Original Article

Risk factors for vascular trauma during antineoplastic chemotherapy: contributions of the use of relative risk*

Fatores de risco para trauma vascular durante a quimioterapia antineoplásica: contribuições do emprego do risco relativo

Factores de riesgo para el trauma vascular durante la quimioterapia antineoplásica: contribuciones del empleo del riesgo relativo

Cíntia Capucho Rodrigues[1], Caroline Guilherme[2], Moacyr Lobo da Costa Júnior[3], Emilia Campos de Carvalho[4]

ABSTRACT

Objective: To identify the relationship between risk factors for vascular trauma and the emergence of adverse events of infiltration or phlebitis for antineoplastic chemotherapy. **Methods:** A study with a quantitative, observational method with 30 women with breast cancer. **Results:** The type of catheter material presented an association that suggested risk (RR = 2.76, CI = 1.199, 6.369); the infusion rate factor presented RR = 2.22, however, CI = 0.7672, 6.436; the trajectory factors, number of punctures and vein mobility presented RR <1, but these cannot be considered as protective factors. Insertion site and the visibility of the vein presented a risk close to 1. **Conclusion:** The use of a metal catheter for venipuncture was considered in this study as a factor for Risk for Vascular Trauma. An analysis of the association for the RR showed these results were consistent with the research literature data.

Keywords: Blood vessels/injuries; Antineoplastic agents/therapeutic use; Oncology nursing; Risk factors

RESUMO

Objetivo: identificar a relação entre os fatores de risco para trauma vascular e o surgimento de eventos adversos de infiltração ou flebite por quimioterapia antineoplásica. **Métodos:** Estudo de abordagem quantitativa observacional com 30 mulheres com câncer de mama. **Resultados:** O tipo de material do cateter apresentou associação que sugere risco (RR=2,76; IC=1,199; 6,369); o fator velocidade de infusão apresentou RR=2,22; entretanto, IC= 0,7672; 6,436; os fatores trajetória, número de punção e mobilidade da veia apresentaram RR<1 mas não podem ser considerados como fatores de proteção. Local de inserção e a visibilidade da veia apresentaram risco próximo a 1. **Conclusão:** O uso de cateter com metal para punção venosa foi considerado neste estudo como fator para Risco de Trauma Vascular. A análise da associação pelo RR mostrou-se concordante com os dados da literatura pesquisada.

Descritores: Vasos sanguíneos/lesões; Antineoplásicos/uso terapêutico; Enfermagem oncológica; Fatores de risco

RESUMEN

Objetivo: identificar la relación entre los factores de riesgo para el trauma vascular y el surgimiento de eventos adversos de infiltración o flebitis por quimioterapia antineoplásica. **Métodos:** Estudio de abordaje cuantitativo observacional realizado con 30 mujeres con cáncer de mama. **Resultados:** El tipo de material del catéter presentó asociación que sugiere riesgo (RR=2,76; IC=1,199; 6,369); el factor velocidad de infusión presentó RR=2,22; mientras que, IC= 0,7672; 6,436; los factores trayectoria, número de punción y movilidad de la vena presentaron RR<1 mas no pueden ser considerados como factores de protección. Local de inserción y la visibilidad de la vena presentaron riesgo próximo a 1. **Conclusión:** El uso de catéter con metal para punción venosa fue considerado en este estudio como un factor de Riesgo de Trauma Vascular. El análisis de la asociación por el RR se mostró concordante con los datos de la literatura investigada.

Descriptores: Enfermería oncológica; Vasos sanguíneos/lesiones; Antineoplásicos/uso terapéutico; Enfermería oncológica; Factores de riesgo

** Paper taken from the Master's Thesis "Vascular Trauma: incidence in patients submitted to chemotherapy treatment for breast cancer", presented to the University of São Paulo at Ribeirão Preto College of Nursing – USP – Ribeirão Preto (SP), Brazil.*

[1] M.Sc. in Nursing. University of São Paulo at Ribeirão Preto College of Nursing – USP – Ribeirão Preto (SP), Brazil.

[2] Ph.D. candidate, Interunit Doctoral Program at EE/EERP-USP

[3] Associate Professor, University of São Paulo at Ribeirão Preto College of Nursing – USP – Ribeirão Preto (SP), Brazil.

