Subcutaneous Venous Port Implantation Under Guidance of Imaging Methods: Single Centre Experience

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ABSTRACT

The aim of this study is to present our experience about subcutaneous venous ports placed under guidance of imaging method. In this study, the records of interventional radiology unit were reviewed and 150 consecutive subjects, who underwent subcutaneous venous port implantation under guidance of imaging methods between the dates of 01.03.2007 and 04.09.2008 were presented. Patients were evaluated in terms of technical success, perioperative and late term complications. Thecnical success was 100%. None of the subjects had perioperative (first 30 days) complication. During long term follow-up, 3 subjects had skin necrosis and 4 subjects had infection related with catheter (2.6%). Rate of catheter sepsis calculated ad 1.3%. Complication which required extraction of port (skin necrosis, infection) occurred in 7 subjects (4.6%). One hundred and twenty one (121) of the patients are still alive and their ports are functional. Due to low rates of perioperative and early term complication, if there are qualified staff and adequate equipment, technique of subcutaneous venous port placement under guidance of imaging method should be preferred instead of landmark technique.

Keywords: Venous port, Interventional radiology, Adult

ÖZET

Görüntüleme Yöntemleri Kılavuzluğunda Subkutan Venöz Port İmplantasyonu: Tek Merkez Deneyimi

Bu çalışmanın amacı, ünitemizde görüntüleme kılavuzluğunda yerleştirilen subkutan venöz portlar ile ilgili deneyimlerimizi ve sonuçlarımızı sunmaktır. Bu çalışmada girişimsel radyoloji bölümü kayıtları incelenerek 01.03.2007 ile 04.09.2008 tarihleri arasında görüntüleme yöntemleri kılavuzluğunda subkutan venöz port implantasyonu işlemi uygulanan, sıralı 150 olgu incelenmiştir. Teknik başarı, perioperatif ve geç dönem komplikasyonlar açısından değerlendirilen olgularda, teknik başarı %100 olarak gerçekleşti. Hiç bir olguda perioperatif (ilk 30 gün) komplikasyon izlenmedi. Hiçbir olgumuzda kateter disfonksiyonu gelişmedi. Uzun dönem izlemlerde 3 olguda deri nekrozu, 4 olgumuzda kateter ile ilişkili enfeksiyon(% 2.6) saptandı. Kateter sepsis oranı %1.3 olarak hesaplandı. 7 olguda portun çıkartılmasını gerektiren komplikasyon (deri nekrozu, enfeksiyon) gelişti (%4.6). Hastaların 121 tanesi hala hayatta olup portları fonksiyoneldir. Görüntüleme kılavuzluğunda uygulanan subkütan venöz port yerleştirme tekniği, landmark tekniğe göre, perioperatif ve erken dönem komplikasyon oranlarının düşüklüğü nedeniyle, deneyimli ekip ve yeterli ekipman varsa öncelikle tercih edilmelidir.

Anahtar Kelimeler: Venöz port, Girişimsel radyoloji, Yetişkin

INTRODUCTION

Subcutaneous venous ports, presenting a safe venous route for the subjects who require sustained infusion or total parenteral nutrition, were preferred instead of external catheters due to low infection rates and patient comfort they supplied, following the first venous port implantation by Niederhuber et al. in 1982.[1] Implantation of port catheters by surgical departments via landmark (in guidance of anatomical marks, blinded) method became a common application and implantation in the angiography room under guidance of imaging methods was firstly performed by Morris et al. in 1992.[2] Afterwards, percutanous venous port implantation has begun to take an important place among interventional radiological applications.[3] In this study, we aimed to present our experiences and results on subcutaneous venous ports implanted in our unit.

MATERIAL and METHOD

In this study, the records of interventional radiology unit were reviewed and 150 subjects, who underwent subcutaneous venous port implantation under guidance of imaging methods between the dates of 01.03.2007 and 04.09.2008 were presented.

