RESEARCH ARTICLE / *Araştırma Makalesi*

Our Experiences with Peripherally Inserted Central Catheters in Newborn Infants

Yenidoğan Bebeklerde Periferden Yerleştirilen Santral Kateter Deneyimlerimiz

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Abdtract

Objective Some newborn infants, especially preterm babies are followed in neonatal intensive care unit (NICU) for a long time, so they need a long-term vascular access. Umbilical vein catheters, central venous catheters and peripherally inserted central catheters (PICC) are used for this aim. PICCs are preferred because of having relatively easier insertion, cost effectiveness and long life. In this study we aimed to evaluate the clinical features of newborn infants in whom PICC was inserted and PICC complications.. **(Sakarya Med J 2019, 9(3):522-527).**

Materials and Methods Medical records of the newborn infants in whom PICC had been inserted from June 2016 to June 2019 were evaluated retrospectively. Demographic features of the patients, reasons for PICC insertion, clinical features of the infants during PICC insertion, and complications of the application were recorded.

Results Data of 151 PICCs in 129 newborns were collected. In 134 (88.7%) PICC application, antibiotic treatment was needed. 72 (47.6%) had sepsis before and 17 (11.2%) after PICC insertion. While 45 (29.80%) treated for congenital pneumonia before PICC insertion. Sepsis was not detected in 17 (11.2%) PICC insertions.
There was no statistical difference in terms of the frequency of occlusion, leak and/or thrombophlebitis by sort of body parts such as the upper body veins or lower body veins and the right veins or left veins($p>0.05$).

Conclusion We concluded that PICC application has many advantages in newborn patients despite some complications. The usage of upper or lower extremity veins as well as right or left side veins does not change the frequency of complications.

Keywords peripherally inserted central catheters; newborns; complications

Öz

Amaç *Bazı yenidoğanlar, özellikle preterm bebekler yenidoğan yoğun bakım ünitelerinde (YYBÜ) uzun süre takip edilir, bu nedenle uzun süreli damaryolu ihtiyaçları olur. Uzun süreli damaryolu sağlamak amacıyla umbilikal ven kateterleri, santral venöz kateterler ve periferik olarak yerleştirilmiş santral kateterler (PYSK) kullanılır. PYSK'lar nispeten kolay yerleştirme, maliyet etkinliği ve uzun ömürleri nedeniyle tercih edilir. Bu çalışmada PYSK uygulanan yenidoğan bebeklerin klinik özelliklerini ve PYSK komplikasyonlarını değerlendirmeyi amaçladık.* ***(Sakarya Tıp Dergisi 2019, 9(3):522-527)***

Gereç ve Yöntemler *Haziran 2016 - Haziran 2019 tarihleri arasında YYBÜ'de PYSK yerleştirilen yenidoğan bebeklerin tıbbi kayıtları retrospektif olarak incelendi. Hastaların demografik özellikleri, PYSK yerleştirilme nedenleri, bebeklerin PYSK yerleştirme sırasındaki klinik özellikleri ve uygulama komplikasyonları kaydedildi.*

Bulgular *129 yenidoğan bebekte 151 PYSK'ya ait veriler toplandı. PYSK yerleştirilen hastalardan 134 'ünün (%88,7) antibiyotik tedavi ihtiyacı oldu. 72'sinde (%47.6) PYSK yerleştirilmeden önce, 17'sinde (%11.2) PYSK yerleştirildikten sonra sepsis vardı. 45 hasta ise PYSK yerleştirilmeden önce konjenital pnömoni nedeniyle tedavi edildi.17 (%11.2) PYSK yerleşiminde ise PYSK süresi boyunca sepsis gözlenmedi. PYSK yerleştirilen hastalarda vücudun üst bölge damarları, alt bölge damarları ve sağ taraf damarları ve sol taraf damarları arasında tıkanma, sızıntı ve / veya tromboflebit sıklığı açısından istatistiksel bir fark bulunmadı ($p> 0.05$).*

Sonuç *Yenidoğan hastalarda PYSK uygulamasının bazı komplikasyonlara rağmen birçok avantaja sahip olduğu sonucuna vardık. Çalışmamız üst veya alt ekstremite venlerinin yanı sıra sağ veya sol taraftaki venlerden PYSK uygulanmasının komplikasyon sıklığını etkilemediğini göstermektedir.*

Anahtar Kelimeler *periferden yerleştirilen santral kateterler; yenidoğan; komplikasyonlar*

INTRODUCTION

Life expectancy among very low birth weight infants is increased due to improved neonatal care and advances in neonatology.

