



Implantation of the invasive blood pressure catheter: an integrative review of the literature

Implantação do cateter de pressão arterial invasiva: revisão integrativa da literatura
Implantación del catéter de presión arterial invasivo: una revisión integradora de la literatura

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RESUMO

Objetivo: descrever evidências científicas sobre a implementação e controle do dispositivo para mensuração de pressão arterial invasiva (PAI). **Métodos:** revisão integrativa da literatura, realizada nas bases: Literatura Latino-americana e do Caribe em Ciências da Saúde (LILACS), Scientific Electronic Library Online (SciELO), PubMed, através dos Descritores em Ciências da Saúde (DeCS) e os Medical Subject Headings (Mesh): hemodinâmica (hemodynamic); monitorização (monitoring); pressão arterial (blood pressure); invasiva (invasive). Foram selecionados artigos no idioma inglês, português e espanhol, publicados entre 2009 e 2018. A busca resultou em uma amostra de 10 artigos. **Resultados:** Os artigos foram analisados e apresentados em 4 grupos temáticos de acordo com as informações que forneciam a respeito da punção do cateter de PAI, sendo: 1- Indicações para punção do cateter de PAI; 2 - Contraindicações e complicações decorrentes do uso do cateter de PAI; 3 - Locais de punção mais indicados; 4-Implantação e manutenção do cateter de PAI. **Conclusão:** novas pesquisas podem contribuir na atenção ao paciente com dispositivo de IBP, assim como auxiliando médicos e enfermeiros no atendimento ao paciente, reduzindo os riscos e eventos adversos potenciais do cateter de IBP. **Descritores:** Protocolo Assistencial; Pressão Arterial Invasiva; Cuidados; Estudos de validação.

ABSTRACT

Objective: to describe scientific evidence on the implementation and control of the device for measuring invasive blood pressure (IBP). **Methods:** integrative review of the literature, based on Latin American and Caribbean Literature in Health Sciences (LILACS), Scientific Electronic Library Online (SciELO), PubMed, through the Descriptors in Health Sciences (DeCS) and the Medical Subject Headings (Mesh): hemodynamic; monitoring; blood pressure; invasive. Articles were selected in English, Portuguese and Spanish, published between 2009 and 2018. The search resulted in a sample of 10 articles. **Results:** The articles were analyzed and presented in 4 thematic groups according to the information they provided regarding the puncture of the IBP catheter, being: 1- Indications for IBP catheter puncture; 2 -Contraindications and complications resulting from the use of the IBP catheter; 3 - Most indicated puncture sites; 4- Implementation and maintenance of IBP catheter. **Conclusion:** Further research may contribute to patient care with an IAP device, as well as assisting physicians and nurses in patient care, reducing the risks and potential adverse events of the IAP.

Keywords: Assistance Protocol; Invasive Blood Pressure; Care; Validation studies.

RESUMÉN

Objetivo: describir evidencias científicas sobre la implementación y control del dispositivo para la medición de la presión arterial invasiva (PAI). **Métodos:** revisión integradora de la literatura, llevado a cabo en las bases: Ciencias de la Salud de América Latina y el Caribe (LILACS), Scientific Electronic Library Online (SciELO), PubMed, a través de los Descriptores en Ciencias de la Salud (DeCS) y Medical Subject Headings (Mesh): hemodinámica (hemodynamic); seguimiento (monitoreo); presión arterial (blood pressure); (invasiva). Se seleccionaron los artículos en Inglés, portugués y español, publicados entre 2009 y 2018. La búsqueda resultó en una muestra de 10 artículos. **Resultados:** Los artículos fueron analizados y presentados en 4 grupos temáticos de acuerdo con las informaciones que suministra acerca de la punción del catéter de PAI, siendo: 1- Indicaciones para punción del catéter de PAI; 2 - Contraindicaciones y complicaciones derivadas del uso del catéter de PAI; 3 - Lugares de punción más indicados; 4- Implementación y mantenimiento de catéter IBP. **Conclusión:** nuevas investigaciones pueden contribuir en la atención al paciente con dispositivo de IBP, así como auxiliando médicos y enfermeros en la atención al paciente, reduciendo los riesgos y eventos adversos potencial del catéter de PAI.

