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Comparison of Two Techniques in Central Venous Port Application

Santral Venöz Port Uygulamasında İki Tekniğin Karşılaştırılması

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Abstract

Aim: Central venous access devices (CVADs) have been used for prolonged infusion chemotherapy and have facilitated the problem of vascular access. The aims of this study were to analyse the results and complications of two CVAD implantation techniques.

Methods: We performed a retrospective study of 118 implantable venous access devices inserted via the subclavian vein using two different surgical techniques between January 2015 and June 2017 in İstanbul Haseki Training and Research Hospital, Clinic of General Surgery. While the devices were placed under fluoroscopic guidance in group 1, they were placed without fluoroscopy in group 2. All procedures were performed under sedation and local anesthesia. All devices were placed at the anterior chest wall over the pectoralis fascia. Outcome and complications were followed and recorded elaborately.

Results: A total of 118 venous access devices were implanted. During follow-up, a total of eight complications were observed. Pneumothorax was observed in five, wound infection in two and catheter fracture was observed in one patient. There was no statistically significant difference in complications between the two groups.

Conclusion: CVADs increase quality of life of patients with oncologic diseases during chemotherapy. Common periprocedural complications of CVADs are pneumothorax, wound infection and catheter occlusion. In critical patients, the use of fluoroscopy may be helpful in reducing complications. However, since fluoroscopy increases costs and requires experience, CVAD insertion under fluoroscopy guidance may not always be possible. There is also a risk of radiation exposure when using fluoroscopy. In regard to comparison of the two techniques, fluoroscopy guidance did not alter the results and its superiority over the other technique was not observed. Although image-guided insertion of subcutaneous chest ports has advantages over unguided insertion, the latter can be used in a selected group of patients in experienced hands.

Keywords: Central venous access devices, complications, fluoroscopy

Öz

Amaç: Santal venöz katater uzun süreli kemoterapi infüzyonu gereken ve damar yolu problemi olan hastalarda kullanılır. Bu çalışmada iki farklı teknik kullanılarak uygulanan santal venöz port işlemlerinin sonuçları ve komplikasyonları karşılaştırıldı.

Yöntemler: Ocak 2015 ve Haziran 2017 tarihleri arasında subklavian vene iki farklı teknikle uygulanan santral venöz port işlemi uygulanan 118 olgu retrospektif olarak analiz edildi. Grup 1 floroskopi altında işlem yapılan olgulardan, grup 2 ise floroskopi kullanılmadan port takılan olgulardan oluşuyordu. Tüm işlemler sedasyon ve lokal anestezi altında uygulandı. Tüm portlar göğüs ön duvarında pectoral kasın fasyası üzerine yerleştirildi. Sonuçlar ve komplikasyonlar değerlendirildi.

Bulgular: Toplam 118 port işlemi uygulandı. Bu olguların takiplerinde sekiz komplikasyon izlendi. Beş olguda pnömotoraks, iki olguda yara yerinde enfeksiyon, bir olguda ise katater kırılması görüldü. İstatistiksel olarak komplikasyon açısından her iki grup arasında anlamlı farlılık saptanmadı.

Sonuç: Santral venöz portlar kemoterapi süresince onkolojik hastaların yaşam kalitelerini yükseltir. Santal venöz portların yaygın görülen komplikasyonlarının başında pnömotoraks, yara yeri enfeksiyonu ve katater tıkanmasıdır. Kritik hastalarda floroskopi kullanılması bu komplikasyonların azaltılmasında yardımcı olabilir. Bununla birlikte, bu tekniklerin floroskopi altında kullanımı her zaman mümkün olmayabilir, maliyetleri artırabilir ve deneyim gerektirir. Floroskopi kullanıldığında radyasyona maruz kalma riski de vardır. Bu çalışmanın sonuçlarına göre floroskopi kullanılması sonuçları değiştirmedi ve diğer gruba göre üstünlüğü gösterilemedi. Floroskopi altında santral venöz port takılması işleme kılavuzluk açısından avantajlı olmakla birlikte floroskopi kullanılmadan da deneyimli ellerde düşük komplikasyon oranlarıyla bu işlem uygulanabilir.

Anahtar Sözcükler: Santral venöz port, komplikasyon, floroskopi

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Introduction

Central venous access devices (CVAD) were used for nutrition, transfusion of blood and blood products in the past (1). CVADs facilitate vascular access difficulty in chemotherapy patients and have some superiority over other techniques and using CVADs is more comfortable for patients (2). However, the use of those devices is associated with early and late complications. These complications can sometimes be life-threatening (3). CVADs can be implanted by different techniques (4-6). These procedures can be performed under local anaesthesia. Use of periprocedural fluoroscopy or ultrasound guidance can be useful to avoid complications. However, the use of those techniques under fluoroscopy may not always be possible, increase costs and require experience. There is also a risk of radiation exposure when using fluoroscopy. This study was planned to investigate the results of procedures in which fluoroscopic techniques were not used.

