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Implantation of Totally Implantable Access Ports via The Internal Jugular Vein in Oncological Patients - A Single General Surgeon Experience

Onkolojik Hastalarda İnternal Jügüler Ven Yoluyla Venöz Port Implantasyonu- Tek Bir Genel Cerrahın Deneyimi

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Öz

Santral venöz erişim tekrarlayan kemoterapi, hemodiyaliz, kan transfüzyonları, total parenteral beslenme ve kan örnekleri alımı gereken onkoloji hastaları için kritik öneme sahiptir. Bu çalışma, genel anestezi altında ve ultrasonografi ve floroskopi rehberliğinde bir genel cerrahın Totally Implantable Access Port (TIAP) implantasyon deneyimini sunmayı ve erken ve geç komplikasyonları değerlendirmeyi amaçlamaktadır. Bir retrospektif çalışma, Ocak 2020 ile Aralık 2022 tarihleri arasında TIAP implantasyonu yapılan hastalar üzerinde yürütüldü. Solid tümörler için intravenöz kemoterapi uygulanan hastalar dahil edildi. İşlemlerin tamamı tek bir genel cerrah tarafından gerçekleştirdi. Bütün hastalara genel anestezi uygulandı ve bir perkütan Seldinger tekniği kullanıldı. Erken ve geç komplikasyonlar izlendi ve ilgili veriler toplandı. Çalışma, yaş ortancası 46 yıl, çoğunluğu kadın (%65.1) olan 186 hasta içeriyordu. Genel başarı oranı %99.5 idi. Erken ve geç komplikasyonlar sırasıyla vakaların %1.6'sında ve %5.9'unda meydana geldi. En yaygın geç komplikasyonlar port yerinde enfeksiyon (%1.6) ve semptomatik tromboz (%1.6) idi. Bir hastada oluşan port migrasyonu aynı gün düzeltildi. Pnömotoraks vakası gözlenmedi. Kemoterapisi sonlanan 92 hastada port çıkarıldı. TIAP implantasyonunun ultrasonografi ve floroskopi rehberliğinde ve genel anestezi altında bir genel cerrah tarafından gerçekleştirilmesi durumunda yüksek başarı oranı ve düşük komplikasyon oranı söz konusudur. Bu bulgular, özel bir hastane ortamında ve genel anestezi altında TIAP implantasyonunun güvenli ve etkili olduğunu vurgulamaktadır. Çalışma, genel cerrahların onkoloji hastaları için etkili ve güvenli bir şekilde TIAP implantasyonunu gerçekleştirmelerini destekleyen bir kanıt olarak değerlendirilebilir. Böylelikle farklı klinik ortamlarda daha yaygın olarak kullanılmasını sağlayabilir.

Anahtar Kelimeler: Genel Anestezi, Genel Cerrah, Hastane Onkoloji Servisi, Vasküler Erişim Cihazı

Abstract

Central venous access is pivotal for patients undergoing repetitive chemotherapy, hemodialysis, blood transfusions, total parenteral nutrition, and blood tests. This study aims to present the single-center experience of a general surgeon in Totally Implantable Access Port (TIAP) implantation under general anesthesia using ultrasonography and fluoroscopy guidance and assess early and late complications. A retrospective study was conducted on patients who underwent TIAP implantation between January 2020 and December 2022. Patients eligible for intravenous chemotherapy with solid tumors were included. A single general surgeon performed the procedures. General anesthesia was administered in all patients, and a percutaneous Seldinger technique was utilized. Early and late complications were monitored, and relevant data were collected. The study comprised 186 patients with a median age of 46, predominantly female (65.1%). The overall success rate was 99.5%. Early and late complications occurred in 1.6% and 5.9% of cases. The most common late complications were pocket infection (1.6%) and symptomatic thrombosis (1.6%). Port migration occurred in one patient but was promptly corrected. No pneumothorax cases were observed. Port removal was performed in 92 patients upon chemotherapy completion. Implantation of TIAPs under general anesthesia, guided by ultrasound and fluoroscopy, resulted in a high success rate and low complication rate when performed by a skilled general surgeon. These findings underscore the safety and efficacy of TIAP implantation under general anesthesia in a private hospital setting. The study contributes to the growing body of evidence supporting general surgeons in providing effective and safe TIAP implantation for oncology patients, potentially expanding its availability in diverse clinical settings.

