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RESEARCH ARTICLE / *Araştırma Makalesi*

Evaluation of Total Intravenous Port Catheter Procedures with Ultrasonography

Ultrasonografi Eşliğinde Yapilan Total İntravenöz Port Katater İşlemlerinin Değerlendirilmesi

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Abstarct

Objective	In our study, we aimed to evaluate our total intravenous port catheter procedures accompanied by ultrasonography.
Materials and Methods	107 patients over 18 years of age who underwent total intravenous port catheter with ultrasonography in order to perform oncological treatment between January 2014 and January 2019 were included in the study. The files of the patients included in the study were analyzed retrospectively and patient demographic information, malignancy type, accessed vein, duration of operation, and complication rates were evaluated. Patients under 18 years old and whose records could not be reached were excluded from the study.
Results	72 of the patients included in the study were male and 35 were female, and their mean age was 61.38 ± 11.26. While catheter was placed in the internal jugular vein in 105 of the patients who applied total intravenous port catheter, 2 of patients were placed in the subclavian vein. During the procedure, complications developed in 16 (14.95%) patients. These were arterial puncture and hematoma in 11 patients, pneumothorax in 3 patients, hemothorax in 1 patient, and hemopneumothorax in 1 patient.
Conclusion	The use of ultrasonography in total intravenous port catheter lengthens the processing time and decreases the complication rate as the experience of use increases.
Keywords	intravenous injections; central venous catheterization; ultrasonography

Öz

Amaç	*Çalışmamızda ultrasonografi eşliğinde uygulanan total intravenöz port katater işlemlerimizi değerlendirmeyi amaçladık.*
Gereç ve Yöntemle	*Ocak 2014 ve Ocak 2019 tarihleri arasında onkolojik tedavi uygulanması amacıyla ultrasonografi eşliğinde total intravenöz port katater uygulanan 18 yaş üstü 107 olgu çalışmaya dahil edildi. Çalışmaya alınan hastaların dosyaları retrospektif olarak incelenerek hasta demografik bilgileri, malignite tipi, erişilen ven, işlem süresi, oluşan komplikasyon oranları değerlendirildi. 18 yaş altı ve kayıtlarına ulaşılamayan hastalar çalışmaya dahil edilmedi.*
Bulgular	*Çalışmaya dahil edilen hastaların 72'si erkek, 35'i kadın olup ortalama yaşları 61.38 ± 11.26 idi. Total intravenöz port katater uygulanan hastaların 105'inde katatater internal juguler vene yerleştirilirken 2'sinde subklavian vene yerleştirildi. Hastaların 16 (14.95%)'sında işlem esnasında komplikasyon gelişirken 11 hastada arter ponksiyonu ve hematom, 3 hastada pnömotoraks, 1 hastada hemotoraks ve 1 hastada hemopnömotoraks gelişti.*
Sonuç	*Total intravenöz port katater yerleşiminde ultrasonografi kullanımı işlem süresini uzatmakla birlikte kullanım deneyimi arttıkça komplikasyon oranını düşürmektedir.*
Anahtar Kelimeler	*intravenöz enjeksiyonlar; santral venöz kateterizasyon; ultrasonografi*

INTRODUCTION

Totally implantable venous access ports (TIVAPs) are especially used in infusion therapy of various chemotherapy drugs.[1] They can also be used for blood sampling, parenteral nutrition, blood transfusion, and administration of all intravenous drugs. With the long-term use of cytotoxic chemotherapies in the treatment of malignancy, the use of TIVAPs has also increased.[2] Comparing to peripheral catheters, TIVAPs have advantages such as less pain, decreased incidence of phlebitis development and needle penetration, reduced hospitalization requirements and improved quality of life in patients with cancer diagnosis.[2,3]

Currently many techniques are available for TIVAPs insertion. Access to cephalic, subclavian (SCV) or internal jugular veins (IJV) with cut-down or percutaneous procedures is preferred by interventional radiologists and surgeons.4 Despite its advantages, some complications may occur, such as arterial puncture, pneumothorax, hemothorax, air embolism, brachial plexus injuries and thrombosis.[2,4] The usage of ultrasound is reported to decrease the complication rate for TIVAPs insertion.[5]

In our clinic, TIVAPs is performed by percutaneous ultrasound-guided procedure under local anesthesia with a daily hospitalization. In our study, we aimed to evaluate the cases of ultrasound-guided TIVAPs insertion.

