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Original Article

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Image-Guided Subcutaneous Port Implantation in Patients with Malignant Diseases

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ABSTRACT

To present the results of our retrospective study on 49 totally implantable subcutaneous venous ports inserted in angiography unit under ultrasound and fluoroscopic guidance. 49 subcutaneous venous chest ports were placed in 48 patients (mean age, 49.3±16.7 years). One patient underwent port implantation twice. All the ports had single lumen catheters. The procedures were performed under ultrasound and fluoroscopic guidance in angiography unit. All ports were placed on the anterior chest wall. The technical success rate was 100%. There was no procedure-related minor or major complication. There was no early complication (in the first month). Late complications occurred at a rate of 8.3% (n:4). In patients with malignant diseases, radiological implantation of subcutaneous venous ports can be performed with similar or lower complication rates, as compared to the surgical literature, due to the obvious advantage of imaging guidance. Hence, port implantation with imaging guidance may become a more preferred implantation method in the future.

Key words: *Ultrasound, subcutaneous venous port, malignancy.*

Görüntüleme Eşliğinde Malign Hastalarda Derialtı Port Yerleştirilmesi

ÖZET

Anjiyografi ünitesinde ultrason ve floroskopi altında 49 tamamen implante edilebilen subkutan venöz port retrospektif olarak incelendi. 49 subkutan venöz göğüs portu 48 hastada (ortalama yaş 49.3 ± 16.7 yıl) yerleştirildi . Bir hastaya iki port implantasyonu uygulandı. Tüm portlar tek lümen kateterine sahipti. Prosedürler ultrason ve anjiyografi ünitesinde floroskopi altında yapıldı. Tüm portlar göğüs ön duvarına yerleştirildi. Teknik başarı oranı %100 idi . İşleme bağlı minör veya major komplikasyon gözlenmemiştir . Erken komplikasyon (birinci ay) olmadı. Geç komplikasyonlar % 8.3 oranında oluştu (n: 4) . Cerrahi literatürde malign hastalıklarda, subkutan venöz portların radyolojik implantasyonu benzer veya daha düşük komplikasyon oranları ile tercihedilebilir. Bu nedenle, görüntüleme kılavuzluğunda port implantasyonu gelecekte daha çok tercih edilen implantasyon yöntemi olabilir .

Anahtar kelimeler: *Ultrasound, deri altı venöz port, malignite*

INTRODUCTION

Subcutaneous venous ports are preferred to external catheters, particularly in patients who have received intermittent long-term infusion therapies, due to low infection rates and high patient comfort (1). Traditionally, port implantation is performed by surgery departments under general anesthesia, with venous cut-down occurring in the operation room. Since the first port implantation performed in an angiography unit using interventional radiology techniques was reported by Morris et al. in 1992, radiological venous port placement has become very common (2). Venous port catheters, also known as "subcutaneous venous access devices", arose as the next-generation venous access devices. Whereas surgical placement of ports under general anesthesia was

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the early standard, the majority of ports are currently inserted by interventional radiologists using moderate intravenous sedation and same-day discharge. As the demand for ports steadily increased (due to improved devices and increasing numbers of individuals with cancer in our aging population), the need for safe, efficient and rapid subcutaneous venous access device insertion became critical (3). The purpose of this study was to present our experience and results for patients who underwent subcutaneous venous port implantations using US and fluoroscopy guidance due to malignancy in our interventional radiology unit.

