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■ Original Article ■

Complications of Central Venous Totally Implantable Access Port: Internal Jugular Versus Subclavian Access

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Background: Totally implantable access port (TIAP) provides reliable, long term vascular access with minimal risk of infection and allows patients normal physical activity. With wide use of ports, new complications have been encountered. We analyzed TIAP related complications and evaluated the outcomes of two different percutaneous routes of access to superior vena cava.
Methods: All 172 patients who underwent port insertion with internal jugular approach (Group 1, n = 92) and subclavian approach (Group 2, n = 79) between August 2011 and May 2013 in a single center were analyzed, retrospectively. Medical records were analyzed to compare the outcomes and the occurrence of port related complications between two different percutaneous routes of access to superior vena cava.
Results: Median follow-up for TIAP was 278 days (range, 1-1868). Twenty four complications were occurred (14.0%), including pneumothorax (n = 1, 0.6%), migration/malposition (n = 4, 2.3%), pinch-off syndrome (n = 4, 2.3%), malfunction (n = 2, 1.1%), infection (n = 8, 4.7%), and venous thrombosis (n = 5, 2.9%). The overall incidence was 8.7% and 20.3% in each group (p = 0.030). Mechanical complications except infectious and thrombotic complications were more often occurred in group 2 (p = 0.033). The mechanical complication free probability is significantly higher in group 1 (p = 0.040).
Conclusions: We suggest that the jugular access should be chosen in patients who need long term catheterization because of high incidence of mechanical complication, such as pinch-off syndrome.

Key Words: jugular vein; subclavian vein; vascular access; vascular access devices.

Introduction

Central venous catheters (CVCs) are needed for the clinical management of malignant and benign conditions. Indications for CVC placement include safe administration of parenteral nutrition, specific drugs (e.g., catecholamines), and hemodynamic monitoring.[1] In particular, CVCs have become an important part of managing cancer patients because of the administration of supportive blood products, antiemetics, antibiotics, analgesics, and continual chemotherapy or other systemic therapy.[2] However, repeated venipuncture may cause physical and psychological trauma to patients.

Broviac et al[3] were the first to describe a long term venous catheter system, and since then the totally implantable access port (TIAP) has been used for cancer patients.[4] The TIAP provides reliable, long-term vascular access with minimal risk of infection while allowing patients to continue normal physical activity.[4] However, approximately 15% of patients with TIAP experience catheter-related complications.

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[5] Previous research has found that TIAP complication rates differed according to central venous access routes.[6-9] Furthermore, there is no consensus on whether a central venous insertion site is less prone to complications.

Therefore, the purpose of this study was to analyze TIAP-related complications that were all performed at a single institution and to evaluate the outcomes of two different percutaneous routes (internal jugular and subclavian) as access to superior vena cava.

Materials and Methods

This study included 171 patients who underwent an implantation with a Bard Port™ (Bard Inc., Salt Lake City, UT, USA) constructed of titanium and silicon rubber with 6 Fr polyurethane catheter tubing attached. The implantations were performed by a single surgeon between August 2011 and May 2013 and the results were retrospectively analyzed. All subcutaneous port devices were implanted via percutaneous landmark access with fluoroscope guidance to the internal jugular vein or via infraclavicular access to the subclavian vein. All implantations occurred under local anesthesia in an operating room, using standard surgical sterile techniques, and a chest X-ray was always performed after implantation.

Patients were divided into two Groups; Group 1 (internal jugular access) and Group 2 (subclavian access). Patient characteristics, including diagnosis, port placement sites,

Table 1. Baseline characteristics of patients

	Group 1	Group 2	Total
Total patients, No. (%)	92 (53.8)	79 (46.2)	171 (100)
Age (year)			
Median	62	57	59
Range	1-82	15-77	1-82
Gender, No. (%)			
Male	34 (37.0)	24 (30.4)	58 (33.9)
Female	58 (63.0)	55 (69.6)	113 (66.1)
Type of disease, No. (%)			
Malignancy	85 (92.4)	77 (97.5)	162 (94.7)
Brain	0 (0)	1 (1.3)	1 (0.6)
Head and neck	1 (1.1)	1 (1.3)	2 (1.2)
Breast	18 (19.6)	22 (27.8)	40 (24.7)
Lung	16 (17.4)	4 (5.0)	20 (12.3)
Thymus	0 (0)	1 (1.3)	1 (0.6)
Esophagus	1 (1.1)	4 (5.0)	5 (3.0)
Stomach	13 (14.1)	17 (21.5)	30 (18.5)
Colon	0 (0)	2 (2.5)	2 (1.2)
Genital	6 (6.5)	5 (6.3)	11 (6.8)
Bone	3 (3.3)	3 (3.8)	6 (3.7)
Leukemia	0 (0)	2 (2.5)	2 (1.2)
Lymphoma	27 (29.3)	15 (19.0)	42 (25.9)
Benign	7 (7.6)	2 (2.5)	9 (5.3)
Side, No. (%)*			
Right	81 (88.0)	20 (25.3)	101 (59.1)
Left	11 (12.0)	59 (74.7)	70 (40.9)