MATERIALS and METHODS

Patients over 18 years of age who underwent ultrasound-guided TIVAPs insertion for the malignancy treatment between January 2014 and January 2019 were included in this cross-sectional descriptive research study. Patient data were analyzed retrospectively. Patients' demographic data, type of malignancy, accessed vein, duration of operation, and complication rates were recorded. Patients under 18 years old and whose records could not be reached were excluded from the study.

Surgical Procedure

Before the procedure, complete blood count, prothrombin time (PT), activated partial thromboplastin time (aPTT) and international normalized ratio (INR) test were performed to all patients. All patients were operated in the supine position by providing routine surgical asepsis in the operating room. The head of the patient was rotated to the opposite side of the procedure until the end of the procedure. Right IJV was preferred for application in all patients. Left IJV or SCV was preferred for the patients who underwent mastectomy, radical cervical dissection, received cervical irradiation, or had venous thrombus on ultrasonography. Peripheral oxygen saturation (SpO2), electrocardiography (ECG), and blood pressure monitoring were performed in the patients. Port catheter, wire, dilator and chamber were flushed with a heparin solution (1 mL/100U) before the surgery.

Local anesthesia was applied to the area where the venous puncture would be performed and the anterior thoracic region where the port chamber would be placed. The surgeon was positioned at the head side of the patient, holding high frequency ultrasound probe in left hand and a puncture needle in right hand. Venous punction was performed after determining the IJV or SCV with the ultrasound probe. After the successful punction, an introducer wire was sent in to the vein and a 0.5 cm incision was made right next to it. The intravenous catheter port was placed after the dilator introducer was sent over the wire. Approximately 2 cm incision was made in the anterior thoracic region, where the radio opaque port chamber would be placed. Port pocket was prepared with blunt dissection. Silicon catheter was delivered to the port pocket from the neck region by blunt dissection with the help of metallic tunneler. Connection between catheter and port chamber was provided. The port was tested by taking blood with Huber needle and then heparinized solution was injected. The incisions were closed up with absorbable sutures. Chest x-ray was applied to the patients after the procedure (Figure 1). Patients without complications were referred to

the oncology department, with the suggestion of using the TIVAPs following day.

Ethical Approval

Balikesir University Clinical Research Ethics Committee approval (Decision No:2019/44) has been taken for this study and patient consent was obtained to use the details of their medical records. The study was performed in adherence to the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects".

Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences version 24.0 software (SPSS Inc., Chicago, IL, USA)). Number and percentage, including mean ± standard deviation, median and range, frequencies and proportions were used for descriptive values.

RESULTS

72 (67.28%) male and 35 (32.72%), a total of 107 patients, with the mean age of 61.38 ± 11.26, included in the study. The patients were received oncological treatment with the diagnosis of colon (n=35, 32.71%), rectum (n=29, 27.10%), gastric (n=27, 25.23%) and other malignancies (n=20, 18.69%). Mean operating time was determined as 34.53 (range: 15-75) minutes. Catheter was placed into IJV in 105 (98.13%) patients and SCV in 2 (1.87%) patients. TIVAPs were applied to 91 (85.04%) of the patients on the right side (90 IJV, 1 SCV), and 16 patients (14.95%) (15 IJV and 1 SVC) on the left side (Table 1).