Keywords: General Anesthesia, General Surgeon, Hospital Oncology Service, Vascular Access Devices

Introduction

Central venous access is a critical concern for oncology patients who require repeated administration of chemotherapy, hemodialysis, blood transfusions, total parenteral nutrition, and blood tests (1,2). Prolonged chemotherapy cycles in cancer patients can make accessing peripheral veins increasingly challenging, potentially disrupting treatment. While Hickmann and Broviac tunneled externalized central venous catheters are commonly used in chemotherapy patients due to their ease of implantation (3-5), they are not without drawbacks, including a higher risk of infections from skin microflora (6,7), thrombotic complications leading to catheter malfunction (8), and restrictions on patient activities (9). Besides the type and technique used during the catheter insertion, the central venous access insertion site might influence the early or late occurrence of complications (1). Additionally, the choice of catheter type, insertion technique, and access site can impact the success and maintenance of catheters in chemotherapy patients (10,11).

Totally implantable access ports (TIAPs) provide a safe alternative for venous access with lower infection and malfunction rates than external systems. Access points, such as the subclavian,

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jugular, and upper extremities, can be used for venous access (12). Different techniques, including direct percutaneous puncture using the Seldinger technique or venous cutdown with open insertion, can be employed for catheter insertion, each with unique advantages and disadvantages. However, procedural complications may increase with blind approaches for venous access localization, necessitating ultrasound, and fluoroscopy-guided percutaneous techniques to minimize risks (13,14). Several guidelines, including National Institute for Health and Care Excellence (NICE) recommendations, endorse using ultrasound when inserting central venous catheters (11,15).

The insertion of TIAPs can be performed by interventional radiologists, general or vascular surgeons, or anesthesiologists (16,17). Depending on patients' characteristics, catheter insertion under general anesthesia by surgeons was common practice (2,18). Nevertheless, limited circumstances for general anesthesia availability in interventional radiology might influence the trends in central venous catheter insertions for each hospital (17). So, the choice of who performs the procedure may depend on various factors, including the availability of interventional radiology and the patient's specific characteristics. In our tertiary hospital for oncology patients, general surgeons have been inserting TIAPs under general anesthesia for over a decade.

In this study, we aim to present the experience of a single general surgeon in TIAP implantation using ultrasonography and fluoroscopy guidance and assess early and late complications.

Material and Method

Study

A retrospective study was conducted on patients who underwent TIAP placement between January 2020 and December 2022. The local institutional review board approved the study (11.07.2023; 2023,14/301). All procedures adhered to ethical standards outlined by the responsible committee on human experimentation (institutional and national) and the Helsinki Declaration of 1975, as revised in 2008. Given the study's retrospective nature and the data's unanimity, written informed consent could not be obtained from the patients.

Patients

The study included all consecutive patients with solid tumors eligible for intravenous chemotherapy who underwent TIAP placement at Al Zahra Private Hospital Dubai, United Arab Emirates, between January 2020 and December 2022. Exclusion criteria encompassed an American Society of Anesthesiologists (ASA) grade of 5, active infections, coagulopathy (defined as a platelet count less than 50,000/µl and/or international normalized ratio >1.5), life expectancy less than six months, and incomplete follow-up (1,2).

All procedures were performed by a single general surgeon with 23 years of experience in the field but no previous experience in port insertion. The initial ten operations were conducted under the supervision of an experienced surgeon.

Surgical technique

General anesthesia was administered for all operations following a preoperative anesthesia assessment. Prophylactic treatment included a single dose of 1.2-gram amoxicillin-clavulanic acid, with ciprofloxacin 400 mg provided for patients with penicillin allergies. All procedures utilized the percutaneous Seldinger technique (19), with a single-lumen implantable port/titanium PowerPort® (Becton, Dickinson and Company, New Jersey, USA) inserted for all patients (Figure-1).

