* spreading through medical devices used in nursing care: what can we learn from Portugal?. *International Journal Of Infectious Diseases*, 73, 292-293. doi: 10.1016/j.ijid.2018.04.4081

Hassan, M., Gonzalez, E., Hitchins, V., Ilev, I. (2016). Detecting bacteria contamination on medical device surfaces using an integrated fiber-optic mid-infrared spectroscopy sensing method. *Sens. Actuator B-Chem*, 231, pp. 646-654. Available from: <https://doi.org/10.1016/j.snb.2016.03.044>

Infusion Nurses Society (2016). Infusion therapy standards of practice. *Journal of Infusion Nursing*, 39(1S), 1-160. Retrieved from <http://source.yiboshi.com/20170417/1492425631944540325.pdf>

Marsh, N., Webster, J., Mihala, G., & Rickard, C. (2017). Devices and dressings to secure peripheral venous catheters: A Cochrane systematic review and meta-analysis. *Int J Nurs Stud.*, (67), pp. 12-19. Available from <http://dx.doi.org/10.1016/j.ijnurstu.2016.11.007>

McArthur, A., Klugárová, J., Yan, H., & Florescu, S. (2015). Innovations in the systematic review of text and opinion. *International Journal Of Evidence-Based Healthcare*, 13(3), 188-195. <http://dx.doi.org/10.1097/xeb.0000000000000060>

Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R., ... & Mu, P. (2017). Chapter 7: Systematic reviews of etiology and risk. In: Aromataris, E., & Munn, Z. (Eds.). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute. Retrieved from <https://reviewersmanual.joannabriggs.org/display/MANUAL/Chapter+7%3A+Systematic+reviews+of+etiology+and+risk>

Oliveira, A., Graveto, J., Osório, N., Costa, P., Oliveira, V., Costa, F., & Parreira, P. (2018). Potential for contamination of tourniquets during peripheral venipuncture: a scoping review protocol. *Revista De Enfermagem Referência*, 4(17), 143-148. doi: 10.12707/riv17104

Parker, S., Benzies, K., & Hayden, K. (2016). A systematic review: effectiveness of pediatric peripheral intravenous catheterization strategies. *Journal Of Advanced Nursing*, 73(7), 1570-1582. <http://dx.doi.org/10.1111/jan.13211>

Parker, S., Benzies, K., Hayden, K., & Lang, E. (2017). Effectiveness of interventions for adult peripheral intravenous catheterization: A systematic review and meta-analysis of randomized controlled trials. *International Emergency Nursing*, 31, 15-21. <http://dx.doi.org/10.1016/j.ienj.2016.05.004>

Rickard, C., Webster, J., Wallis, M., Marsh, N., McGrail, M., French, V., ... & Whitby, M. (2012). Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomised controlled equivalence trial. *Lancet*, 380(9847), pp. 1066-1074. doi: 10.1016/s0140-6736(12)61082-4

Royal College of Nursing. (2016). Standards for infusion therapy (4th ed.). Royal College of Nursing.

Tufanaru, C., Munn, Z., Aromataris, E., Campbell, J., & Hopp, L. (2017). Chapter 3: Systematic reviews of effectiveness. In: Aromataris, E., & Munn, Z. (Eds.). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute. Retrieved from <https://reviewersmanual.joannabriggs.org/display/MANUAL/Chapter+3%3A+Systematic+reviews+of+effectiveness>

Wallis, M., McGrail, M., Webster, J., Marsh, N., Gowardman, J., Playford, E., ... & Rickard, C. (2014). Risk Factors for Peripheral Intravenous Catheter Failure: A Multivariate Analysis of Data from a Randomized Controlled Trial. *Infect Control Hosp Epidemiol*, 35(01), pp. 63-68. <https://doi.org/10.1086/674398>