Complications developed during the procedure in 16 (14.95%) of the patients. The most common complication was artery punction and hematoma (n=11, 10.28%). In addition, pneumothorax developed in 3 patients, hemothorax in 1 patient, and hemopneumothorax in 1 patient (Table 2). Patients who developed arterial punction and subsequently hematoma were treated with compression during the procedure. Chest tube was applied to 4 of the patients with hemothorax and / or pneumothorax. In one patient with pneumothorax, conservative treatment with oxygen was sufficient. Patients without complications were discharged after the procedure. The mean length of hospital stay of patients with complications was 1.93 (range: 0-9) days. In 106 patients, the port was used without any problems. One patient underwent revision 120 days later due to skin defect on the port chamber. Thrombosis, catheter breakage (pinch-off syndrome), port pocket hematoma was not observed. None of the ports were removed due to complications.

Table 1: Descriptive data of patients and Totally implantable venous access ports procedures

		n=107
Age (mean ± STD)		61.38±11.26
Gender	Male	72 (67.28%)
	Female	35 (32.72%)
Type of Malignency	Colon	35(32.71%)
	Rectum	29(27.10%)
	Gastric	27 (25.23%)
	Breast	5 (4.67%)
	Liver	3 (2.80%)
	Lung	2 (1.86%)
	Larynx	2 (1.86%)
	Over	2 (1.86%)
	Esophagus	2 (1.86%)
	Pancreas	2 (1.86%)
	Colangiosarcoma	1 (0.93%)
	Skin	1 (0.93%)
Accessed vein	Internal Jugular Vein	105 (98.14%)
	Subclavian Vein	2 (1.86%)
TIVAPs side	Right	91 (85.04%)
	Left	16 (14.95%)

* n: number, STD: standard derivation, TIVAPS: Totally implantable venous access ports

Table 2: Complications totally implantable venous access ports placement in recent study		
Complications (n=16)	n	%
Arter punction and hematoma	11	10.28%
Pneumothorax	3	2.80%
Hemothorax	1	0.93%
Hemopneumothorax	1	0.93%
*n: number.		

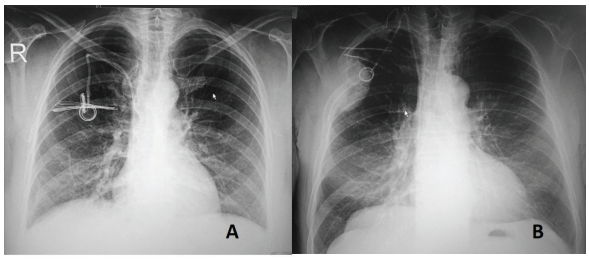

Figure 1: A) TIVAPs applied to the subclavian vein on the postoperative chest x-ray, B) TIVAPs applied to the internal jugular vein on the postoperative chest x-ray

DISCUSSION

TIVAPs are devices that provide safe, easy access and improves quality of life in cancer patients receiving intravenous therapy.4 Peripheral intravenous chemotherapy applications cause vein wall damage, obliteration of the vein, and vascular extravasation and that leads to inappropriate doses of chemotherapy treatment, pain, phlebitis and cellulitis. TIVAPs have advantages compared to peripheral vascular access because of the low risk of extravasation and drug administration through the main venous structures. In addition, it is easy to apply, it can be applied under local anesthesia and the patients can be discharged on the same day. The availability of home treatment opportunities with the use of chemotherapy pumps also increased the usage of TIVAPs.

The most common TIVAPs applied malignancies are colorectal, gastric and breast cancers.7 Yanık et al.8 determined 25% of the cases consisted of patients with colorectal cancer, 20% of them with breast cancer and 14% of them with gastric cancer in their study with 3000 patients. Velioğlu et al.4 detected these rates as 22.35% colon cancer, 20.07% breast cancer, 13.04% gastric cancer. In our study, 32.71% of patients were colon cancer, 27.10% were rectum cancer, and 25.23% were gastric cancer. In our study, the number of patients treated for colorectal cancer was higher than in the literature.