Some newborn infants, especially preterm babies are followed in NICU for a long time, so they need a long-term vascular access for total parenteral nutrition until full enteral feeding was established or for administration of life-sustaining medications.[1]

Umbilical vein catheters, central venous catheters, and peripherally inserted central catheters (PICC) are used for a long-term vascular access. PICCs are most preferred alternative because of having relatively easier insertion, cost effectiveness, lower maintenance requirements, and long life. They can be inserted without anesthesia. PICCs are inserted through a peripheral vein and advanced into central vein.[2] Babies are protected from the stress of multiple vascular access attempts thanks to PICC application.[3-5] Although PICCs are generally safe method of venous access, they are free of complications such as infection, breakage, occlusion, venous thrombosis, pericardial and pleural effusions.

There are limited studies showing the results of PICC applications from our country. In this study we aimed to evaluate the clinical features of newborn infants in whom PICC was inserted and PICC complications.

MATERIALS and METHODS

In our NICU, PICC has been actively applied since 2015. The study was designed as a cross-sectional and descriptive study. The study was approved by the local ethical committee (Date; 27.06.2019, ID; B.30.2.ATA.0.01.00/393). The medical records of the newborn infants in whom PICC had been inserted from June 2016 to June 2019 were evaluated retrospectively. Demographic features of the patients, reasons for PICC insertion, clinical features of the infants during PICC insertion, and complications of the application were recorded.

Indication

PICC was inserted in the term and preterm infants needed intravenous treatment and/or TPN for longer than 7 days.[6] It was not applied in patients having low life expectancy. Application was postponed in case of bleeding tendency. When the end of the catheter could not be advanced into central vein, it was used as a peripheral catheter (n=5) and these cases were excluded from the study. When venous access could not be achieved, procedure was terminated and tried again later. PICC could not be inserted in 10 patients.

Insertion of the catheters

PICC lines were inserted at the baby's bedside by a neonatologist and a nurse practitioner in the setting of sterile conditions. Insertion site was selected based on the accessibility of veins and the dimension of catheter. During the study period, we used Vygon catheter (PremiCath/Vygon Corp. Aachen, Germany) characterized by 20–30 cm long and a single lumen with an introducer cannulae. After the catheter was inserted, catheter tip position was evaluated by a direct radiography covering thorax and limbs in standard resting position. If the catheter had malposition, it was manipulated, and then its proper localization was corrected by a retaken radiography. We aimed at the position that the tip of the catheter was in superior or inferior vena cava. 24G and 28G needles were used for 2F and 1F catheters, respectively. PICC catheters were not used for getting blood samples or for delivery of blood products in order to avoid infection or occlusion. The catheters were stabilized to skin using a sterile strip and fully covered with sterile transparent film dressing (Tegaderm 3M, Turkey). Antibiotics were not used prophylactically.

Catheter care

Every day the external part of the catheter was controlled for kings and extension, the flow rate of the fluids was checked and the skin was controlled in terms of erythema

and swelling along the vein. In case of occlusion, thrombophlebitis, leak, migration, extremity edema and thrombus the catheters were removed. Also, when PICC was unindicated (discharge, no need for TPN and/or drug administration) they were removed.

Statistical Analysis

Analysis was done by SPSS (Statistical Package for the Social Sciences) for Windows, version 20.0, (SPSS, Chicago, IL, USA) program. Categorical data were shown as median±standard deviation. The significance of frequencies was evaluated by Chi-square test.

RESULTS

The data of 151 PICC inserted in 129 newborn infants were collected. The demographic features of the patients were given in Table 1.