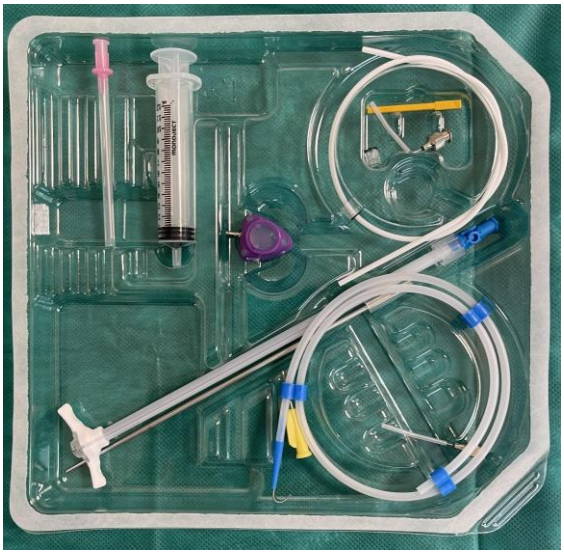

Figure 1. Single-lumen implantable port / titanium PowerPort® (Becton, Dickinson and Company, New Jersey, USA)

The preferred venous access site was the right internal jugular vein, with the left internal jugular vein used for patients with right-sided breast cancer or in cases of unsuccessful attempts at the right jugular vein. Before induction, the internal jugular vein was visualized using 2D ultrasound, with a 500 ml saline bolus administered to increase vessel diameter when necessary. Patients were supine in the Trendelenburg position, and a headring was employed to stabilize the neck. After a timeout, patients were draped in a sterile manner. Once prepared, ultrasound-guided access to the right/left internal jugular vein was identified. The needle was introduced, and the guidewire was advanced to the superior vena cava and right mid-atrium. Subsequently, dilators and the catheter were introduced 13-15 cm from the skin area, with fluoroscopy used to confirm the placement of dilators and the catheter. Following these steps, a

transverse incision was made in the subclavian area, creating a pocket for the port. The catheter was tunneled subcutaneously to the pocket in the right/left subclavian area, where the port was connected to the catheter and secured in place (Video). The position of the port and catheter was confirmed by fluoroscopy for the final time (Figure 2a). Adequate inflow and outflow were verified with heparinized saline. The port was secured to the deep fascia using a 3-0 polyglactin suture. Subcutaneous skin closure was performed with a 3/0 polyglactin suture, followed by subcuticular closure with a 2/0 polyglactin suture. A waterproof dressing was applied to the wound.

A chest X-ray was obtained before discharge to reconfirm the tip's position and rule out pneumothorax (Figures 2b and 2c). All procedures were performed as day-case surgeries, and patients were discharged the same day after review by the surgical team.

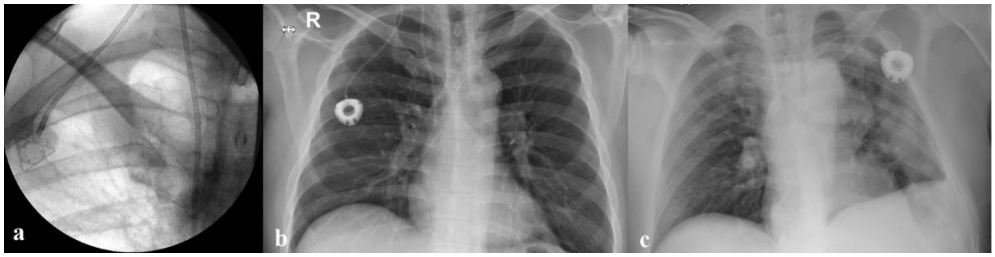

Figure 2. a) Final image of port and catheter of flouroscopy during the procedure, b) Chest X-ray after right-side port-a-cath placement, and c) Chest X-ray after left-side port-a-cath placement.

Follow-up

Early and late complications were documented, with any complications occurring within the first seven to ten days after implantation considered early complications (20). All patients were followed up in the outpatient clinics of the department for six months postoperatively. Additionally, all patients were subjected to sonography at least every six months during their oncology clinic follow-up to check for venous thrombosis. Removal of TIAPs due to local infectious findings was classified as port infection (20). In cases with clinical signs suggestive of wound infection, broad-spectrum antibiotics were initiated as the first-line treatment. Symptomatic patients with port thrombosis underwent immediate ultrasound examination.

