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REVIEW PROTOCOL

Adverse events with arterial catheters in intensive care units: scope review protocol

Eventos adversos com cateteres arteriais em unidades de terapia intensiva: protocolo de revisão de escopo

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ABSTRACT

Objective: To map in the world scientific production which are the adverse events associated with the use of arterial catheters in critical patients. **Method:** This is a scoping review that will be conducted according to the methodology proposed by Joanna Briggs Institute (JBI), using the *Preferred Reporting Items checklist for Systematic Reviews and Meta-Analyses extension for Scoping Reviews* (PRISMA-SCR). The research question was built using the PCC strategy, namely: "What adverse events related to the use of arterial catheters in patients admitted to intensive care are most evident in the literature?" Data collection will take place in the following databases: LILACS; MEDLINE; EMBASE; CINAHL, EBSCOhost; and Web of Science. **Results:** The results may demonstrate how the issue of patient safety involving arterial devices has been addressed. **Conclusion:** This review study may contribute to the advancement of knowledge and the promotion of safety culture.
Descriptors: Vascular Access Devices; Arterial Pressure; Patient Safety.

RESUMO

Objetivo: Mapear na produção científica mundial quais os eventos adversos associados ao uso de cateteres arteriais em pacientes críticos. **Método:** Trata-se de uma revisão de escopo que será conduzida de acordo com a metodologia proposta pelo Joanna Briggs Institute (JBI), utilizando o checklist *Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews* (PRISMA-ScR). A questão de pesquisa foi construída utilizando a estratégia PCC, sendo: "Quais eventos adversos relacionados ao uso de cateteres arteriais em pacientes internados em terapia intensiva estão mais evidentes na literatura?". A coleta dos dados se dará nas seguintes bases de dados: LILACS; MEDLINE; EMBASE; CINAHL, da EBSCOhost; e Web of Science. **Resultados:** Os resultados poderão demonstrar como a temática da segurança do paciente envolvendo dispositivos arteriais, vem sendo abordada. **Conclusão:** Este estudo de revisão poderá contribuir para o avanço do conhecimento e para a promoção da cultura de segurança.
Descritores: Dispositivos de Acesso Vascular; Pressão Arterial; Segurança do Paciente.

INTRODUCTION

Contemporary medicine has undergone significant changes with the advent of technology in the hospital setting. With the introduction of devices to medical devices in clinical practice, accurate and real-time data became available to professionals responsible for assisting critical and complex patients. The challenge is present as professionals need specialized training to be able to interpret these data to promote safe and effective decision-making[1].

Health technology and invasive procedures have an undeniable and growing presence in intensive care units (ICUs), contributing to remarkable advances in hemodynamic monitoring and other practices. According to Al-Qatsheh et al.[1], blood pressure monitoring sensors

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are crucial in critical environments, providing real-time data for decision-making, and emphasizing the importance of theoretical knowledge in invasive blood pressure practices by nursing professionals[1-2].

In this context, arterial catheters have emerged as a fundamental device, with multiple studies pointing out their usefulness in complex clinical scenarios[3]. However, the insertion of an arterial catheter is not without risks and challenges. Larsen et al.[4] highlight the importance of arterial catheter fixation methods to prevent failures and complications, while, Ogliari, Piazzetta e Martins Filho[5] argue that arterial puncture procedures have their own set of potential complications, including infections and bruises[3-5].

The installation of an arterial line (LA) consists of one of the invasive procedures performed to establish hemodynamic monitoring and, even with its clear importance in critical contexts of assistance, is still an invasive procedure, with risks and is liable to cause harm to patients. It is done using a percutaneous artery puncture, with the installation of a catheter connected to a pressurized system with a pressure transducer. This technology is capable of capturing the pressure oscillations detected by the circuit and transforming them into electrical signals that will be encoded in pressure reading waves and then displayed on multiparametric[2].

The procedure has well-defined indications in clinical practice, being for patients: critical, in intensive care units, especially with circulatory shock; in use of vasoactive medications; submitted to major surgeries, the main cardiac, neurological, and pulmonary ones; submitted to procedures in which the loss of large blood volume is expected; in the use of mechanical ventilation with the need of serial gases; and with the need for frequent laboratory tests[3].

