

**Phlebitis in peripheral vascular catheters of hospitalized patients**

Flebite em cateteres vasculares periféricos de pacientes hospitalizados

Flebitis en catéteres vasculares periféricos de pacientes hospitalizados

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**ABSTRACT**

**Objective:** To identify the occurrence of mechanical and chemical phlebitis in peripheral venous catheters of hospitalized adult patients. **Method:** a descriptive observational study with 100 patients over 18 years of age who underwent peripheral venous puncture, performed in September and October 2016 at the Adult Hospitalization Unit of a University Hospital. The site of insertion of the peripheral puncture device was evaluated daily in order to identify signs and symptoms of phlebitis. Statistical analysis was performed using the chi-square test, considering statistical significance when  $p < 0.05$ . **Results:** Phlebitis occurred in 21% of cases, with grade 1 (52.4%) prevalent. Of the 21 cases, 14 occurred due to mechanical causes, 50% due to repeated punctures and 7 due to chemical causes, which presented a statistically significant value in relation to some medications used ( $p = 0.008$ ). **Conclusion:** the result of the study made the importance of the multiprofessional team in the care of these patients perceptible.

**Descriptors:** Pharmaceutical; phlebitis; peripheral catheterization.

**RESUMO**

**Objetivo:** identificar a ocorrência de flebite mecânica e química em cateteres venosos periféricos de pacientes adultos hospitalizados. **Método:** estudo observacional descritivo com 100 pacientes maiores de 18 anos submetidos a punção venosa periférica, realizado nos meses de setembro e outubro de 2016 na Unidade de Internação Adulto de um Hospital Universitário. Foram avaliados diariamente o local de inserção do dispositivo de punção periférica com finalidade de identificar sinais e sintomas de flebite. A análise estatística foi realizada utilizando o teste Qui-quadrado, considerando significância estatística quando  $p < 0,05$ . **Resultados:** foi observado a ocorrência de flebite em 21% dos casos, prevalecendo as de grau 1 (52,4%). Dos 21 casos, 14 ocorreram por causas mecânicas, 50% devido a punções repetidas e 7 por causas químicas que apresentou valor estatisticamente significativo em relação a alguns medicamentos utilizados ( $p=0,008$ ). **Conclusão:** o resultado do estudo tornou perceptível a importância da equipe multiprofissional na assistência a esses pacientes

**Descritores:** Farmacêuticos; flebite; cateterismo periférico.

**RESUMÉN**

**Objetivo:** identificar la ocurrencia de flebitis mecánica y química en catéteres venosos periféricos de pacientes adultos hospitalizados. **Método:** estudio observacional descriptivo con 100 pacientes mayores de 18 años sometidos a punción venosa periférica, realizado en los meses de septiembre y octubre de 2016 en la Unidad de Internación Adulto de un Hospital Universitario. Se evaluaron diariamente el lugar de inserción del dispositivo de punción periférica con el fin de identificar signos y síntomas de flebitis. El análisis estadístico fue realizado utilizando la prueba Chi-cuadrado, considerando significancia estadística cuando  $p < 0,05$ . **Resultados:** se observó la ocurrencia de flebitis en el 21% de los casos, prevaleciendo las de grado 1 (52,4%). De los 21 casos, 14 ocurrieron por causas mecánicas, 50% debido a punciones repetidas y 7 por causas químicas que presentó valor estadísticamente significativo en relación a algunos medicamentos utilizados ( $p = 0,008$ ). **Conclusión:** el resultado del estudio hizo perceptible la importancia del equipo multiprofesional en la asistencia a esos pacientes.

