

Subcutaneous port catheter implantation by interventional radiologist in oncology patients

Implante de catéteres con puerto subcutáneo por radiólogo intervencionista en pacientes oncológicos

Álvaro Ariza Fonseca[1]
Álvaro Martínez[1]
Diana Leal Contreras[1]
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Summary

Introduction: Subcutaneous port catheter implantation is a procedure that has shown benefits for patients requiring chemotherapy. Over time, this procedure has become more and more frequent in the hands of the interventional radiologist. *Objective:* To review the incidence of complications of the implantation of catheters with subcutaneous reservoir for chemotherapy by interventional radiology in our institution. *Methods*: A retrospective review of the electronic records was carried out in a period of 31 months from the start of the procedure in our institution to assess the incidence of complications. *Results:* Between March 2019 and September 2021, a total of 377 chemotherapy catheters were implanted, a procedure carried out in the fluoroscopy suite under local anesthesia, except for one that was performed in the operating room under general anesthesia. The incidence of complications was relatively low, reaching 8.2%, and the spectrum of complications included pneumothorax, suture dehiscence, infection, port rotation and port extrusion. *Conclusion:* Our results indicate that central catheters with subcutaneous port can be implanted safely in the fluoroscopy suite under local anesthesia by the interventional radiologist under ultrasonographic and fluoroscopic guidance.

Resumen

Introducción: El implante de catéteres con puerto subcutáneo es un procedimiento que ha demostrado beneficios para los pacientes que requieren quimioterapia. A lo largo del tiempo este procedimiento se ha hecho cada vez más frecuente en manos del radiólogo intervencionista. *Objetivo:* Revisar la incidencia de complicaciones del implante de catéteres con reservorio subcutáneo para quimioterapia por radiología intervencionista en nuestra institución. *Métodos:* Se realiza una revisión retrospectiva de los registros electrónicos en un periodo de 31 meses desde el inicio de la realización del procedimiento en nuestra institución para evaluar la incidencia de complicaciones. *Resultados:* Entre marzo de 2019 y septiembre de 2021 se implantaron un total de 377 catéteres para quimioterapia, procedimiento llevado a cabo en la sala de fluoroscopia bajo anestesia local, excepto uno que se realizó en salas de cirugía bajo anestesia general. La incidencia de complicaciones fue relativamente baja alcanzando un 8,2% y el espectro de complicaciones incluyó neumotórax, dehiscencia de suturas, infección, rotación y extrusión del puerto. *Conclusión:* Nuestros resultados indican que los catéteres centrales con puerto subcutáneo pueden ser rutinariamente implantados en forma segura en la sala de fluoroscopia bajo anestesia local por el radiólogo intervencionista bajo guía ecográfica y fluoroscópica.

Introduction and theoretical framework

The implantation of subcutaneous port catheters for chemotherapy facilitates the administration of therapeutic agents and reduces the complications associated with venous access (1). This technique was described in 1982 and has become popular because of its advantages, particularly patient safety (2). Since the early development of the technique, port catheters have been implanted by surgeons. In 1992 the image-guided procedure was described and began to be performed by interventional radiologists (3).

Multiple studies have tried to establish which is the best technique, whether implantation by surgeons or by interventional radiology, and the published series emphasize the appearance of complications (4, 5). Complications can be early if they are related to the catheter implantation process or late if they appear during the catheter maintenance period. However, evidence suggests that the intervention routinely presents better results when the person who performs the implantation is more experienced, regardless of the specialty (6). It is also important to clarify that the primary objective of the implantable catheter is to facilitate the chemotherapy

[1]Radiologist. Department of Diagnostic Imaging, Los Cobos Medical Center. Bogotá, Colombia.

process and, therefore, the procedure should focus on the patient not only from the clinical point of view, but also in the biopsychosocial context. Niederhuber, who developed the implantable catheter in 1982, did so to facilitate the chemotherapy process in his wife (7).

Historically, in Bogota, and probably in the country, catheters have been implanted mostly by surgeons in operating rooms. Performing the procedure in the fluoroscopy room under local anesthesia makes it possible to optimize time and movements and free up the demand for operating rooms. The following is a series of cases of catheters implanted in the fluoroscopy room by interventional radiologists under ultrasound and fluoroscopic guidance.

The complications observed in this series are relatively few, reaching 8.2 % compared to those described in the literature (5, 6, 8) which range from 7.2 % to 12.5 % and have a similar spectrum both perioperative and in early follow-up, including infectious, mechanical, pneumothorax and thrombosis complications.

