

Risk Factors Affecting the Longevity of Totally Implantable Access Ports in Pediatric Cancer Patients

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Abstract: BACKGROUND: Totally implantable venous access port system (Port-A-cath) is widely used in pediatric cancer patients. However, port-A-cath is not free of complications that may necessitate device removal and consequently delay in chemotherapy. OBJECTIVE: In this study, we investigated the indications for Port-A-cath removal and the underlying possible risk factors, that may predispose to premature removal (i.e. removal before completion of therapy), such as the type of cancer and clinical parameters. METHODS: The study is a retrospective review of port-A-cath removal in pediatric hematology-oncology patients during the period from January 2011 to December 2013. 106 patients were included in the study among which 6 were excluded. Data were collected by reviewing patients' files, with supplementation from electronic patient's records. RESULTS: Over three years period, 100 port-A-cath were removed. The indications of removal were completion of therapy 74 (74%), infection 20 (20%), malfunction (blockage) 5 (5%) and mechanical complications 1 (1%). Cross table analysis of data showed that young age (less than 5 years of age) is the only significant risk factor P -value less than 0.05, with no other significant risk factor that independently contribute to the premature removal of port-A-cath. CONCLUSION: We observed that risk factors are interdependent in predisposing to port-A-cath complications and hence early removal. Following standardized meticulous surgical techniques and proper maintenance care are appropriate strategies to prevent infection and other complications.

Key word: Port-A-cath, hem-oncology, pediatric.

1. Introduction

The survival of children with cancer improved significantly during the last decades after the advancement in the field of chemotherapy. These patients usually receive several sessions of chemotherapy, repeated blood extractions. Using the conventional venous access in such cases would cause discomfort and pain, which could be avoided by using the port-A-cath [1]. Port-A-cath became a crucial part in management of pediatric oncology patients. However, port-A-cath is not free of complications that may necessitate premature removal of the catheter and the possible reinsertion of a new one. Premature removal is defined as removal of the implantable venous access before the completion of the therapy protocol. Upon reviewing the literature, risk factors behind these complications are not fully covered and it

showed marked discrepancies between different studies [1-3]. Some studies attributed the occurrence of infection to the following factors: non meticulous handling, timing of insertion in relation to therapy, patient related factors such as the age, the disease type and the treatment regimen. While other studies have shown no association between these risk factors and the complications. In this study, we investigated the reasons behind the removal of port-A-cath and analyzed risk factors that might affect the durability of the port-A-cath such as underlying diseases, demographic and clinical parameters of patients.

2. Material and Method

In this retrospective study, we reviewed the files of all 100 pediatric hemato-oncology patients under 16 years of age, who underwent port-A-cath removal at King Fahd Specialist Hospital-Dammam during the period from January 2011 to December 2013. The incidence of mature and premature removal of

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portacath within this group has been studied. Data were collected from paper charts and electronic medical records of the patients by the principal investigators and co-investigators. Variables that have been reviewed were: demographics of the patients (age, gender and date of birth), patients' diagnosis, surgical details (selected vein, duration of surgery), platelet count, absolute neutrophil count (ANC), chemotherapy status and antibiotic prophylaxis at the time of insertion, time and reason for removal (Table 1).

For statistical analysis: we used R software version 3.1.2. We reported the descriptive data in form of median and interquartile range (IQR) for continuous data. The binary and categorical variables were reported in the form of numbers and percentages.

In regard to the primary unadjusted analysis of the premature removal of port-A-cath, we used Wilcoxon Rank Sum test to analyze continuous data (age and

time of removal) between the two groups. To compare the premature removal of port-A-cath among categorical groups (gender, diagnosis, site of insertion, operation duration, neutrophil and platelet counts, chemotherapy and antibiotic therapy), we used Fisher's exact test.

3. Result

A total of 106 pediatric patients underwent insertion of Portacath during the period between January 2011 and December 2013 in our center. Six patients were excluded from the analysis because they were non-oncology patients. Of these 100 patients, only 26 patients had premature removal of port-A-cath (PRP). We found that pediatric patients who had premature removal of the port-A-cath were younger (median (IQR), 5 (2.75-10.5 years) than pediatric patients whom port-A-cath was not removed prematurely 8

Table 1 Characteristics of PRP and NPRP among pediatric patients 2011-2013.

Characteristics	Premature Removal (PRP) (N = 26)	Non Premature Removal (NPRP) (N = 74)	P value
Age in years Median (IQR)	5 (2.75-10.5)	8 (4.75-13)	0.04
Female N (%)	9 (34.6)	31 (41.9)	0.6
Neutrophil count N (%)			
< 1000	9 (34.6)	27 (36.5)	1
> 1000	17 (65.4)	47 (63.5)	
Chemotherapy status N (%)			
On therapy	11 (42.3)	31 (41.9)	1
Off therapy	15 (57.70)	43 (58.1)	
Diagnoses N (%)			
AML	1 (3.8)	7 (9.5)	
ALL	14 (53.8)	34 (45.9)	0.8
Lymphoma	4 (15.4)	14 (18.9)	
Solid tumors	7 (26.9)	18(24.3)	
Others	0	1 (1.4)	
Antibiotic StatusN (%)			
On antibiotic	11 (42.3)	35 (47.3)	0.7
Prophylaxis	13 (50)	30 (40.5)	
No antibiotic	2 (7.7)	9 (12.2)	
Operation duration N (%)			
< 1 hour	21 (80.8)	59 (79.7)	1
> 1 hour	5 (20.2)	15(20.3)	
Site of insertion N (%)			
EJV	20 (76.9)	49 (66.2)	
IJV	4 (15.4)	9 (12.2)	0.5
SCV	2 (7.7)	15 (20.3)	
Femoral vein	0	1 (1.4)	
Platelets count N (%)			
< 50,000	7 (26.9)	18 (24.3)	1
> 50,000	19 (73.1)	56 (75.7)	

IQR: interquartile range, EJV: external Jugular vein, IJV: internal Jugular vein and SCV: subclavian vein.

