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Early and late complications and predictors of port removal in cancer patients with totally implantable venous access devices (TIVADs): a single-center retrospective study

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ABSTRACT

Aims: Totally implantable venous access devices (TIVADs), placed subcutaneously, are widely used in cancer patients for the administration of long-term intravenous therapies. However, these systems may be associated with early and late complications that can necessitate device removal. This study aimed to evaluate the incidence and clinical characteristics of complications related to port catheter implantation in oncology patients, and to identify risk factors associated with port removal.

Methods: In this retrospective, single-center study, 313 adult cancer patients who underwent subcutaneous port catheter implantation between January 2022 and July 2024 were included. All procedures were performed under local anesthesia using a dual-incision technique with ultrasound and fluoroscopy guidance. Patients were monitored for early (<30 days) and late (≥30 days) complications. Factors associated with port removal were analyzed using univariate and multivariate logistic regression models.

Results: The mean age of the patients was 62.45±7.75 years, with the most common malignancies being colorectal (45.0%), gastric (25.9%), and pancreatic cancers (8.9%). Early complications were observed in 3.2% of patients, while late complications occurred in 25.6%. The most frequent complications included infection (8.3%), catheter dysfunction (4.8%), and venous thrombosis (3.8%). Port removal was required in 66 patients (21.1%), most commonly due to local infection (6.1%), occlusion (4.8%), skin erosion (5.4%), and catheter-related bloodstream infection (CRBSI) (2.2%). Univariate analysis revealed significant associations between port removal and low body-mass index, metastasis, chemotherapy, and several complications ($p<0.05$). In multivariate analysis, metastatic disease was identified as an independent risk factor (OR: 10.14; $p<0.001$), while advanced age was inversely associated with port removal (OR: 0.95; $p=0.021$).

Conclusion: Complications related to TIVADs are common and may frequently lead to port removal, especially in metastatic cancer patients. Infection and mechanical dysfunction are the leading causes of removal. Careful follow-up and individualized preventive strategies in high-risk patients may improve long-term port functionality.

Keywords: Cancer patients, complications, port removal, totally implantable venous access device, venous port catheter

INTRODUCTION

In the treatment of cancer patients, the long-term intravenous administration of agents such as chemotherapy, antibiotics, blood products, and nutritional solutions is often required. This necessity has led to the widespread use of methods that ensure reliable vascular access while minimizing the risk of complications. Totally implantable venous access devices (TIVADs) were developed for this purpose and have become an integral part of oncologic treatment practice in recent years.[1-2]

Despite their advantages, TIVADs are associated with early and late complications such as infection, venous thrombosis, catheter dysfunction, and skin erosion. These complications may disrupt port function, interfere with treatment continuity, and in some cases require complete device removal. The reported rates of port-related complications vary widely in the literature, depending on factors such as insertion technique, venous access route, clinical characteristics of the patient population, and follow-up duration.[3-5]

Complication and port removal rates also show wide variation across studies. While complication rates have been reported between 2% and 26%, port removal rates typically range from 1.2% to 10.8%.[5-9] In contrast, a study focusing solely on breast

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cancer patients reported a notably high port removal rate of 30.2%.[10] These discrepancies may stem from differences in patient selection, duration of port use, and criteria for removal. Moreover, an imaging-based review highlighted the broad clinical and radiological spectrum of port-related complications, emphasizing the importance of early diagnosis, another potential contributor to the variability in reported rates.[11]

In recent years, alternative surgical approaches to TIVAD implantation have emerged, particularly with respect to anatomical site selection and incision technique. Among breast cancer patients, upper arm port placement has gained popularity, and a single-incision technique described by Song et al.[12] has been shown to provide shorter procedure times and better cosmetic outcomes.

Most existing studies focus on isolated cancer subgroups, and data regarding heterogeneous oncologic populations reflective of real-world practice remain limited. Additionally, many studies do not classify the clinical relevance of complications in detail, nor do they sufficiently explore the factors influencing decisions for port removal. To address this gap, the present retrospective study analyzes early and late complications following TIVAD implantation in 313 cancer patients with various tumor types and evaluates the clinical predictors of port removal, with reference to findings reported in the literature.