Methods

In this retrospective study, patients with CVADs were evaluated. A total of 118 CVADs were placed in the department of general surgery at Haseki Training and Research Hospital between January 2015 and June 2017. The same type of CVADs was inserted in all patients. The subclavian vein was used for catheter placement. If the first attempt was unsuccessful, surgeons were allowed to switch the procedure from one side to the other side of the patients. All devices were inserted by the same experienced surgeon in the operating room. All the procedures were performed with the patient under sedation and local anesthesia and following the aseptic rules. In group 1, the devices were placed under fluoroscopic guidance. After the procedure, plain X-ray was taken to visualize catheter position and the chest for possible pneumothorax in both groups. The rates of complications during follow-up after discharge from the hospital were recorded and the outcomes were compared between the two groups. Wound infection was defined as erythema with or without tenderness. Chest X-ray was obtained for pneumothorax and malposition of the ports. On the date of 10 August 2016, approval number 393 was obtained from the Haseki Traning and Research Hospital Ethics Committee for this study. Written informed consents were obtained from all patients.

Statistical Analysis

Demographic information, such as age and sex, and type of cancer and complications were recorded and analyzed using the SPSS programme (SPSS Inc. Chicago, IL). The Kolmogorov-Simirnov test and Mann-Whitney U test were used for statistical analysis. A p value of less than 0.05 was considered statistically significant. Although a retrospective evaluation was planned, ethics committee approval was received for this study.

Results

A total of 118 CVADs were inserted from January 2015 to June 2017 (Table 1). There were 80 males and 38 females. The mean age of the patients was 58.62 years (range: 29-82 years). There was no significant difference in demographic characteristics between the groups (Table 2). The primary malignancies were colorectal cancer and

Table 1. Surgery procedures

		Frequency (n)	Percent	Valid percent	Cumulative percent
Valid	Group 1 (Without flouroscopy)	94	79.7	79.7	79.7
	Group 2 (Under flouroscopy)	24	20.3	20.3	100.0
	Total	118	100.0	100.0	-

Table 2. Demografic features

			Surgery procedure		Total
			Group 1 (Without flouroscopy)	Group 2 (Under flouroscopy)	
Gender	Male	Count	65	15	80
		% within gender	81.3	18.8	100.0
	Female	Count	29	9	38
		% within gender	76.3	23.7	100.0
Total		Count	94	24	118
		% within gender	79.7	20.3	100.0

gastric cancer (Table 3). CVADs were inserted on the right side in 111 patients and left side in seven. Complications were observed in eight patients; two in the fluoroscopy group and six in the other group. The overall complication rate was 5.8%. Pneumothorax developed in five patients in group 1 (5.3%). The patients were discharged without any other problem after a thorax tube was installed (Table 4). Malposition occurred in two patients and was corrected. Partial fracture of the catheter was a complication after four months in a 50-year-old female patient. The catheter was removed under local anesthesia and a new catheter was inserted to the other side. Local wound infections developed in two patients in group 2. Infections were treated with antibiotics uneventfully. There was no statistically significant difference in the frequency of pneumothorax development between the groups (p=0.252).

Catheterization under fluoroscopic guidance was associated with a lower rate of complications compared with the other group. However, the difference was not statistically significant (p=0.7).

Discussion

Nowadays, CVADs have been more commonly employed than in the past in the treatment of malignancies to infuse continuous chemotherapy and to get rid of multiple venipunctures, which gets even more difficult after multiple chemotherapy courses. As expected, the cosmetic results of totally implantable venous access (TIVA) devices are preferred by patients compared to that of CVADs. It is not a surprising fact that implanted devices are preferable for patients with active live. Insertion of a CVAD can be made both by surgeons and radiologists. Despite disadvantages, a major advantage of CVADs inserted by an interventional radiologist is that it can be done as an outpatient procedure not necessitating operating room time. However, complications are better diagnosed timely and treated accordingly if the procedure is done by a surgeon in an operating room. Although insertion of CVADs by interventional radiologists has been more convenient and is favored by both medical oncologists and patients, low rates of complications would no longer be defended, since a complication in a patient makes that rate 100% for that patient.

