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RESEARCH ARTICLE

Subcutaneous Venous Access Device (Port) Placement and Methods of Dealing with Complications that Develop During the Procedure

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ABSTRACT

Objective: Subcutaneous Venous Access Devices (SVADs), commonly known as port catheters, play a crucial role in the monitoring of pediatric patients with chronic diseases requiring long-term treatment. They have become indispensable for children with conditions such as malnutrition, renal insufficiency, and chronic intestinal problems, in addition to oncology patients undergoing chemotherapy. The aim of this study is to present the port catheter procedures performed by the radiological method in our Pediatric Cardiology Department and the methods of dealing with complications.

Materials and Methods: The data of 254 pediatric patients who underwent port placement procedures between October 2020 and October 2022 were analyzed retrospectively. The complications and the management strategies were explained.

Results: Our clinic conducted the port placement procedure for 254 patients, and the port was successfully placed in 253 patients, resulting in a procedural success rate of 99.6%. The median procedure duration was 30 minutes (IQR 20-40 minutes). The fluoroscopy time was 30 seconds (IQR 18-45 seconds). 15 complications (5.9%) were observed. Except for one complication, none required the removal of the port.

Conclusion: Port catheters are indispensable in pediatric patients with chronic diseases requiring long-term treatment. Performing port insertion procedures with the support of ultrasound (USG) and fluoroscopy in angiography suites may provide the opportunity to achieve high success rates and low complication rates.

Keywords: Pediatric cardiology, pediatrics, port catheters, radiological method

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INTRODUCTION

Subcutaneous Venous Access Devices, commonly known as port catheters, play a crucial role in the monitoring of pediatric patients with chronic diseases requiring long-term treatment. They have become indispensable for children with conditions such as malnutrition, renal insufficiency, and chronic intestinal problems, in addition to oncology patients undergoing chemotherapy. These devices have gained prominence in providing long-term venous access due to their longer life, lower infection risk, and the ability to facilitate the patient's daily activities more comfortably compared to central venous catheters. As a result, their usage rates are progressively increasing.[1]

The increasing prevalence of malignancies in children, particularly hematological malignancies, in recent years has further heightened the need for Subcutaneous Venous Access Device usage. While the placement of SVADs was previously predominantly performed by surgeons, the growing demand has led to other healthcare professionals, including interventional radiologists and anesthesiologists, frequently undertaking these procedures. In the surgical technique, the procedure is performed in the operating room without the support of imaging. Conversely, in the radiological technique, the procedure is performed in the angiography suite using imaging techniques such as ultrasound (USG) and fluoroscopy. The use of imaging support helps reduce the com-

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plication rates and shortens the procedure time. Moreover, success rates are generally higher with this approach.[1]

In this study, we presented the results of Subcutaneous Venous Access Device placement procedures conducted in our pediatric cardiology department and the associated complications.

MATERIALS and METHODS

Patients

Between October 2020 and October 2022, the data of 254 pediatric patients who underwent port placement procedures were retrospectively analyzed. Each patient underwent a single port placement procedure. All patients were admitted to pediatric services. Among the patients, 152 (59.8%) were male, and 102 (40.2%) were female. The median age of the patients was 5 years (IQR 4–6 years). Other demographic data for the patients are provided in Table 1. The primary diseases included leukemia in 186 (73.3%) patients, neuroblastoma in 25 (9.9%) patients, lymphoma in 13 (5.1%) patients, Ewing sarcoma in 12 (4.8%) patients, osteosarcoma in 10 (3.9%) patients, other solid tumors in 5 (1.9%) patients, and short bowel syndrome in 3 (1.1%) patients.

Anesthesia

Considering the age and overall medical condition of the patients, the procedure was performed under general anesthesia in 75% of cases. Among these, 70% were ventilated with a laryngeal mask, while 5% were intubated. The remaining 25% of patients underwent the procedure under deep sedation, primarily applied to adolescent patients. For patients undergoing the procedure under general anesthesia, ventilation was initially preferred using a laryngeal mask, except for those with incompatible head and neck anatomy, where intubation was performed. Anesthesia induction involved the use of propofol, ketamine, and midazolam. Sevoflurane gas was employed to maintain general anesthesia.

Procedure

Patients with a platelet count above 50,000/mm^3 and an international normalized ratio (INR) value below 1.5 were selected for the procedure. For prophylaxis, intravenous administration of cefazolin sodium was given to patients 30 minutes before the procedure. The antibiotic dose was adjusted based on the patient's weight. Venous access sites for the intervention were assessed using pre-procedural ultrasound (USG). Initially, the right internal jugular vein and right subclavian vein were preferred for the procedure. In cases where these veins were occluded, the left internal jugular vein was used. All procedures were performed in the catheter angiography suite of the pediatric cardiology department by pediatric cardiologists experienced in catheter angiography. Following the monitoring (electrocardiography, arterial blood pressure, pulse oximetry), and after anesthesia induction, the patient was positioned supine. The procedural area was sterilized with povidone-iodine solution, and the patient was covered with surgical drapes. Local anesthesia (prilocaine) was applied to the port pocket area. The ultrasound probe and cable were covered with a sterile case.