While reviewing the subjects, data of standardized database, formed prospectively, were analyzed. Age, gender, diagnosis, indication, complications occurred during and after the procedure and technical success were documented in this database. Also, digital radiography, obtained at the end of the procedure, was included to the documentation data.

Fifty five (38.7%) of the patients were female, while 92 (61.3%) of were male. Ages of the patients ranged from 18 through 79 and the average age was 53.28. The procedure of port implantation was performed by the interventional radiological staff educated on port implantation. All of the subjects who were performed the procedure had a platelet count of >75.000/mm^3 and INR value below 1.5. Distribution of the subjects according to the diagnosis was shown in Table 1.

All of the implantation procedures were performed in angiography room, under guidance of imaging methods (ultrasonography + scopy), under intravenous sedation and/or local anesthesia. Sedation was performed by anesthesia team by giving IV phentanyl and midazolam and none of the patient was performed general anesthesia. The selection of anesthetic method was made by the patient after getting informed.

The analysis of subcutaneous venous port implantation under guidance of imaging methods has no risk or financial load for patients. This study was approved by Uludağ University Medical Research Committee. All of the patient files include written educational and consent form indicating that the patients were informed about the procedure signed by patient or one of his relatives.

Method of Procedure

A riser (folded towel, a patient pad etc.) is placed to the interscapular region of the subject, by making a slight extension to the neck. Afterwards, neck is turned to the opposite side of procedure. Because, the face of the patient will be covered with a cloth during the procedure, placing an oxygen mask is useful for comfortable respiration.

A surgical skin cleaning is performed by wiping the area, lying between mandibula and the inferior part of the breast and between and sternum to midaxillary line, with povidone-iodur Batticon at least three times (alternatively, 2% chlorhexidine or 70% alcohol can be used). After clothing the whole body of the patient, except the procedure site, with water resistant sterile cloth, ultrasonographic probe is getting prepared in a sterile way for use.

Table 1. Distribution of the subjects, who underwent venous port implantation, according to diagnosis

Gastrointestinal tumor	103
Pharynxlaryngeal cavity	23
Breast Ca	5
Osteosarcoma	3
Pancreatic Ca	4
Short bowel syndrome (for TPN)	3
Lung Ca	2
Ear Ca	2
Over Ca	2
Lymphoma	1
Transititional cell renal Ca	1
Metastatic Ca with unknown origin	1

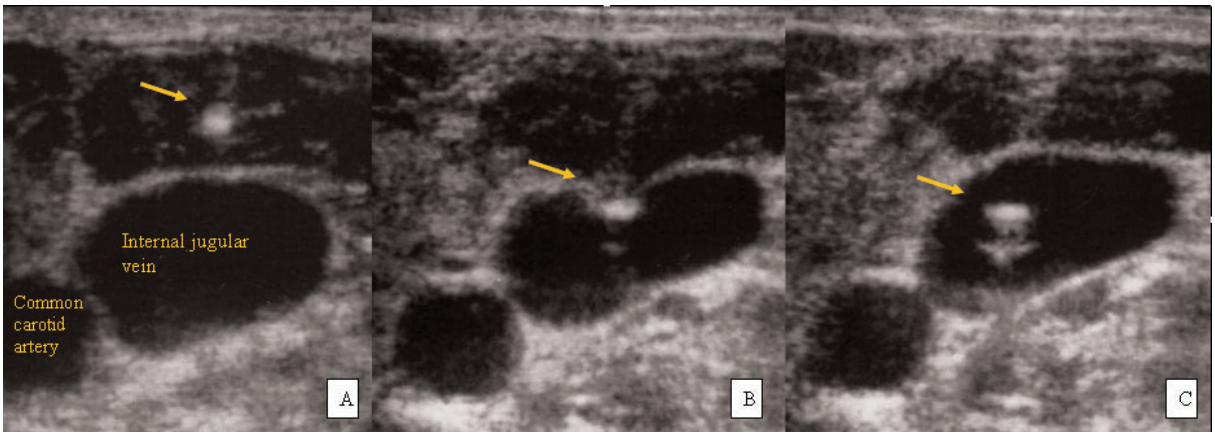

Figure 1. Entering of the needle (yellow arrow) to internal jugular vein in guidance of US (following images).