**Descritores:** Farmacêuticos; flebitis; cateterismo periférico.

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## INTRODUCTION

Vascular catheters are widely used for the care of hospitalized patient, it is essential to administer intravenous (IV) solutions and medicines. The IV route provides that the drug is administered directly into the bloodstream.<sup>1</sup> Currently, the most used Peripheral Venous Catheter (PVC) is the over-needle because it is flexible and allows a longer residence time.<sup>1-2</sup>

The increasing use of IV therapy caused the Peripheral Venous Puncture (PVP) is often performed in hospital care, which increases the probability associated local complications like phlebitis, infiltration, and hematoma, which may occur in 50% to 75% of patients undergoing this procedure.<sup>3</sup> In this context, one of the most frequent complications associated with CVP is phlebitis, implying failure and interruption of IV therapy.<sup>4</sup>

Phlebitis is characterized by inflammation of the internal layer of the vein, presenting symptoms classified in different degrees of edema, pain and erythema in the contour of the insertion site of the CVP or along the path of the vein, being able to evolve causing a palpable fibrous cord with blush fever, increased sensitivity at the site and fever.<sup>4-5</sup>

The classification of phlebitis according to the intensity of signs and symptoms follows a scale ranging from 0 to 4. Grade 0 is without symptoms; grade 1, erythema at the site of access with or without pain; grade 2, local pain with erythema or edema; grade 3, local pain with erythema or edema and formation of palpable and grade 4 venous cord, the same symptoms as the previous one but with palpable

## Phlebitis in peripheral vascular catheters

venous cord > 2.5 cm and presence of purulent drainage.<sup>2</sup>

The classification according to the causal factors is divided into: mechanical phlebitis, chemical phlebitis, bacterial phlebitis and post-infusion phlebitis,<sup>6</sup> and the present research will address the first two.

Mechanical phlebitis is related to the use of a catheter of inadequate size, inadequate fixation, repeated punctures and long catheter permanence.<sup>3,6</sup> Phlebitis chemistry is associated with IV drugs or solutions that generate irritation in the blood vessel, as they have extreme pH values, osmolarity values higher than 900 mOsm/L, diluted medications in the same vial or syringe being improperly associated causing incompatibility, small particles present in solution IV.<sup>4,7</sup> Antimicrobial drugs, especially in the  $\beta$ -lactam group, are also associated with the frequent occurrence of chemical phlebitis.<sup>8</sup> Drug-related errors, in addition to compromising quality of care, have an impact on patient hospitalization.<sup>9</sup>

The growing scientific and technological development in the area of health have produced strategies and mechanisms for effective teamwork, with quality and efficiency. In the hospital environment, this expansion made it indispensable to have multiprofessional health teams, where each professional is responsible for their area of action, and together bring improvements to the safety of care provided to patients.<sup>10</sup>

The pharmacist has long had their professional role focused on administrative processes regarding health care. The historical changes influenced a restructuring of the

profession making pharmaceutical care to be integrated with the multiprofessional team, focused on the patient aiming at promotion, protection and recovery of health, and prevention of injuries.<sup>11</sup>

Considering the risks of complications associated with PVP, because it is an invasive procedure that communicates the venous system with the external environment, it is also life-threatening if errors occur involving the preparation and/or administration of medications. However, the pharmacist can corroborate with the patient's safety activities, assessing the PVP at the time of the clinical evaluation visit, pertinent to the activities of the profession. In this sense, the study aimed to identify the occurrence of mechanical and chemical phlebitis in CVP of adult patients.

## METHODS

This is a quantitative descriptive observational study, carried out in the months of September and October of 2016, at the Adult Hospitalization Unit located on the 8th floor of the University Hospital in the metropolitan region of Porto Alegre. We evaluated 100 patients older than 18 years submitted to the PVP procedure. The calculation of this convenience sample was performed based on the census of inpatients in the study area and on the time available for the conclusion of this study.

Daily a student of the course of pharmacy, with training in technical nursing course and previously qualified to identify phlebitis, application of inclusion and exclusion criteria, and the Term of Consent. The study

hospital approved the survey together with the team. Only the nurse responsible for the unit knew that an inspection activity was being carried out, but she did not know the contents of this.