The vein was punctured using the Seldinger technique with 18–20 gauge needles under USG guidance. After puncture, a guide wire was advanced through the needle, and its position was fluoroscopically confirmed. The wire was left in the right atrium or inferior vena cava. Following the incision, a subcutaneous port pocket was created using blunt dissection, and its width was verified. The port pocket was opened wider, allowing for a slight excess compared to the port chamber. The pocket was irrigated with vancomycin, dried, and the port chamber was placed into the pocket. In some patients, it was sutured to the fascia at two points. A tunnel was created from the port pocket to the puncture site using a tunnel opener, and the port catheter was passed through the tunnel and brought out from the puncture site. In some patients, the port was initially directed to an intermediate lateral point before being advanced to the puncture site. A peel-away sheath was advanced over the guide wire, and under fluoroscopy, the wire was pulled back to calculate the length. The length was determined so that the tip of the wire would be at the junction of the superior vena cava (SVC) and right atrium (RA). The wire and dilator were removed, and the port catheter was shortened according to the calculated length. It was then threaded through the tear-away sheath into the SVC. While withdrawing the peel-away sheath, pressure was applied with both thumbs to prevent the port from coming back out. After completely removing the sheath, the position of the port was verified using fluoroscopy (Fig. 1). The presence of blood return from the port was checked using the port needle, and the port lumen was washed with heparinized saline. After confirming the proper function of the port, the port pocket was closed with continuous subcuticular sutures using 3/0 or 4/0 Vicryl (Fig. 2). In procedures for children weighing less than 30 kg, a 5F Polysite (Perouse, Ivry-Le-Temple, France) port system was used, while for those weighing between 30–60 kg, a 6F system, and for those weighing over 60 kg, a 7F system was employed. After awakening, patients were transferred to the ward where they were admitted.

Table 1. Demographic characteristics of the patients

Patients	254
Male/female ratio	1.49
Age (median)	5 (IQR 4–6)
Heigth (cm)	120 (IQR 110–135)
Weight (kg)	20 (IQR 15–25)

IQR: Interquartile range

Ethics

The study complied with the Helsinki Declaration and our institution's ethical standards (2023.04-41, May 16, 2023). The study was approved by the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (31.01.2024.76).

RESULTS

Our clinic conducted the port placement procedure for 254 patients, and the port was successfully placed in 253 patients, resulting in a procedural success rate of 99.6%. In one case, the port did not function, and re-puncture was not feasible, leading to the deferral of the procedure. The median procedure duration was 30 minutes (IQR 20–40 minutes). The fluoroscopy time was 30 seconds (IQR 18–45 seconds). The average radiation dose was 0.6 mGy (range: 0.4–0.8 mGy). The radiation dose per square centimeter was 320 Gy/cm^2 on average (range: 280–350 Gy/cm^2).

For the intervention, the right internal jugular vein was used in 194 patients (76.4%), the right subclavian vein in 45 patients (17.7%), and the left internal jugular vein in 15 patients (5.9%). During the procedures, 15 complications (5.9%) were observed. Except for one complication, none required the removal of the port. The most common complication was catheter folding, observed in 3 patients. Pneumothorax occurred in two patients. Two patients experienced oozing-type prolonged bleeding. In one patient, the wire passed into the right pleural area but did not lead to any complications. Other complications and management strategies are detailed in Table 2.

DISCUSSION

In this study, we evaluated ports implanted using ultrasound (USG) and low-dose fluoroscopy in the cardiac catheterization and angiography suite. We observed that the procedures could be performed with low complication rates and high success rates. Our study holds the distinction of being one of the limited studies conducted in our country on this subject.

Malign diseases such as leukemia and lymphoma, chronic gastrointestinal system diseases like short bowel syndrome,

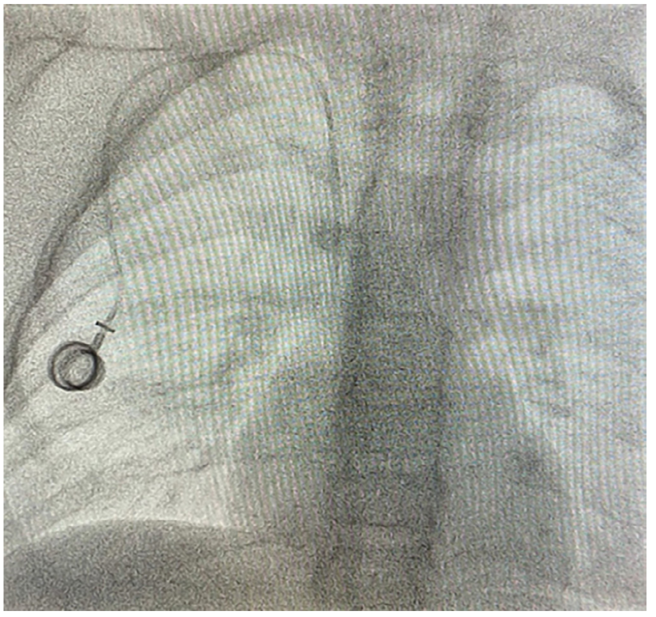

Figure 1. Fluoroscopy shows port catheter after implantation. The distal tip is in the SVC-RA junction