MATERIALS AND METHODS

This study included 48 patients from our database who were treated between January 2010 and November 2011. This study was conducted retrospectively. In total, 49 venous ports were placed in 48 patients, 26 women (54%) and 22 men (46%), aged between 2 and 77 years (mean age, 49.3±16.7 years). All port implantation procedures were performed by two radiologists with at least two years experience. One patient underwent port placement twice. Two of the ports initially implanted at a different hospital were explanted in our unit because of candida infection. The indication for port implantation was either systemic chemotherapy or long-term antibiotic treatment. Single lumen ports were used in all patients and all ports were placed on the anterior chest wall. All 49 implanted ports were manufactured by Deltec (SIMS Deltec, St. Paul, MN, USA). Two port chambers were originally manufactured for pediatric patients and 47 ports had low profile chambers. All of the procedures were performed in the interventional radiology unit with local anesthesia. Pediatric patients underwent sedation. Anesthesiologist used fentanyl (1-2μg/kg) and midazolam (0.1-0.2 mg/kg) intravenously in pediatric patients. General anesthesia was not used. Patients with an INR (international normalized ratio) higher than normal and a platelet count less than 70,000 mm3 received blood products before the procedure to correct the deficiencies. Ultrasound (US) examination of the internal jugular veins was performed prior to skin site preparation in sterile fashion. Right internal jugular vein access (IJV) was initially preferred in all patients. If the right IJV was occluded, then the left IJV or subclavian veins were accessed. Skin at the insertion site was widely prepared cranio-caudally from the mandible to the nipple and laterally from the sternum to the mid-axillary line. During each procedure, the interventional radiologist and the assistant nurse wore a cap and a mask and meticulously followed a sterile protocol, which included a full surgical scrub prior to performing the procedure.

Venous access was performed under US (Viamo, Toshiba, Japan) guidance with a 7.5 MHz linear array probe. In most patients, venous puncture was performed using an 18 G venous needle included in the port packages. After puncturing the vein with the needle, a 0.035 inch guide wire was pushed forward into the inferior caval vein. After the peel-away sheath was placed, and while holding the tip of the guide wire at the level of the atriocaval junction or high atrium, the guide wire outside of the peel away sheath was bent to measure the length of the port catheter. Next, the guide wire was removed, and the sheath was capped to prevent bleeding or air embolization. The second step of the procedure, subcutaneous pocket dissection, was then initiated. Following infiltration of the skin of the pectoral region and the subcutaneous tissue with 2% xylocaine local anesthesia, a 2–3cm incision was made approximately 3 cm caudal to the clavicle with a number 15 scalpel. A subcutaneous pocket, large enough for the port reservoir, was created using blunt dissection towards the caudal direction from the incision. Extreme care was taken to avoid an excessively large port pocket size, so that the port barely fit into the pocket. Once the pocket was created, the catheter was tunneled to the vein access site using the trochar that came with the port kit. The port was connected to the catheter and flushed and then, placed into the port pocket. Stay sutures for the port base were routinely used. The port catheter was trimmed to length, using the previously bent guide wire, and then advanced through the peel-away sheath. After insertion, the catheter tip position and catheter curve at the venous puncture site were evaluated using fluoroscopy. One gram cefazolin sodium (Sefazol, Mustafa Nevzat İlaç Sanayi AŞ, İstanbul, Turkey) was administered to the surface port and port pocket. Using a Huber needle, the port was accessed and successful blood aspiration confirmed that it was functional. The reservoir was flushed with 100 U/ml of heparin solution while carefully monitoring for any leakage at the connection site. The incision was closed in layers with resorbable 4-0 vicryl interrupted inverted mattress sutures, subcutaneously, and running subcuticular stitches to close the

***Table 1**. The distribution of patients according to their diagnoses*

Patient undergoing port placement	*n*	*%*
Hematologic malignancies	*8*	*16*
Gastointestinal malignancies	*25*	*52*
Breast carcinoma	*5*	*10*
Genitourinary system malignancies	*2*	*4*
Others	*9*	*18*
Total	*48*	*100*

skin. The venous puncture site incision was closed in the same manner. The total procedure took 30-40 minutes with one minute of fluoroscopy time.

Outpatient cases were discharged home after two hours of observation and all the patients were called back for a routine follow-up one week post-procedure. At the one-week follow-up, redness, swelling, increased local temperature, hematoma, and suture dehiscence were checked at the site of port placement. Port details, port indications, early and late complications, durations of hospital stays, and reasons for removal were obtained by retrospective review of patient records.