Variables and data collection

The medical records of patients were retrieved from the hospital information system. Demographic data (age, sex), clinical characteristics (diagnosis, access site, success rate), and follow-up data (port removal, follow-up duration) were collected and recorded.

Statistical analysis

The Shapiro-Wilk test was used to assess the normal distribution of numerical variables. The median with minimum and maximum values was employed for continuous variables without normal distribution for descriptive statistics. Categorical variables were presented as numbers and percentages.

Results

The study included 186 patients with a median age of 46 years, with the majority being female (65.1%). Breast cancer (48.4%) and gastrointestinal malignancies (26.9%) were the most prevalent oncological diagnoses in the study group. The right jugular vein was the most commonly selected access route (93.0%). The overall success rate was 99.5% (n=185). The access was unsuccessful in one patient with sizeable cervical lymph nodes around the right internal jugular vein. Nevertheless, the left-sided intervention was performed without any complications. Detailed demographic and clinical characteristics are provided in Table 1.

Table 1. Demographic and clinical characteristics of the patients.

Gender	Value (N=186)
Age (year) †	46 (17-76)
Sex ‡	
Female	121 (65.1)
Male	65 (34.9)
Diagnosis ‡	
Breast cancer	90 (48.4)
Gastrointestinal	50 (26.9)
Stomach	14 (28.0)
Colorectal	33 (66.0)
Esophagus	3 (6.0)
Hepatopancreatobiliary	10 (5.4)
Pancreas	5 (50.0)
Liver	5 (50.0)
Female reproductive	14 (7.5)
Ovarian	7 (50.0)
Cervix	4 (28.6)
Uterus	3 (21.4)
Male reproductive	11 (5.9)
Testis	2 (18.2)
Prostate	9 (81.8)
Osteosarcoma	4 (2.2)
Renal	7 (3.8)
Access side ‡	
Right jugular vein	173 (93.0)
Left jugular vein	13 (17.0)

†: median (min-max), ‡: n (%)

The median follow-up duration was 396 days, ranging from 180 to 583 days. Early and late complications occurred in 1.6% and 5.9% of cases, respectively (Table 2).

Port migration occurred in the fifth patient of the study group, which was promptly corrected under local anesthesia. No cases of pneumothorax were observed.

The most frequent late complications were pocket infection (1.6%) and symptomatic thrombosis (1.6%), occurring in three patients.

All patients received at least one cycle of chemotherapy. Port removal was performed in 92 patients upon completion of chemotherapy during the follow-up period. However, in six patients, TIAP devices were removed before completing chemotherapy due to port leak (n=1), port infection (n=2), and catheter-associated venous thrombosis (n=3).

Table 2. Distribution of the early and late complications in patients with TIAP.

	Value (N=186)
Follow up (days) †	396 (180-583)
Early complications ‡	3 (1.6)
Port migration	1 (0.5)
Hematoma	1 (0.5)
Arterial puncture	1 (0.5)
Late complications ‡	11 (5.9)
Port infection	2 (1.1)
Pocket infection	3 (1.6)
Port leak	1 (0.5)
Symptomatic thrombosis	3 (1.6)
Asymptomatic thrombosis	2 (1.0)

†: median (min-max), ‡: n (%)

Discussion

In this study, we have demonstrated that a general surgeon's implantation of TIAPs under general anesthesia yields a remarkably high success rate of 99.5% and relatively lower rates of both early and late complications. These findings provide valuable insights into the safety and efficacy of TIAP implantation, mainly when conducted by a general surgeon in a private hospital setting.

Several professional societies, such as the Japanese Society of Interventional Radiology and the Shanghai Expert Consensus, have developed clinical questions and guidelines for central venous port placement (11,21). These guidelines emphasize blood vessel selection, port implantation site, antimicrobial prophylaxis, image guidance, disinfection, and post-administration procedures for drugs via the CV port. Adhering to these guidelines and recommendations can contribute to more favorable outcomes and should be considered in practice.