[4] Full Professor. University of São Paulo at Ribeirão Preto College of Nursing – USP – Ribeirão Preto (SP), Brazil.

Corresponding Author: **Emilia Campos de Carvalho**
Av. Bandeirantes, 3900 – Monte Alegre – Ribeirão Preto – SP. Brasil.
CEP -14040-390. E-mail: ecdcava@usp.br

Received article **14/09/2011** and accepted **02/01/2012**

INTRODUCTION

A number of factors have been described as enhancers of possible problems in cancer treatment, which include infiltration, phlebitis or tissue necrosis: the length of cancer treatments; patients' cognitive, sensory and perceptive conditions[1]; as well as vascular and cutaneous fragility; thrombocytopenia; progressive deterioration of the peripheral venous network[2]; patients' age[3]; venous types and conditions[4,5]; and the therapeutic protocol defining the drugs and their action, dosage, characteristic, volume, concentration and association and established infusion time[3,6-8]; besides the selection of recent puncture sites in the system used for infusion; choice of intravenous devices, use of infusion pump[3,9,10], fixation form[10,11], excess circuits linked to the site[11] and tourniquet use to improve the visualization of the vein[11,12].

The North American Nursing Diagnostics Association (NANDA-I)[13] appoints some of these possible risk factors as characteristics of the diagnosis Risk for Vascular Trauma, recently incorporated into Taxonomy II. To consolidate or complement these diagnoses, literature recommends diagnostic validation studies. Among diagnostic validation alternatives, experts on the theme have considered clinical validation positive[14]. Determining the presence of problems or not, based on the considerations of risk factors present in antineoplastic chemotherapy situations, can reveal a useful strategy to analyze the components of this phenomenon and plan nursing care for this clientele.

Aim

To assess the relation between the risk factors for vascular trauma and infiltration or phlebitis events deriving from peripheral intravenous antineoplastic chemotherapy for breast cancer.

METHODS

This quantitative and observational study was accomplished during an antineoplastic chemotherapy session for breast cancer treatment, at an oncology outpatient clinic of a teaching hospital in the interior of São Paulo State, Brazil. Data were observed throughout the procedure, identifying whether the outcome occurred or not.

To analyze the impact of each risk factor on the determination of whether vascular trauma events took place, considered as phlebitis or infiltration, the Relative Risk (RR) was calculated, based on the absolute risk ratio of the event between subjects exposed and not exposed to the risk factors under analysis (insertion site, venous visibility and pathway, catheter type and caliber, nature of the solution and infusion speed). This indicator (RR) expresses the measure of this association[15]; its calculation can reveal to be a useful strategy for clinical nursing decision making.

Patients with breast cancer were considered eligible, independently of the histological type and staging; treated for the first time and, hence, without previous antineoplastic chemotherapy use; submitted to outpatient treatment and over 18 years of age. For this report, data observed during the therapeutic procedure in the first cycle were considered, so as to check the occurrence of the outcome. Patients recruited at the service within six months as from May 2009 took part in the study.

This research received approval from the Research Ethics Committee at the *Hospital das Clínicas de Ribeirão Preto* (Proc No 12.956/2008). Participants signed the Informed Consent Term, which included information about the research aims and the guarantees involving participation in the research process, according to National Health Council Resolution 196/96 on research involving human beings.

The instrument used was submitted to face and content validation with the help of three nurses, two of whom were oncology specialists and one nursing diagnosis expert. Then, as a test, the researcher and a nurse applied the instrument to three patients. Both observers collected the data at the same time, with a 95% inter-observer agreement rate, which is considered satisfactory for this kind of studies[16]. The instrument included: sociodemographic identification of the subjects; venous network conditions in the limb that is to be punctured and the following variables related to the peripheral venipuncture process for antineoplastic chemotherapy: visibility, palpability, mobility, trajectory, vein elasticity, insertion site of the device, material and caliber of the device, use of infusion pump, infusion time and speed/flow and number of punctures during the therapeutic cycle. To assess for the presence of phlebitis and infiltration, the Infusion Nursing Society[17] recommended criteria were adopted. The presence of any of the criteria (symptoms), on both scales, ranging from 1 to 4, was considered as the outcome.

RESULTS

Study participants were 30 patients, whose ages ranged between 32 and 68 years, with a mean age of 47 years.