Table 1: Demographic features of the patients with PICC

Feature	Median±SD
Birth weight (gr)	1060±649
Gestational age (weeks)	28.5±3.8
Gender (n=129) (M/F)	60/69

PICC: peripherally inserted central catheter,
SD: standart deviation, **M:** male, **F:** female

Eight out of 129 patients were term and remaining 121 were preterm infants. Thirteen patients had additional congenital anomalies (diaphragmatic hernia=2, gastroschisis=2, congenital heart disease=1, duodenal atresia=1, esophageal atresia=1, intestinal atresia=1, anal atresia=1, biliary atresia=1, hydronephrosis=1, intraabdominal mass=1 and multiple congenital anomalies=1).

The 134 (88.7%) catheters were 1F and 17 (11.3%) were 2F. The right and left side veins were used for 131 and 20 PICCs, respectively.

Eighteen (13.9%) and two (1,5%) patients needed to second and third PICC, respectively (Table 2). Long term TPN and/or antibiotic requirements caused extra PICCs. Eighty-five patients were inserted an umbilical catheter before PICC.

Table 2: Clinical features of the patients with PICC

Postnatal age at PICC insertion (day)	**Median±SD**	
Postnatal age at first PICC (day)	9±16	
Postnatal age at second PICC (day)	27.5±29.11	
Postnatal age at third PICC (day)	52±36.77	
Duration of catheter		
First PICC (n=129)	21±17.5	
Second PICC (n=20)	20.50±11.67	
Third PICC (n=2)	25	
Hospitalization time (day)	55±27.8	
	n	%
Anatomical region that PICC is inserted (n)		
Basilic vein	76	50,33
Right	67	44,37
Left	9	5,96
Cephalic vein	46	30,46
Right	42	27,81
Left	4	2,65
Axillary vein	19	12,58
Right	17	11,26
Left	2	1,32
Jugular vein	4	2,64
Right	2	1,32
Left	2	1,32
Popliteal vein	2	1,32
Right	2	1,32
Saphenous vein	2	1,32
Right	1	0,66
Left	1	0,66
Temporal vein	2	1,32
Left	2	1,32
Previous umbilical vein catheterization (n)	85	65,89
Ventilation support		
Invasive ventilation	20	15,5
CPAP	71	55
Free flow oxygen	27	20,9
No need	11	8,5

PICC: peripherally inserted central catheter, **SD:** standart deviation,
CPAP: continuous positive airway pressure

The 134 (88.7%) PICCs insertions were needed antibiotic treatment because of infections. 72 (47.6%) had sepsis before and 17 (11.2%) after PICC insertion. While 45 (29.80%) had congenital pneumonia before PICC insertion. Sepsis was not detected in 17 (% 11.2) PICC insertions.

In patients' sepsis developed after PICC insertion blood culture yielded a pathogen in all patients except one. Methicillin-resistant coagulase-negative staphylococci grew in 12 cases, methicillin-resistant Staphylococcus aureus grew in 3 cases and Serratia marcescens grew in 1 case.

The 17 (11.2%) PICCs did not develop sepsis.

One hundred eighteen (91.4%) patients were needed ventilation support (Table 2).

There was no statistical difference in terms of the frequency of occlusion, leak and/or thrombophlebitis by sort of body parts such as the upper body veins or lower body veins and the right veins or left veins ($p>0.05$).

DISCUSSION

Some patients in NICU requires long-term vascular access. Frequent occlusion and repeated intravenous insertions are important problems of peripheral intravenous access. In addition, since they are an important risk factor for infections, insertion sites should be changed frequently. Also fluids and medications with high osmolarity or high concentration in content cannot be administered through the peripheral veins.[4-6] Central venous catheterization should be used when vascular access is needed for a long period of time or a fluid with high osmolarity is given.[7] For this purpose umbilical catheters have been used for many years. Unfortunately, umbilical catheters cannot be used more than 14 days.[8] So, healthcare providers have to turn to peripheral venous access. It is a painful, traumatic and disturbing condition for these babies, and has a high risk of infection.[4,5,7] Peripherally inserted central venous catheters have been used for a long term vascular access worldwide over the last 40 years.1 The studies examining PICC application in newborn infants have shown an increased in food intake and a decreased in catheter/cannula count.[9] The usage of PICCs has increased progressively since Shaw first used them to neonates in the 1970s.[10] They have been still using widely since 2015 in our unit and for the last 20 years in our country.