Material and Methods

A retrospective descriptive study was conducted involving 377 oncology patients who had a subcutaneous port catheter implanted for chemotherapy in the interventional radiology service for 31 months (March 2019 to September 2021).

Description of the procedure

Before the procedure was performed, the clinical history was reviewed for a history of thromboprophylaxis and coagulation tests were obtained. Although the procedure has a low risk of bleeding, some of the patients may have severe hematologic compromise, either due to their baseline condition or to the evolution of their disease (9). Serum creatinine and history of adverse reactions to contrast media were also reviewed, since cavography may be required to evaluate thrombosis and anatomical variants. A preliminary chest X-ray (Figure 1) and a jugular and subclavian Doppler ultrasound study (Figure 2) were obtained for all patients. The procedure was performed in a standardized manner as described below. Local anesthesia was administered using lidocaine with epinephrine. The majority (85 %) of the procedures were performed with the Celsite system from B Braun Melsungen AG. The procedure included venous catheterization with real-time ultrasound vision (Seldinger technique) with 19G-gauge needle (Figure 3), followed by cavography (Figure 4). The catheter was then inserted into the superior vena cava. Using fluoroscopic guidance, the optimal length was established so that the distal end of the catheter would be in the cavoatrial junction or in the distal third of the superior vena cava, since the location of the catheter tip is essential to reduce maintenance complications. Once the appropriate length was verified, the catheter was joined to the reservoir. The skin pocket was carefully designed to avoid complications, taking into consideration patient comfort in daily life and during chemotherapy sessions. For this reason, an adequate depth of the reservoir membrane was ensured, away from the incision, but easily palpable to allow access to the port. The reservoir was inserted into the skin pocket and the catheter was enabled with normal saline. Heparinized solution was not used, since there is no variation in the incidence of thrombosis, infection or safety in port maintenance between using heparinized solution or normal saline (10).