Descritores: Protocolo Asistencial; Presión Arterial Invasiva; Cuidar; Estudios de validación.

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INTRODUCTION

Hemodynamic monitoring is one of the essential tools for the treatment of critically ill patients, capable of detecting severe physiological changes in a fast way, leading to a therapeutic decision that aims to benefit patients with minimal risk⁰ Erro! Fonte de referência não encontrada.

The critical patient in the use of invasive equipment suggests the need for continuous monitoring and accuracy of vital signs: (Blood Pressure, Heart Rate, Respiratory Rate, satO²-oxygen saturation, temperature and pain scale), these parameters being indispensable and which aim to avoid complications in the clinical setting, through early diagnosis and early intervention. Usually, hemodynamic monitoring consists of catheters inserted into the patient and connected to a monitor where the values are converted into waves or numbers by the transducers⁰.

One of the most used devices in hemodynamic monitoring of the patient is the Invasive Blood Pressure (IBP) catheter that allows the continuous checking of blood pressure (BP) and is recommended in several situations.

In 1856, Fraive made the first human measurement of invasive BP accurately. During a surgery, Fraive performed the catheterization of the brachial artery in a severe patient, with a device called a hemodynamometer: a glass tube, containing mercury and anticoagulant, which allowed that from then further research in this area were considered⁰.

Currently, IBP catheters are more sophisticated, allowing easier and safer patient bedside care, including real-time monitoring, the latest developments in this area allow

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accuracy of results, as well as the potential to reduce risk, contributing for maximum patient safety⁰.

It is important to note that for the passage of the IBP catheter, the doctor and nurse are the only professionals qualified for this, within the legal scope of each profession, namely:

The law project 7703 (2006) states that for the implantation of the IBP device the physician is the qualified professional, and must have scientific and technical competence to execute the puncture in a correct way, avoiding complications, being their competence to perform invasive procedures⁰.

For nursing, according to resolution 390/11 of the Federal Nursing Council, the arterial puncture for monitoring of blood pressure by the invasive method is also constituted as a private activity of the nurse, based on the principles of Ethics and legislation, "but must possess the knowledge, skills and abilities that guarantee technical-scientific rigor to the procedure, taking into account the continuous training necessary for its accomplishment"⁰ Erro! Fonte de referência não encontrada.

With this, these professionals must be qualified for such a procedure; at present there are few scientific articles that describe it, suggesting more extensive studies on the subject.

The present study is of relevance for the care area of implantation of an IAP catheter, since the limitation of works on the subject; the importance of the correct implantation of the IBP catheter and the lack of standardization in the accomplishment of this device; stimulated

the development of this work. In this way, the objective of this work is to describe the implantation of the IBP catheter through the available scientific evidence.

METHODS

It is the integrative review, which is a research method in evidence-based practice, incorporates clinical practice in order to synthesize the main results on a given topic, in an organized manner, making an in-depth analysis of the most relevant researches in a given preclinical area selected⁰.

The integrative review is composed of six well-defined classes: At the first moment the objective of the research was considered and the hypotheses were raised, in a clear and specific way, with the following guiding question that guided the research: how is the implantation of the IBP catheter?

The guiding question was structured through the PICO strategy, namely: P (population): Intensive Care Unit; I (Intervention): implantation of the IBP catheter; C (comparison): was not performed; O (results): procedure description.

Thirdly, the selection of the articles in the databases: SCIELO (Scientific Electronic Library Online), LILACS (Latin American and Caribbean Literature in Health Sciences) and PubMed, determining the sample of this research stage.