The studies on PICC applications from our country are very limited and their patient population is low. In the current study we presented our experiences in PICC application (151 PICCs in 129 babies) between 2016-2019. To our knowledge our study is the largest retrospective research in terms of covering patient population in Turkish literature.

The median weight in the first PICC application was very low (1050±697 gr). This suggests that these patients would need TPN for a long time. So a safe and long-lasting peripheral vascular access is very important for these babies. Out of 129 babies 109 (84.5%), 18 (13.9%), 2 (1,5%) were needed only one, two, and three PICCS, respectively. This finding shows that only one PICC application is enough for the most babies, and if needed, the applications could be repeated. This is very important, because it does not only decrease the number of peripheral vascular access attempts but also risk of infections. In addition, it increases the patient comfort.

In NICU, the site of peripheral vascular access is frequently needed to be changed every about 3-4 days. Whereas, the median duration for each PICC in our study was 20 days. This finding suggests that it can decrease significantly the number of peripheral vascular access attempts (Table 2). A mean duration for PICC in previous studies was 11-32 days.

The main reason (32-75%) to remove the catheter in those studies was the termination of treatment.[11,12] Similarly,

the termination of the treatment was the major reason (56.76%) of the catheter removal in our patients. Additionally, 33.75% and 9.46%. of the catheters were removed due to complications, and exitus, respectively (Table 3).

Table 3: Removal reasons of PICCs (n=151)

Removal reasons	**n**	**%**
Mechanical reasons		
Occlusion	38	25,68
Leak	1	0,67
No need	84	56,76
Thrombophlebitis	11	7,43
Exitus	14	9,46
Total	148*	100

PICC: peripherally inserted central catheter
*Three patients were referred to other centers with patent PICCs for different reasons.

Occlusion was an important complication that results in early failure of the catheter. Its frequency in literature has been reported as about 16.6% while it was 25.68 in our study.[13]

Colacchio et al. reported the phlebitis as the most frequent (30.3%) complication of PICC in newborn infants, and catheter related sepsis followed it (22%).[14] However, another study did not show any evidence of increasing the risk of systemic infections associated with PICC.[9] In our study the frequency of thrombophlebitis was lower than reported values. This may result from strict catheter care in our unit.

Different parameters can affect the frequency of catheter related complications. Jain et al. reported the catheters not positioned centrally led to more often and earlier complications, and resulted earlier withdraw.[15] Similarly, Racadio et al. reported these group of patients had complications seven times more.[16]

Bashir et al. reported the infection rate in PICCs inserted through the right upper extremity veins compared to left side was higher. The reason is not clear, but it may be speculated the differences in drainages of right and left upper extremity veins might play a role. Right brachiocephalic vein is shorter than the left one, and the branches of the right brachiocephalic vein has sharper angles compared to left ones. That may explain the higher frequency of infections in these patients.[17] Panagiotounakou et al. compared the PICCs inserted through axillary veins to the PICCs inserted through the forearm veins.[18] They found the closer the PICCs were inserted in the target vein, the 12 times lower the complications rate were. Tsai et al. reported that culture positive sepsis was more frequent in femoral PICCs, however, noninfectious complications were more frequent in catheters inserted through other veins than femoral ones.[13] However, Viet Hoang et al. found that catheter related blood stream sepsis was lower, that catheter duration was longer, and that the time of occurrence of the complication was shorter in PICCs inserted through the lower extremity veins.[19] Also Özkiraz et al. reported similar complication rates in in PICCs inserted through the upper and lower extremity veins.[20]

In our study, we did not found any difference in terms of complications (occlusion, leak, thrombophlebitis) between PICCs inserted through the upper or lower extremity veins and right or left side veins.

We concluded that PICC application has many advantages in neonatal patients with some complications. The usage of upper or lower extremity veins as well as right or left side veins does not change the frequency of complications.

Conflict of interest

All authors declare that they have no conflict of interest.

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