The vein of entrance is found via ultrasonography (US). Ideal localisation for the entering to the internal jugular vein is just above the clavicula. An infraclavivular approach is appropriate for subclavian entering. Nowadays, supraclavicular approach for subclavian entering is quitted.

In guidance of US, local anesthetic agent (e.g. prilocaine) is injected between skin and vein by using a dental injector. Here, the aim is not only accomplish local anesthesia, but also to incise the space between vein and skin to prevent vascular injury during skin incision.

Then, a 1 cm skin incision including dermal and epidermal tissue is performed on the area of venous entrance. Subcutaneous tissues are dissected from each other with the help of a clamp.

In guidance of US, vein is entered with a 18 G venous needle (Figure 1). In guidance of scopy, a 0.035 inch guide wire is moved forward into the venous needle through vena cava inferior. Afterwards, the needle is taken out. Peel away sheet is placed with the help of guide wire under scopic observation. After taking away guide wire, formation of air emboli and haemorrhage is prevented by closing down the stopper of peel away sheet. Thus, the first step of the prosedure is completed.

In the second step, cutaneous and subcutaneous tissues at the localisation where the port pocket will be formed is anaesthetized with local anesthetic. Cutaneous-subcutaneous incision is performed according to the size of the port that will be used. Generally, an incision of 2-3 cm is sufficient. With the help of a clamp, firstly, subcutaneous tissues are dissected until fascia. Then, port pocket is formed. The size of port pocket should be formed as a pocket where it is hard to place the reservoir.

There are some holes on the sides of the reservoir for suturation. However, no suturation is needed when the port pocket grasp the reservoir tightly. Trying to suture, causes unnecessary need of larger incision and larger port pocket.

After forming port pocket, local anesthetic is applied to the area across the port pocket incision until venous entrance. A tunnel is formed by using a trocar. Catheter, placed back part of the trocar, is moved forward through the tunnel.

By using appropriate key method, reservoir is attached to the end of the catheter at the localisation of port pocket. Reservoir is placed to the port pocket. After observing that the catheter is not kinking, the system is controlled by making injection through reservoir. After, observing the functioning of the system free of problems, soft tissue between catheter and sheath at the site of venous entrance is dissected with clamp. Under scopic observation, size of the catheter is figured and catheter is cut.

Dilatator of peel away sheet is taken out and catheter is moved forward into the sheath. Afterwards, the sheath is broken by paying attention not to take back the catheter and sheath is taken out slowly. After observing with scopy that catheter and the reservoir are at the appropriate position and testing the system by injection, the incision sites are sutured ant the procedure is finished (Figure 2).

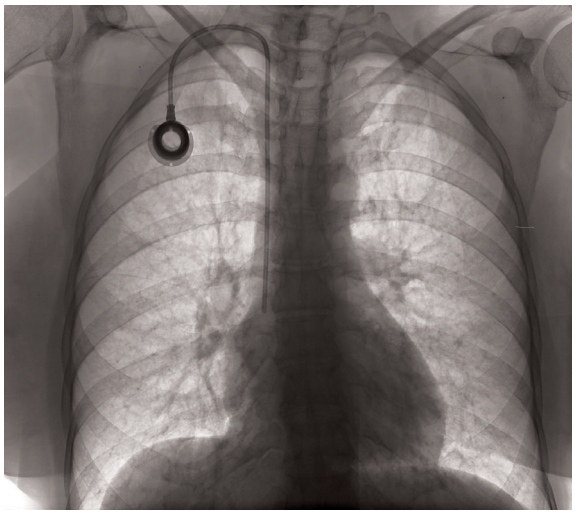

Figure 2. Digital radiography of the subject who underwent placement of port catheter through right internal jugular vein.

