

Risk factors for site complications of intravenous therapy in children and adolescents with cancer

Fatores de risco para complicações locais da terapia intravenosa em crianças e adolescentes com câncer
Factores de riesgo para complicaciones locales de la terapia intravenosa en niños y adolescentes con cáncer

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ABSTRACT

Objectives: to analyze predictive factors for the incidence of complications related to peripheral venous catheters in children and adolescents with cancer. **Methods:** a longitudinal follow-up study, conducted at a pediatric oncology clinic unit of a hospital in Bahia, with 333 peripheral venous catheters inserted in 77 children and 26 adolescents. Data collection took place between April 2015 and December 2016 through direct observation of peripheral intravenous catheter insertion, medical record data collection and daily observation of the puncture site. **Results:** the incidence of complications was 18.6%. The modeling of the variables confirmed that the risk factors for complications in children/adolescents with cancer were: prolonged peripheral intravenous therapy ($p=0.002$), history of complications ($p=0.000$), non-irritating/vesicant medications ($p=0.003$) and vesicant solutions ($p=0.000$). **Conclusions:** the goal has been achieved. Results can contribute to the theoretical, practical and social context.

Descriptors: Pediatric Nursing; Child Hospitalization; Catheterizations, Peripheral; Infusion, Intravenous; Adverse Effects.

RESUMO

Objetivos: analisar fatores preditores para a incidência de complicações relacionadas a cateteres venosos periféricos em crianças e adolescentes com câncer. **Métodos:** estudo longitudinal de seguimento, realizado na unidade de clínica oncológica pediátrica de um hospital da Bahia, com 333 acessos inseridos em 77 crianças e 26 adolescentes. A coleta ocorreu entre abril de 2015 a dezembro de 2016 por meio da observação direta da inserção do cateter intravenoso periférico, coleta em prontuário e observação diária do sítio de punção. **Resultados:** a incidência das complicações foi de 18,6%. A modelagem das variáveis confirmou que os fatores de risco para complicações em crianças/adolescentes com câncer foram: terapia intravenosa periférica prolongada ($p=0,002$), antecedentes de complicações ($p=0,000$), medicamentos não irritantes/vesicantes ($p=0,003$) e soluções vesicantes ($p=0,000$). **Conclusões:** o objetivo foi alcançado. Os resultados podem contribuir para o contexto teórico, prático e social.

Descritores: Enfermagem Pediátrica; Criança Hospitalizada; Cateterismo Periférico; Infusões Intravenosas; Efeitos Adversos.

RESUMEN

Objetivos: analizar los factores predictivos de la incidencia de complicaciones relacionadas con los catéteres venosos periféricos en niños y adolescentes con cáncer. **Métodos:** estudio longitudinal de seguimiento, realizado en una unidad de clínica de oncología pediátrica de un hospital de Bahía, con 333 inserciones de catéteres en 77 niños y 26 adolescentes. La recolección se realizó entre abril de 2015 y diciembre de 2016 a través de la observación directa de la inserción del catéter intravenoso periférico, la recolección de registros médicos y la observación diaria del sitio de punción. **Resultados:** la incidencia de complicaciones fue del 18,6%. El modelo de las variables confirmó que los factores de riesgo para complicaciones en niños/adolescentes con cáncer fueron: terapia intravenosa periférica prolongada ($p=0.002$), antecedentes de complicaciones ($p=0.000$), medicamentos no irritantes/vesicantes ($p=0.003$) y soluciones vesicantes ($p=0.000$). **Conclusiones:** el objetivo se ha logrado. Los resultados pueden contribuir al contexto teórico, práctico y social.

Descriptor: Enfermería Pediátrica; Niño Hospitalizado; Cateterismo Periférico; Infusiones Intravenosas; Efectos Adversos.

INTRODUCTION

It was estimated that in 2018 about 12,500 new cases of childhood cancer would be diagnosed in Brazil, according to data from the National Cancer Institute (INCA). The most frequent types of cancer among children and adolescents are leukemia, neuroblastoma, Wilms tumor, retinoblastoma, germinal tumor, osteosarcoma and sarcomas⁽¹⁾. The treatment is performed through clinical evaluation, and radiotherapy, chemotherapy and surgical procedures may be used⁽²⁾.