Eligible participants were initially presented to the Consent Form, at which time they received an explanation of the research, and agreed, they signed the document. The visits for the observation of the puncture site and completion of the check-list for data analysis occurred later. All were followed up from the first CVP inserted during hospitalization until their hospital discharge and/or withdrawal.

The checklist was developed by the research team, based on pertinent information to answer the purpose of the study, not being a validated questionnaire. The data used were: chart number, gender, age, reason for hospitalization, date on catheter fixation/dressing - for evaluation of length of stay, type of dressing used for fixation, caliber and catheter manufacturing material, aspect of the site label on the packaging of the drug/diluent/electrolyte in administration, signs of phlebitis, mechanical causes, vesicant and/or irritant medications, diluents used and pertinent observations.

In addition to the information collected daily at the visits, consultations were also carried out in the electronic medical record of the hospital's computerized system, to identify the prescribed drugs that were being administered via PVC.

Phlebitis was classified according to the degree of intensity of signs and symptoms, and it could be of degree 1 to 4.<sup>2</sup> In relation to the

causal factors, two types were evaluated: mechanical phlebitis<sup>3,6</sup> and chemistry<sup>4,7-8</sup>, among them mechanical phlebitis related to the use of catheter of inadequate caliber, inadequate fixation, repeated punctures and long time of catheter permanence. And chemical phlebitis referring to IV drugs or solutions that generate irritation in the blood vessel.

The data collected in the checklist was passed to the Microsoft Excel 2010 software in a spreadsheet to perform the frequency analysis. Statistical analyzes were performed in Statistical Package for Social Sciences (SPSS) software 16.0. To evaluate the existence of a relationship between the qualitative variables, the Chi-square test was used and statistical significance was considered, when  $p < 0.05$ .

The study was approved by the Research Ethics Committee of the Lutheran University of Brazil, Canoas campus, Rio Grande do Sul, with CAAE No. 57078416.4.0000.5349 and opinion No. 1,697,419, according to ethical precepts of human research contained in Resolution No. 466 of 2012.

## RESULTS

Of the 100 patients evaluated, the predominance was female (56%) and 85% were younger than or equal to 50 years. The reason for hospitalization was 50% for both clinical and surgical cases (Table 01).

The mean length of hospital stay for each patient was 11.55 ( $\pm 0.5$ ) days. Of the 100 evaluated, 26 (26%) used continuous infusion of serum therapy and 74 (74%) saline peripheral

venous access. Regarding the packaging of the drugs, 71 (71%) were labeled with information pertaining to the infusion and 29 (29%) were not identified. The same thing happened with the equipment, which must be on the label the date of installation. The use of pumps for infusion of IV therapy was not observed, therefore, the teams observed were of the gravitational macrogotes type.

Among the 100 eligible, 16 (76.19%) patients were female, and there was no association with statistical significance with gender and occurrence of phlebitis ( $p = 0.147$ ). In relation to age, 20 (95.24%) were older than 50 years and there was no association with statistical significance with age and the occurrence of phlebitis ( $p = 0.147$ ).

Of the 100 patients followed up, 21% presented the occurrence of phlebitis, of which 14 (66.67%) were cases of mechanical phlebitis. A total of 288 PVPs were evaluated during the study (Table 01). In all cases the needle catheter was used, and the material of manufacture was polytetrafluoroethylene. The dressing used in 271 (94.10%) punctures was the transparent adhesive film, the others used micropore tape and tape.

Of the 288 punctures, in 100 (34.72%) the residence time was shorter than 96 hours (Table 01), leading to repeated punctures, a factor that predisposes to mechanical phlebitis. Regarding the reason for the withdrawals or substitutions, the majority, 105 (36.46%) accesses, were exchanged for the occurrence of some type of adverse event such as phlebitis, infiltration or hematoma at the puncture site (Table 01).