It was accomplished through the use of the controlled vocabulary - Descriptors in Health Sciences (DeCS) in the databases: Lilacs and Scielo and the Medical Subject Headings (MeSH) in the PubMed database: hemodynamic; monitoring; blood pressure; invasive, with the Boolean AND, described in table 01.

Table 1 - Crosses between DeCS and MeSH used in the LILACS, PubMed and SCIELO databases. São Paulo, 2018

Databse	DECS	MeSH	Found Articles	Excluded Articles	Selected Articles
LILACS	Monitorização hemodinâmica AND pressão arterial AND invasiva	-	61	58	3
SCIELO	Monitorização hemodinâmica AND pressão arterial AND invasiva	-	19	18	1
PUBMED	-	Hemodynamic monitoring AND blood pressure AND invasive	727	721	6
TOTAL	-		807	797	10

Sourcr: data from the research

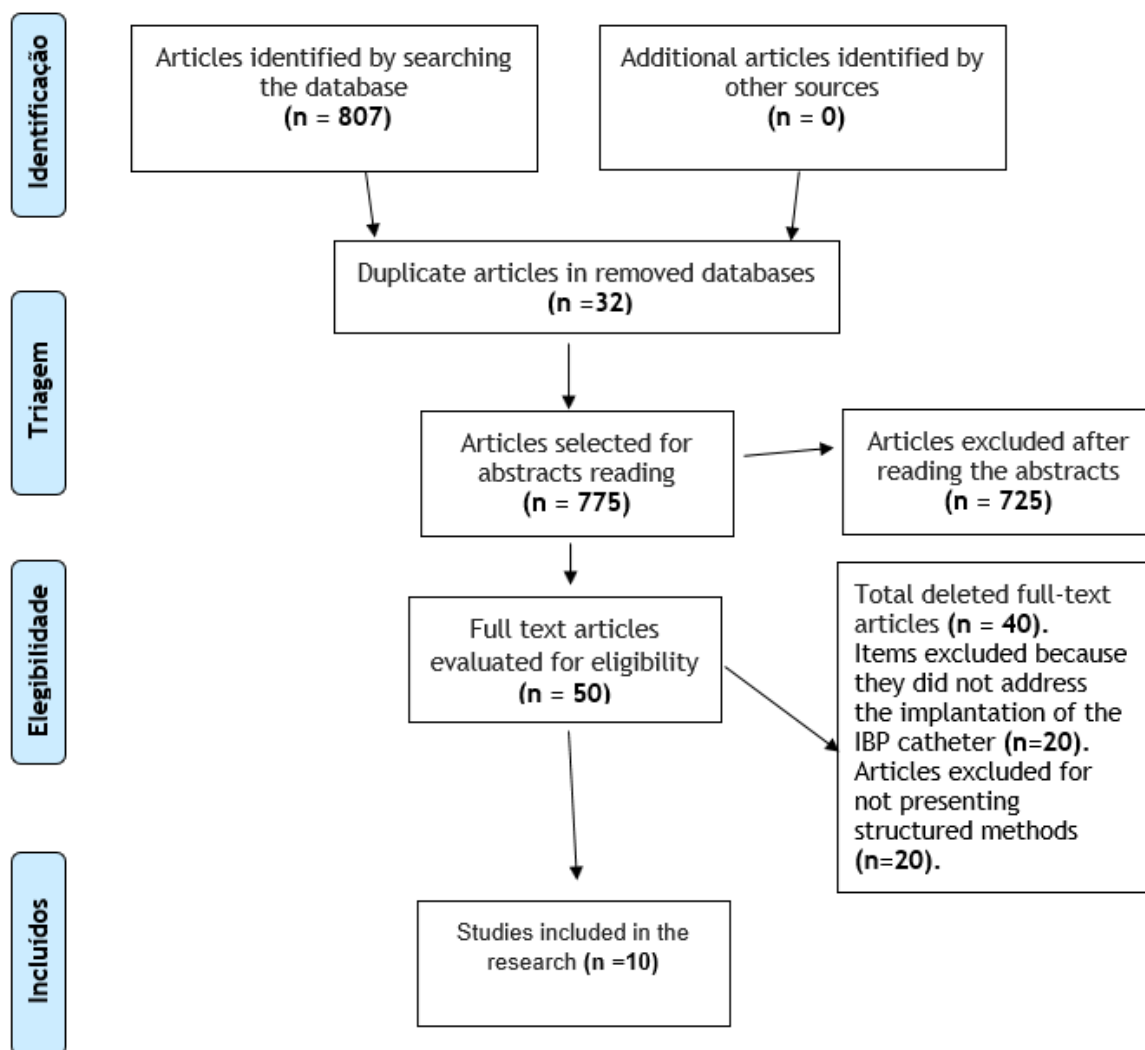
In the fourth stage were defined the inclusion criteria of this stage of integrative Rev Pre Infec e Saúde.2018;4:7285