METHODS

Ethics

This study was designed as a retrospective, single-center, observational clinical investigation. Approved by the Researches Ethics Committee of Hitit University Faculty of Medicine (Date: 14.08.2024, Decision No: 2024/67) and conducted in accordance with the principles of the Declaration of Helsinki. Data from patients who underwent port catheter implantation between January 2022 and July 2024 were reviewed.

Patient data were retrospectively collected from hospital records and electronic medical databases. Informed consent forms were obtained from all patients prior to the procedure.

Patient Selection

The study included adult patients aged 18 years or older who underwent subcutaneous venous port catheter implantation for the administration of systemic therapy related to malignancy. All procedures were performed under local anesthesia using a dual-incision technique, guided by ultrasonography and fluoroscopy, and conducted by the same surgical team. Only patients who had at least one documented use of the port after implantation were included in the analysis.

Exclusion Criteria

- Patients who were followed up at another center after port implantation
- Patients with incomplete follow-up data or who never used the implanted port
- Patients with active infection, sepsis, or increased bleeding risk due to anticoagulation at the time of the procedure
- Patients who underwent port implantation using a different technique (e.g., single incision, upper extremity placement)

Procedural Technique

Port catheter implantations were performed under sterile conditions and local anesthesia, with Doppler ultrasound guidance. One incision was made for venous puncture, typically the internal jugular vein or, if anatomically favorable, the subclavian vein, and a second incision was created in the pectoral region to form the port pocket. The catheter was tunneled subcutaneously to connect with the port chamber. Under fluoroscopic guidance, the catheter tip was advanced to the cavoatrial junction and its position was confirmed. Following implantation, port function was tested with saline and heparinized saline. All patients underwent post-procedural chest radiography, and were discharged with a 10-day course of oral prophylactic antibiotics.

Follow-up and Clinical Monitoring

After port implantation, all patients were regularly followed for early (<30 days) and late (≥30 days) complications. In patients with suspected infection, blood cultures and catheter tip cultures were obtained. For other catheter-related complications (e.g., thrombosis or malposition), additional imaging modalities such as venous Doppler ultrasonography or CT angiography were used when necessary.

Definitions and Classification of Complications

Complications related to the venous port catheter system were categorized into early and late complications according to widely accepted criteria in the literature:

Early complications: Defined as complications occurring within the first 30 days following implantation. These included:

- Pneumothorax
- Catheter malposition
- Pocket infection
- Wound complications
- Technical failure or malfunction at initial use

Late complications: Defined as complications occurring after 30 days, typically associated with long-term use. These included:

- Catheter-related bloodstream infections (CRBSI)
- Venous thrombosis (clinically evident and/or confirmed by Doppler USG)
- Catheter occlusion/dysfunction
- Catheter migration or fracture
- Skin erosion or port chamber rotation
- Extravasation
- Any complication requiring port system removal

Definitions

CRBSI: Presence of clinical signs of infection along with isolation of the same microorganism from both blood culture and catheter tip culture, or infection not attributable to another source.

Local infections: Defined as cases limited to redness, tenderness, or purulent discharge around the port site, without systemic signs of infection. These patients were initially managed conservatively, with port removal reserved for refractory or progressive cases.

Venous thrombosis: Confirmed thrombus detected by Doppler USG or CT venography in patients with symptoms such as pain, edema, or catheter dysfunction on the port side.

Catheter dysfunction: Inadequate filling, poor infusion flow, or inability to achieve blood return through the catheter.

Skin erosion: Breakdown of overlying skin exposing the port chamber or rendering it superficial.

Extravasation: Leakage of cytotoxic agents outside the vein causing damage to surrounding tissue.

Statistical Analysis

The data analyses were performed using SPSS version 23.0 (IBM Inc., Chicago, IL, USA). The distribution of continuous variables was assessed using visual methods (histograms, Q-Q plots) and analytical tests (Kolmogorov–Smirnov test). Continuous variables that did not follow a normal distribution were presented as median (minimum–maximum) or as mean±standard deviation. The Mann–Whitney U test was used for comparisons between groups.