Our results align with previous research indicating the advantages of port-a-cath implantation using the Seldinger technique, including high success rates, extended indwelling times, cost-effectiveness, and a reduced incidence of complications (22-24). However, it is worth noting that a recent Cochrane review found no significant difference in overall complication rates between the Seldinger and venous cutdown techniques (10). Our study employed the Seldinger technique with the inferior jugular vein for all patients. While most clinical trials have utilized the subclavian vein for venous access, some have opted for the internal jugular vein (10,21). Prospective studies are necessary to determine the superiority of one technique or venous insertion site over another definitively.

Although many studies in the literature have demonstrated the safety of chemotherapy ports, the majority of these procedures have been performed by interventional radiologists (26,2). Recent studies have indicated a shift in the healthcare landscape even for the non-tunneled vascular catheters. The numbers of non-tunneled central venous catheter insertions decreased for surgeons, radiologists, and anesthesia providers. In contrast, line insertions performed by emergency physicians, advanced practice nurses, and physician assistants increased (17). A recent study by Karolin et al. (27) reported results of TIAP procedures performed exclusively by a general surgeon in a single-center setting, albeit using a standardized open approach. Several other single-center studies have reported positive outcomes with large case volumes, employing various techniques performed by general surgeons (28,29). Notably, Jeon et al. (20) demonstrated that TIAP implantation can be safely and effectively performed by surgical residents, suggesting that TIAP placement should be considered a fundamental surgical technique for resident training across various specialties. These findings might have implications for resident training and maintenance of competence for surgeons in future.

In our study, all TIAP implantation procedures were performed by a single general surgeon under general anesthesia, using the Seldinger technique via the internal jugular vein with guidance from ultrasonography and fluoroscopy. We, alongside other researchers, believe that ultrasound guidance offers significant advantages in visualizing vessel anatomy and diameter (30,31). While some physicians may rely on anatomical landmarks to assess the internal jugular vein, it has been shown that ultrasound-guided prepuncture of the vein facilitates cannulation (1,6). In our study, the remarkable 99.5% success rate in accessing the vein can be attributed to ultrasound guidance, reinforcing the importance of visualizing vessels before puncture and recommending the routine use of ultrasound guidance.

Thrombosis leading to catheter blockage and catheter-related infections are complications that may necessitate port removal. Several risk factors,

including catheter type, insertion site, catheter usage duration, cancer type, chemotherapy treatment frequency, and port usage for nutrition and blood draws, contribute to thromboembolic events following TIAP implantation (31). In our study, we observed symptomatic thrombosis in only three patients during the follow-up period, and our rate of symptomatic port thrombosis was lower than previously reported rates (22). The reasons for such variations in reported rates remain unclear (31). However, the localization of the catheter tip placed in the upper portion of the superior vena cava may be associated with an increased risk of port thrombosis (2,29). So, careful placement of the tip of the catheter during the procedure by fluoroscopy and adjustment of its length might be vital in reducing thrombotic complications (29). Monthly flushing of ports with a heparinized saline solution mixture may also help prevent such complications, although results in the literature are conflicting (31,32).

Numerous studies have shown that TIAPs are associated with fewer infections than external devices. Avoiding exposure to the external environment and cutaneous contamination significantly reduces the risk of catheter infections (6,33). Our infectious complication rates were consistent with previously reported outcomes (34,35). Variations in infection rates may be linked to patients' characteristics (2).

The major limitation of our study is its retrospective design. We did not perform a learning curve analysis at the initiation of the study. Nonetheless, the study benefits from substantial sample size and meticulous data collection through a prospectively maintained database. Furthermore, the study was conducted by a surgeon in a private hospital with a comprehensive oncology center, where patients received close and thorough follow-up care. This aspect may be crucial in accurately assessing both complications and procedure success rates.

Conclusion

In conclusion, our findings suggest that TIAP insertion under general anesthesia, guided by ultrasound and fluoroscopy, is a safe procedure associated with a low complication rate. Notably, this procedure can be successfully performed by trained general surgeons. The results of our study contribute to the growing body of evidence supporting the role of general surgeons in providing effective and safe TIAP implantation for oncology patients, potentially expanding the availability of this valuable intervention in various clinical settings.

Conflict of interest statement

There is no conflict of interest, or nothing to disclose.

Ethics Committee Approval: Ethics committee approval was obtained from Al Zahra Hospital Dubai (11.07.2023; 2023,14/301) for the study.

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