Chemotherapy is the most widely used therapy for treating children and adolescents with cancer. Medications administered through the peripheral intravenous catheter represent a risk for complications at the site of Intravenous Therapy (IVT), and may cause damage to the veins and surrounding tissues due to the inherent characteristics of these medications, regarding its vesicant and/or irritant potential⁽³⁻⁵⁾.

Site complications of IVT most commonly associated with chemotherapy infusion include phlebitis, thrombophlebitis, infiltration, leakage, and catheter obstruction due to precipitation of incompatible substances⁽⁴⁻⁵⁾.

When these complications occur, there is a need of catheter removal and new peripheral intravenous catheter (PIC) attempts⁽⁴⁾, causing stress and pain for both the child and adolescent and their families⁽⁶⁾. Attempts may damage even more the already weakened venous network, and potentiate other complications such as site infection, nerve damage and vasospasm⁽⁴⁾, in addition to demanding more time from the professional performing this intervention.

Site complications also increases the hospitalization time of the child⁽⁴⁾ and the hospital expenses. The prevention of these events requires investment in continuing education of health professionals involved in the care of children and adolescents with cancer, as well as the use of materials that may reduce their rates⁽⁷⁻⁸⁾.

Based on the fact that evidence-based care can be implemented with the safety of the pediatric patient in mind, it is essential to consider and recognize, from the beginning of IVT, which are the demographic, clinical and therapy indicators used by the child that will intensify the occurrence of the above complications.

However, the production and publication of knowledge on this subject is incipient. It was found from January 2015 to March 2019, when consulting national and international databases and portals such as the *Biblioteca Virtual em Saúde* (BVS), National Library of Medicine (PubMed), Science Direct, SCOPUS, Web of Science and CUIDEN. using the health descriptors: Cancer; Child; Pediatric Nursing; Hospitalization; Extravasation of Diagnostic and Therapeutic Materials; Adverse Effects; Catheterization, Peripheral; Patient Safety; Infusions, Intravenous; Risk factors; Phlebitis; Catheter Obstruction, and its Portuguese-language counterparts indexed in the Medical Subject Headings (MESH).

This research was relevant. Its results may stimulate further investigations and contribute to the development of strategies that prevent the onset of site complications due to peripheral IVT. It can also assist nursing workers in improving their skills and competences and strengthen measures to promote patient safety.

The research questioned, "What factors may predispose the incidence of site complications related to peripheral intravenous catheters in children and adolescents with cancer?"

OBJECTIVES

To analyze predictive factors for the incidence of complications related to peripheral venous catheters in children and adolescents with cancer.

METHODS

Ethical aspects

The research was approved by the Research Ethics Committee of the State University of Feira de Santana (CEP-UEFS) with opinion number 841.612 and CAAE 34172014.7.0000.0053, respecting the ethical aspects proposed by Resolution 466/2012.

Study design, setting and period

This is a longitudinal follow-up study carried out at the oncology clinic of a hospital specialized in child care, located in Feira de Santana-BA, from April 2015 to December 2016. Equator guidelines were followed and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) instrument was used.

Population and sample: inclusion and exclusion criteria

The population of this research included children/adolescents hospitalized and submitted to peripheral IVT infusion. In the sample calculation, we considered the population of 400 children/adolescents hospitalized each month in the cancer clinic unit, the frequency of site complications (phlebitis, infiltration, leakage and obstruction), 75.3%⁽⁹⁾, 95% CI and error sample rate of 5%. Including a 20% loss, 201 peripheral intravenous device insertions were estimated. The final sample was 333 devices.

Children/adolescents, aged between 29 days and 16 years, who were conscious, with clinical stability and recommendation for peripheral IVT were included in the sample. Children/adolescents with contact or respiratory precaution were not included in the sample; with intravenous catheter inserted in urgent or emergency conditions; concomitant use of peripheral and central venous catheters or with catheters inserted in the night shifts or on weekends. Children/adolescents who presented changes in their health status when the clinical condition was aggravated were excluded; transferred to other health units; and whose peripheral intravenous catheter was removed due to accidental loss.

Study Protocol

Data collections were performed by properly trained collaborating researchers during the morning and afternoon shift, from Monday to Friday, as the hospital did not allow collectors to stay during the night shift and on weekends. When selecting participants, the responsible companion was approached, as well as the child and adolescent. They were informed about the research regarding the objectives, risks and benefits, with acknowledgement and agreement included in the Informed Consent Form (ICF) and the ICF for the children/adolescents. Those responsible for the research participants signed the ICF

and children older than seven years old, who could read and write, signed the children/adolescents ICF.