**Table 01:** Characteristics of the evaluated patients

Variables	N=100	%
<b>Sex</b>		
Female	56	56
Male	44	44
<b>Age</b>		
≤ 50 years old	15	15%
≥ 50 years old	85	85%
<b>Reason for hospitalization</b>		
Clinical	50	50%
Surgical	50	50%
Variables	N=288	%
<b>Length of stay</b>		
< 96 hours	100	34.72%
= 96 hours	131	45.49%
> 96 hours	57	19.79%
<b>Reason for change</b>		
Adverse event	105	36.46%
Hospital routine	94	32.64%
End of	89	30.90%
Therapy/Discharge		

The mean number of punctures among those with phlebitis was 4.16 ( $\pm$  1.34). Of the 21 (21%) patients with phlebitis, 7 (33.33%) used continuous infusion of saline therapy and 14 (66.66%) saline peripheral venous access. Transparent film dressing was used in 16 (76.20%) patients with phlebitis.

Of the 21 punctures assessed with phlebitis, 7 (33.33%) were performed on forearm veins, followed by the antecubital fossa (23.80%), and the most used catheters were the 20G and 22G caliber catheters (Table 2). Regarding the degree of intensity of signs and symptoms, most were classified as grade 1, with

52.4% (11 cases) (Table 2), characterized by erythema at the PVC site with or without pain.

Regarding the causal factors, phlebitis due to mechanical causes prevailed with 14 (66.67%) cases. With respect to mechanical phlebitis, 3 (21.43%) were caused by inadequate fixation, 7 (50%) by repeated punctures and 4 (28.57%) by catheter permanence time greater than 96 hours, but did not present significant statistic. These causes were observed through the date present in the dressing for knowledge of both the number of punctures as well as the length of time of the same PVC.

**Table 02:** Characteristics related to phlebitis.

Variable	n=21	%
<b>Punction site</b>		
Back of the Hand	4	19.0%
Fist	4	19.0%
Forearm	7	33.33%
Antecubital Fossa	5	23.80%
Lower members	1	4.80%
<b>Catheter Gauge</b>		
20 gauge	7	33.33%
22 gauge	11	52.40%
Not visible	3	14.30%
<b>Intensity degree</b>		
Degree 1	11	52.40%
Degree 2	10	47.60%
<b>Causal Factors</b>		
Mechanical causes	14	66.67%
Chemical Causes	7	33.33%

The irritant drugs used by the patients during the data collection period were Amoxicillin + Clavulanate, Cephalotin, Cefotaxolin, Cefotaxime, Ceftriaxone, Cefuroxime, Dipyron, Levofloxacin, Meropenem, Oxacillin, Piperacillin + Tazobactam, Sulfamethoxazole + Trimetropine, Tramadol and Vancomycin. Among the 100 patients evaluated, 61% of the cases included

one or more of these medications in their prescriptions being administered continuously.

Considering the 21 cases of phlebitis observed, 7 (33.33%) were due to the occurrence of chemical phlebitis, but taking into account the 61 patients using irritant drugs, the rate drops to 11.47% (7 cases). Drugs related to the occurrence of phlebitis in the study are described in the following table (Table 03).

**Table 03:** Irritant drugs used in each of the 7 patients who presented chemical phlebitis

Patients	Drugs
1	Meropenem
2	Meropenem + Vancomycin
3	Tramadol + Piperacillin + Vancomycin + Cefotaxime

4	Dipyron + Tramadol + Vancomycin
5	Dipyron + Tramadol + Meropenem
6	Dipyron + Ceftriaxone + Amoxicillin + clavulanate
7	Oxacillin

Most patients used more than one irritant medication and it was not possible to identify the cause of phlebitis. However, it was observed that meropenem, vancomycin, tramadol and dipyron were used in common by more than one patient. Meropenem, vancomycin, tramadol and dipyron were associated with statistical significance with the development of chemical phlebitis ( $p = 0.008$ ) and were present in 3 (42.86%) of the 7 cases.