Categorical variables were expressed as frequencies and percentages (%). Relationships between categorical variables were analyzed using the Chi-square test, and Fisher's exact test was used when more than 20% of the expected cell counts were below 5. All tests were two-tailed.

To identify factors associated with port removal, univariate analyses were initially conducted. Variables with a p-value <0.05 and those deemed clinically relevant were included in a binary logistic regression model. In the multivariate analysis, independent effects of variables were reported as odds ratios (OR) with 95% confidence intervals (CI) and corresponding p-values.

A p-value <0.05 was considered statistically significant for all analyses.

RESULTS

A total of 313 cancer patients who underwent subcutaneous venous port implantation were included in this study. Demographic and clinical characteristics are summarized in Table 1. The mean age of the patients was 62.45 ± 7.75 years, and the mean body-mass index (BMI) was 26.31±2.07 kg/m². Among the patients, 32.3% were female, 15.3% had diabetes mellitus (DM), 41.2% had hypertension, 7.3% had chronic obstructive pulmonary disease (COPD), and 1.9% had chronic kidney disease (CKD). The most common malignancies were colorectal cancer (45.0%), gastric cancer (25.9%), and pancreatic cancer (8.9%). The proportion of patients receiving ongoing chemotherapy was 30.0%, and metastatic disease was present in 51.4% of the cases.

Table 1. Baseline demographic and clinical characteristics of the patients (n=313)

Variables		n=313
Age		62.45±7.75
BMI (kg/m²)		26.31±2.07
Sex (female)		101 (32.3%)
DM		48 (15.3%)
Hypertension		129 (41.2%)
COPD		23 (7.3%)
CKD		6 (1.9%)
Cancer type	Lung	6 (1.9%)
	Breast	13 (4.2%)
	Endometrium	2 (0.6%)
	Ovary	2 (0.6%)
	Prostate	9 (2.9%)
	Esophagus	8 (2.6%)
	Stomach	81 (25.9%)
	Hepatobiliary	15 (4.8%)
	Pancreas	28 (8.9%)
	Colo-rectal	141 (45.0%)
	Hodgkin lymphoma	3 (1.0%)
	Multiple myeloma	5 (1.6%)
Receiving chemotherapy		94 (30.0%)
Presence of metastasis		161 (51.4%)

BMI: Body-mass index, COPD: Chronic obstructive pulmonary disease, DM: Diabetes mellitus, CKD: Chronic kidney disease

Table 2 presents data on complications encountered during the operative and postoperative periods. Ports were implanted on the right side in 83.7% of cases, and the most commonly used venous access route was the internal jugular vein (IJV) (97.1%). Early complications (<30 days) occurred in 10 patients (3.2%), while late complications (≥30 days) were observed in 80 patients (25.6%). The most frequent complications were infection (8.3%), venous thrombosis (3.8%), and catheter occlusion/dysfunction (4.8%).

Pneumothorax was detected in only 2 patients (0.6%), both of whom required tube thoracostomy. Figure 1 shows a chest radiograph demonstrating pneumothorax after port implantation. Catheter malposition, defined as incorrect positioning of the catheter tip and rotation of the port chamber, was observed in only 1 patient (0.3%), and the port system was removed in that case (Figure 2).

Infection developed in 26 patients (8.3%), of which 7 (2.2%) were diagnosed as CRBSI and 19 (6.1%) as local infections. Microbiologically, *Staphylococcus aureus* was isolated in 13 patients (5 CRBSI, 8 local), and coagulase-negative staphylococci (CoNS) were identified in 13 patients (2 CRBSI, 11 local infections).