After obtaining consent and/or consent for the child or adolescent to participate in the research, the researchers observed the PIC, performed by nursing technicians from the researched unit itself. Next, the children's and adolescent's medical records were checked. We used a structured form with demographic and clinical data, characteristic of previous IVT, current PIC and IVT used. The insertion site of the intravenous catheter was monitored daily by the investigating researchers, once every shift, to investigate the possible manifestation of complications by evaluating clinical signs and symptoms that could be presented by participants while using the catheter, through the following phlebitis⁽¹⁰⁾ and infiltration/extravasation scales⁽¹¹⁾ proposed by the Infusion Nurses Society, which assess the severity of complications.

In this research, we considered as outcome the complication variable resulting from IVT (described as yes or no). Exposure variables were classified into: child characteristics (gender, race/skin color, nutritional status, prematurity, having edema, child agitation and length of hospitalization); current PIC (catheter site, vein visibility, vein palpability, vein path, vein mobility, catheter gauge, puncture method and catheter stabilization); previous IVT (clinical history of difficult PIC access, prolonged peripheral IVT, previous use of IVT, type of catheter previously used, history of complications, history of phlebitis, history of infiltration, history of extravasation and history of obstruction); and current (use of non-irritant/vesicant medication, use of vesicant solution and use of non-irritant/vesicant solution).

Results and statistics analysis

The collected data were tabulated in Statistical Package for the Social Sciences (SPSS) spreadsheets, version 22.0. We used the descriptive and inferential statistics technique for data analysis. Absolute and relative frequencies, and complication rate were calculated (number of complication incidence/total catheters observed) were calculated. To assess the association between outcome and exposure variables, Pearson's chi-square test and Fisher's test were applied, adopting a significance level of 5% and calculating Relative Risks (RR). In the multiple analysis, logistic regression was performed and modeling was achieved when all variables presented $p \leq 0.05$.

RESULTS

A total of 333 peripheral intravascular devices inserted in 103 participants were observed (77 children and 26 adolescents), of which 62 devices presented some complication associated with the use of IVT, corresponding to 39 children/adolescents. In the study sample, it was observed that the incidence of complications among children and adolescents with cancer was 18.6%. The most frequent complications were extravasation (41.9%) and phlebitis (24.2%). Regarding rates, according to the Infusion Nurses Society evaluation formula⁽⁵⁾, it was found that extravasation (7.8%) and phlebitis (4.5%) were the most frequent (Table 1).

When assessing the severity of phlebitis and infiltration, it was observed that grade 1 phlebitis (50%) and grade 1 infiltration

were more frequent (55.6%), according to the Infusion Nursing Society (INS) evaluation scale⁽¹⁰⁾.

Table 1 describes the demographic characteristics of the children/adolescents who presented the complications studied in this research and the 62 peripheral intravascular devices. It was observed that 41% of the participants were between 36 and 83 months old, female (53.8%) and self-reported as non-white (69.2%). Regarding clinical characteristics, about 15.4% of children/adolescents were classified as malnourished, 10.3% had a history of prematurity and 5.1% had edema in the area to be catheterized. During PIC procedure, 23.1% were agitated and 20.5% of children/adolescents were hospitalized for more than eight days (Table 1).

Table 1 – Incidence, complication rate of Intravenous Therapy, demographic and clinical characteristics of children/adolescents with complications admitted to pediatric oncology clinic units, Feira de Santana, Bahia, Brazil, 2015 - 2016