Data are shown as number of patients with percentages in parentheses.
*$p < 0.05$ (statistical comparison by chi square test).

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Table 2. Comparison of port related complications

	Group 1	Group 2	p-value
Mechanical complications, No. (%)	2 (2.2)	9 (11.4)	0.033
Pneumothorax	0 (0.0)	1 (1.3)	0.462
Hemothorax	0 (0.0)	0 (0.0)	-
Migration/malposition	1 (1.1)	3 (3.8)	0.336
Pinch off syndrome	0 (0.0)	4 (5.1)	0.044
Malfunction	1 (1.1)	1 (1.3)	1.000
Infectious complications, No. (%)	4 (4.3)	4 (5.1)	1.000
Thrombotic complications, No. (%)	2 (2.2)	3 (3.8)	0.663
Total, No. (%)	8 (8.7)	16 (20.3)	0.030

Data are shown as number of patients with percentages in parentheses.

and port-related complications were collected. Port-related complications were documented in accordance with the Society of Interventional Radiology reporting standards. [6] Data were collected until the device was removed or the patient passed away. The comprehensive database was approved by the Institutional Review Board.

Independent t-tests, Fisher exact and chi square tests were used to compare the clinico-pathologic characteristics and evaluate the outcomes of two different percutaneous routes of access to superior vena cava. Kaplan-Meier and log rank tests were used to demonstrate the mechanical complication-free probability between each intravenous access. All analyses were performed with SPSS version 13.0 for Windows (SPSS, Chicago, IL, USA).

Ethics statement

The study protocol was approved by the institutional review board by Yonsei University Wonju College of Medicine (approval number YUMC-13-5-073). Informed consent was waived by the institutional review board.

Results

Table 1 shows patient characteristics. Of 171 patients, 58 (33.9%) were male and 113 (35.3%) were female. Median follow-up for TIAP was 278 days (range, 1–1,868). Median age at time of port placement was 59 years (range, 1-82). Indications for TIAP included chemotherapy for solid organ malignancy (n = 118, 69.0%), lymphoproliferative disorder (n = 44, 25.7%), and a benign condition (n = 9, 5.3%). The

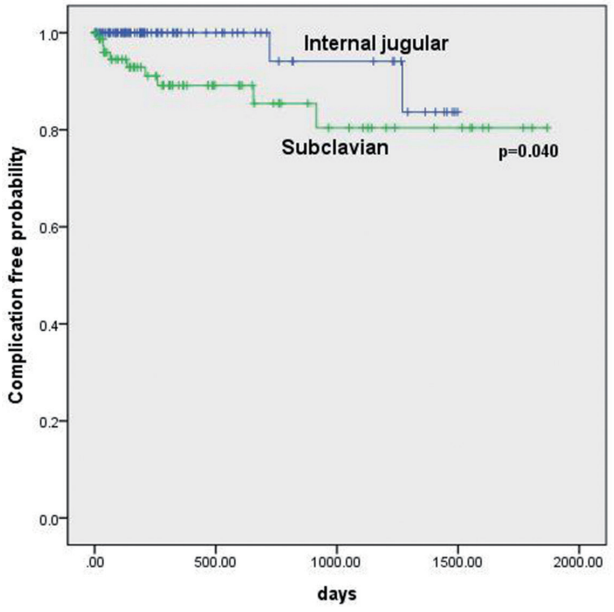

Fig. 1. The mechanical complication free probability between two groups.

preferred site of access was the right internal jugular vein (n = 81) in group 1. However, left subclavian access was more frequent in group 2 (n = 59). There were no statistical differences in the baseline characteristics of patients except the laterality of percutaneous access route to superior vena cava.