As for the characteristics of the veins accessed in the study, these were predominantly fixed (60%), straight (73%), visible (60%) and all were palpable and flexible (Table 1).

Table 1. Characterization of study subjects' veins and devices used for chemotherapy treatment (n=30). Ribeirão Preto, 2010

Variables		No	%
Visibility of the vein	Not visible	12	40
	Visible	18	60
Palpability of the vein	Not palpable	0	0
	Palpable	30	100
Mobility of the vein	Mobile	12	40
	Fixed	18	60
Trajectory of the vein	Tortuous	8	26
	Straight	22	73
Elasticity of the vein	Hardened	0	0
	Flexible	30	100
Insertion site	Hand	23	76
	Forearm	7	23
Material of the device	Metal	11	36
	Vialon/Teflon	19	63
Caliber of the device	22	4	13
	23	11	36
	24	15	50
Use of infusion pump	Yes	30	100
	No	0	0
Vesicant medication	Yes	30	100
	No	0	0
Infusion time	> 30 min.	18	60
	Up to 30 min.	12	40
Number of punctures	> 1	9	30
	1	21	70

Among the materials chosen for the venipuncture in this study, Metal (36%), Vialon (43%) and Teflon (20%) devices were identified (Table 1). Three months after the start of the research, Metal catheters stopped being used at the sector to infuse vesicant medication. It should be reminded that the researcher did not interfere in the service's decision, although the accomplishment of a study may arouse the employees' interest in studying the event under observation.

The following factors were considered for relative risk analysis: visibility, trajectory and mobility of the vein, insertion site, material of the device, infusion time and number of punctures necessary to successfully install the device. Only one risk factor (material of the device) revealed to be associated (Table 2).

DISCUSSION

Even if protective measures are adopted, adverse events can happen. In this study, trauma was observed in the first antineoplastic chemotherapy cycle in 13 situations.

In this study, the observed data appointed that, preferably, visible and palpable veins were used for venous accesses to administer antineoplastic chemotherapy. In cases of veins that were hard to access, the use of ultrasound has been recommended[18] to help locating the vein and enhance the security of the procedure with a view to reducing possible vascular traumas.

The preferred location of the venous network was the back of the hand (76%); this choice supports findings from previous studies[19]. The location of puncture devices has been appointed as an intervening factor in vascular trauma events. Literature recommends avoiding areas bordering on joints or bony prominences[20-21], as movements can cause mechanical trauma to the veins[22]. Therefore, access locations should preferably be chosen in the following order: forearm, back of the hand, fist

Table 2. Distribution of risk factors according to the presence or not of the outcome peripheral vascular trauma and respective relative risk (RR) and confidence interval (CI). Ribeirão Preto, 2010

Risk factor		With outcome	No outcome	Total	RR and CI
Visibility of the vein	Not visible	5	7	12	0.9375 (0.4025; 2.184)
	Visible	8	10	18	
Mobility of the vein	Mobile	3	9	12	0.45 (0.1554; 1.303)
	Fixed	10	8	18	
Trajectory of the vein	Tortuous	2	6	8	0.5 (0.1403; 1.782)
	Straight	11	11	22	
Insertion site	Hand	10	13	23	1.014 (0.383; 2.687)
	Forearm	3	4	7	
Material of the device	Metal	8	3	11	2.76 (1.199; 6.369)
	Vialon/Teflon	5	14	19	
Infusion time	> 30 min	10	8	18	2.22 (0.7672; 6.436)
	≤ 30 min	3	9	12	
Number of punctures	> 1	3	6	9	0.69 (0.2507; 1.955)
	1	10	11	21	

and antecubital fossa[23-26]. Studies also appoints lower rates of thromboembolism in veins located in the forearm and back of the hand[2,25].

Patients' age in this sample was compatible with the epidemiology of breast cancer. The age variable should be considered when choosing the venous devices and infusion site[27]. Elderly people present physiological changes that inference in venous mobility and fragility, besides sensory or cognitive alterations that can hamper the identification of local pain.

The choice of the device caliber should be compatible with the vein, type and duration of treatment, with a view to reducing possible vascular traumas.

As for the use of Vialon or Teflon for chemotherapy infusion, literature recommends the use of both due to the flexibility of the material, which reduces the risk of dislocations[24,28,29]. Another situation that should be taken into account in this sense is the irritation the material produces on the vessel wall, as Teflon can cause further irritation than Vialon[3]; at outpatient services, however, the exposure time of the vessel to the catheter is shorter, as it is only left in place during the infusion time of the drug, i.e. an average 3 hours in this study.