Catheter occlusion or dysfunction was observed in 15 patients, all of whom underwent port removal. Venous thrombosis occurred in 12 patients, but only 6 of these required port

Table 2. Operative and postoperative data of the patients (n=313)

Variables		n=313
Port insertion side (right)		262 (83.7%)
Venous access route (IJV)		304 (97.1%)
Early complication (<30 days)		10 (3.2%)
Late complication (≥30 days)		80 (25.6%)
Pneumothorax		2 (0.6%)
Venous thrombosis		12 (3.8%)
Infection (overall)		26 (8.3%)
	CRBSI	7 (2.2%)
	Local infection	19 (6.1%)
Infection microorganism	*Staphylococcus aureus*	13 (4.2%)
	CoNS	13 (4.2%)
Port removal required		66 (21.1%)
Reason for port removal	Catheter occlusion/ dysfunction	15 (4.8%)
	Catheter malposition	1 (0.3%)
	Skin erosion	17 (5.4%)
	Extravasation	1 (0.3%)
	Venous thrombosis	6 (1.9%)
	Local infection	19 (6.1%)
	CRBSI	7 (2.2%)

IJV: Internal jugular vein, CRBSI: Catheter-related bloodstream infection, CoNS: Coagulase-negative Staphylococci

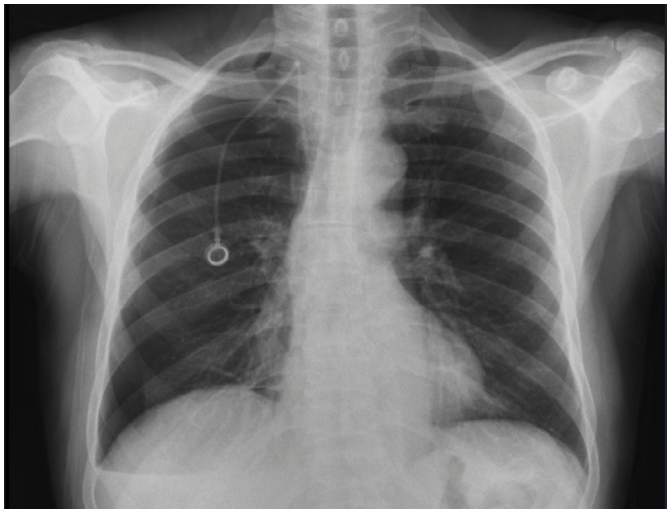

Figure 1. Posteroanterior chest radiograph demonstrating pneumothorax following port implantation. The lung contour is visible, separated from the right lateral thoracic wall, indicating the presence of a pneumothorax

removal due to symptomatic or extensive thrombosis; the remaining 6 patients were managed conservatively with anticoagulation therapy.

In total, port removal was performed in 66 patients (21.1%). The reasons for port removal were as follows:

- Catheter occlusion/dysfunction: 15 (4.8%)
- Catheter malposition: 1 (0.3%)
- Skin erosion: 17 (5.4%)
- Extravasation: 1 (0.3%)

Figure 2. Chest radiograph of a patient showing catheter tip malposition and rotation of the port reservoir

- Venous thrombosis: 6 (1.9%)
- Local infection: 19 (6.1%)
- CRBSI: 7 (2.2%)

Univariate Analysis Findings

Comparisons between patients who underwent port removal and those who did not are presented in Table 3. Univariate analyses revealed statistically significant associations between port removal and the following variables (p<0.05):

Table 3. Univariable comparison of demographic and clinical variables between patients with and without port removal

Variable	Port removed (n=66)	Not removed (n=247)	p-value
Age (years)	59.80±7.17	63.29±7.73	0.023[a]
BMI (kg/m²)	25.11±1.86	26.66±2.02	<0.001[a]
Sex (female)	23 (34.8%)	78 (31.6%)	0.648[b]
Diabetes mellitus	8 (12.1%)	40 (16.2%)	0.48[b]
Hypertension	23 (34.8%)	106 (42.9%)	0.265[b]
COPD	4 (6.1%)	19 (7.7%)	0.783[c]
CKD	0 (0.0%)	6 (2.4%)	0.349[c]
Presence of metastasis	53 (80.3%)	108 (43.7%)	<0.001[b]
Receiving chemotherapy	31 (47.0%)	63 (25.5%)	0.001[b]
CRBSI	7 (10.6%)	0 (0.0%)	<0.001[c]
Venous thrombosis	6 (9.1%)	6 (2.4%)	0.03[c]
Catheter occlusion/dysfunction	15 (22.7%)	3 (1.2%)	<0.001[c]
Malposition	1 (1.5%)	0 (0.0%)	0.208[c]
Skin erosion	17 (25.8%)	0 (0.0%)	<0.001[c]
Extravasation	1 (1.5%)	0 (0.0%)	0.208[c]
Infection (any)	26 (39.4%)	0 (0.0%)	<0.001[c]