Variáveis	Oncology Clinic	
	N	%
Occurrence of complication (n=333)	62	18.6
Type of complication (n=62)		
Phlebitis	15	24.2
Extravasation	26	41.9
Infiltration	12	19.4
Obstruction	9	14.5
Complication Rate (n=333)		
Phlebitis	15	4.50
Extravasation	26	7.80
Infiltration	12	3.60
Obstruction	9	2.70
Phlebitis degree (n=14)*		
Degree 1	7	50.0
Degree 2	5	35.7
Degree 3	2	14.3
Degree of infiltration (n=9)**		
Degree 1	5	55.6
Degree 2	4	44.4
Age in months (n=39)		
Up to 35mo (infant)	6	15.4
From 36mo to 83mo (Preschool)	16	41.0
From 84mo to 131mo (School)	6	15.4
≥132mo (Adolescent)	11	28.2
Gender (n=39)		
Female	21	53.8
Male	18	46.2
Race/color (n=39)		
White	12	30.8
Non-white***	27	69.2
Nutritional status (n=39)		
Eutrophic	33	84.6
Malnourished	6	15.4
Prematurity (n=39)	4	10.3
Edema (n=39)	2	5.1
Agitation (n=39)	9	23.1
Length of hospitalization (n=39)		
Up to 7 days	31	79.5
≥ 8 days	8	20.5

Note: *1 child/adolescent from the oncology clinic the Phlebitis Degree could not be analyzed;
*3 children/adolescents from the oncology clinic the Infiltration Degree could not be analyzed;
*** This category includes black and brown.

Table 2 - Associations between sociodemographic and clinical variables and the occurrence of complications in children and adolescents admitted to pediatric oncology clinic units, Feira de Santana, Bahia, Brazil, 2015 – 2016

Variables	Yes (n=62) N (%)	Oncology Clinic		RR	CI	p value
		No (n=271) N (%)				
Age						
Up to 6 years (up to 83 months)	34 (17.3%)	163 (82.7%)	0.84	0.535 – 1.315	0.443*	
≥ to 7 years (84 months or more)	28 (20.6%)	108 (79.4%)				
Gender						
Female	34 (20%)	136 (80%)	1.16	0.741 – 1.829	0.508*	
Male	28 (17.2%)	135 (82.8%)				
Race/color						
Whites	19 (18.8%)	82 (81.2%)	1.01	0.624 – 1.651	0.952*	
Non-whites	43 (18.5%)	189 (81.5%)				
Nutritional status						
Malnourished	10 (33.3%)	20 (66.7%)	1.90	1.081 – 3.332	0.036*	
Eutrophic	52 (17.6%)	244 (82.4%)				
Prematurity						
Yes	9 (28.1%)	23 (71.9%)	1.60	0.872 – 2.926	0.146*	
No	53 (17.6%)	248 (82.4%)				
Edema						
Yes	4 (44.4%)	5 (55.6%)	2.48	1.153 – 5.345	0.066**	
No	58 (17.9%)	266 (82.1%)				
Child hyperactivity						
Yes	14 (15.9%)	74 (84.1%)	0.81	0.472 – 1.398	0.446*	
No	48 (19.6%)	197 (80.4%)				
Length of hospitalization (days)						
Greater than or equal to 7 days	14 (73.7%)	5 (26.3%)	4.82	3.316 – 7.007	<0.001**	
Less than 7 days	48 (15.3%)	266 (84.7%)				

Note: * Pearson's chi-square; ** Fisher's exact test.

Table 3 - Associations between the variables related to current Peripheral Intravenous Catheter, current Intravenous Therapy and the occurrence of complications in children and adolescents admitted to pediatric oncology clinic units, Feira de Santana, Bahia, Brazil, 2015 – 2016

Variables	Yes (n=62) N (%)	Oncology Clinic		RR	CI	p value
		No (n=271) N (%)				
Peripheral Intravenous Catheter site						
Lower limbs	1 (33.3%)	2 (66.7%)	1.80	0.357 – 9.051	0.463**	
Upper limbs	61 (18.5%)	268 (81.5%)				
Vein Visibility						
Non-visible	16 (33.3%)	32 (66.7%)	2.06	1.278 – 3.336	0.005*	
Visible	46 (16.1%)	239 (83.9%)				
Vein palpability						
Not palpable	18 (26.5%)	50 (73.5%)	1.60	0.987 – 2.575	0.062*	
Palpable	44 (16.6%)	221 (83.4%)				
Vein path						
Tortuous	20 (21.3%)	74 (78.7%)	1.21	0.752 – 1.949	0.435*	
Rectilinear	42 (17.6%)	197 (82.4%)				
Vein mobility						
Mobile	15 (16.9%)	74 (83.1%)	0.87	0.516 – 1.484	0.617*	
Fixed	47 (19.3%)	197 (80.7%)				
Catheter gauge						
20 G	3 (42.9%)	4 (57.1%)	1.93	0.779 – 4.808	0.403**	
24 G	28 (15.1%)	158 (84.9%)	0.68	0.428 – 1.079	0.100*	
22 G	31 (22.1%)	109 (77.9%)				
Catheter type						
Teflon®	25 (16.1%)	130 (83.9%)	0.78	0.490 – 1.228	0.276*	
Polyurethane	37 (20.8%)	141 (79.2%)				

