Long-term catheter in pediatric oncology: how to decrease complications

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RESUMO

Introdução: Pacientes oncológicos pediátricos requerem acesso venoso central durante todo o tratamento. Desta forma, o cateter totalmente implantável(CTI) são utilizados de rotina. Em um estudo prospectivo randomizado prévio, foi observada uma taxa de complicação maior no cateter implantado na veia subclávia quando comparado a jugular. Baseado nestes resultados, foi proposta uma mudança na rotina de im-plantação de cateter: a veia preferencial foi a jugular e a marca do cateter foi modi-ficada. **Objetivo:** Avaliar o impacto da mudança de rotina na sobrevida do cateter. **Materiais e Métodos:** É um estudo retrospectivo de dois períodos. No período 1, os pacientes foram randomizados para implantação do cateter na veia subclávia ou jugular, de janeiro de 2004 a abril de 2006. O período de observação foi de 50 meses até março de 2008. No período 2, a veia jugular foi a via preferida e a marca do cateter foi modificada. O período de observação foi de 50 meses até março de 2011. **Resultados:** A taxa de complicação foi maior no período 1. A taxa foi de 37,7% no periodo 1 e 17,3% no periodo 2, p=0.013. A análise da sobrevida do catéter demonstrou maior sobrevida no período 2 (p=0.001), em pacientes maiores que 5 anos(p=0.036), em pacientes pesando mais do que 20 Kg (p=0,046), implante na veia jugular (p=0.019) e marca de cateter (p=0.002). **Conclusão:** A veia de implante e a marca do cateter podem influenciar a taxa de complicações e a sobrevida dos cateteres totalmente implantáveis.

Palavras-chave: Catéteres de permanência, cateterismo venoso central, protocolos de quimioterapia combinada antineoplásica.

ABSTRACT

Introdução: Pediatric oncology patients require venous access during all treatment. Therefore, totally implantable venous access devices (TIVAD) are routinely used. In a previous randomized prospective study, it was observed a higher complication rate in TIVAD implanted in the subclavian vein, than in jugular vein. Based on these results, changes in implantation catheter routine were proposed: the preferential route was the internal jugular puncture and the catheter brand was changed. **Aim:** The aim of this study is to evaluate the impact of the routine changes on catheter's survival. **Materials and Methods:** It is a retrospective study of two different periods. On Peri-od 1, the patients were randomized for implantation in subclavian or jugular vein; from January 2004 to April 2006.The observation period was 50 months, until March 2008. On period 2, the jugular puncture was preferred and the catheter's brand was changed. The observation period was also for 50 months, until March 2011. **Results:** Complication rate was higher in period 1. Total rate was 37,7% in period 1 and 17,3% in period 2, p=0.013. Catheter's survival analysis showed better survival in period 2 (p=0.001); patients older than 5 years of age (p=0.036); patients weigh-ing more than 20 Kg (p=0,046); implantation in jugular vein (p=0.019) and cathe-ter's brand (p=0.002) . **Conclusions:** The site of implant and the catheter's brand can influence the result of complications of LCTD. The LCTD implanted in jugular vein appears to have lower rates of long-term complications and higher survival.

Keywords: Indwelling catheters, central venous catheterization, antineoplastic combined chemotherapy protocols.

INTRODUCTION

Pediatric oncology patients require venous access during all treatment for chemotherapy administration, blood samples and infusion of other medications. For these reasons, totally implantable venous access devices (TIVAD) are routinely used, providing comfortable and safe venous access.

The implant and the maintenance of long-term catheter is associated with several complications[1]. Complications can diminish the catheter survival. Strategies for raise the catheter survival have already been analyzed. In a previous study we found that the LTCD implanted in the jugular vein have better survival than in subclavian vein[2]. Furthermore, catheters of different brands may have differents results[2]. The hypothesis is that the change in catheter's implantation routine, with preferential implantation in the jugular vein and the modification of the catheter's brand, can influence their survival. The purpose of this study is to assess the impact of these changes on catheter survival.

METHOD

Study Design

This study is a retrospective review of a collected database created in 2004. Patients that had LTCD implanted were included. The study was developed in the Pediatric Oncology Institute GRAACC of the Federal University of São Paulo, Paulista School of Medicine (IOP-GRAACC/UNIFESP-EPM), within two periods.