Table 3. Primary malignancies

		Frequency (n)	Percent	Valid percent	Cumulative percent
Valid	**Colon**	42	35.6	35.6	35.6
	Rectum	18	15.3	15.3	50.8
	Gastric	37	31.4	31.4	82.2
	Esophagus	5	4.2	4.2	86.4
	Larenx	2	1.7	1.7	88.1
	Breast	5	4.2	4.2	92.4
	Lung	1	0.8	0.8	93.2
	Pancreas	4	3.4	3.4	96.6
	Overian	2	1.7	1.7	98.3
	Bladder	1	0.8	0.8	99.2
	HCC	1	0.8	0.8	100.0
	Total	118	100.0	100.0	-

HCC: Hepatocellular carcinoma

Table 4. Pneumothorax rates

		Surgery procedure		Total
Pneumothorax		**Group 1 (Without flouroscopy)**	**Group 2 (Under flouroscopy)**	
No	**Count**	89	24	113
	% within surgery procedure	94.7%	100.0%	95.8%
Yes	**Count**	5	0	5
	% within surgery procedure	5.3%	0.0%	4.2%
Total	**Count**	94	24	118
	% within surgery procedure	100.0%	100.0%	100.0%

Moreover, many studies attempting to compare CVADs with either Groshong or Hickman catheters reported a higher rate of complications in regard to central external catheters with external lines (7-10). In a study conducted by Walshe, et al. (11) catheter removal due to phlebitis was reported in 6.6% of patients with peripherally inserted central catheter (PICC). Hence, the rate of complication associated with peripheral lines is similar to that with CVADs except for pneumothorax, in fact, occurring less frequently. Type of malignancy and the chosen oncologic medicines are also responsible for side effects because of the increased rates of thrombosis and complications. In this very heterogeneous group of patients with malignancies, it is too difficult to make even scientific speculations about comparison of methods, especially when different factors are taken into consideration in every different patient in his or her tailored microenvironment. Having external lines inserted for administration of chemotherapeutic agents makes the patients more vulnerable to infections without a doubt if PICCS are used because of line infection in those neutropenic patients (11). Since scientific modalities of oncologic treatment develop much faster than surgical methods, the increased use of different, even tailor made and continuous infusional chemotherapy regimens resulted in the increased employment of CVADs which turned the face of treatment of cancer into another in our era which is also helped by newly evolving drugs. The compliance and compatibility of patients are also harmed by difficulties in venous blood sampling or venous line accesses before port catheters improve the quality of life and healthcare units. Not only chemotherapy, but also antibiotherapy and blood transfusion through port catheters are more convenient compared to external lines such as PICCS. Apart from patients with malignancies, port catheter implantation can also be employed in patients, in whom fluid therapy or blood products for subacute or chronic diseases, such as chronic diarrhea, short gut syndrome, hemophagocytic syndrome, and hemolytic uremic syndrome, are required. The most common leading factor for removal of a port has almost always been infections or fear of possible infections especially in patients with hematological malignancies or solid tumors who are more vulnerable to develop port infections, which can be classified as sepsis, port reservoir site infection and infections within the tunnel of catheter. It should be kept in mind that patients with a higher body mass index are more prone to infectious complications. Despite the fact that infections at the port reservoir are known to be less frequent than sepsis, Yazici et al. (12) reported the rate of pocket infection as high as 26.3%. Non-infectious complications encountered in patients who take steroid treatment are not due to altered immune system and neutropenia; on the contrary, they are caused by conservation of port catheter and the presence of a reservoir under a thinner skin and subcutaneous adipose tissue, in addition to negative effects of steroids on wound healing. The incidence of catheter-related mortality ranges between 2.8% and 3.5% and recurrent disease and neutropenia have been considered to contribute to mortality (12).

Although insertion of CVADs has been done by surgeons traditionally, during the last decade, they have begun to be placed by radiologists, too. Since surgical and radiological techniques are similar for CVAD implantation, surgeons have begun to use image-guided port placement techniques such as scopies not to get any help from radiologists. However, in time, with the gain of experience, the use of imaging techniques is left aside by experienced surgeons. The image-guided port placement techniques are thought to eliminate the complications such as pneumothorax, hemothorax, arterial injury, and catheter malpositioning. However, in some clinics and ours, similar rates of complications between patients in whom imaging guidance was used or not, created a debate whether experience knows better than imaging guidance despite contrary arguments. When the device is the source of the infection, the infected port should be removed immediately; in addition, antibiotherapy should be administered. Placing a CVAD also necessitates utmost knowledge. For example; in patients with mastectomy, the site of mastectomy should not be used for implantation. The trapezius muscle or the right parasternal region can be used in patients with bilateral mastectomy. Making of a very superficial pocket for port implantation, especially in skinny patients, can lead to skin erosions in 1% of patients. The clue to minimize that complication is to place the port under the pectoral fascia or muscle. Catheter fracture can be encountered following so called "pinch off" syndrome where pinching of the port catheter occurs between the clavicle and the first rib. The risk of pneumothorax is around 0.1% to 3.2%, due to underlying lung parenchyma especially in cases in which a collapsed subclavian vein is present. Soft tissue necrosis or non-healing wounds due to a catheter fracture or a broken catheter because of subcutaneous extravasation of the chemotherapeutic agent into the subcutaneous tissue is also among complications which can be encountered. Avoidance of suturing a port with stay sutures can also avoid infection to some extend if the port pocket is tight enough. Suturing the port to the subcutaneous tissue is recommended only in cases with a large port pocket or in patients with excessive and loose subcutaneous fat tissue. However, we recommend stay sutures instead of port revisions of displayed devices since they will not stay in their place forever. TIVA ports (TIVAPs) can be used as a synonym for CVADs. Kock et al.