To be continued

Children/adolescents who presented complications associated with the use of IVT had a catheter inserted in the veins of the right upper limb (53.8%), and 23.1% of them were not visible; 25.6% not palpable; 20.5% had a tortuous path and 25.6% had vein mobility. The 22 Gauge catheter was the most used one (56.4%) to perform the PIC. Most participants used an intravenous device made of polyurethane (56.4%), inserted by the direct method (94.9%), with a stabilized catheter hub (87.2%) with sterile cover and hypoallergenic micropore® tape (82.1%), without the use of splint to immobilize the catheterized limb (84.6%).

When analyzing the current IVT used, most children/adolescents used irritant medications (94.9%) and about 46.2% vesicant medications. Non-irritating and vesicant medications (66.7%), vesicant solutions (56.4%) and non-irritant/vesicant solution (74.4%) were also used.

In the bivariate analysis there was a statistically significant association between the outcome and the nutritional status variables (p=0.036), length of hospitalization (p<0.001) (Table 2), vein visibility (p=0.005), use of irritant medication (p=0.004), vesicant (p=0.002), non-irritant/vesicant medication (p=0.001), use of vesicant solution (p=0.000), non-irritant/vesicant solution (p=0.003) (Table 3), difficulty for previous PIC (p=0.034), peripheral and prolonged IVT (p<0.001) and history of complications (p=0.003) (Table 4).

In the study sample, being a child/adolescent with cancer and malnourished increased the risk of complications associated with TIV by 1.9 times. Children/adolescents hospitalized for a period ≥ 7 days had a 4.8 times higher risk when compared to those with shorter hospitalization time (Table 2). This risk also occurred in relation to

Table 1 (concluded)

Variables	Oncology Clinic		RR	CI	p value
	Yes (n=62) N (%)	No (n=271) N (%)			
Puncture method					
Direct	58 (19.7%)	237 (80.3%)	1.87	0.719 – 4.855	0.173**
Indirect	4 (10.5%)	34 (89.5%)			
Catheter stabilization					
No	10 (19.6%)	41 (80.4%)	1.07	0.579 – 1.952	0.844*
Yes	52 (18.4%)	230 (81.6%)			
Use of irritating medications					
Yes	53 (22.6%)	182 (77.4%)	2.45	1.261 – 4.781	0.004*
No	9 (9.2%)	89 (90.8%)			
Use of non-irritating/vesicant medication					
Yes	41 (26.6%)	113 (73.4%)	2.27	1.404 – 3.667	0.001*
No	21 (11.7%)	158 (88.3%)			
Use of vesicant solution					
Yes	36 (35%)	67 (65%)	3.09	1.976 – 4.838	0.000*
No	26 (11.3%)	204 (88.7%)			
Use of non-irritating/vesicant solution					
Yes	49 (23.4%)	160 (76.6%)	2.24	1.265 – 3.953	0.003*
No	13 (10.5%)	111 (89.5%)			

Note: * Pearson's chi-square; ** Fisher's exact test.

Table 4 - Associations between variables related to previous Intravenous Therapy and the occurrence of complications in children and adolescents admitted to pediatric oncology clinic units, Feira de Santana, Bahia, Brazil, 2015 - 2016