Several incidents may be related to the implantation of an arterial catheter, such as hematoma formation, device loss, hemorrhage, arteriovenous fistula formation, vessel stenosis, vascular insufficiency, limb ischemia, thrombosis, distal necrosis, embolization, arterial dissection, pseudoaneurysm formation, and bloodstream infection. Erroneous decision-making, related to the dose administered of vasoactive medications, due to the failure of wave analysis and system calibration, in addition to inadequate circuit assembly, also has a great impact on intensive practice[3-5].

It is estimated that more than one-third of patients admitted to intensive care units (ICU) have the establishment of an arterial line during hospitalization and that, in the USA, about 2 million arterial catheters are inserted per year. In addition, the occurrence of adverse events associated with arterial catheters has a high impact on mortality rates, length of stay, delay in patient evaluation, and hospital costs. Failures related to inadequate catheter maintenance, displacement, bleeding, ischemia, and infections require catheter replacement in about 60% of the cases. The development of strategies for early recognition and prevention of these events, regarding safe practices, is necessary in this context[4-6].

Despite these advances and concerns, a gap is observed in the literature where, although there are guidelines for the care of peripheral arterial catheters, there are few studies that address adverse events related to the use of arterial catheters in critical patients. This observation is corroborated by the World Health Organization, which stresses the need for actions aimed at eliminating preventable health damage[7-8].

A preliminary search was conducted between December 2022 and January 2023 at *JBI* Evidence Synthesis, *Cochrane Database of Systematic* Reviews, *Cumulated Index to Nursing and Allied Health Literature* (CINAHL), *National Library of Medicine National Institutes of Health* (PUBMED), and *Open Science* Framework (OSF). Until January 12th, 2023, no scope revisions or systematic reviews were found in progress. Only a systematic review of guidelines, published in 2022, was identified. However, the study comprised seven guidelines focusing only on bloodstream infection for several vascular catheters. This makes clear the space for future publications of specific revisions and guidelines for arterial catheters and with the approach of other possible adverse events [7].

The publication of protocols is justified by the need to ensure that the review method is capable of reproduction, in addition to denoting the quality of the research to be developed through methodological transparency[9].

A broad review of the literature becomes relevant to promote discussions and support critical patient care in a systematized way, to mitigate the occurrence of incidents related to this type of device, improve the quality indicators of institutions, reduce the length of hospital stay, increase patient satisfaction and considerably reducing costs related to high complexity care.

Given the above, the objective of the present study is to map the scientific production of the adverse events associated with the use of arterial catheters in critical patients.

METHOD

This is a scoping review that will be conducted according to the methodology proposed by Joanna Briggs Institute (JBI), using the *Preferred Reporting Items checklist for Systematic Reviews and Meta-Analyses extension for Scoping Reviews* (PRISMA-SCR).)[10].

The research question was built using the PCC strategy, the elements of the mnemonic: P – Population; C – Concept and C – Context. The elements were defined as: P (adult patients using arterial catheters); C (adverse events) and C (intensive care units or critical care). In such a way the research question was: "What adverse events related to the use of arterial catheters in intensive care patients are most evident in the literature?".

This protocol is registered by the OSF. With the registration DOI: 10.17605/OSF.IO/XYNQB.

Inclusion criteria

The studies will be selected according to the elements defined by the PCC mnemonic. They will be considered adult participants over 18 years old who are using an arterial catheter for hemodynamic monitoring and may be inserted in the radial, femoral, brachial, axillary, and pedis artery.

About the concept, adverse events are all incidents that result in damage to the patient, including impairment of some structure or function of the body, injury, suffering, disability, or death. The World Health Organization (WHO) characterizes the various factors that may contribute to the occurrence of these incidents, being circumstances, actions, or influences capable of giving rise to, contributing and even increasing the risk of occurrence of these events, which may be due to human systematic or external origin [8]. In this interview, the study will consider any incidents that occurred during insertion, maintenance, handling, or removal of arterial catheters, with some damage to the patient.

Finally, the context will consider studies carried out in Intensive Care Units (ICU), regardless of the specialty, and may be clinical, surgical, or cardiological, in public or private hospital institutions. As long as they are sectors intended for the treatment of critical and complex patients.

Exclusion criteria

Studies will not be included in which patients are only in the use of other intravascular devices, without covering the arteries, and studies about adverse events on various types of intravascular catheters, without delimiting results for arterial lines. Studies with a pediatric population will not be considered.

Types of sources of evidence

The review will include articles of various methodological, primary, or secondary outlines, which may be quantitative, qualitative, or mixed, as well as guidelines and expert opinions, provided they respond to the research question. Theses and dissertations may also be included, as well as relevant productions that are in the list of references of the included studies. No time, geographic, or language clipping will be established.

