A Comparative Study of Low-Profile and Regular Type Totally Implantable Venous Access Devices in Patients with Malignant Tumors: Retrospective Analysis of 4501 Implantations

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ABSTRACT

The purpose of this study was to evaluate safety and efficacy of image-guided radiological totally implantable venous access devices with special reference to rate of skin complications of both regular and low-profile types. 4395 patients were referred to Interventional Radiology Unit between March 2003-September 2013. 4501 implantations of totally implantable venous access device were performed in patients under sonography and fluoroscopy. During this period 2299 regular-type and 2202 low-profile type totally implantable venous access devices were used. Success rate, periprocedural early and long-term complications were evaluated. Periprocedural and early complications of totally implantable venous access devices included 16 (0.4%) arterial punctures, 101 (2.2%) minor hematoma, 1 (%0.02) disconnection of the catheter, 4 (0.09%) septum separation, 38(0.8%) minor erythema-pain and tenderness, 23 (0.5%) short term fever without bacteriemia and 25 (0.6%) inversion of the port. Late complications included 6(0.1%) cellulitis, 8 (0.2%) bacteriemia and sepsis, 305 (6.8%) venous thrombosis, 62 (1.4%) catheter thrombosis, 6 (0.1%) catheter migration and 3 (0.07%) catheter fracture. A total of 53 (1.18%) skin perforation were seen. There was statistically significant difference between regular and low-profile totally implantable venous access devices particularly in patients with normal and thinner subcutaneous fat tissue (p= 0.024 and <0.001 respectively). The present study is the largest series in the literature in patients with malignant tumors. Image-guided radiological totally implantable venous access device placement is safe and reliable method with a low risk of complications and the results of this study further justify the use of low profile totally implantable venous access device based on lower skin complications.

Keywords: Port, TIVAD, Low-profile, Regular, Skin perforation

ÖZET

Malign Tümörlü Olgularda Düşük Profilli ve Standard Tip TİVEC kullanımının Karşılaştırmalı Çalışması: 4501 Olgunun Retrospektif Analizi

Bu çalışmanın amacı radyolojik görüntüleme eşliğinde yerleştirilen, standart ve düşük profilli, tamamen implante edilebilir venöz erişim cihazlarının cilt komplikasyonları yönünden güvenirlik ve etkinliğinin değerlendirilmesiydi. Mart 2003 ve Eylül 2013 tarihleri arasında 4395 hasta Girişimsel Radyoloji ünitesine başvurdu. Bu hastalara ultrasonografi ve floroskopi eşliğinde 4501 tamamen implante edilebilir venöz erişim cihazı yerleştirildi. Bu süre içinde 2299 standard tipte, 2202 düşük profilli tamamen implante edilebilir venöz erişim cihazı kullanıldı. Başarı oranı, işlem sırasında, erken ve geç komplikasyonlar değerlendirildi. Tamamen implante edilebilir venöz erişim cihazı yerleştirilmesi sırasında gelişen erken dönem komplikasyonlar arteriel giriş 16 (%0.4), minör hematom 101 (%2.2), kateter ayrılması 1 (%0.02), septum ayrılması 4 (%0.09), minör eritem-ağrı ve hassasiyet 38 (%0.8), bakteriyemi olmaksızın kısa süren ateş 23 (%0.5) ve portun ters dönmesi 25 (%0.6) olarak sıralandı. Geç komplikasyonlar selülit 6 (%0.1), bakteriyemi ve sepsis 8 (% 0.2), venöz trombozis 305 (%6.8), kateter trombozu 62 (%1.4), kateter migrasyonu 6 (%0.1) ve kateter kırılması 3 (%0.07) olmuştur. Kronik dönemde toplam 53 cilt perforasyonu (%1.18) görüldü. Özellikle normal ve ince subkutan yağ dokusu olan hastalarda standard ve düşük profilli tamamen implante edilebilir venöz erişim cihazı kullanımı arasında istatistiksel olarak anlamlı fark mevcuttu (sırasıyla p= 0.024 ve <0.001). Bu çalışma malign tümörlü hastalarda tamamen implante edilebilir venöz erişim cihazı kullanımı ile ilgili literatürdeki en geniş seridir. Radyolojik görüntüleme eşliğinde tamamen implante edilebilir venöz erişim cihazı yerleştirilmesi düşük komplikasyon riski ile güvenilir bir metottur. Bu çalışma ayrıca düşük profilli tamamen implante edilebilir venöz erişim cihazı kullanımının daha düşük cilt komplikasyonlarına yol açtığını ortaya koymuştur.