RESULTS

Right IJV access was used in 47 patients, left IJV access in one patient and subclavian vein access in one patient with bilateral IJV occlusion. In total, 49 port implantations were successfully performed. The distribution of patients according to their diagnoses is shown in Table 1. Our patients were predominantly diagnosed with gastrointestinal malignancy (52%). There were no complications related to the procedure. The technical success rate was 100%. There were no major adverse instances of arterial puncture, air embolism, hemothorax, pneumothorax, or mediastinal, pleural or pulmonary injury related to catheter insertion. The rate of late complication was 8.3% (n=4) (Table 2). Total port implantation time was between 15 and 420 catheter-days, with a mean catheter time of 220 days and a total of 100.180 catheter-days for all ports. All the ports had single lumen catheters. After port placement, fluoroscopy revealed that one patient's catheter was curved. The catheter was successfully straightened by manipulating the skin by hand (Figure 1). Ports were removed from six patients. Two of the patients reached the end of treatment(after six months), whereas, in the remaining four (8.3%) patients, complications developed that necessitated port removal. Among the four patients, one underwent a second port placement. Six patients died after the procedure due to the progression of their primary malignant diseases, and one patient was lost to follow-up. At this time, 35 patients are still living with functioning ports.

There was no procedure-related early (first month post-procedure) infection observed. One infection was diagnosed during long-term follow-up. As a result of antibiotic resistant bacteremia (Staphylococcus aureus) and sepsis, one port (2%) was explanted after 120 days. The patient then underwent a second port placement on the contralateral chest wall. Two patients had their ports removed due to thrombosis after 60 days and 62 days, respectively. The patient who underwent left chest port

***Table 2**. Complications related to port implantation*

	n	*%*
Early		
Hematoma during the procedure	-	-
Hemothorax	-	-
Pneumothorax	-	-
Arterialpuncture	-	-
Total	-	-
Late		
Sepsis	*1*	*2*
Cathetermalposition	*1*	*2*
Symptomaticjugularveinthrombosis	*2*	*4,1*
Total	*4*	*8,3*

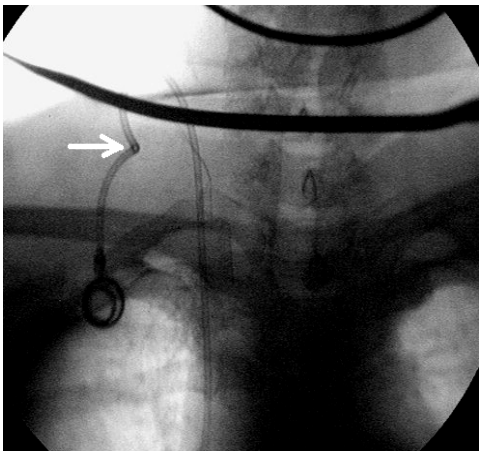

***Figure 1**. Catheter was seen curved with fluoroscopy.*

placement was controlled after 30 days. At this time, malposition of the catheter was observed, and it also seen catheter was lied down under the skin after leaving IJV. The port was removed but not replaced per the decision of our patient.

DISCUSSION

In this study, we performed subcutaneous venous port implantation using US and fluoroscopy guidance on 48 patients who had malignant diseases. A technical success rate of 100% was observed. There was no minor or major procedure-related complication. There were four patients with late malfunction including two cases of thrombosis, one catheter malposition and one catheter infection. All four patients had their ports removed. Two additional patients had their ports explanted after reaching the end of their treatment. No procedure-related deaths occurred. In the presented series, the technical success of image-guided catheterization was 100% in all patients, whereas technical placement failure occurred in upto 10% of cases in the surgical series(8-10). The availability of imaging in the interventional radiology unit to guide venipuncture and catheter insertion eliminates uncertainty encountered with unguided techniques. Major complications of blind punctures, such as hematoma or pneumothorax, are not observed when real-time US guidance is employed. Strict adherence to the rules and performance of the procedure by an experienced radiologist are enough for success of insertion of this system. It is clear that even with correct and reliable catheter placement technique, adequate follow-up nursing care is crucial to long-term catheter viability. On the other hand, the difference between the complications of right and left side attempts was not observed in our study. Therefore, both sides seem to be safe for catheterization under the guidance of imaging modalities.