review were: articles in full original and revision in the theme; articles published between 2009

and 2018; articles in languages: Portuguese; English and Spanish. Exclusion criteria: dissertations and theses; repeated articles in databases; articles that the procedure of passage of the IBP catheter did not involve adult patients. Subsequently the search was carried out from March to May 2018,

resulting in 807 articles, of which 797 were excluded; after this pre-selection the articles were selected for analysis, being: 725 removed after reading the abstracts; of these 32 articles were repeated in the databases, then 50 articles were selected for eligibility; after reading, 40 articles were still removed because they did not provide information about the implantation of the IBP catheter. It resulted in 10 articles that composed the final sample, as described below in flowchart 01.

Flowchart 01: process of selection of articles in the databases according to the PRISM (2009), São Paulo, 2018.



In the last step the collected data were carefully analyzed; being classified in 04 thematic groups: 01 - Indications for puncture of the IBP catheter; 02 - Contraindications and complications resulting from the use of the IBP catheter; 03 - Most indicated puncture sites; 04 Implementation and maintenance of IBP catheter. In order to facilitate interpretation, the data were presented and discussed according to thematic groups

RESULTS AND DISCUSSION

According to the criteria for inclusion of the research, 10 articles completed the final sample, table 02 shows the list of articles selected: identification number, title, year of publication, research design and information

about the IBP catheter.

Among the selected articles 10 (100%), 5 (50%) were integrative review studies, 2 (20%) were systematic reviews, 1 (10%) was a prospective study, 1 (10%) were descriptive cross-sectional and 1 (10%) were observational descriptive of the case study type.

The articles were published between 2007 and 2018. Of the articles published 7 (70%) belong to the English language, 1 (10%) Spanish and 2 (20%) Portuguese.

Regarding the databases, PubMed stood out, presenting 5 (50%) of the articles. In order to categorize the articles by stage of the implementation of the IBP catheter, the 10 articles were described in table 02, with increasing criteria according to the respective year of publication.

Table 02. Representation of the articles classified by number, title, year of publication, research design and information about the IBP catheter. São Paulo, 2018.

Nº	Title	Year	Design	Information about the IBP catheter implantation
01	Understanding Intrusion Detection 1: Indications	2007	Integrative review	Indications; Monitoring and recording of IBP.
02	Radial Artery Cannulation: A Comprehensive Review of Recent Anatomic and Physiologic Investigations	2009	Integrative review	Continuous and local monitoring best suited for puncture.
03	Radial Artery Cannulation: A Review Article	2012	Integrative review	Indications for puncture; contraindications; materials and care.
04	Invasive Monitoring in the Intensive Care Unit	2013	Integrative review	Indication for implantation and punctures.
05	Radial artery cannulation: A systemic review	2013	Systematic review	Most suitable sites for puncture; Doppler use.
06	Tempo estímulo-resposta aos alarmes de pressão arterial invasiva: implicações	2014	Observational, descriptive,	Indications for puncture; care with alarms and