Anahtar Kelimeler: Port, Tamamen implante edilebilir venöz erişim cihazı, Düşük profil, Regüler, Cilt perforasyonu

INTRODUCTION

Long term vascular access is mandatory for cancer patients who are in need of repeated administration of chemotherapeutics or antibiotics.[1,2] Silicone-based tunneled catheters were the pioneer material in the market used for prolonged intravascular infusions and blood sampling.[3] These catheters were then revised by Hickman et al in 1979.[4] Niederhuber et al was the first to report a totally implantable venous access device (TIVAD) placement in 1982.[5]

TIVAD and tunnelled catheter implantation with cut-down technique or blind puncture using anatomical landmarks was first described by general surgeons.[6] After the introduction of peel-away sheaths, radiologically guided TIVAD and tunneled catheter implantation was introduced to the market.[7] Compared with the other tunneled catheters, TIVADs provided a better cosmetic result, more comfortable postprocedural period and low long-term complication rate.[1,7] Meanwhile, TIVADs are also convenient for administration of other routine medications, daily nutrient supplements or blood sampling. For long term central venous access, TIVADs implantation under image guidance by interventional radiologists was described as a safe and effective alternative to surgical technique.[8,9] Two types of TIVADs are usually preferred in adults named as regular and low-profile. The difference between these 2 types is the size in height, base diameter and septum size. In this retrospective study, we present the technical success and complication rates of image-guided radiological TIVAD implantation procedures. To our knowledge, this is the largest series reported in the literature and we point out the importance of low-profile Type (LT) TIVADs are associated with a decreased rate of skin perforation.

MATERIAL AND METHOD

Patient Selection

4395 patients who underwent image-guided radiological TIVAD placement at Interventional Radiology Section of Ankara Numune Education and Research Hospital between March 2003 and February 2013 were included in the study. The group consisted of a slight preponderance of females (2309 female 52.5% versus 2086 male 47.5%) with a mean age of 49.6 years (Range 18 to 84 years). Malignancies encountered were hematologic (1589 patients), gastrointestinal (1375 patients), breast carcinoma (557 patients), genitourinary (634 patients) and other malignancies (271 patients) in the decreasing order of frequency.

In the early years of this 10 year period, we used Regular Type (RT) of TIVAD (Port-A-Cath Smiths Medical, London, UK) in all patients. But with the increasing experience of the unit staff about TIVAD usage and high skin necrosis ratio with RT TIVAD, we changed our choice of TIVAD. If the subcutaneous fat tissue thickness was significant, RT TIVAD was preferred. If the subcutaneous fat tissue thickness was normal or thinner, LT TIVAD was used. The respective height, base diameter and septum size of the RT TIVAD and LT TIVAD are as follows: height 14.7 vs 11.5 mm, base diameter 30.5 vs 25 mm and septum size 11.4 vs 9.5 mm. Both TIVADs are easily inserted using the same technique except for a larger pocket which is required in cases of RT TIVAD.

Implantation technique

A complete blood count and INR measurement were performed for every patient the day before the procedure and patients with a platelet count over 50000 mm^3 and INR rates lower than 1.5 were included. Patients with INR rate over 1.5 received fresh frozen plasma before the implantation. All patients received a single intravenous dose of 1 gram cefazolin an hour before the procedure and continued up to 3 days for prophylaxis.

All TIVAD implantations were performed in the Interventional Radiology Suite by interventional radiologists. Before the implantation, an ultrasonographic evaluation of the internal jugular veins (IJV) was performed to confirm the patency and to identify a preexisting venous trombosis. Right IJV was the preferred entry site because of its straight course and short distance to right atrium, however left IJV was preferred as a second choice due to patency problems and anatomical limitations. In case of bilateral small or trombosed IJVs, subclavian veins (SCV) were used for venous access. Transfemoral route was used for TIVAD implantation when all the routes described above were inaccessible.