SVC: Superior Vena Cava; RA: Right Atrium

Figure 2. Port pocket sutured with vicryl using subcuticular continuous suture method

Table 2. Complications, management strategies and success status

Complication (n)	Manegement strategy	Success (yes/no)(n)
Port kinking (3)	External massage in two patients, Port removal and reimplantation in one patient	Yes (3)
Pneumothorax (2)	Tube thoracostomy	Yes (2)
Prolonged bleeding (2)	Compression	Yes (2)
Sheath kinking (2)	Advancing with a new sheath	Yes (2)
Coming out of the port catheter after being advenced through the peel-awaysheath	Implantation of the port with a new peel-away sheath	Yes
Inability to advance the port catheter through the peel-away sheath	Take a larger size peel-away sheath	Yes
Inability to advance the peel-away sheath	Correcting the wire position or taking a stronger wire	Yes
Passage of the wire into the pleural area	Taking the wire back and puncturing again	Yes
Loss of the wire position	Puncturing again	Yes
Port disfunction	Removing the port ang trying again	No

infectious diseases, and chronic kidney diseases necessitate treatments that can last for months or even years.[2] In pediatric patients, where vascular interventions are already difficult, port catheters become even more crucial, offering a longer lifespan, greater comfort, and the possibility of performing treatments with less pain. In previous years, the procedure for placing port catheters was performed in operating rooms using the surgical method. In recent years, primarily interventional radiologists have been performing port catheter insertions using radiological methods in angiography suites.[3] Studies have been published indicating that the radiological method allows for a shorter procedure time and lower complication rates compared to the surgical method. Additionally, it has been demonstrated that the radiological method is more cost-effective.[4] All the port catheter insertion procedures presented in our study were performed using the radiological method in the pediatric cardiology catheter angiography suite, administered by experienced pediatric cardiologists in the field of angiography.

In studies where the radiological method was employed, high success rates have been reported.[5,6] Our study also demonstrated a similar success rate of 99.6%, with all procedures, except one, being completed successfully. Complications during port catheter insertion using the radiological technique have been reported at rates ranging from 2.3% to 5.8%.[5–7] In our study, this rate was also similar to the literature (5.9%). Common complications include bleeding-hematoma, pneumo-hemothorax, port kinking, and absence of blood return from the port. The majority of these complications are manageable and do not ultimately impede the success of the procedure.[8]

It is known that puncturing the subclavian vein can lead to pneumothorax. The risk is particularly increased in cases where multiple punctures are performed to access the vein.[9] Two of our patients experienced pneumothorax and were treated with tube thoracostomy. Both of these patients had undergone subclavian vein puncture attempts, and the vein was not accessed in the first attempt. The risk of pneumothorax is much lower with internal jugular vein punctures.[10] Despite the higher rate of internal jugular vein punctures in our study compared to subclavian vein punctures (82.3% vs. 17.7%), none of the patients who underwent internal jugular vein puncture experienced pneumothorax.

Port kinking is a condition that obstructs blood return from the port, leading to port dysfunction. This issue is generally resolved with various maneuvers such as external massage, and occasionally it may necessitate the removal and reinsertion of the port.[7] In three of our patients, port kinking occurred during the procedure. In two patients, it was easily resolved with external massage, while in the other patient, the port had to be removed and reinserted during the same session. Bleeding and hematoma are other common complications that can occur during port insertion and may require the use of a cautery. Two of our patients experienced oozing-type bleeding, which was promptly stopped with brief compression. It is known that maintaining appropriate platelet and INR levels before the procedure reduces this risk.[2,7] However, in children with hematologic disorders, platelet function can be impaired despite normal platelet count.[11] The guide wire can inadvertently exit the vessel while advancing, leading to unwanted situations such as hemothorax and pneumothorax.[8]

In one of our patients, the wire had passed into the right pleural space, but it did not result in any complications. After retracting the wire, the procedure was successfully completed by performing another puncture.

Limitations

The main limitations of this study include its retrospective nature and the limited number of cases conducted at a single center.

CONCLUSION

Port catheters are indispensable in pediatric patients with chronic diseases requiring long-termtreatment. Performing port insertion procedures with the support of USG and fluoroscopy in angiography suites may provide the opportunity to achieve high success rates and low complication rates.

Disclosures

Ethics Committee Approval: The study was approved by the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (No: 31.01.2024.76, Date: 05/02/2024).

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