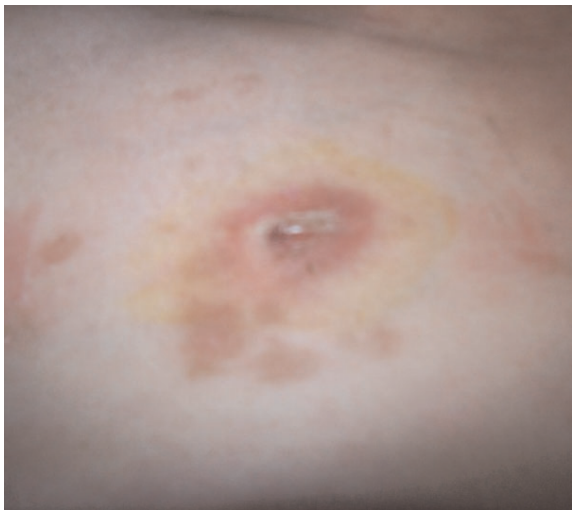

Figure 3. Subject who had infection of port pocket, there is hyperaemia and purulent discharge at the localization of port pocket.

After the procedure, subject should be observed for 1-2 hours for haemorrhage or slow occurring pneumothorax.

Subjects are asked to come back 72 hours later, for taking out the stiches and for evaluation.

It is recommended to start to use the port 3-5 days later. However, in case of emergency, before taking the patient out of intervention room, it can be started to use attaching port needle with set. Under such kind of condition, placement of the needle by the same doctor who performed the procedure decreases probable complications.

RESULTS

All of the patients were placed a single-lumen port. All of the ports were placed to pectoral region. Totally, 91 Port-A-Cath II (Smiths, England), 40 Polysite (Perouse Laboratoires, France), 8 Celsite ST301 (B. Braun, Germay), 7 BardPort (C.R. Bard, USA), 4 FB Medical (FB Medical, France) brand ports were used.

Sedation + local anesthesia was applied to 17 subjects, while only local anesthesia was applied to 133 subjects. All of the patients, who underwent local anesthesia, tolerated the procedure. None of these patients needed additional sedation.

As a venous entrance, right internal jugular vein was used for 136 patients, while left internal jugular vein was used for 12 patients. Left subclavian vein was preferred as a venous entrance for 1 patient who has obstructed both internal jugular veins and for 1 (who had a short bowel syndrome due to mesenteric ischemia) patient right subclavian vein was chosen as a venous entrance who had trombosed right internal jugular vein, left subclavian vein and left internal jugular vein (for the subject who had a short bowel syndrome due to mesenteric ischemia).

Technical success was described as a functional port which was at the appropriate position (infusion and aspiration should be performed easily). Totally 150 procedures of port placement were performed with 100% technical success.

None of the subjects had perioperative complication related with procedure. An enduration at the site of the port was occurred in 1 subject through the end of the first chemotherapy session (6th day after the procedure and third day of chemotherapy application). At the examination of this subject, the position of the catheter was found as normal. The catheter was functional and no extravasation was detected on catheterography. Extravasation caused by dislocation of the needle from reservoir during chemotherapy application was decided as a cause of

Figure 4. Subject who had skin necrosis, port catheter is clearly seen through necrotic area.

enduration, no problem was faced during the further sessions of this subject. There was no case facing with a problem in short term (first 30 days) except this subject.

During the period when the catheter was mounted, 1 of our subjects died due to sepsis (Day 152), 1 due to cranial metastasis (Day 60), 1 due to (Day 99), 5 due to cardiopulmonary arrest (between the days of 32 and 310, 162 days on average). Because the subject died due to sepsis, died following entubation in emergency room, cultures could not be obtained and he was diagnosed clinically.

Catheter was taken out in 21 subjects, due to cutaneous necrosis in 3 subjects (between the days of 94 and 286, 191 days on average), infection of port pocket in 2 subjects (86, 216 days),development of bacteriemia in 2 subjects (84, 302 days), completion of the treatment in 14 subjects (between the days of 199 and 499, 337 days on average).