The skin was prepared with chlorhexidine for a standard sterile technique. A local anesthetic (20 ml prilocain) was injected to the area of TIVAD implantation and venous puncture. Venous puncture was performed under the guidance of ultrasonography with an 18G needle using the Seldinger technique. A 0,035-inch guidewire was inserted into IJV and the tip of the wire was advanced to the vena cava inferior via vena cava superior and right atrium. The peel away sheath was meticulously placed over the guidewire. A suf-

ficient size of subcutaneous port pocket was created in the infraclavicular area and catheter was tunneled from the port pocket to the venous access site with the aid of trochar. The port chamber was connected to the catheter and checked for leaks just before port implantation to the port pocket. After the decision of catheter length that would remain in the venous lumen under fluoroscopy, the catheter was placed to the high atrial region via peel away sheath. The port was accessed with a 22G Huber needle and flushed with 2-5 ml of 100U/ml heparinized saline solution after the procedure. If the port pocket was noticed too loose or wide, the port chamber was fixed by a simple suture to the fascia underneath. The tip of the catheter, a possible kink at the puncture site or pneumothorax was evaluated with a postprocedure chest X-ray. TIVAD implantation was completed with a few interrupted skin sutures.

All patients were informed about the local infection signs like fever, swelling and redness at the access site and were recommended to contact their primary physician as soon as possible.

Follow-up

TIVADs were used for intravenous access by medical staff immediately after implantation in majority of the cases. Access site was subjected to a daily care and chlorhexidine was used for local antisepsis just before use. A 22-gauge noncoring Huber needle (Gripper needle, Smiths Healthcare Manufacturing S.A. de C.V., Mexico) was inserted into the TIVAD. Heparinized saline was injected to control the patency of the catheter or subcutaneous leakage. A semi-permeable dressing was used to cover the needle and the needle was changed every 5 days when longer infusions were required. Heparinized saline flush at dilution of 100U/ml was used after every access or monthly during times of port inactivity. X-ray follow-up was obtained every 2 months to confirm the location of catheter tip. All complications were noted in accordance with the recommendations of the Society of the interventional Radiology (SIR). Complications were classified as periprocedural (<24 hours after implantation), early (1 to 30 days after the procedure) and late (>30 days after).

All data were collected from the hospital records and the end point of the study was TIVAD removal or death of the patient.

Statistical Analysis

Difference between groups in terms of categorical data was evaluated by Chi-Square test or Fisher's Exact test where applicable. Bonferroni correction was applied to control type I error. P value less than 0.05 was considered significant.

RESULTS

A total of 4501 TIVADs were implanted in 4395 patients. Reimplantantion was required in 106 patients due to complications: venous thrombosis (47 patients), skin perforation (45 patients), catheter migration (6 patients), catheter fracture (3 patients) and cellulitis (1 patient). The total follow-up period was 2.484.552 catheter days (range 5-1855 days; mean 552 days). Correct venous puncture site was achieved in 4358 of 4501 implantations with the aid of ultrasonography and primary technical success rate was detected as 96.8%. Alternative venous access sites were used for puncture in 143 TIVAD implantations due to primary site problems such as superior vena cava thrombosis, inability to puncture due to obesity or low central venous pressure. The overall secondary technical success rate for TIVAD implantation at alternative sites was 100%.

Periprocedural Complications

All periprocedural complications were summarized in Table 1. Even though all venous punctures were achieved under ultrasonography guidance, an accidental arterial puncture occurred in 16 implantations and manual local compression was immediately applied for treatment. A minor oozing of blood was noted at the incision site in 92 cases which were treated with manual compression without any further intervention. A minor hematoma developed around the TIVAD pocket in 101 (2.2%) cases which were asymptomatic. A mechanical complication occurred in one patient due to disconnection of the catheter from its reservoir part at the first injection. In this patient the catheter was retrieved under fluoroscopy by a goose-neck snare via the right femoral vein without any complication and another port catheter was implanted. Among the type of complications presented, minor hematoma was significantly more frequent with regular type of TIVAD ($p< 0.001$).

Periprocedural complications like pneumothorax, hemothorax, air embolism or major hematoma were not observed in any patient.

Table 1. Complications of TIVAD

Complications	RT TIVAD (n= 2299)	LT TIVAD (n= 2202)	Total	p
Periprocedural complications of TIVADs				
Arterial punctures	10 (0.4%)	6 (0.3%)	16 (0.4%)	0.360
Minor hematoma	72 (3.1%)	29 (1.3%)	101 (2.2%)	<0.001
Early complications of TIVADs				
Disconnection of the Catheter	0	1 (0.05%)	1 (0.02%)	0.489
TIVAD septum separation	1 (0.04%)	3 (0.1%)	4 (0.09%)	0.364
Minor erythema, pain and tenderness	21 (0.9%)	17 (0.8%)	38 (0.8%)	0.604
Fever without bacteriemia	10 (0.4%)	13 (0.6%)	23 (0.5%)	0.465
Inversion of TIVAD	6 (0.3%)	19 (0.9%)	25 (0.6%)	0.0066
Late complications of TIVADs				
Cellulitis	3 (0.1%)	3 (0.1%)	6 (0.1%)	1.000
Death due to bacteriemia and sepsis	3 (0.1%)	5 (0.2%)	8 (0.2%)	0.499
Venous thrombosis	139 (6.0 %)	166 (7.5 %)	305 (6.8%)	0.046
Catheter lumen thrombosis	27 (1.2%)	35 (1.6%)	62 (1.4%)	0.232
Catheter migration	2 (0.09%)	4 (0.2%)	6 (0.1%)	0.443
Catheter fracture	2 (0.09%)	1 (0.05%)	3 (0.07%)	1.000
Skin perforation	34 (1.5%)	19 (0.9%)	53 (1.20%)	0.055