	para a segurança do paciente crítico		exploratory.	system calibration.
07	Ultrasonic Technology Improves Radial Artery Puncture and Cannulation in Intensive Care Unit (ICU) Shock Patients	2016	Prospectiional and randomized.	Indications for puncture; complications of incorrect puncture and use of ultrasound.
08	Validez y fiabilidad del test modificado de Allen: una revisión sistemática y metanálisis	2017	Systematic review and meta-analysis.	Adverse events and puncture guided by the Allen test.
09	Comparaç�o de valores de press�o arterial invasiva m�dia do paciente cr�tico em diferentes dec�bitos	2017	Descriptive, cross-sectional.	Interpretation of IBP, indications; system flush.
10	Cannulation, Artery	2018	Integrative review	Puncture sites; complications and technique.

After the selection, the articles were analyzed and presented in 4 thematic groups according to the information they brought to the implantation of the IBP catheter, being: 1 - Indications for puncture of the IBP catheter; 2 - Contraindications and

complications of the use of the IBP catheter; 3 - Most indicated puncture sites; 4- Implementation and maintenance of IBP catheter, described in Table 02; complications and technique.

Table 02: Categorization of the articles in thematic groups, representing important phases of implantation of the IBP catheter.

Thematic group	Articles
1. Indications for puncture of the IBP catheter	1, 6 and 7
2. Contraindications and complications of the use of the IBP catheter	4 and 8.
3. Most indicated puncture sites	2 and 5.
4. Implementation and maintenance of IBP catheter	3, 9 and 10.

Source: data from the research

Indications for IBP catheter puncture:

The arterial puncture should only be performed by competent professionals (doctors and nurses), aiming to measure BP continuously serving as a basis for rapid decision making⁰.

It is important to consider indications for IBP puncture, before performing the procedure, in order to avoid adverse events related to puncture, considering: hypertensive emergencies; use of vasoactive drugs; large

surgeries; continuous BP monitoring; multiple collections of arterial blood gas and accurate recording of BP. Blood pressure assessed by the invasive method improves the outcome of patients who are using vasoactive drugs or in shock⁰.

IBP monitoring is essential for critical patients, especially during the infusion of vasoactive drugs, as this reliable method is considered in the monitoring of severe patients⁰.

Contraindications and complications due to the use of the IBP catheter:

The main complications are: infection; thrombosis; damage to local nerves; bleeding and local hematoma; it is indicated that every patient with hemodynamic instability is monitored invasively for better control of their vital signs⁰.
Erro! Fonte de referência não encontrada.,⁰

In describing the main complications, efficient methods are indicated to avoid them, considering the Allen test before puncture as a method that avoids possible complications resulting from the procedure⁰.

The Allen test should be performed on all patients before the arterial puncture, as it aims to evaluate the collateral blood flow, however, some care should be taken in the analysis of the color of the hand. If blood return does not occur or delay puncture in the radial is contraindicated, however, the test should be performed with caution since false positives and/or negatives may occur, in these cases another noninvasive test is indicated⁰.

The main complications correspond to vascular impairment: hematoma and thrombosis; local infection and injury; being, ischemia and

thrombosis have been reported as the most common complications resulting from the use of the IBP catheter⁰.

The literature describes hematoma, which occurs in approximately 10% of cases, and is associated with punctures with large caliber catheters, followed by local hemorrhage, mainly in the withdrawal of the device and thrombosis that is often asymptomatic. Infection and ischemia are more rare and related to failures before or during puncture⁰.

Most indicated puncture sites:

IBP catheter puncture should be performed in a safe place, in order to reduce the chances of complications; the scientific evidence highlights puncture in the radial artery as the safest place⁰.