Variables	Oncology Clinic		RR	CI	p value
	Yes (n=62) N (%)	No (n=271) N (%)			
Cinical history of difficult Peripheral Intravenous Catheter access ^a					
Yes	31 (24.6%)	95 (75.4%)	1.62	1.037 – 2.528	0.034*
No	31 (15.2%)	173 (84.8%)			
Prolonged peripheral Intravenous Therapy					
Yes	14 (70%)	6 (30%)	4.56	3.099 – 6.724	<0.001**
No	48 (15.3%)	265 (84.7%)			
Previous use of Intravenous Therapy					
Yes	62 (18.8%)	268 (81.2%)	-	-	1.00**
No	0 (0%)	3 (100%)			
Type of catheter previously used ^b					
Central Venous Catheter + Peripheral Intravenous Catheter	8 (16%)	42 (84%)	0.815	0.413 – 1.606	0.547*
Central Venous Catheter	-	-			
Peripheral Intravenous Catheter	54 (19.6%)	221 (80.4%)			
Hystory of complications ^c					
Yes	56 (23.5%)	182 (76.5%)	3.69	1.644 – 8.264	0.003*
No	6 (6.4%)	88 (93.6%)			
Hystory of Phlebitis					
Yes	24 (25.3%)	71 (74.7%)	1.13	0.712 – 1.791	0.607*
No	32 (22.4%)	111 (77.6%)			
Hystory of infiltration					
Yes	49 (25.7%)	142 (74.3%)	1.72	0.835 – 3.556	0.119*
No	7 (14.9%)	40 (85.1%)			
Hystory of extravasation					
Yes	4 (14.8%)	23 (85.2%)	0.60	0.236 – 1.531	0.257*
No	52 (24.6%)	159 (76.5%)			
Hystory of obstruction					
Yes	28 (24.3%)	87 (75.7%)	1.07	0.677 – 1.691	0.773*
No	28 (22.8%)	95 (77.2%)			

Note: * Pearson's chi-square; ** Fisher's exact test; ^a 3 children/adolescents with oncology did not use previous Intravenous Catheter; ^b 1 child/adolescent had used Peripheral Intravenous Catheter + Central Venous Catheter + Peripherally Inserted Central Venous Catheter and 4 children/adolescents had used Peripheral Intravenous Catheter + Peripherally Inserted Central Venous Catheter; ^c 1 child/adolescent could not have data related to the history of complications collected.

non-visibility of the vein (RR=2.06) (Table 3).

The risk of complications of IVT was 2 times higher for children/adolescents with cancer who used irritating, non-irritating/vesicant medications and non-irritating/vesicating solutions. When using vesicant solutions, the risk increased three times compared to children/adolescents who did not use medication and solutions of this nature (Table 3).

Children/adolescents with a clinical history of difficult PIC access presented a 1.6 times greater risk for complications associated with IVT. Prolonged prior use of IVT caused a 4.6 times greater risk compared to those who used IVT for shorter time. A history of complications was also associated with the risk of developing complications (RR=3.69) (Table 4).

When performing Poisson regression, only the variables related to previous and current IVT demonstrated modeling. It was confirmed that children/adolescents with cancer who used prolonged peripheral IVT (p=0.002) and had a history of complications (p<0.001) were predisposed to the occurrence of complications of IVT (Table 5).

The model of variables related to current IVT ratified that the use of non-irritating/vesicant medications (p=0.003) and vesicant solutions (p<0.001) were risk factors for the occurrence of complications in children/adolescents with cancer (Table 5).

DISCUSSION

According to the results of this research, it was observed that the rate of phlebitis was as recommended by 5% of the Infusion Nursing Society⁽¹¹⁾, with a rate of 4.5%. Some studies conducted with children have converged with these results, as phlebitis rates ranged from 1.5% to 4.7%^(9,12-13).

Tabela 5 - Regressão Logística das variáveis relacionadas à Terapia Intravenosa prévia associadas à ocorrência de complicação em crianças e adolescentes admitidos em unidades de clínica oncológica pediátrica, Feira de Santana, Bahia, Brasil, 2015 – 2016

Variables	Complicações da Terapia Intravenosa		p value
	RR	IC	
Terapia Intravenosa periférica prolongada	3.44	1.58 – 7.50	0.002
Antecedente de complicações	4.22	2.84 – 6.26	<0.001
Utilização de medicamentos não irritantes/vesicantes	1.99	1.26 – 3.15	0.003
Utilização de solução vesicante	2.65	1.69 – 4.17	<0.001

In the multiple analysis, only the prolonged peripheral IVT variables, history of complications, use of non-irritating/vesicant medications and use of vesicant solution were kept associated with the occurrence of site complications.

In a randomized clinical trial conducted in 2014 at a large university hospital, it was identified that the experimental group catheter remained on average uncomplicated for 3.73 (± 2.25) days and a maximum of seven days, whereas in the control group it was preserved for 3.28 (± 1.66) and maximum of seven days. The reason for removal was hospital discharge, followed by phlebitis⁽¹⁴⁾.