Central venous catheter implantation was first performed by Niederhuber in 1982.[9] Although the application rates increase due to the its advantages, this process is not complication free. TIVAPs complications are divided into two groups; early period developing in the first 30 days and delayed complications developing after 30 days. Another classification of the complications are according to their severity; as minor and major complications. Minor complications can be defined as those who do not need additional surgical intervention and do not require medical treatment for more than 24 hours. Major complications are the conditions that require additional surgical intervention and medical treatment more than 24 hours. Arterial puncture, catheter malposition, pneumothorax, air embolism, arrhythmia and hemorrhage are examples of early complications. Delayed complications are infection, venous thrombosis, pulmonary embolism, venous stenosis and pinch-off syndrome.[10] 15 of the 16 complications in our study (arterial puncture, pneumothorax, hemothorax) were early term complications whereas one was (port pocket incision erosion) late term complication. 11 of these 16 complications were evaluated as minor complications and 5 as major complications.

In previous studies, image-guided port insertion was shown to significantly reduce procedure-related complication rates such as hemothorax, pneumothorax, arterial injury and catheter malposition.[5,6,11] In studies that ultrasonography were not used, complication rates ranged between 6-21.2%.[4,8,11,12] In our study, the complication rate was 14.95%. The most common TIVAPs complication in our study was arterial punction (10.28%). This rate was 3% in study of Velioğlu et al.[4], and varied between 6-8% in the

literature.[2,10] Despite the usage of ultrasound device, arterial punction rates were higher in our study when compared to the literature. The reason might be that, ultrasound guided TIVAPs is user-dependent; and in the learning period, as it was the case in our study, the clinician might lack the technical expertise that is required to carry out the procedure properly.

During the placement of TIVAPs, pneumothorax and hemothorax may occur as a result of punction at an incorrect angle. This rate increases especially in SCV access.4 This rate was found 1% in the study of Yanık et al.[8] and 0.8% in the study of Velioğlu et al.[4] The rate varies between 0.5-4% in the literature.[10-12] The second most common complication in our study was pneumothorax (2.80%) and our complication rate of pneumothorax was compatible with the literature.

Port incision infection and skin dehiscence is another common complication of TIVAPs placement. Placing the port chamber in the superficial fascia, placing the port needle improperly, preparing the port pocket to the fragile region where radiotherapy or mastectomy was performed may be the causes of port infection. In our study, skin erosion was detected in only 1 (0.93%) case. This low complication rate was the result of preparing the port pocket to the deep fascia and having experienced nurses to perform chemotherapy.[4,5,8,11,13] Port related infection is detected in 0.5-9% of cases in studies.[4,8,14,15] It is presented with an unknown cause of fever and irregular blood glucose. In these patients, catheter removal and oral antibiotics are recommended.[15] This rate was found as 3.2% in a study of Aziret et al.[14] and Yanık et al.[8], has found this rate 3.1% in their study. Afterwards TIVAPs has been removed and the patients has received oral antibiotics. In our study, port related infection never developed due to the good nurse care in our hospital.

Another most frequently observed complication in studies was catheter malpositioning.[4,8] This is the arterial placement of the catheter or its placement elsewhere except the superior vena cava and right atrium. If it cannot be detected early, causes thrombosis, vascular wall erosion and cranial retrograde injection. In the study of Aziret et al.[14] evaluating the effectiveness of fluoroscopy use, this rate was 2.4% in the non-fluoroscopy group and it was not seen in fluoroscopy group. They reported that radiology guided methods were decreased the frequency of this type of complication.[14] In our study, it was found that this complication was not occured. We can say that correct detection of the vein with the help of ultrasound devices, decreases this complication.