Data are presented as mean±standard deviation for continuous variables and number (percentage) for categorical variables. a:Mann–Whitney U. b:Chi-square. c: Fisher's exact. BMI: Body-mass index, COPD: Chronic obstructive pulmonary disease, CKD: Chronic kidney disease, CRBSI: Catheter-related bloodstream infection

- Lower BMI
- Presence of metastasis
- Receiving chemotherapy
- Presence of infection

- Venous thrombosis
- Catheter occlusion/dysfunction
- Skin erosion
- CRBSI
- Positive microbiological culture results

In contrast, no significant relationship was found between port removal and variables such as sex, DM, hypertension, COPD, CKD, side of port placement, or the venous access route used (p>0.05). Although local infections were more frequent, most cases were successfully managed with conservative treatment, allowing preservation of the port system. Therefore, local infections did not show a statistically significant association with port removal (p>0.05). In contrast, systemic infections such as CRBSI were more decisive in the decision to remove the port.

Multivariate Logistic Regression Findings

Among the variables that showed statistical significance in the univariate analysis, direct complication-related factors leading to port removal were excluded from the multivariate model. Instead, the multivariate logistic regression analysis was performed using only demographic and clinical predictors. Based on this approach, two independent risk factors for port removal were identified: the presence of metastasis significantly increased the risk of port removal (OR: 10.14; p<0.001), whereas older age was inversely associated with port removal (OR: 0.95; p=0.02) (Table 4). Receiving chemotherapy approached statistical significance (p=0.054), while BMI was not found to be an independent risk factor (p=0.35).

Table 4. Multivariate logistic regression analysis of factors associated with port removal

Variable	OR	95% CI	p-value
Age	0.951	0.912–0.991	0.021
Presence of metastasis	10.14	3.55–29.01	<0.001
Receiving chemotherapy	1.97	0.98–3.95	0.054
BMI	0.90	0.71–1.18	0.35

OR: Odds ratio, CI: Confidence interval, BMI: Body-mass index. Variables with p<0.05 in univariate analysis were included in the model

These findings suggest that while certain complications (such as infection, thrombosis, or occlusion) are direct causes of port removal, clinical features like metastatic disease and advanced age may serve as indirect but important predictive factors for port discontinuation.

DISCUSSION

TIVADs are widely used in oncology patients to facilitate chemotherapy, parenteral nutrition, and long-term intravenous therapy. Although these systems enhance patient comfort, they are associated with a range of potential complications, including infection, venous thrombosis, catheter dysfunction, and skin erosion. The incidence of such complications may vary depending on factors such as implantation technique, patient characteristics, duration of use, and the structural properties of the port system employed.

In our retrospective study, early (<30 days) and late (≥30 days) complications, as well as clinical factors associated with port removal, were thoroughly investigated in 313 oncology patients who underwent subcutaneous venous port catheter implantation. The overall complication rate was 28.8%, with the most common late complications being infection (8.3%), catheter dysfunction (4.8%), and venous thrombosis (3.8%). Port explantation was required in 66 patients (21.1%), mostly due to infection, mechanical occlusion, skin erosion, and thrombosis. These findings underscore the significant impact of TIVAD-related complications on both clinical outcomes and continuity of oncologic treatment.

In our cohort, TIVAD-related infections occurred in 8.3% of patients, with 2.2% classified as CRBSIs and 6.1% as localized infections. These rates are higher than those reported in some large-scale studies, but comparable to others. For example, in a prospective study, the overall port-related infection rate was reported at 2.8%, with only 1.7% resulting in port removal.[13] Similarly, in the study by Walser,[1] CRBSI rates ranged between 0.3–1.4 per 1000 catheter days, and pocket infections were reported at a rate of 2–3%. In contrast, our study found a notably higher local infection rate of 6.1%, nearly double that reported in these series. Furthermore, infections remain one of the most concerning late complications in oncology patients receiving TIVADs. Wang et al.[14] developed and validated a nomogram to predict post-insertion infection risk based on clinical variables such as diabetes, chemotherapy regimen, leukocyte count, and serum albumin levels. While our study did not include individualized risk prediction, our infection rates are consistent with the literature and support the continued safe use of TIVADs in oncologic practice.