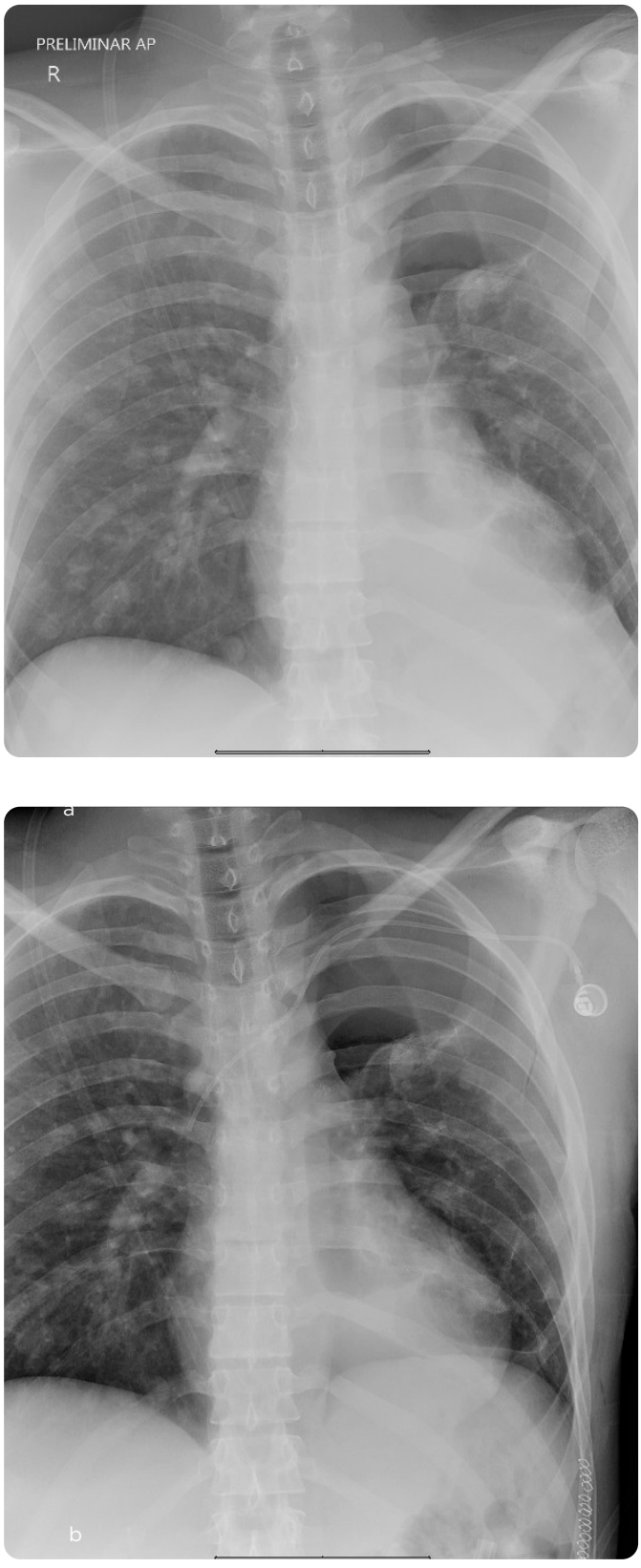


Figure 1. Chest X-ray before the procedure. a) Preliminary image, AP projection, left pneumothorax chamber is observed in relation to surgical history. b) Control after catheter implantation with subcutaneous reservoir on the same side/ hemithorax without modification of the pneumothorax chamber.

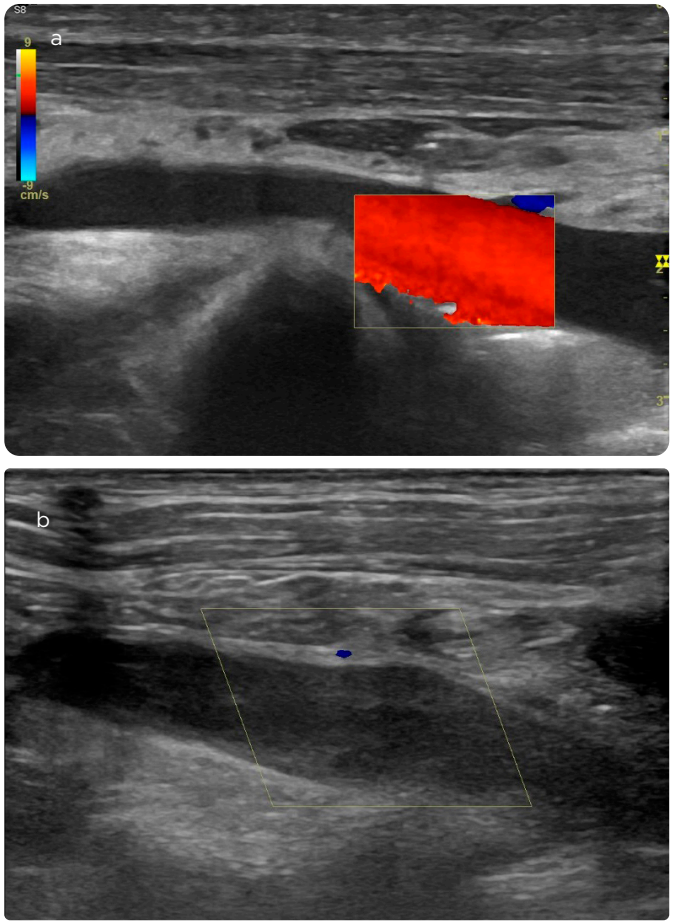


Figure 2. Ultrasound scan with Doppler. a) Preliminary scan of the proximal left subclavian vein with normal flow. b) Preliminary scan with absence of flow in the subclavian vein due to venous thrombosis.



Figure 3. Venous catheterization with ultrasound guidance: echoes of the needle tip inside the left subclavian vein.



Figure 4. a) Cavography: left subclavian vein, innominate vein and superior vena cava normal. b) Cavography of a different patient confirming left superior vena cava as an anatomical variant. In this case the catheter was advanced in the left vena cava and it was verified that the flow of contrast medium from the tip of the catheter was anterograde towards the right atrium. c) Same patient as in image b: the definitive position of the catheter in the left superior vena cava is observed.

Statistical analysis

An Excel database was constructed from the hospital's electronic records (clinical history, radiology information system and PACS image archiving system) that included demographic data, access route (inpatient vs. outpatient), underlying pathology, access vein for the catheter, port laterality, catheter tip level, operative complications and complications during follow-up. A descriptive univariate analysis of the different complications was performed with information from the Excel database.

Results

Demographic data

The study population consisted of 377 oncology patients requiring chemotherapy catheter implantation. The male/female patient sex ratio was 178/199 with an average age of 57.9 years (range 20-87 years). Ninety-eight percent of patients (n=369) had ambulatory access route and 2% (n=8) had in-hospital access route. The average time for implantation was 45 minutes.