The preferred site for puncture should be radial, contralateral to the dominant hand, but the pediatric artery can also be used, since the artery presents good caliber and lower chances of infection⁰.

The radial pathway is described in many studies as the preferred one for puncture, followed by femoral and brachially consecutively. The radial artery is commonly used for arterial puncture and shows a success rate of 79%, its location is superficial and presents a good contralateral blood supply through the ulnar artery. For its puncture, the Allen test should be performed, in order to evaluate if the collateral circulation is with good flow⁰.

The femoral artery is a large vessel and has less chance of thrombosis. The selection of the artery should be according to the caliber of

the catheter and of the artery, therefore, it should not totally obstruct the punctured artery⁰.

Implementation and maintenance of IBP catheter

Patient monitoring devices are increasingly sophisticated, accurately measuring a variety of vital signs, including the IBP that requires the nursing staff to be diligent and careful in handling and monitoring⁰.

In this aspect, the nursing team must follow the patient, as well as the maintenance of the device; are also fundamental in responding to alarms triggered by parametric monitors, and it is essential to maintain the security of alarm systems. While the patient has IBP puncture, this should be constantly evaluated, including the alarm, which must be properly adjusted, avoiding false attitudes in the analysis of the same⁰.

The interpretation of the BP values correctly assists in the diagnosis of the patient, for that, all steps of the passage of the device must be carefully followed, as well as care in the maintenance of the same, the lack of protocols on the subject makes difficult this systematization of the routine⁰⁻⁰.

After puncture, a continuous analysis of the pressure curve, washing of the system, handling and testing of the device should occur, avoiding possible errors. Reliable values serve as parameters for early therapeutic interventions,

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an BP curve can be altered by several factors, including hematomas and thrombi in the system, so it is essential to evaluate the curve continuously, avoiding misinterpretation⁰.

In order to perform the procedure, the necessary material must be used, as well as the aseptic technique of puncture, which must be performed with rigor, respecting the sequence and maintenance of the catheter⁰.

Regarding the materials for puncture, the literature describes the need for a catheter, a pressure transducer, a saline filled equipment and the parametric patient monitor⁰⁻⁰.

The effectiveness of the use of ultrasound before arterial puncture, offering greater patient safety, this technique has been widely used in medical practice, in recent years the high frequency of ultrasound devices have become a “third medical eye” and presents advantages when compared with other manual techniques⁰.

The use of ultrasound before the arterial puncture showed an improvement in the success rate at the first puncture, besides allowing to visualize anatomical alterations and to reduce the incidence of complications associated with puncture, such as hematoma and local hemorrhage. The article also presented the main indications for placement of the IBP catheter, in line with the other articles in the thematic group⁰.

To accurately measure blood pressure, it is necessary to evaluate the phlebostatic axis, patient position, fluid volume, and perform a system wash test every 6 hours at a minimum.

CONCLUSION

The quality of health services has been a priority, hospital institutions are aim for professionals who offer qualified assistance, as well as hospital context procedures that must be standardized and correctly performed.

Therefore, from this review, it was possible to observe the importance of implantation of the IBP catheter, through well-defined steps, and thus to list the indispensable items in the catheter puncture.

For all the aspects discussed here, it is concluded that there is a need for standardization of care during the passage of the IBP catheter, as well as its maintenance and withdrawal. This work was fundamental to the clinical practice of passing the IBP catheter, since it allowed to list the best available scientific evidence and thus, to provide a synthesis of the same.

It is instigated that this work can assist in the practice of medical and nursing assistants, who routinely manipulate the IBP catheter.

The present study is the beginning of a systematization of care for patients with IBP catheters, contributing to further future research on the subject, which is still under-researched and requires many adaptations.

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Rezer F and Guimarães HP made substantial contributions in the writing and design of the manuscript; collection, analysis and interpretation of the data, in the essay of the article and in the final version to be published. GM Guerra contributes to article writing or critical review.

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