When examining the microbiological distribution of infections in our study, the most frequently isolated pathogens were CoNS and *Staphylococcus aureus*, each detected in 13 cases (4.2%). This distribution aligns with the common pathogens reported in the review by Lebeaux et al.,[15] which noted that CoNS infections typically respond to antibiotic therapy, whereas infections caused by *S. aureus* or *Candida* species often necessitate port removal. Furthermore, antibiotic lock therapy has been reported to achieve up to a 75% success rate in managing CoNS-related infections. However, in our series, the majority of patients with CoNS infections ultimately required port removal. This may be attributed to the fact that antibiotic lock therapy is not routinely implemented in our institutional protocol, or possibly due to the presence of advanced biofilm formation that reduced the efficacy of systemic antibiotics.

In the systematic review by Ruesch et al.,[3] the infection rate associated with catheters inserted via the IJV was reported to be 6.3%, which may partially explain the 8.3% overall infection rate observed in our study, where the IJV was utilized in 97.1% of cases. Additionally, some studies have reported infection rates ranging between 2.8% and 3.0%.[7,8] This discrepancy may be attributed to the high prevalence of metastatic disease in our patient population (51.4%), their immunocompromised status, and the possibility of longer catheter dwell times.

In the guideline-level review by Vescia et al.,[2] infection rates in TIVAD systems were reported to range between 3% and 12%, while the incidence of CRBSIs was defined as 0.2–1.4 per 1.000 catheter-days. In our study, the CRBSI rate was 2.2% on a per-case basis. Although this rate cannot be directly compared due to the absence of catheter-day data, it should still be considered within acceptable limits. However, the relatively high incidence of port pocket infections highlights the need for close monitoring, especially in patients with thin subcutaneous tissue or those receiving immunosuppressive therapy.

The impact of the insertion side on complication rates has been increasingly recognized in recent literature. In a 2024 retrospective comparative study of female breast cancer patients, O'Mahony et al.[16] demonstrated that catheter tip migration from the supine to erect position was significantly more pronounced in right-sided ports. Importantly, in left-sided ports, zone migration was statistically associated with an increased risk of complications (p=0.023). Although our study did not directly assess catheter tip position changes, the lower rate of complications observed in right-sided ports may be partly explained by the positional instability highlighted in O'Mahony's study.[16]

In conclusion, although the overall infection rates observed in our study were consistent with the ranges reported in the literature, the relatively high rate of local infections is noteworthy. This finding suggests a need to reassess post-insertion care protocols, particularly regarding standardized skin care and port site hygiene. Moreover, as emphasized in the study by Lebeaux et al.,[15] therapeutic strategies for *S. aureus* and CoNS infections should be tailored according to the specific pathogen involved.

In our study, catheter-related venous thrombosis was observed in 3.8% of patients, and port removal was required in only half of these cases (1.9%). This rate aligns with the broad range of thrombosis incidences reported in previous studies. Particularly, in ports inserted via the IJV, the incidence of thrombosis has been reported to range between 2% and 6%.[1,3] In some series, the thrombosis rate was considerably higher for the jugular route (12.8%) compared to the subclavian (6.5%) and cephalic (9.2%) veins.[4] The high prevalence of IJV usage in our study (97.1%) may partially explain the observed thrombosis rate. Similarly, Liu et al.[17] reported a 6.1% incidence of TIVAD-related thrombosis in a large cohort of 1.586 breast cancer patients, identifying left-sided IJV access, larger-diameter catheters (particularly 8F), and prolonged indwelling duration as independent risk factors. Although their study focused exclusively on breast cancer patients, the clinical relevance of catheter size, laterality, and duration shares meaningful parallels with our findings. Nevertheless, the fact that most thrombosis cases in our cohort were managed conservatively without necessitating port removal helped keep the explantation rate limited.