The most frequent access was the left subclavian vein, followed by the right internal jugular vein, right subclavian vein and left jugular vein. Access in cases of breast cancer was contralateral to the tumor. Only one patient required right femoral access due to extensive involvement of the central veins of the neck and thorax (Table 1).

Table 1. Demographic characteristics and venous access

Variables	*n* (%)
Total	377 (100)
Male	178 (47)
Female	199 (53)
Average age (years)	57.9
Venous access	
Left subclavian	151 (40)
Right jugular	105 (28)
Right subclavian	79 (21)
Left jugular	41 (11)
Right femoral	1 (0.3)

The spectrum of implant complications included infection, suture dehiscence, port rotation and extrusion. In relation to the catheter, one pneumothorax occurred.

Of the complications described (Table 2), the cases with infection were initially managed with antibiotic therapy, but 4 of the 20 ports in patients with infection had to be removed. Catheters that presented port extrusion and suture dehiscence were also removed, as well as the catheter that showed port rotation. In total, 14 catheters required premature removal.

The patient who presented pneumothorax required management with hospitalization and closed thoracostomy. There were no vascular injuries, hematomas or bleeding.

Table 2. Incidence of complications

Complications	*n* = 377 (%)
Total complications	31 (8.2)
Infection	20 (5.3)
Extrusion	6 (1.6)
Suture dehiscence	3 (1.1)
Port rotation	1 (0.3)
Pneumothorax	1 (0.3)
Thrombosis	0
Vascular lesions	0

Discussion and conclusions

The availability of ultrasound and fluoroscopy in different hospitals makes image-guided minimally invasive techniques the current choice for routine patient management. Implantation of chemotherapy reservoir catheters in oncology patients is performed by surgeons and interventional radiology specialists. However, interventional radiologists usually have more training and experience in ultrasound-guided vascular access. This can translate into shorter operative time and fewer vascular complications, such as arterial puncture and hematoma.

In the series described here, the implantation of all the catheters with reservoir was performed by interventional radiology, thanks to an interdisciplinary management agreement with the oncology service through which there is fluid communication regarding the clinical condition of the patient and the need for diagnostic procedures (biopsies, drains) and therapeutic procedures (implantation of catheters for chemotherapy, management of post-surgical complications, etc.). The fluoroscopy room is fully equipped for monitoring and life support and is authorized by the territorial health control entities to perform the procedures. The procedure was performed under local anesthesia in all cases, except in one case in which the patient did not give consent. In this case, the implant was performed by the interventional radiologist in the operating room under general anesthesia, a process that logistically took longer and was more costly due to room and anesthesia fees (4).

The spectrum of complications in this study population was found to be comparable to that described in the literature. However, the incidence of complications is generally lower than documented in the literature (1 ,6). The lower rate of early complications could be explained by the routine and expert use of ultrasound to guide vascular access, which decreases the number and depth of punctures, particularly in patients with difficult anatomy (obesity, chest deformities, etc.). However, this series suggests a higher number of skin pocket complications, probably due to the learning curve of the surgical technique for soft tissue surgery.

The final results are comparable in quality and with a better cost-effectiveness ratio than procedures performed in operating rooms, since those performed in fluoroscopy rooms do not require general anesthesia or sedation and do not incur costs for operating room fees. In addition, at least in the study institution, operating rooms are in high demand and the time to schedule an outpatient procedure is longer than the time required to make the fluoroscopy room available. The time that elapses between the request for port catheter implantation and the time it is performed is an important consideration for both the oncology service

and the patient, who perceives better care to the extent that the procedure is done expeditiously. However, it is worth noting that some patients perceive the procedure performed under local anesthesia as more stressful and prefer general anesthesia in order to have no memory of the episode. Procedures that can alleviate this stress, such as asking the patient what he/she prefers to listen to during the procedure (medical conversation, non-medical conversation, music, silence) have been established in the institution and are effective in most cases. The low rate of late complications is attributed to the short follow-up period of this cohort (31 months), which is explained by the fact that the university hospital opened its doors approximately 36 months ago.

In conclusion, interventional radiology insertion of subcutaneous port central catheters for chemotherapy is a safe technique with a low incidence of complications and can be performed effectively in outpatients in the radiology department.

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Correspondence

Álvaro Ariza
Carrera 16 # 82-95 consultorio 505
Bogotá, Colombia
Correo electrónico: nuevaradiologia@hotmail.com

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