On Period 1, patients were randomized for implantation in subclavian or jugular vein; from January 2004 to April 2006. Patients weighing less than 6 Kg had catheters implanted by cutdown and were excluded from the sample. The observation period was 5O months, until March 2008. The preference brand was Arrow® and lifeport®; On Period 2, the jugular vein was preferred. LTCD were implanted in 2007 and observed for 50 months, until March 2011. During this period, the preferred catheter was Polysite ®. The same surgery team did all procedures in two periods.

Age, side of implantation, oncologic disease and catheter brand were also analysed.

The surgical technique was previously described[2].The procedure was done under general anaesthesia and antibiotic prophylaxis (cephalotin 50 mg/Kg). Confirmed position of the distal tip of the catheter in the superior vena cava was carried out in all cases by intraoperative fluoroscopic control. In all cases flushing of the catheter was done using a solution of heparin sodium (5000 IU of heparin in 10 mL of isotonic saline)

The demographic data was analysed with age, sex, weight, side and local of catheter's implantation, oncologic disease, and catheter brand.

The results analysis included rates of total complications and the type of complication The considered endpoints were need for catheter removal, revision or end of treatment. Infection was defined as those that led to catheter removal.

The follow up was considered from implantation to removal or patient death.

Statistical Analysis

The chi-square test was used for categorical variables. Student's t test or Mann-Whitney test were used for quantitative variables.

The incidence of complications during follow-up was analysed by Kaplan-Meier and log rank test. The confidence intervals were 95%. Deaths were censored for statistical analysis. The used software was SPSS 19.0.

RESULTS

The demographic data of both groups of patients are summarised in Table 1. Based on the Independent t-test and Mann-Whitney test, there were no statistically significant differences between the periods with respect to age, sex, weight, diagnosis and side. Mean age was 76 months (Period 1) and 104 months (Period 2). Mean weight was 26 kg (Period 1) and 29 Kg (Period 2). The type of diagnosis was very similar, 41 % of lymphoproliferative disease in Period 1 and 40% in Period 2 (Table 1).

There were differences regarding implantation site, side and catheter brand between the two periods. The catheter's brand in the Periods was described in Table 1.

Complication rate was higher in Period 1 (37.7% in Period 1 vs 17.3% in Period 2, p=0.013),

Table 1. Patients characteristics - Period 1 and Period 2.

	Perido 1 n=77	Period 2 n=52	p-value
Sex n (%)			
Female	30 (39.0%)	29 (55.8%)	0.060
Male	47 (61.0%)	23 (44.2%)	
Age (months) mean (SD)	76.6 (72.2)	104.4 (89.5)	0.112[MW]
Weight (kg) mean (SD)	26.4 (19.8)	29.2 (22.1)	0.694[MW]
Diagnosis n (%)			
Lymphoproliferative disease	32 (41.6%)	21 (40.4%)	0.982
Solid tumor	34 (44.2%)	23 (44.2%)	
CNS	11 (14.3%)	8 (15.4%)	
Implant site n (%)			
Jugular	34 (44.2%)	49 (94.2%)	<0.001
Subclavian	43 (55.8%)	3 (5.8%)	
Side n (%)			
Right	59 (76.6%)	48 (92.3%)	0.020
Left	18 (23.4%)	4 (7.7%)	
Catheter brand n (%)			
A	58 (75.3%)	-	<0.001
B	8 (10.4%)	11 (21.2%)	
C	2 (2.6%)	41 (78.8%)	
Other	9 (11.7%)	-	

CNS, central nervou sustem, MW, Mann Whitney's test.
Catheter brand: A - Arrow®; B - Lifeport®; C - Polysite®.

and there was no difference in mortality in both periods (31.2% vs 38.5%, p=0.391).

Catheter survival analysis showed differences between Periods 1 and 2, p=0.001 (Figure 1), patients younger than 5 years of age, p=0.036 (Figure 2); patients weighing less than 20 Kg, p=0.046; site of implantation, p=0.019 (Figure 3); and catheter brand, p=0.002 (Figure 4). No difference was found regarding diagnosis (p=0.923), side (p=0.269) or sex (p=0.161).

DISCUSSION

Venous access is a milestone for pediatric cancer treatment. Chemotherapy drugs have a sclerosing effect on peripheral veins. Thus, LCTD allows safety and effectiveness in the treatment and also can bring comfort to oncologic patients.