Data collection will take place in the following databases: Latin American and Caribbean Literature in Health Sciences (LILACS), through the Virtual Health Library (VHL); *Medical Literature Analysis and Retrieval System* Online (MEDLINE), through PUBMED; EMBASE; CINAHL, by EBSCOhost; and *Web of* Science (WOS). The search in gray literature will also be performed using *Google* Scholar.

Search strategy

The search in the databases will be carried out in three steps. The first step consists of an initial search in two databases, namely: Medline (PUBMED) and CINAHL. To analyze words contained in titles and abstracts of the articles captured, in addition to the terms of indexing. Subsequently, the second step will be performed with a comprehensive search containing all indexed terms and keywords in all included databases. The search strategies for each database will be structured with the help of a librarian. The third and final stage will be done with a manual search in the reference lists of the studies included in the review. In the case of studies with complete texts unavailable in the bases, the authors will be contacted.

Example of a search strategy applied in the Medline database (PubMed), on January 15th, 2023, which resulted in 129 publications:

(((“blood pressure determination”[mh] OR “blood pressure determination”[tiab] OR “blood pressure monitors”[tiab] OR “blood pressure monitor”[tiab] OR “blood pressure”[mh] OR “blood pressure”[tiab] OR “arterial pressure”[mh] OR “arterial pressure”[tiab] OR “arterial pressures”[tiab] OR “hemodynamic monitoring”[mh] OR “hemodynamic monitoring”[tiab]

OR "vascular access devices"[mh] OR "vascular access devices"[tiab] OR "vascular access device"[tiab] OR "intra arterial lines"[tiab] OR "intra arterial line"[tiab] OR "arterial lines"[tiab] OR "arterial line"[tiab] OR "arterial catheter"[tiab] OR "arterial catheters"[tiab])) AND (("patient harm"[mh] OR "patient harm"[tiab] OR "patient safety"[mh] OR "patient safety"[tiab])) AND (("intensive care units"[mh] OR "intensive care units"[tiab] OR "intensive care unit"[tiab] OR "icu intensive care units"[tiab] OR "critical care"[mh] OR "critical care"[tiab] OR "intensive care"[tiab] OR "critical care nursing"[mh] OR "critical care nursing"[tiab]))

Selection of studies

After the searches are made in the databases, accessed via the Capes Periodic Portal (Coordination for Improvement of Higher Education Personnel), the results will be exported to the *EndNote Web reference manager*, where duplicates will be identified and then deleted.

Subsequently, the sample of the studies will be exported to *the Rayyan software*, where the blind evaluation will be performed by two reviewers. The inclusion and exclusion criteria will be applied by the two reviewers independently, analyzing titles and abstracts. Soon after, a consensus meeting will be held to compare the selected studies. A third reviewer will be consulted if there is a dissension about the inclusion of a study.

Then, after capturing the pre-selected studies, the full reading of the studies will be carried out. The analysis will be carried out in detail, based on the inclusion criteria already established, the possible exclusions should be justified.

This whole process will be described in a narrative and detailed way by filling out the PRISMA-SCR flowchart.

Data extraction

The data of the included studies will be extracted by two reviewers independently, through an extraction form developed by the reviewers. This form should contain data recommended by the JBI manual, such as: authors, year of publication, country of origin (where the source was published or conducted), objectives, population, context, and sample size within the source of evidence (if applicable), methodology, type of intervention (if applicable), results and main findings related to the question of the scoping review.

A pilot test will be carried out with the initial form. The extraction test will be done on at least two selections. The extraction form can be modified in the course of selection, depending on the need. The necessary modifications will be detailed in the review, as well as the entire data extraction process.

At the end of the extractions, the data extracted by the two reviewers will be compared and in the case of dissent, the third reviewer will be triggered.

Analysis and presentation of data

The data found in the review will be presented through tables and tables, with descriptive and narrative analysis of the results, providing a broad view of the approach to adverse events associated with arterial catheters in the scientific literature. In the end, the objective is to answer the research question and achieve the established goal.

Expected results

The results of this scoping review may demonstrate how the subject of patient safety, regarding the use of invasive arterial devices, has been approached in the literature worldwide. In addition, they can subsidize new studies and strengthen the use of more incipient methodologies.

CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interests.

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Data analysis and interpretation: Gomes PMM, Braz AO
Writing and/or critical review of the intellectual content: Gomes PMM, Braz AO, Paes GO
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