For the subjects whose catheter was taken out due to infection of port pocket and cutaneous necrosis, wound region was left to secondary healing and antibiotic was given and daily care of the wound was performed (Figure 3).

One hundred and twenty one (121) of the patients have still been alive and have functional port.

At the date of 01.12.2008 when the study data was collected, the duration of port use ranged between 32 -603 days, and the average was 285 days and when all of the ports were taken into account, total duration of use was found as 42638 days.

None of our subjects had infection in short term. In long term observations, 4 of our subjects (2.6%) had infection associated with catheter. Rates of catheter sepsis were calculated as 1.3%. Seven subjects (4.6%) had complications (cutaneous necrosis, infection) which required extraction of the port. Catheter dysfuntion occurred in none of our subjects.

DISCUSSION

Venous ports are closed systems which consist of a reservoir and catheter and placed subcutaneous area as a whole. They are ideal for long term and intermittent medical therapy. It is the central venous route, which has the lowest risk of infection and highest patient compliance. Because they have no part visible out of the body, they are cosmetic. They are usually preferred for oncologic patients.[4]

There are some sorts of venous ports with double reservoir and double lumen. Nowadays, port catheters with double reservoir developed for dialysis have been put in use. Catheter parts of the venous ports are made of silicon or polyurethane, while reservoir parts are made of titanium or plastic and injection membranes are made of silastic material. Both of the ports made of titanium or plastic are MR (Magnetic Resonance) compatible.

Reservoir part is mostly placed subcutaneously on the fascia of pectoralis major. It is recommended to place under pectoralis major muscle, for the patients who are thin and does not have sufficient subcutaneous tissue. Placement of the port highly close to skin and choice of larger ports for thin patients may cause subcutaneous necrosis. Ports were placed on the fascia of pectoralis major of our subjects who had subcutaneous necrosis. During the treatment of the subjects, a weight loss was observed between 14-16 kilograms. Their subcutanous adipose tissue lessened according as weight loss (Figure 4).

Reservoir could be placed into the parasternal area or onto the trapezius or deltoid muscles, if pectoral region can not be used due to causes such as operation, radiotherapy and burn injury.[4]

Nowadays, the causes why port implantation in guidance of imaging methods became widespread are

completion of the procedure in shorter time compared with landmark method and rapid increase of number of patients receiving chemotherapy.[3]

The difference between landmark method and procedure of subcutaneous venous port implantation in guidance of imaging is that the latter is performed under guidance of US and scopy.[4]

Use of US provides observing the anatomy and blood flow dynamically. So, anatomical varieties, calibration of vein via which the procedure will be performed, relation of mainly vein and the arteries and the other anatomical structures and the lesions that can cause a problem while entering to the vein (mass, lymphadenomegaly etc.) can be seen easily. Moreover, entering to the vein in guidance of US increases the rate of success at first time. Because of these advantages, venous entering in guidance of US makes the complications like pneumothorax, hemothorax, arterial injury and haematoma which are frequently seen in surgical series, rare complications.[5]

In literature, with landmark method frequency of hemothorax is reported as 0.5%-12.5% and pneumothorax as 1.7%-3%, while these complications are not seen with method under guidance of imaging. Rate of haematoma occurence during the procedure is 8% and 0.4% for landmark method and method in guidance of imaging respectively.[4,6,7] In our study, none of our subjects had pneumothorax, hemothorax, arterial injury or haematoma. Low rates of complication is not only based on high rate of success at the first time of entering to the vein in guidance of US, but also based on passing through the only anterior wall of the vein, different from landmark method.

Because the procedure is performed under guidance of scopy, the movement of the catheter with peel away sheet and guide wire and trace can be watched as real time. Thus, there is probability of wrong placement of catheter. Additionally, the termination of the procedure and trying the catheterisation via another appropriate vein is an advantage of implantation in guidance of imaging. However, with landmark method, because the reason that precludes catheterisation is unknown in these subjects, it is persisted on performing the procedure, even repeated venous entering are performed with a thought of the probability of guide wire being outside of the vein. As a result of these unnecessary repetitions, rate of occurrence of perioperative complications, mainly vascular injury, is getting increased.