A survey of adults with cancer who used IVT for more than 30 minutes showed that they were 2.2 times more likely to have vascular trauma than those who used it for less than 30 minutes (RR=2.22 CI=0.7672 - 6.436)⁽¹⁵⁾. In other studies conducted with adults, PIC use for more than 72 hours showed a statistical difference in the occurrence of phlebitis⁽¹⁶⁻¹⁷⁾ and extravasation⁽¹⁸⁾.

Another risk factor that was associated with the outcome in the multiple analysis was the variable "having a history of complications". A research ratified this result, showing that children with surgical conditions, who had a history of infiltration and extravasation, had a 40 times higher risk for phlebitis (OR=40.6; CI=4.2 - 350.0; p=0.001)⁽¹⁹⁾. In another study, children with a history of phlebitis and infiltration had a 31 times higher risk of infiltration (OR=31.281; CI=8.168 - 72.878; p=0.001)⁽¹²⁾.

It was considered that the antecedents of complications were associated with the occurrence of complications of IVT because the tissue regeneration process did not recover injured vascular tissues with the same characteristics as the original cell structures⁽²⁰⁾. These blood vessels are susceptible to relapse when exposed to contributing factors (type of fluids and frequency of IVT use).

Children/adolescents with cancer are more exposed to complications because they used medicines of various types, such as chemotherapy. These are mostly vesicants or irritants. In addition to undergoing this treatment frequently and for prolonged time, the blood vessels of children/adolescents are constantly damaged, weakening the vascular endothelium.

According to the American INS 2011⁽¹¹⁾, those with a pH higher than 9 and lower than 5, and an osmolarity greater than 600 mOsm/L, are considered risky fluids for complications. However, the American INS 2016⁽⁵⁾ brought a new concept: only fluids with osmolarity greater than 900 mOsm/L offer risk. Researches agreed with this investigation, because the use of solutions or medications with potential risk (osmolarity greater than 350 mOsm/L, pH lower than 5 or greater than 9) predisposed the occurrence of infiltration⁽¹²⁾ and phlebitis⁽¹⁹⁾.

Another retrospective cohort study conducted with children who had or had not infiltration after receiving an intravenous infusion at a children's hospital in South Korea in 2011 showed that children who used vesicants such as phenytoin (OR=12.38; CI=3.52 - 43.59; p<0.001), ampicillin (OR=3.61; CI=2.11 - 6.17; p<0.001), cefotaxime (OR=2.03; CI=1.31 - 3.14; p=0.002),

vancomycin (OR=4.43; CI=1.38 - 14.19; p=0.012) and vesicating solutions such as electrolytes (OR=4.73; CI=1.65 - 13.56; p=0.004), were associated with the occurrence of infiltration. However, it differed regarding the use of non-irritating/vesicant solution as saline hydration (OR=1.85; CI=0.63 - 5.41; p=0.2)⁽²¹⁾.

As one research pointed out that the use of ampicillin (p=0.005), vancomycin (p=0.005), phenytoin (p=0.005) and electrolytes (p=0.005) were associated with the occurrence of infiltration in children⁽¹⁵⁾.

According to authors, also in a multicenter prospective study with children, it was observed that the use of antibiotics (p=0.005), including cefotaxime (p=0.024) and vancomycin (p=0.031), and proton inhibitors (p=0.004) were predisposing factors for the occurrence of complications of peripheral intravenous IVT⁽²²⁾, and in the adult population, the predisposing factor for the occurrence of complications was the use of medications such as anticonvulsants, gastric protector⁽²³⁾, antibiotics⁽²⁴⁾ and electrolytes⁽²⁴⁾. Regarding extravasation, the use of corticosteroids, anticoagulants, potassium chloride (vesicant) and gentamicin (irritant) showed statistical significance⁽²⁵⁾.

Another research with adults pointed that the type of infusion (hydration or medications) was statistically associated with the occurrence of complications (p=0.006)⁽¹⁸⁾.

The modeling confirmed that the use of non-irritating/vesicant medications (p=0.003) and vesicant solutions (p=0.000) was associated with the occurrence of complications of IVT in children/adolescents with cancer.