The rate of catheter dysfunction or occlusion in our cohort was 4.8%, and all such cases required port removal. This figure is consistent with those reported in the literature, which generally range between 2% and 5%.[1,2] However, some studies focusing on single-incision port placements have reported lower rates, as low as 1.2% or even 0.1%.[6,8] Variations in dysfunction rates may be attributed to differences in implantation technique, tunnel length, catheter material, intensity of use, and maintenance protocols. Our findings indicate that this complication often necessitates invasive intervention. Moreover, an umbrella review by Elliott et al.[18] emphasized that catheter occlusions remain a frequent and serious issue, with rates as high as 14–36%, and highlighted the role of standardized flushing and locking protocols in prevention. This underscores the need for further protocol development to reduce dysfunction-related port removals.

Skin erosion complications were observed at a relatively high rate of 5.4% in our series, and all cases resulted in port removal. In contrast, lower rates have been reported in the studies by Nakamura et al.[7] (1.5%), El-Balat et al.[10] (0.7%), and Biffi et al.[13] (0.3%). This discrepancy may be attributed to several factors, including the thickness of the subcutaneous tissue at the port pocket site, patients' cachectic or metastatic status, nutritional deficiencies, and immunosuppression. Additionally, reduced skin elasticity in elderly or systemically compromised patients may facilitate the development of this complication.

Furthermore, in the study by Song et al.,[12] the single-incision technique used for TIVAD placement in the upper arm was associated with shorter procedure times and better cosmetic outcomes, while maintaining comparable complication rates. Differences in implantation site (chest vs. upper arm) and surgical technique may play a decisive role in the frequency of complications such as infection and skin erosion. These findings suggest that the surgical approach not only affects cosmetic outcomes but also has a direct impact on clinical results and patient satisfaction.

In our study, a total of 66 patients (21.1%) required removal of the port system. This rate exceeds the 1.2% to 10.8% range reported in many previous studies.[5-9] However, some series involving only breast cancer patients have reported port removal rates as high as 30.2%.[10] This discrepancy may be explained by differences in patient populations, particularly the proportion of metastatic cases, overall systemic conditions, and the clinical protocols followed. In our study, complications that did not resolve despite conservative treatment also played a decisive role in the decision to remove the port.

The relatively higher complication rates observed in our study compared to some other series can be attributed to the broader and more clinically representative patient population. Many studies in the literature focus solely on specific oncological subgroups; for example, Hong et al.[9] examined head and neck malignancies, El-Balat et al.[10] studied only breast cancer patients, and Song et al.[19] evaluated patients with right-sided breast cancer. In contrast, our study included a wide range of tumor types, including colorectal, gastric, pancreatic, pulmonary, and hematologic malignancies, with 51.4% of patients being in the metastatic stage. This scenario likely reflects the coexistence of multiple factors that may predispose to complications, such as immunosuppression, malnutrition, poor skin integrity, and limited mobility.

These findings demonstrate that complications associated with TIVADs are not solely dependent on technical proficiency;

rather, factors such as patient selection, procedural practices, follow-up protocols, and individualized care strategies play a critical role in outcomes.

In our study, univariate analysis identified several variables significantly associated with port removal, including advanced age, presence of metastatic disease, current chemotherapy, BMI, and complications such as CRBSI, catheter dysfunction, thrombosis, and skin erosion. However, since these complications were direct causes of port explantation, only demographic and clinical variables were included in the multivariate logistic regression model. In this analysis, metastatic disease [OR: 10.14, 95% CI: 3.55–29.01; p<0.001] emerged as the strongest independent predictor of port removal. Conversely, advanced age [OR: 0.95, 95% CI: 0.91–0.99; p=0.021] was inversely associated with port explantation, while ongoing chemotherapy showed a borderline association (p=0.054).

Metastatic disease is typically accompanied by increased risk factors such as malnutrition, immunosuppression, and poor skin and tissue integrity, all of which predispose patients to complications like infection, skin erosion, and thrombosis. Indeed, the impact of metastasis on port removal has been indirectly reported in studies by El-Balat et al.[10] and Lebeaux et al.[15] Our data confirm this trend, indicating a stronger inclination toward port removal—rather than preservation—when complications arise in metastatic patients.