Observing the end point where the tip of catheter reaches and placing it in an appropriate position is another advantage of using scopy. With landmark method, the length of the catheter is calculated conjecturally, 25-40% of the catheters are not placed in ideal localisation.[8]

Because of the reasons mentioned above, in literature, success rate is 94.4% with landmark method, while it is 99.4% with method in guidance of imaging.[3,7,9-13] In our study, technical success rate was 100%.

Surgeons prefer subclavian vein as a site of venous entrance, because with landmark method, it provides safer possibility of entering. But, clear disadvantages of subclavian vein prevent its use as a routine venous entrance. Incidence of thrombus, pneumothorax and hemothorax occurence is higher in subcalvian venous entering than in the internal jugular venous entering. For the subjects, who have graft or fistula for haemodialysis venous catheterisation is not performed at the same side. Additionally, embolisation or kinking of catheter (Pinch-off syndrome) may be caused by compression of costaclavicular ligament or subclavius muscle to subclavian vein, and/or by excessive use of catheter.[3] Radiologists prefer internal jugular vein. This is another advantage of port implantation under guidance of imaging. Because right internal jugular vein is larger and contains flat route that makes easier the catheterisation, it is preferred to left internal jugular vein. Moreover, because right internal jugular venous entrance provides reaching directly to the heart without contact of the catheter to the venous wall, possibility of symptomatic stenosis and thrombus formatiosn is insignificant. Among all of the venous routes, internal jugular route was reported as a route with least possibility of thrombus formation.[3,4]

We performed 136 of 150 catheterisation via right internal jugular vein, 12 of via left internal jugular vein and 2 of via subclavian vein. In the US examination of the subject for whom left subclavian vein was used, we detected thrombus in both internal jugular veins and in right subclavian vein. In the subject, for whom right subclavian vein was preferred

Table 2. Table 2: Reasons to prefer left internal jugular vein (IJV)

Right breast Ca + history RT	2
Thrombosis of Right IJV	1
Thin calibrated Right IJV	1
Metastatic mass on Right neck	2
Need to change the port located in right pectoral region (malposition, dysfunction, infection at pectoral area)	6

had a obstruction of both of the internal jugular veins due to infection of central venous catheters placed previously. The reasons of preferring the left internal jugular vein are presented in Table 2.

In the review of literature, no significant difference was found in the rates of infection and late complication of the ports placed by surgeons or interventional radiologists.[4,11,14]

Infection related with port ranges between 2.6% and 9% in various series in literature. Infection of port pocket was reported in the 0.3-4.4% of the subjects.[4,11,15,16] In our study, two subjects (1.4%) had infection of port pocket. Our rate of infection related with catheter was figured out as 4.2% and, all of those subjects had infection in long term follow-up (106 catheter days, on average). We had no subject who had infection in short term.

According to our experiences, during the long term follow-up, except secondary malposition, there is no significant difference between port implantation with landmark method or under guidance of imaging. Secondary malposition is a rare complication of port catheterisation in guidance of imaging due to use of scopy during placement of catheter.[3,4] Most of the complications occurred in this period are related with attention paid to the care of catheter. Frequently occurring complications are: infection, formation of fibrin sheath, pinch-off syndrome, formation of coagulum or precipitate in the catheter or development of stenosis.

Additionally, when compared according to the duration of venous entering that forms the first step of the procedure, it was determined that catheterisation under guidance of imaging was performed significantly in shorter time than landmark method.[17] This is another advantage of subcutaneous venous port implantation in guidance of imaging.

CONCLUSION

The method of subcutaneous venous port implantation, performed under guidance of imaging has a clear superiority to landmark method in point of low rates of perioperative and short term complications and short procedure time. If the long term and serious health problems are taken in to account for the subjects who require subcutaneous venous port, completion of the procedure with possible least complication carries a higher significance.

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