Early Postprocedural Complications

Early complications are summarized in Table 1. TIVAD septum was seperated from the reservoir part in 4 (0.09%) cases. These TIVAD's were all replaced completely with a new one. Minor erythema, pain and tenderness were observed at the port pocket area without any purulant discharge in 38 (0.8%) patients. Another 23 (0.5%) patients had short term fever below 38^0C without bacteriemia. These patients were managed successfully with the administration of appropriate antibiotics. In 25 (0.6%) patients, TIVAD's had revised because of the inversion of the port catheter in the pocket. With regard to the early complications, inversion of TIVAD was more frequent with LT TIVAD (p= 0.007).

Late Postprocedural Complications

All late complications were summarized on Table 1. Cellulitis was noted in 6 (0.1%) patients and managed with wide spectrum antibiotics. Removal of TIVAD was necessary just in one patient due to antibiotic resistance. Bacteriemia and sepsis developed in 8 (0.2%) patients with hematologic malignancies. Blood cultures taken from TIVAD revealed Staphylococcus epidermidis in 5, Staphylococcus aureus, Candida albicans and Escherichia coli in the remaining cases. All of these patients were lost despite aggressive antibiotherapy. On follow-up, venous thrombosis developed in 305 (6.8%) patients and all received low molecular weight heparin. A total of 47 TIVAD were removed due to progression of venous thrombosis.

Skin perforations were seen in 53 (1.18%) patients totally. With RT TIVAD, skin perforation ratio of the patients with the thicker, normal and thinner subcutaneous fat tissue thickness were respectively 0.6%, 2.1% and 8.9%. LT TIVAD caused significantly lower skin perforation ratio than the RT TIVAD; 0%, 0.8% and 1.2% respectively. Except skin perforation, all other short and long-term complication rates were similar between RT and LT TIVADs (Table 2).

Other late complications were catheter lumen thrombosis in 62 (1.4%), catheter migration in 6 (0.1%) and catheter fracture in 3 (0.09%) cases. Venous thrombosis was encountered more frequently in LT TIVAD and the difference was statistically significant. As noted in table 2 skin perforation was similar for both RT and LT TIVADs. It is more common with the use of RT TIVAD in thinner patients (p< 0.001). When the subgroups were compared, statistically significant difference was noted in skin perforation in normal and thinner individuals (p= 0.024* and p< 0.001* respectively).

DISCUSSION

Current improvements in medical oncology and anticancer drugs necessitate a safe long-term central ve-

Table 2. Distribution of used TIVADs and Skin perforation data

	Skin Perforation/RT TIVAD	Skin Perforation/LT TIVAD	P* Value
Thicker	9/1609 (0.6%)	0/257 (0%)	0.620
Normal	11/533 (2.1%)	8/1052 (0.8%)	0.024
Thinner (cachectic)	14/157 (8.9%)	11/893 (1.2%)	<0.001
P Value	<0.001	0.151	

*Bonferroni correlation was applied

nous access for administration of intravenous chemotherapy, parenteral nutrition, blood transfusion, fluid replacement or frequent blood sampling in the majority of the patients.[2,8,10-12] A central venous access gives a great advantage to cancer patients with unrestricted mobility and improved quality in daily activities or reducing the anxiety associated with repeated peripheral venous punctures.[2,4,8,10-15]