Procedural complications are listed in Table 2. Twenty four complications occurred (14.0%), including pneumothorax (n = 1, 0.6%), migration/malposition (n = 4, 2.3%), pinch-off syndrome (n = 4, 2.3%), malfunction (n = 3, 1.8%), local infection (n = 8, 4.7%), port related bacteremia (n = 3, 1.8%), and venous thrombosis (n = 5, 2.9%). The overall incidence was 8.7% and 20.3% in each group (p = 0.030). All

patients with port related complications underwent TIAP removal. Mechanical complications, except infectious and thrombotic complications, occurred more often in group 2 (p = 0.033), and pinch-off syndrome only occurred in group 2. The mechanical complication-free probability was significantly different between the 2 groups according to Kaplan-Meier and log rank tests (p = 0.040, Fig. 1).

Discussion

Over the past 50 years, there have been significant technical advances in the management of central venous catheters.[1,2] The TIAP has been extensively used world-wide to improve patient convenience and quality of life.[1,2,7] The access vein varied according to surgeon's preference. However, the choice of access route is critical for predicting port implantation complications. Until now, the subclavian and internal jugular veins were the most common percutaneous routes of access to superior vena cava.[7-11] In the past, the subclavian vein has been the most popular route for placement of central venous catheters.[10,12,13] In the present study, a chronological change from subclavian to internal jugular access was also observed.

Several recent studies reported that the complication rate of TIAPs varied between 6-21%.[13] Historically, TIAPs have been associated with mechanical, infectious, and thrombotic complications.[4-13] Recently, a review of the Cochrane Database of Systemic Reviews concluded that subclavian and internal jugular central venous access (CVA) routes have similar risks for catheter-related complications in long-term catheterization in cancer patients.[14] Biffi et al. also demonstrated that CVA site had no impact on early and late complication rates.[8] However, another review found that the subclavian approach had a higher risk of malpositions,[1] while other studies recommend the internal jugular vein because the subclavian approach has a higher incidence of mechanical complications.[8-10] In our study, mechanical complications happened significantly more often with the subclavian approach according to the Kaplan-Meier and log rank tests. In particular, pinch-off syndrome only occurred in subclavian group. Pinch-off syndrome is defined as the anatomical compression of a catheter between the clavicle and first costoclavicular space, leading to fracture, transection, or embolization of the catheter.[15] Aitken et al[16] suggested that prompt removal of the catheter was required in patients with pinch-off syndrome. Interestingly, immediate catheter malpositioning did not occur in our series. Araújo et al[10] reported 15 cases of immediate catheter malpositioning. These discrepancies regarding the incidence of catheter malpositioning may be partly due to the use of image-guided CVA. The present study used fluoroscope-guided access in all patients. In recent years, ultrasound, venography, and fluoroscope-guided access have become widely used for reducing postoperative complications and mal-positioning.[9] The current study found that infectious and thrombotic complications did not differ significantly between groups, which is consistent with previous studies.[1,7-14]

Many clinicians prefer the superior vena cava route via the right-sided approach due to the shorter length of catheter required for implantation. Left-sided approaches are used in certain clinical situations, such as in patients who had been previously implanted with a right-sided intravenous port, or underwent a right-modified radical mastectomy.[6] In our study, the left subclavian approach was commonly performed to prevent catheter kinking because the left subclavian vein runs to the brachiocephalic vein at an obtuse angle.[17] However, 14 of 16 complications (87.5%) occurred using the left subclavian catheter compared to the right subclavian catheter, although this difference was not statistically significant. Thrombosis and pneumothorax were only developed in left subclavian TIAP. These data should be interpreted with caution because the left subclavian approach may be more prone to TIAP-related complications.

In addition, previous studies have demonstrated that TIAP complication rates vary among surgeons according to level of surgical experience,[4,11] with the highest complication rates observed in trainees.[4,11] In the present study, one cardiovascular surgeon performed all TIAP implantations.

The present study was limited by its nonrandomized, retrospective design. Subclavian access was preferred in the early insertion period, but a shift to internal jugular access was noted later. In addition, although there were no significant differences in complication rates, the laterality of access vein differed between groups. Finally, the study sample included two pediatric patients, but pediatric anatomical characteristics such as small vessels were not considered

when making comparisons in the present study.

As a result, we recommend jugular access in patients who require long-term catheterization, because the subclavian approach is associated with a high incidence of mechanical complications, such as pinch-off syndrome. However, more research on this topic is needed in order to better understand the association between surgical complications and percutaneous routes of access to superior vena cava.

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