Implantation of the long-term catheter device can be done by puncture or dis-section of a central vein. The reservoir remains in the subcutaneous tissue. Radioscopy is of essential in the procedure, to check the central position of the catheter tip[3].

The best site of puncture is not defined yet. However, subclavian implantation is the choice in adults[4-7], and pediatric patients[8].

The dissection technique for catheter implantation has lower rates of early complications[9]. The cephalic vein[3,7,10-12] and external jugular vein can be used mainly in adults patients[13,14] because, these

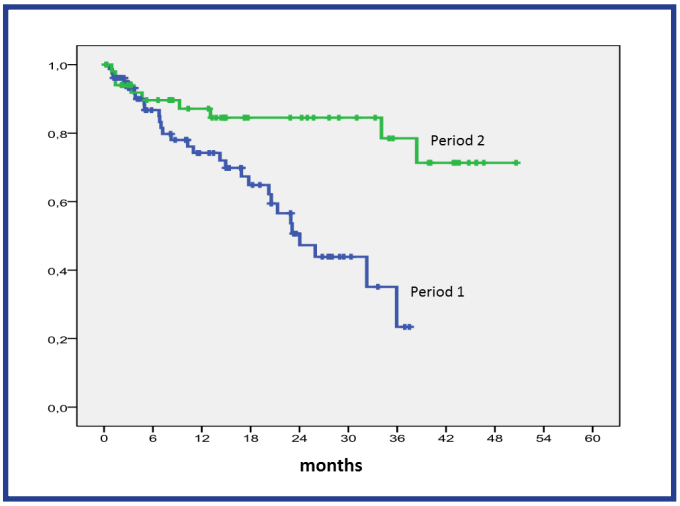

Figura 1. Catheter survival between periods 1 and 2.

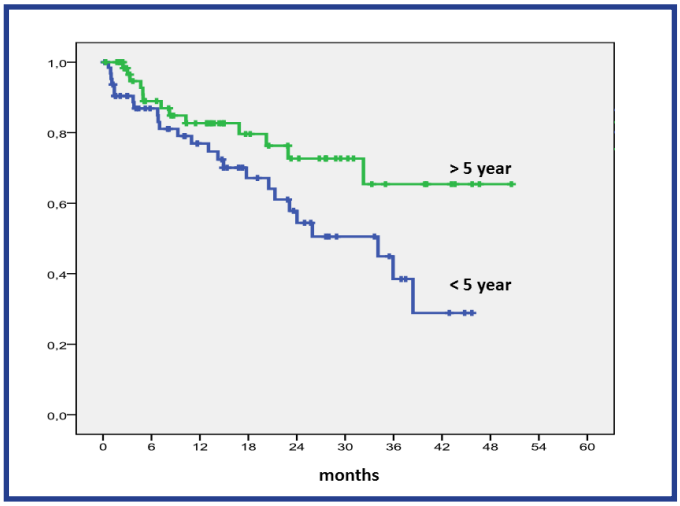

Figura 2. Catheter survival in patients younger and older than 5 years of age.

veins could be very thin in children .

Although the discussion about the best technique for catheter implantation still remains in literature, one must bear in mind that the puncture can be repeated several times, whereas dissection can be performed just once in each vein.

In this series, no difference was observed when comparing the groups related to age, sex, follow-up, side, and previous chemotherapy. In a previous paper, Catheter's brand was a risk factor for catheter embolism[2]. Thus, the catheter's brand has been modified and the internal jugular vein has become the preferred route in order to decrease complication rates . The aim of this study is to evaluate the impact of such actions in the occurrence of complications, being compared in two periods. On the second period, a lower complication rate was observed: fewer infections, no embolism and longer catheter survival.

The incidence of complications in the literature in LTCD varies from 1.8 to 25%[4,5]. Infection is one of the most frequent complications described and it is the main cause for catheter removal. In our series, only infections, which led to catheter removal, were considered.

Patients with lymphoproliferative disease have higher infection rates than solid tumor patients[15], varying from 4.8% to 8%. In the present series, the infection rate found was 16.8% in Period 1 and 15.3% in Period 2, which was higher than in the referred literature. However all the patients in this series are children, 40% of them have lymphoproliferative diseases and that could explain the discovered differences.