After its first introduction by Niederhuber et al in 1982, multiple reports on TIVAD implantation were published pointing to its safety or benefit for long-term chemotherapy and central venous access.[16,17,18,19] At the beginning, TIVADs were implanted by general surgeons who are familiar to cutdown or landmark techniques.[6] Furthermore, the discovery of peel-away sheaths allowed TIVAD implantation with Seldinger technique.[7,20] In literature, surgical TIVAD implantation using Seldinger/landmark/cutdown techniques with the SCV or IJV had a complication rate varying between 4% and 24.6% (18,21-26). Image guidance with fluoroscopy and ultrasound for IJV or SCV puncture provided a higher technical success rate and low risk of periprocedural complications compared to the surgical technique.[13,23,27-31] Right IJV is the preferred site for TIVAD implantation by the interventional radiologists because of its straight course that reduces catheter complications like thrombosis and low risk of catheter pinch-off phenomen between the first rib and the clavicle.[32-35] Femoral veins are usually not preferred for puncture however it might be advantageous in conditions like tumoral involvement or stenosis/thrombosis of superior vena cava and puncture problems related to low central venous pressure or obesity.[32]

Studies on ultrasound-guided vessel punctures demonstrated success rates over 90%.[30,36-38] In the present study, ultrasonographic evaluation done before the procedure or its guidance during venous puncture allowed a primary technical success rate as high as 96.8%. In 138 of 143 failed patients, a successful venous puncture could not be achieved due to low central venous pressure or obesity. In the remaining 5 patients, successful venous puncture was possible however a guidewire could not be propogated because of chronic occlusion of the superior vena cava. Alternative sites like left IJV, bilateral SCV or femoral veins were preferred for all failed primary venous punctures with a secondary technical success rate of 100%.

TIVADs which were implanted with a landmark/seldinger or cutdown technique of the SCV were associated with higher complication rates.[9,18,21,22,26] Subclavian vein puncture was reported to be associated with pneumothorax (0.6-4.3%)[2,8,39,40] and inadvertant arterial puncture (2.4%)[9,21,40] in surgical series. It is evident that these complications were decreased prominently with ultrasound-guided venous punctures.[13,20,41] Teichgräber et al reported an accidental arterial puncture in 0.16% of 3160 patients undergoing TIVAD implantation.[19] In the present study, an inadvertant arterial puncture was reported in 16 (0.3%) patients and easily controlled by local pressure. Any other periprocedural complication like pneumothorax, hemothorax, nerve injury, arrhytmia or air embolism were not recorded.

The optimal position for port catheter tip is at the cavoatrial junction. This position of tip provides a decreased risk of postprocedural thrombotic complications and inevitable catheter dysfunction during aspiration and infusion.[42,43] All TIVAD implantations at our unit were performed under fluoroscopy and position of the catheter tips were checked.

Postinterventional bleeding is another minor complication which arises within 24 hours and usually due to coagulation disorders necessitating a local or systemic therapy.[31,44] In the present study, minor cutaneous bleeding after the TIVAD implantation were noticed in 92 patients and easily managed with local pressure.

Pocket and entry site hematomas may cause difficulties in palpation of port septum or wound healing due to local tension. Blood and fluid collections may reach huge sizes and needs to be evacuated. It should be noted that a hematoma is also associated with an increased risk for abscess.[1] In the present study, pocket hematomas were observed in 101 (2.2%) (RT TIVAD, 72 cases (3.1%)-LT TIVAD, 29 cases (1.3%)) TIVAD implantations without any significant wound dehiscence or abscess formation on follow-up. RT TIVAD caused more pocket hematomas due to the larger size of incision and TIVAD pocket.

Catheter dislodgement from the reservoir part of the port is a rare complication.[45,46] A regular check of the TİVAD before each use with the heparinized saline is crucial and specialized nursing care is necessary to prevent irreversible complications associated with subcutaneous antineoplastic agent leakage. In the present study, TIVAD reservoir part and catheter was not connected properly in 1 patient and catheter dislodgement appeared just after its first use.

Infection is a major complication in the early and late period after TIVAD implantation and may be cathegorized as wound/pocket infection, cellulitis and catheter-related blood stream infections.[47,48] Chemotherapeutics for malignancies definitely suppress the immune system however regimens towards hematologic and gastrointestinal malignancies produce a profound immunosuppression compared to others. There is no consensus about the periprocedural antibiotic prophylaxis in the literature and statistical difference wasn't noted between patients with or without periprocedural antibiotic prophylaxis undergoing TIVAD implantation.[47-50] However, Gebauer and Da Costa et al concluded that periprocedural antibiotic prophylaxis decreased the risk of infection undergoing pacemaker implantation.[51,52] In this study, all patients received prophylactic antibiotic before the procedure and were continued up to 3 days.