Table 2 Reasons for premature removal.

Reasons of Premature Removal (PRP)	N (%)
Infection	20 (76.9)
Malfunction (blockage)	5 (19.2)
Mechanical complications	1 (3.8)

(4.75-13 years); $P < 0.05$). However, There was no significant difference between PRP and NPRP patients with regards to gender (34.6% vs. 41.9%; $P = 0.6$), Neutrophil count, less than 1000 (34.6% vs. 36.5%; $P = 1$) and more than 1000 (65.4% vs. 63.5%; $P = 1$), chemotherapy status, on chemotherapy (42.3% vs. 41.9%; $P = 1$) and off chemotherapy (57.7% vs. 58.1%; $P = 1$), diagnoses (AML, 3.8% vs. 9.5%; ALL, 53.8% vs. 45.9 %; Lymphomas, 15.4% vs. 18.9%; Solid tumors, 26.9% vs. 24.3%; others, 0% vs. 1.4%; $P = 1$), antibiotics status (on antibiotics 42.3% vs. 47.3%; prophylaxis 15% vs. 40.5%; no antibiotics 7.7% vs. 12.2%; $P = 0.7$), operation duration (less than one hour 79.8% vs. 79.7%; more than one hour 20.2% vs. 20.3%; $P = 0.5$), site of insertion (EJV, 76.9% vs. 66.2%; IJV, 15.4% vs. 12.2 %; SCV, 7.7% vs. 20.3%; Femoral vein, 0% vs. 1.4%; $P = 0.5$), platelet count (less than 50,000, 26.9% vs. 24.3%; and more than 50,000, 73.1% vs. 75.9 %; $P = 1$). Moreover, the most common reason for PRP was site infection (76.9%) followed by malfunction (19.2%) and mechanical complications (3.8%), respectively (Table 2). However, we examined the odds of PMR using logistic regression considering the above variables in univariate analysis. However, none have reached a significant level. The only variable that was approaching a significant level was the patient age (OR: 0.91, P -value 0.061). There were 26 total pediatric patients who had premature removal (PRP). PRP patients were more likely to be younger (median (IQR), 5 years (2.75-10.5) vs. 8 years (4.75-13); $P < 0.05$).

4. Discussion

Port-A-cath used for almost all hematology/oncology patients as a route for administration of chemotherapy, antibiotics,

medications and blood as well as withdrawing blood samples. In most patients, catheter stays in place until completion of therapy. However, complications can happen and lead to catheter removal before the completion of therapy (premature removal) which necessitates the insertion of another catheter.

In our study, the leading cause for port-A-cath removal was completion of therapy 74%. The mean duration for ports after placement in patients was 724.47 (minimum 2 days and maximum 2213 days). While the premature removal accounts for 26% of cases and among this category infection was the major cause for removal 76.9%, followed by malfunctioning (blockage) 19.2% and mechanical complications 3.8 %, respectively. The mechanical complications included flipping, malposition, and catheter rupture. However, the malfunctioning was mainly due to thrombosis. Patients with Acute lymphoblastic leukemia (ALL) carry the highest risk of early catheter removal because of infection which directly related to the severity of the disease [4, 5]. However, Amos et al. reported that comparable rates of infections and mechanical complications were found in acute leukemia as well as other cancers, in our study no significant differences were detected between ALL and other cancers.

In our study, mechanical complications were 3.8%, which is lower than other reports (4.8% and 5.1%) [6, 7]. We adopted a technique providing special care to port fixation, the angle of tunneling and proper catheter length to avoid these complications. It is clear that each of these steps is essential during the insertion of port-A-cath to avoid flipping, kinking or migration of the catheter.

It is observed that patients less than 5 year old were more susceptible to premature removal of the catheter ($P < 0.05$). Since this study is limited to retrospective investigations the reason for this observation is unclear.

Some studies reported that lower platelet count at the time of surgery may cause hematoma and increase the risk of infection [7]. In this study, we found that the

platelet count has no effect in the durability of the port-A-cath. We believe that low platelet count didn't increase the risk of infection or the risk of mechanical complications; this has also been stated by So-Hyun Num et al. [1] and Amos et al. [3] as well.

There was no significant association between the site of port-A-cath insertion and the early removal of the catheter ($P = 0.5$). In contrast, other studies reported the increased risk of infection when the port-A-cath was inserted in the internal jugular vein [8, 9].

In this study, no significant risk factor leads to infection of port-A-cath even the ANC. Amos et al. reported similar results in their multivariate analysis [1]. None of the following: the use of prophylactic antibiotic, the gender, the operation duration, and the chemotherapy status at the time of insertion proved to be a significant risk factor that could predispose to premature catheter removal.

5. Conclusion

According to this study, Infection was the most common complication leading to premature removal of port-A-cath. There is no single significant risk factor that could attribute by itself to this premature removal. We recommend following standardized meticulous surgical techniques, proper needle insertion under aseptic technique, and proper maintenance care regarding heparinization. The limited numbers of patients in this study could affect the statistical power of our study.

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