(13) reported complications such as catheter malfunction, migration of the catheter, skin necrosis, catheter fracture, catheter disconnection, and pneumothorax. Bassi classified complications as follows: mechanical complications, such as nonthrombotic, withdrawal malfunction, pinch-off effect and thrombotic occlusion; nonmechanical complications such as catheter-related blood stream infections, pocket infection, skin pressure necrosis; and other: superior vena cava thrombosis (14). We assume that catheter-associated infection could be related with underlying diseases of patients or skin contamination caused by working staff in the operating room, therefore, one can think that infectious complications can be seen more frequently in developing countries such as the country of the present study. Beside common complications such as port fracture, drug extravasation and pneumothorax; less frequent but potentially fatal complications are avulsion and tube adhesion to the adjacent tissues and vessels (13,14). Females and patients with lung cancer have an elevated risk of developing thrombosis. Routine chest X-ray after CVAD placement can be employed to check the place of the device after and during insertion, which was the rationale of the present study. Maintenance of TIVAP necessitates special attention in cancer patients because of high risk of infection added by the burden of chemotherapy. Moreover, educating patients and nurses in addition to measures for the prevention of blood clots is also very important. Patients should be warned against any type of chest trauma.

According to Plumhans et al. (15), subclavian venipuncture has been the most popular route for long-term central venous cannulation, although perioperative complications may occur in 12% of cases**.** Due to easier catheterization, radiologists prefer the internal jugular vein nowadays. Their reasons to prefer jugular versus subclavian access are the lower rates of periprocedural complications, better ultrasonographic control, no pinch-off and lower migration and venous stenosis rates. Plumhans et al. (15) also reported that reduction of pain was gained when the port-catheter was inserted through the internal jugular vein. On the contrary, Lorch et al. (16) were in favor of access through the subclavian route since the short distance to the vena cava and right atrium shortened the time needed for the procedure. Using the radiological and landmark methods, subclavian and jugular port placements were prospectively compared by Biffi et al. (17) and no differences were found.

CVADs are used for prolonged infusion chemotherapy and provide significant benefits to cancer patients such as low infection rates, patient comfort, etc. (9,18). However, insertion and use of the catheters are associated with some complications (17,19). In this study, the total rate of complications in both groups rate was 5.8%. Fluoroscopy-guided CVAD implanting reduces the periprocedural complications (20). However, the use of fluoroscopy-guided CVAD implanting technique may not always be possible. For this reason, CVADs are usually inserted without fluoroscopy guidance. In a review, it was reported that the incidence of catheter-related upper extremity deep vein thrombosis varied between 0.3% and 28.3% (21). In this study, there was no thrombotic complication according to the early results. Catheter fracture with subsequent migration is a rare complication after CVAD implantation. The etiology of catheter fracture is unclear (22). In this study, catheter fracture was observed in one patient.

Study Limitations

The present study had some limitations. The limited number of the patients was the most important one. Single center experience was another limitation for a reliable evaluation. Also, the patients were not equally distributed between the groups. The presented data was mostly about the periprocedural experience, since the oncologic treatments were established in another center. However, implantation of the ports always by the same experienced general surgeon was provided with success.

Conclusion

The main dream of the physicians for many years had been a reliable and rapid access to blood vessels in patients who should be treated with chemotherapy. CVADs or TIVAPs have turned this dream to be true in our era as a magic wand. Image-guided port placement techniques such as fluoroscopy in the present study are thought to eliminate complications such as pneumothorax, hemothorax, arterial injury, and catheter malpositioning. Although image-guided insertion of subcutaneous chest ports has really some advantages over unguided insertion, the latter can be used in a selected group of patients in experienced hands. The data which one may extract from the present study may also be helpful for patients and physicians in situations where fluoroscopy could not be reached or used for any reason.

Author Contributions

Surgical and Medical Practices: M.D., A.K., A.H., Ü.G., G.Ç. Concept: M.D., A.K., Ü.G., G.Ç., M.A. Design: M.D., A.K., Ü.G., G.Ç., M.A. Data Collection or Processing: M.D., A.H., Ü.G., G.Ç. Analysis or Interpretation: M.D., A.K., A.H. Literature Search: M.D., Ü.G., G.Ç., A.H. Writing: M.D.

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