Pinch-off syndrome, also known as catheter breakage, is observed as another complication in delayed TIVAPs placement. 82% of cases with this condition were observed between the first rib and clavicle after SCV access. To reduce this, it is recommended to place the catheter through one-third distal clavicle.[15] Pinch-off syndrome has been observed in 2 patients in the study of Yanık et al.[8] and the patients were followed up conservatively due to short life time expectancy. Velioğlu et al.[4] has stated that pinch-off syndrome was detected in 3 (0.14%) of cases in their study. Catheters of 2 cases were removed, 1 patient was followed up conservatively. In our study, SCV access was applied to only 2 cases and no pinch-off syndrome was observed.

Catheter dysfunction is defined as the low amount of aspirated blood and infusion capacity due to the long-term use of TIVAPs. Kinking of the catheter, fibrin deposition, the accumulation of hyperosmolar drugs and fluids that were given, the lean of catheter tip towards the vein wall may cause this dysfunction.[11,14] Aziret et al.[14] found this rate 6% in their study. They stated that it is related to poor care of TIVAPs during untreated periods. In the study of Velioglu et al.[4], this rate was found as 15.6%. They stated that the risk of occlusion increases when TIVAPs are being used for blood transfusion and sampling. No catheter dysfunction has been developed in our patients. We believe that injection of heparinized solution after TIVAPs access and good care of TIVAPS at untreated period (cleansing the

catheter tunnel by the injection of heparinized solutions per every month) is affective in decreasing catheter dysfunction.

If port chamber punction cannot be achieved during the use of TIVAPs, fluoroscopy should be performed. Chamber rotation can be detected in fluoroscopy. Yanık et al.[8] has stated chamber rotation in 4 (0.12%) cases in their study. Machat et al.[10] mentioned that suturing port chamber to the fascia and to prepare a narrow port pocket may prevent rotation. Since we have sutured port chamber to pectoral fascia in our study, no port chamber rotation was observed.

The duration of procedure was 16.1 ± 5.7 (range: 10-55) minutes in the study of Yanık et al.8 and 36 ± 6 (range: 28–45) minutes in the study of Xu et al.[17] which ultrasound guided innominate vein catheterization were performed. In our study, our procedure time was 34.53 ± 14.08 (range: 15-75) minutes, which is longer than the reported procedure duration of previous studies. Ultrasound device setup and lengthened vein screening time might have increased the procedure time in the presented study.

In our study, TIVAPs placement was performed under local anesthesia in the operating room conditions. It has been stated that the procedure in outpatient clinic significantly costs less for TIVAPs placement.[18] Calvert et al.[6] stated that the use of ultrasound increases the average cost £ 10 per case, but the decrease in the complication rate is more profitable eventually.

The limitations of the study are it is retrospective with the low sample size and lack of control group; therefore, do not allow to compare with blind percutaneous TIVAPs placement. Also, we are still in the learning period for the ultrasound usage that might result in higher complication rates than the previous studies. The strengths of our study are that the ultrasound is performed in all patients; also, all TIVAPs are functioning properly and effectively, and have not been removed due to any major complications.

CONCLUSION

The use of ultrasound in TIVAPs placement prolongs the operation time but an experienced ultrasonography decreases the complication rates. We believe that complications and operating times can be evaluated more effective in the studies which will be performed with surgeons who have more patients and more ultrasound experience.

Balıkesir University Clinical Research Ethics Committee – Decision Number: 2019/44 – Date: 13/03/2019

Conflıct of Interest

There are no conflicts of interest regarding employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.

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Contrubutıon

The authors contributed equally at all stages of the study.