The frequency of administration of dipyron was 4 times a day, while that of meropenem, vancomycin and tramadol 3 times a day.

## DISCUSSION

The female gender represented a majority (76.19%) among eligible patients, which differs from other studies.<sup>3,9-12</sup> And did not present a statistically significant relation related to the occurrence of phlebitis, agreeing with another study.<sup>13</sup>

The age over 60 years is one of the factors that predisposes the occurrence of phlebitis,<sup>3,14</sup> but was not significant agreeing with another study.<sup>15</sup>

With regard to the medications administered in the PVC, it is essential that the label be filled with all the information that identifies the professional responsible for the preparation, start and end time of infusion,

amount of drops or milliliters per minute and all constituents of the solution with their respective volumes.<sup>12</sup> On the material of the catheter, a study indicates that the polyurethane catheters are related to lower degree of infectious complications when compared to polyvinyl chloride or polyethylene catheters and also contribute to the decrease of the occurrence of phlebitis in PVC.<sup>4</sup>

The Intravenous Nurse Society (INS) recommends as acceptable a 5% occurrence of phlebitis,<sup>5,12</sup> the study presented a higher percentage. This occurrence, despite being high, was lower than that found by other authors, ranging from 24.7%, 28.3%, 31.1% and 31.6%,<sup>3,5,9-12</sup> fact that the sample is lower than the studies cited.

The duration of the catheter was evaluated according to the protocol used in the study hospital, which guides the routine of PVC replacement every 96 hours. This time-related procedure differs from author to author and can be changed every 48-72 hours<sup>2</sup> or 72-96 hours.<sup>5,9</sup>

Regarding catheter fixation, a study verified the use of hypoallergenic tape that generated difficulty in the daily evaluation of the insertion site, but did not statistically evaluate this data regarding the occurrence of phlebitis. On the other hand, the same study in relation to the catheter permanence time did not verify significant impact.<sup>4</sup>

In this sense, the dressing of transparent adhesive material shows a technological advance in Brazil, aiming to improve the quality of care of the nursing team to patients submitted to PVP therapy and are not associated with an increased risk of phlebitis.<sup>13</sup>

The occurrences of adverse events as a reason for withdrawal of PVC should be analyzed, since they may be due to ineffective care results from PVP until the end of IV therapy. Factors such as degree of understanding and adherence to punctured patient guidelines should also be observed. These care are the responsibility of the multiprofessional team, including continuous updating of knowledge regarding care, as well as prevention of complications of IV therapy.<sup>9</sup>

To maintain the permeability of the catheter, the institution of the study standardized the use of 0.9% physiological solution between one drug and another and soon after the end of the infusion. A contradictory result was found regarding which type of solution is most satisfactory to decrease the risk of phlebitis occurrence, and solutions with heparin may be used to maintain the permeability of PVC.<sup>10</sup>

A cohort study of 60 patients found that continuous infusion predisposed less the occurrence of PVC associated phlebitis.<sup>14</sup> However, other research has shown that administration of intermittent infusion causes an increase in the occurrence of related complications.<sup>5</sup>

The caliber of the catheter has been investigated in relation to the influence on the occurrence of PVC complications. A concordance

was found in which larger caliber catheters are more likely to cause phlebitis because they exert a greater friction against the wall of the punctured vessel, and the use of smaller diameter gauges is relatively more advantageous.<sup>6,14</sup>

Regarding the PVP site, the forearm was the most frequent, but it is in this region that there are more calibrous veins, which can contribute with low rates of phlebitis when compared to the veins located in the back of the hand.<sup>13</sup> Currently, there is no consensus about the anatomical region best suited for PVP or with a lower risk for phlebitis. PVP with larger caliber PVC in veins of the hands and wrists may cause mechanical irritation in the vascular wall leading to phlebitis, because they are tortuous and of lesser lumen. However, PVP in the region of the antecubital fossa and the forearm are the most frequently chosen and therefore have higher rates of phlebitis when compared to the regions of the hand and wrist.<sup>4</sup>