When there are cutaneous signs of local infection, antibiotic treatment should be immediately started. Empiric antibiotic administration was claimed to prevent TIVAD removal in several cases, however catheter or port related infections are potentially life-threatening).[53,54] If there is a doubt of infection in blood or catheter system, serial cultures have to be performed and antibiotic treatment should be started immediately.[12] TIVADs needed to be removed if infectious processes cannot be controlled or relapsed after treatment. Reported rates of infection after TIVAD implantation ranged from 1.1% to 8.8%[9,19,20,40,43] In the present study, local or blood stream infections were observed in 75 (1.67%) cases on follow-up and 67 (89%) of these patients responded to antibiotic therapy. Despite aggressive antibiotherapy, 8 patients which had hematological malignancies were lost due to sepsis.

Most important noninfectious complications after TIVAD implantation are deep vein thrombosis and thrombosis of the catheter. In addition to chemotherapy, procoagulant properties of tumor cells, sedentary life style of these patients, endothelial damage of the venous wall secondary to the puncture and dilatation, mechanical irritation of the vascular wall are all known to increase the risk of thrombosis.[1,55,56] It is clear that endothelial damage and the number of attempted punctures were minimized under the guidance of ultrasonography.[56] There is no consensus for the prophylactic use of anticoagulants to decrease the thrombosis incidence.[16,58,59] The reported incidence of TIVADs related thrombosis ranged between 1.06 to 66%.[55,60,61] When there is a clinical suspicion of deep vein thrombosis based on presence of local swelling, erythrocyanosis, pain and signs of collateral circulation in the limb, an ultrasound examination of the arm should immediately be performed.[19,35,61] Although ratio of the catheter-associated venous thrombosis was reported up to 66 %, few were noted to be symptomatic (3 to 32%).[1,19,41,44,62-65] If the patient is asymptomatic and the catheter is functioning, further progression of venous thrombosis may be prevented with anticoagulant therapy without the need of TIVAD removal.[1,19,35,61] Biffi et al demonstrated that catheter-related thrombosis was highest on entries through IJV (17.1%).[25] However Teichgraber et al pointed out that IJV preference for central venous access was associated with decreased mechanical catheter dysfunctions.[19] In this study, catheter-associated venous thrombosis was reported in 305 of 4501 (6,7%) patients without any catheter malfunction. Even though all patients with catheter-associated venous thrombosis were subjected to subcutaneous low molecular weight heparin, 47 (1%) TIVADs were removed because of the progression of the venous thrombosis. In the literature, partial occlusion of the catheter lumen of TIVAD was reported in a range between 6% and 26% whereas total occlusion rates were as low as 0.39% and 1.61%. Infusion of several thrombolytic agents usually provides catheter patency with a success rate of 88%.[64] TIVAD removal was preferred

in cases with catheter lumen thrombosis instead of thrombolytic therapy in 62 (1.4%) patients.

Skin perforation is a rare complication that can be seen during the long term follow-up. Factors related to skin perforation are; frequent usage of the TIVAD, TIVAD's reservoir part pressure beneath the skin, narrower TIVAD pocket size and weight loss during the therapy period. In general, three major types of TIVAD are used for central venous access. Miniports are available for pediatric patients and their potential benefit is the decreased size of the septum and catheter thickness. However their use in adult patients are not practical due to difficulty in finding the septum by medical staff and higher risk of thrombosis due to decrease in size of catheter lumen. A LT TIVAD may be defined as an intermediate model between adult regular and pediatric miniports. It is almost identical with the RT TIVAD except its thickness and wideness. LT TIVAD systems may provide ease during implantation and low rate of postprocedural skin perforations. This seems to be most beneficial in patients with cachexy during follow-up. Progressive loss of subcutaneous fat tissue during the course of chemotherapy justified the use of these LT TIVAD'S.[68] In the present study, LT TIVAD was preferred nearly in half of the patients. Teichgraber et al and Barwińska-Pobłocka et al reported skin perforation rate among 80 and 83 patients as 2.5 % and 2.41% respectively.[68,69] The difference between RT and LT TIVADs was studied only in the article by Teichgraber et al. The study presented by Teichgraber et al failed to show difference between low profile and standart probably due to low number of subjects included in their study. In the present study we demonstrated that when the subgroups compared, there was a significant difference between two groups in terms of skin perforation in normal and cachectic patients. Additionally minor hematoma was more common in RT group whereas inversion of TIVAD and venous thrombosis were more common in LT group.

In conclusion, due to the ease of insertion and low risk of skin perforation there is a tendency towards use of LT TIVAD's. This is justified by the favorable results in our large-scale study.

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