Catheter's embolism is a complication with potential serious morbidity. The catheter tends to migrate to the right cardiac chambers, but can reach the pulmo-nary arteries and its branches[16]. The exact cause of disconnection and subsequent embolization is not clearly justified in the literature. Aitken and Minton proposed that the clamping of the catheter between the clavicle and the first rib (pinch-off syndrome) could cause obstruction or rupture with catheter embolism[17]. This phenomenon occurs in some catheters in the subclavian vein. Sometimes it is possible to identify this compression by chest radiography (pinch-off sign), where there is nar-rowing of the catheter. When this signal is present, catheter removal is recommended[18].

In this study, it was found a higher incidence of embolism. The catheter's brand, according to a previous study, appears to be a risk factor for embolism[2]. We found no studies comparing this type of complication with the brand. Embolism occurred only in Period 1. We believe that subcutaneous path in the jugular's catheters is a protective factor for embolism. The change in the brand and the catheter implantation site in Period 2 eliminated this type of complication.

Catheter withdrawal is indicated at the end of treatment or if a complication occurs. The complications that lead to further withdrawal of the catheter are thrombosis and infection. The catheter's withdrawal by complication varies from 6 to 22%[19,20].

In our study complications that led to

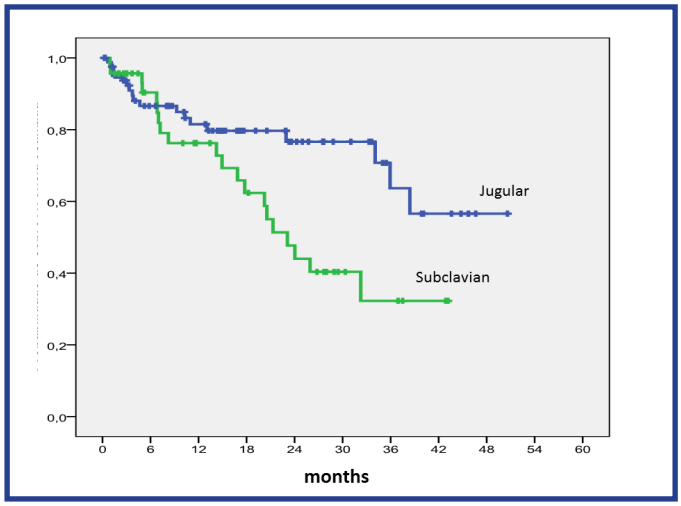

Figura 3. Comparative survival curve according to implantation site.

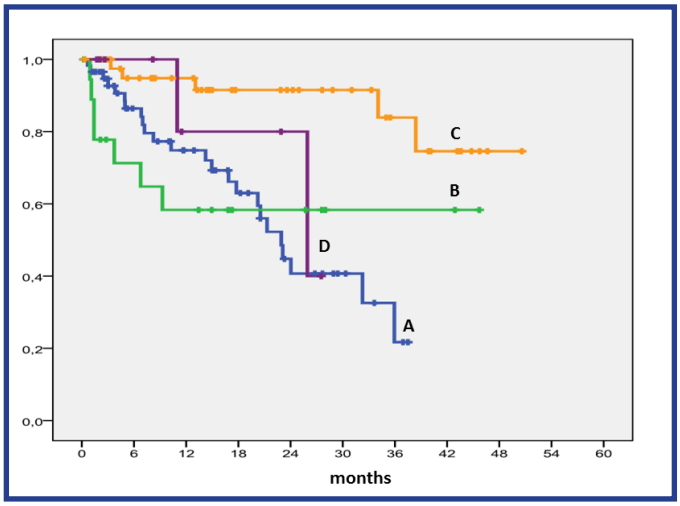

Figura 4. Comparative survival curve according to catheter brand: A - arrow® 6; B - lifeport®; C - polysite ®; D - anothers. omparative survival curve according to

withdrawal occurred in 37% of patients in Period 1 and 13% in Period 2.

The catheter survival was similar to other studies[21]. However, in this study, the LCTD had a higher survival in Period 2

The need for a safe and effective venous access in pediatric oncology patients to maintain chemotherapy and infusion of intravenous medications is a milestone for good results. On the other hand, there are inherent risks in the implantation and maintenance of the catheter. In this study, we found a higher catheters' survival in Period 2, when the catheter was implanted in the jugular vein and there was also a correlation with the brand of the catheter.

CONCLUSION

In conclusion, the implant site and catheter's brand had influence in LTCD complication rate. Jugular vein catheters appear to have lower long-term complications and lasted longer than the subclavian vein catheters.

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