Professionals have also looked at the caliber of the device in this scenario, as smaller-caliber devices reduce vascular trauma during the puncture procedure and, if smaller than the vessel caliber, facilitates blood circulation around the device, helping with the hemodilution of the medication[23,25,30]. In this study, caliber 22 (13%), caliber 23 (36%) and caliber 24 (50%) devices were used, in line with literature recommendations.

In all patients, infusion pumps were used in the observed cycle. Despite considering the importance of controlling the infusion flow through the use of this device, it should be highlighted that positive pressure is produced, which can interfere in the occurrence of vascular traumas.

Drugs recommended by the Ministry of Health[31] to treat breast cancer patients in stages I, II and III include anthracyclines. Among these drugs, Epirubicin stands out, which is considered vesicant medication, i.e. causes necrosis when in contact with tissue. This drug represents a high risk factor for vascular trauma according to literature, as it causes an inflammatory reaction in the vascular trajectory, as well as pain during the infusion[32-35]. Another drug, Cyclophosphamide, in the class of alkylating agents, is also appointed as a vascular trauma factor, because it causes hyperpigmentation and phlebitis in the chemotherapy administration site[2]. In this study, the 30 patients received Epirubicin and Cyclophosphamide in the observed cycle.

Infusion time and prescribed flow are other relevant factors in the monitoring of antineoplastic chemotherapy. Nowadays, some institutions adopt protocols[2] with standards to reduce problems, such as not administering vesicant drugs during prolonged continuous infusion periods (more than 30 minutes) in peripheral veins; avoiding the use of veins punctured more than 24 hours earlier, even if venous return is direct; avoiding the puncturing of inferior limbs, or limbs that were submitted to irradiation or display edemas. Other standards are: not puncturing limbs with lesions or metastases, corresponding to the mastectomy, submitted to surgery (especially involving surgical ganglion removal), with motor and/or sensory disorders (plegia, paresis, paresthesia), excessively punctured, offering better protection to the joints, tendons, nerves and causing less anatomical and functional harm in case of extravasation. In the present study, infusion time varied up to 60 minutes, depending on the drug and its reactions. In view of the Relative Risk rate obtained for this variable, it should be highlighted that, in other studies with larger samples, the results could confirm this represents a risk factor for vascular trauma.

All subjects were exposed to the following risk factors: infusion pump use and vesicant medication administration, which by itself characterizes situations with high possibilities of vascular trauma events, as highlighted. Also, in all accesses, the use of small-caliber devices was observed (device with gauge of 22 or more), as well as palpable vessels with preserved elasticity.

The associations found for the material the devices were manufactured in and the infusion time suggest that these represent risk factors (RR>1); in view of the confidence interval, however, only the factor material of the device shows to be associated with the outcome; the risk of vascular trauma in case of Metal devices is 2.76 times higher in comparison with Vialon/Teflon devices.

The associations found for trajectory, number of punctures and mobility suggest that these serve as protection factors in the study sample; based on the confidence interval, however, this inference does not support the hypothesis of association. When confronted with more difficult venous access (tortuous and mobile veins), however, professionals may pay further attention to the selection and fixation of the devices, with a view to reducing trauma risks; this aspect should be checked in other studies and other clienteles.

Finally, the relative risk ratios for insertion site and visibility of the vein bordered on one, disclosing no association with the outcome and, thus, equally demanding further research with larger samples.

CONCLUSIONS

The adverse events observed (distinct levels of phlebitis and infiltration of isotonic solution) in13 subjects reinforce the high potential of vascular trauma events in the study sample.

One of the concerns in oncology nursing is to avoid vascular trauma or minimize its consequences, as it is not always avoidable, considering that the benefit of treatment surpasses the malefaction vascular trauma causes.

Although no causal relation can be attributed to the factor type of material, as it occurs concomitantly with other factors present in the study situation, the possible presence of its contribution in the development process of the outcomes should be considered in this clientele.

Further research with larger samples is suggested; the contribution of relative risk in clinical practice is highlighted though, as a possible indicator of the association between the presence of risk factors and the outcomes studied, as well as in the analysis of risk factors for nursing diagnoses.

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