Children/adolescents with cancer who used non-irritating/vesicant medications (RR=1.99) and vesicant solutions (RR=2.65) had higher incidences. By analyzing the logistic regression related to these variables in other studies conducted with adults, it was shown that the use of infusions (medications and hydration) was associated with the occurrence of complications (p=0.006)⁽²⁶⁾.

In this sense, it was highlighted the need for knowledge of inherent characteristics of other non-chemotherapeutic drugs regarding pH and osmolarity, in order to classify as irritants or vesicants, to perform care aimed at preventing potential complications in children and adolescents with cancer.

It is also necessary to use clinical tools, such as algorithms, to decide on the safest way to for IVT in children and adolescents with cancer, whether peripheral or central, striving to maintain the integrity and health of the venous network.

Therefore, it is essential to incorporate care practices from the knowledge of the factors that predisposed the occurrence of complications of IVT in children with cancer, in order to enhance their safety.

Research Limitations

Data Collection based on intravenous characterization, as some children participated the research more than once. In addition, the severity of infiltration and phlebitis was assessed using scales designed for adults. At the time of data collection there were not translated pediatric scales to the Portuguese language spoken in Brazil. This may have underestimated the degree of the mentioned complications.

Another limitation for this research: the incipient production of knowledge about the theme in pediatric population at national and international levels. Thus, other studies conducted with neonates and adults regarding complications specifically were used for the discussion.

Having developed the study in a single hospital in Bahia, it is still possible that the data may represent a local reality. Another research bias is related to the non-performance of data collection during the night shift and on weekends, since in these periods, other predictors that could influence the occurrence of site complications of peripheral IVT could be evidenced.

Contributions to the nursing and health area

This research contributes to the theoretical, practical and social context. As for theory, it can contribute to the improvement of the scientific framework on the subject. In practice, it can help nursing professionals to rethink their actions regarding the practices based on scientific evidence, and improve skills and competencies that permeate the entire process of PIC installation until the end of IVT in children, preventing the risks associated with occurrence of complications.

For children/adolescents and their families, it may contribute to the theoretical framework on patient safety. Knowing the factors that predispose the occurrence of

complications can reduce its incidence, reducing the length of hospitalization, and reducing the episodes of stress and suffering due to the attempt of new punctures.

CONCLUSIONS

The data from this research pointed history of complications, use of vesicant and non-irritant/vesicant medications and vesicant solutions as risk factors related to the occurrence of complications.

We recommend further research on the subject, with a multicenter perspective, and consider the limitations pointed to the present research.

ERRATUM

Article "Risk factors for site complications of intravenous therapy in children and adolescents with cancer", with number of DOI: <https://doi.org/10.1590/0034-7167-2019-0471>, published in the journal Revista Brasileira de Enfermagem, 73(4):e20190471, on page 3:

Where to read:

In the multiple analysis, logistic regression was performed and modeling was achieved when all variables presented $p \leq 0.05$.

Read:

In the multiple analysis, Poisson regression with robust variance was performed and modeling was achieved when all variables presented $p \leq 0.05$.

On page 6, Table 5, where it read:

Tabela 5 - Regressão Logística das variáveis relacionadas à Terapia Intravenosa prévia associadas à ocorrência de complicação em crianças e adolescentes admitidos em unidades de clínica oncológica pediátrica, Feira de Santana, Bahia, Brasil, 2015 – 2016

Variables	Complicações da Terapia Intravenosa		p value
	RR	IC	
Terapia Intravenosa periférica prolongada	3.44	1.58 – 7.50	0.002
Antecedente de complicações	4.22	2.84 – 6.26	<0.001
Utilização de medicamentos não irritantes/vesicantes	1.99	1.26 – 3.15	0.003
Utilização de solução vesicante	2.65	1.69 – 4.17	<0.001

Read:

Table 5 - Logistic regression of variables related to previous Intravenous Therapy associated with the occurrence of complications in children and adolescents admitted to pediatric oncology clinic units, Feira de Santana, Bahia, Brazil, 2015 - 2016

Variables	Intravenous Therapy Complications		p value
	RR	CI	
Prolonged peripheral Intravenous Therapy	3.44	1.58 – 7.50	0.002
Hystory of complications	4.22	2.84 – 6.26	<0.001
Use of non-irritating/vesicant medication	1.99	1.26 – 3.15	0.003
Use of vesicant solution	2.65	1.69 – 4.17	<0.0001

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