Other articles also show that PVC located in lower limbs presents greater risk when compared to upper limbs. And that catheters inserted in regions of flexion and greater mobility are more prone to the formation of mechanical phlebitis.<sup>15-19</sup>

The degree of intensity of signs and symptoms found is in agreement with a recent study that evaluated 285 cases of phlebitis in hospitalized patients in the 18-month period.<sup>10</sup> According to other studies, the predominant occurrence was grade 2.<sup>4,12</sup>

Chemical phlebitis is often associated with IV medications or solutions that irritate and injure the blood vessel because they have pH



values lower than 5 and greater than 9, which are considered extreme.<sup>15</sup> Some studies have found no relationship between the types of drugs administered with occurrence of phlebitis.<sup>14,20</sup> Other authors cite potassium chloride, antimicrobials, amiodarone and solutions with low pH and high osmolarity as related to high risk when compared with other medications.<sup>6,10</sup>

The increased frequency of IV drug administration, together with the pH of the drugs and the need to handle PVC more frequently, is shown to be associated with a higher occurrence of phlebitis.<sup>10</sup> Meropenem, vancomycin, tramadol and dipyron were related to the highest risk of phlebitis, and should be prepared and administered safely, ranging from the prescription and dispensing by the pharmacy to a correct administration.<sup>18-19</sup>

Vancomycin is a glycopeptide antimicrobial that has a pH of 2.5 to 4.5, a factor that causes damage to the blood vessel. It was observed that vancomycin was diluted in 100 mL of 0.9% saline, as recommended in the study institution dilution manual, and only if an adverse reaction occurs should the dilution volume be increased, the same orientation was used observed in manuals of other institutions.<sup>20-</sup>  
<sup>21</sup> Phlebitis can occur due to extreme pH, as well as the concentration of vancomycin above 5mg/mL, requiring central venous access to prevent this complication.<sup>22</sup>

Meropenem is an antimicrobial of the  $\beta$ -lactam group, which, despite not having an extreme pH value, was also related to the occurrence of phlebitis in another study in which 171 patients.<sup>23</sup>

Dipyron and tramadol also did not present extreme pH values and were significant for the occurrence of chemical phlebitis, and in these cases were administered with meropenem or vancomycin. These two drugs may cause urticaria and pain at the time of administration and can be a factor causing phlebitis, but we can not say because patients were not supervised in 100% of the hospitalization time and did not report during the interview.

To plan the IV therapy, to know the physical-chemical characteristics of the drugs, to determine the diluent, the volume of dilution and the time of infusion are factors that guarantee a safe IV treatment and with a lower risk of complications.<sup>12</sup>

## CONCLUSION

Although the PVP procedure is quite common in the hospital environment, there are few articles related to the subject, the vast majority of them work with PVC. A fragility of the study was the time of collection and the sample of patients, observing the need for further research to confirm the findings.

The occurrence of phlebitis was found to be above that recommended in the literature, demonstrating that only the availability of a drug dilution manual does not promote its correct and safe use. It is important to provide information on the risk of chemical phlebitis of each drug, as well as the need for frequent evaluation of the insertion sites of the PVC, providing the recognition and rapid management of the signs of mechanical phlebitis. This

evaluation can be performed by any trained and qualified health professional.

The participation and insertion of the pharmacist in the multiprofessional team, especially in the processes that involve the use

of drugs is of great value, always considering the need for constant updating to guarantee the quality of service provided and patient safety.

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## COLLABORATIONS

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**CONFLICTS OF INTEREST**

The authors declare that no have conflicts of interest

**AVAILABILITY OF DATA**

Available upon request to the authors

**FUDING SOURCE**

Does not apply

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