Interestingly, advanced age was inversely associated with port removal in our multivariate model. Although counterintuitive at first glance, this may reflect a clinical preference for conservative management in older patients due to their overall condition and treatment plans, even when complications occur. Additionally, the tendency to avoid aggressive interventions in elderly individuals may lead to a higher rate of port retention, even in the face of infection or mechanical issues. In the study by Walser et al.,[1] older individuals were reported to have higher complication rates, though how this influenced port removal decisions was not clearly addressed. Therefore, the relationship between age and port removal should be interpreted cautiously in the clinical context.

In the study by Song et al.,[12] infection risk was linked to systemic conditions such as diabetes, hypertension, and hyperlipidemia. In contrast, our findings highlight metastatic disease and advanced age as key clinical predictors of port-related complications requiring removal. This discrepancy suggests that patient risk profiles may vary depending on the study population and surgical techniques employed.

In conclusion, metastatic disease appears to be a significant risk factor for reduced long-term TIVAD sustainability. In these patients, a thorough risk assessment should be performed before implantation, and close monitoring for infection, skin integrity, and port function is essential postoperatively. Advanced age was inversely associated with port removal, possibly due to the preference for less aggressive or conservative management in elderly patients. Thus, even when complications occur in older individuals, the clinical tendency may favor port preservation. For both patient groups, the implementation of preventive strategies, including antibiotic prophylaxis, skin care education, and regular port function monitoring, may enhance port longevity and reduce the need for explantation.

Limitations

This study has several limitations. First, due to its retrospective design, data collection was based on patient files and hospital records, which may result in missing or inaccurately documented clinical details. Second, the study was conducted at a single center, with all port implantations performed using the same surgical technique and primarily by the same team. Therefore, the generalizability of the findings to other centers may be limited. Third, since data regarding the duration of catheter use were not collected, complication rates per 1000 catheter-days could not be calculated. Additionally, variability in follow-up durations among patients may have influenced the observed frequency of late complications. Fourth, decisions regarding port explantation were based on individualized clinical judgment, which may have introduced subjectivity, for example, a more conservative approach might have been preferred for elderly patients, potentially affecting the interpretation of explantation rates. Finally, some important clinical variables such as patients' performance status, nutritional condition, chemotherapy regimens, and comorbid systemic diseases could not be included in the model. Thus, future prospective, multicenter studies with longer follow-up periods are needed.

CONCLUSION

Subcutaneous venous port catheters are indispensable tools for meeting the long-term intravenous treatment needs of oncology patients; however, they carry significant risks of complications such as infection, thrombosis, catheter dysfunction, and skin erosion. In this study, early and late complications related to TIVADs were comprehensively evaluated in a heterogeneous patient population characterized by a wide range of tumor types and a high proportion of metastatic disease. Notably, infections and mechanical issues were shown to be closely associated with port removal.

Multivariate analysis revealed that metastatic disease is an independent risk factor significantly increasing the likelihood of port explantation. Conversely, older age was inversely associated with explantation, possibly reflecting a clinical tendency toward less aggressive intervention and more conservative management in this age group. These findings indicate that successful port use is influenced not only by technical expertise but also by patient profile and clinical decision-making processes.

In conclusion, careful risk assessment should be conducted prior to port placement in patients with metastatic disease or of advanced age. Post-implantation, close monitoring of infection, skin integrity, and port function is essential. Individualized preventive measures, such as antibiotic prophylaxis, skin care education, and regular port function assessments, may help reduce complication rates and improve the long-term sustainability of the port system.

ETHICAL DECLARATIONS

Ethics Committee Approval
Approved by the Researches Ethics Committee of Hitit University Faculty of Medicine (Date: 14.08.2024, Decision No: 2024/67).

Informed Consent
Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process
Externally peer-reviewed.

Conflict of Interest Statement
The authors have no conflicts of interest to declare.

Financial Disclosure
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Author Contributions
All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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