Referances

1. *Marcy PY, Schiappa R, Ferrero JM, Dahlet C, Brenet O, Yazbec G, et al. Patient satisfaction and acceptance of their totally implanted central venous catheter: a French prospective multicenter study. J Vasc Access. 2017:11;18(5):390-395.*
2. *Zaghal A, Khalife M, Mukherji D, El Majzoub N, Shamseddine A, Hoballah J, et al. Update on totally implantable venous access devices. Surg Oncol. 2012;21(3):207-215.*
3. *Singh KR, Agarwal G, Nanda G, Chand G, Mishra A, Agarwal A, et al. Morbidity of chemotherapy administration and satisfaction in breast cancer patients: a comparative study of totally implantable venous access device (TIVAD) versus peripheral venous access usage. World J Surg. 2014;38(5):1084-1092.*
4. *Velioğlu Y, Yüksel A, Sınmaz E. Complications and management strategies of totally implantable venous access port insertion through percutaneous subclavian vein. Turk Gogus Kalp Dama 2019;27(4):499-507.*
5. *Breschan C, Graf G, Jost R, Stettner H, Feigl G, Goessler A, et al. Ultrasound-guided supraclavicular cannulation of the right brachiocephalic vein in small infants: a consecutive, prospective case series. Paediatr Anaesth. 2015;25(9):943-949.*
6. *Calvert N, Hind D, McWilliams R, Davidson A, Beverley CA, Thomas SM. Ultrasound for central venous cannulation: economic evaluation of cost-effectiveness. Anaesthesia. 2004;59(11):1116-1120.*
7. *Wang YC, Lin PL, Chou WH, Lin CP, Huang CH. Long-term outcomes of totally implantable venous access devices. Support Care Cancer. 2017 Jul;25(7):2049-2054.*
8. *Yanık F, Karamustafaoğlu YA, Karataş A, Yörük Y. Experience in totally implantable venous port catheter: analysis of 3000 patients in 12 years. Turk Gogus Kalp Dama 2018;26(3):422-428.*
9. *Niederhuber JE, Ensminger W, Gyves JW, Liepman M, Doan K, Cozzi E. Totally implanted venous and arterial access system to replace external catheters in cancer treatment. Surgery. 1982;92(4):706-712.*
10. *Machat, S, Eisenhuber, E, Pfarl, G, Stübler, J., Koelblinger, C., Zacherl, J, et al. Complications of central venous port systems: a pictorial review. Insights Imaging. 2019;10(1):86.*
11. *Biffi R, Corrado F, de Braud F, de Lucia F, Scarpa D, Testori A, et al. Long-term, totally implantable central venous access ports connected to a Groshong catheter for chemotherapy of solid tumours: experience from 178 cases using a single type of device. Eur J Cancer. 1997;33(8):1190-1194.*
12. *Seok JP, Kim YJ, Cho HM, Ryu HY, Hwang WJ, Sung TY. A retrospective clinical study: complications of totally implanted central venous access ports. Korean J Thorac Cardiovasc Surg 2014;47:26-31.*
13. *Kim JT, Oh TY, Chang WH, Jeong YK. Clinical review and analysis of complications of totally implantable venous access devices for chemotherapy. Med Oncol. 2012;29(2):1361-1364.*
14. *Aziret M, İrkörücü O, Gökler C, Reyhan, E, Çetinkünar, S, Çil, T, et al. Performance of venous port catheter insertion by a general surgeon: a prospective study. Int Surg. 2015;100(5):827–835.*
15. *Krupski G, Froschle GW, Weh FJ, Schlosser GA. Centralvenous access devices in treatment of patients with malignant tumors: venous port, central venous catheter and Hickman catheter. Cost-benefit analysis based on a critical review of the literature, personal experiences with 135 port implantations and patient attitude. Chirurg. 1995;66(3):202-207.*
16. *Nace CS, Ingle RJ. Central venous catheter "pinch-off" and fracture: a review of two under-recognized complications. Oncol Nurs Forum. 1993;20(8):1227-1236.*
17. *Xu L, Qin W, Zheng W, Sun X. Ultrasound-guided totally implantable venous access ports via the right innominate vein: a new approach for patients with breast cancer. World J Surg Oncol. 2019:25;17(1):196.*
18. *Feo CF, Ginesu GC, Bellini A, Cherchi G, Scanu AM, Cossu ML, et al. Cost and morbidity analysis of chest port insertion in adults: Outpatient clinic versus operating room placement. Ann Med Surg (Lond). 2017:25;21:81-84.*