Central venous access is vital in the treatment of patients with malignant diseases (5). The role of interventional radiology in central venous access has increased dramatically in the last decade (6, 7). The surgical and radiological techniques used for central venous access are not similar. The major difference between these procedures includes the use of US and fluoroscopy. When using surgical techniques in operating rooms without US and portable fluoroscopy, central vein puncture is performed using anatomic landmarks, and the port catheteries inserted without direct visualization (8). Therefore, chest radiographs are obtained after the procedure to evaluate the position of the catheter tip and to search for complications, such as pneumothorax (8-10). Conversely, in the interventional radiology unit, US is used to guide vein puncture and fluoroscopy enables visualization of both the course and the tip position of the catheter (7). Image guidance virtually eliminates the risk of several complications reported with unguided placement: pneumothorax, hemothorax, hematoma attributed to arterial puncture, pericardial tamponade, air embolization, chylothorax, hydrothorax, nerve injury, arrhythmia, and catheter malposition (7, 9). In the presented series, the technical success of image-guided catheterization were 100% in 48 patients, as in other radiologic series(4, 5, 7, 15, 18) whereas technical placement failure occurred in up to 10% of cases in the surgical series(8-10).

Early complications and those arising in the first 30 days include bleeding problems, air embolism, pneumothorax, wound dehiscence, catheter migration, catheter tip malposition, cardiac perforation and arrhythmias, and infections. Historically, the most common early complication of port placement was arterial puncture and hematoma(19). Reported early complication rates (major and minor) of port placement range from 7 to 11.6% (20) and are lowest when imaging guidance is used as several studies have clearly demonstrated (21). None of these complications occurred in our study, while, in the surgical series occurred in up to 10% of cases. After 30 days, infectious and thrombotic issues dominate port complications. Reported rates of long-term venous access infections range from 0.6 to 27%, depending on catheter location, catheter type and immune status of the patient (22). Surgical and radiological late complications rate are similar. Late complications rate is 8.3% in our study, as well.

Numerous studies have demonstrated that the results of ports placed by vascular interventional radiologists have compared favorably with reported surgical series, in both infection and late complication rates (5, 7). The port infection rate in the related literature ranges from 2.6% to 9% (7, 12). Our infection rates are similar to the rates reported by interventional radiological and in a large surgical series (7). Local infections can be classified as needle access site infections or port pocket infections. Needle access site infections occur at the skin through the needle to the port. Infected patients pres-

ent with local tenderness, pain, erythema, and edema. The most common pathogen for needle access site infections is Staphylococcus epidermidis (13). Port pocket infection is reported to occur at a rate of 0.3% to 4.4% (12). The port, as the source of the infection, should be removed immediately, and local wound care, along with oral antibiotic treatment, should be administered as soon as possible. There were no procedure-related early (within the first month) infections in our study group. However, only one patient(2%) had needle access site infection(Staphylococcus aureus) during follow-up, and their port was removed.

A 'pinch off' syndrome may occur in ports placed through the subclavian vein, secondary to the pinching of the port catheter between the clavicle and the first rib leading to catheter fracture (14). Additionally, in cases of a collapsed subclavian vein, the risk of pneumothorax is reported to be around 0.1% to 3.2% due to underlying lung parenchyma (15, 16). It has been shown in studies of long-term catheters for chemotherapy and hemodialysis that the risk of venous stenosis and thrombosis is higher in subclavian vein accesses compared to IJV accesses (17). We visualized the IJV better than the subclavian vein with US. For those reasons, with the exception of one patient, we did not use the subclavian vein as an access. Pinch off syndrome have been seen 10% in the surgical series, but interventional radiological series have not been seen due to use the IJV as an access. Another impetus for radiologic placement of venous access devices is ease of scheduling in the interventional radiology unit. Scheduling delay of up to several days are encountered in many busy operating rooms (7), while, at our unit, port placement is offered on a same-day basis.

The study was limited because of its retrospective nature and a small patient population. In conclusion, with the aid of image guidance, placement of implantable chest ports occurring in the interventional radiology unit has equel or better safety and success compared with reported surgical series. The availability of both US and fluoroscopy to guide venipuncture and catheter insertion eliminates uncertainty encountered with unguided techniques.

Conflict of interest

There are no conflicts of interest or funding sources to report. All authors are in agreement with this manuscript.

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