

Cephalic Vein Cut-down for Totally Implantable Central Venous Access Devices With Preoperative Ultrasonography by Surgical Residents

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Abstract. *Background/Aim:* Cephalic vein (CV) cut-down for totally implantable central venous access devices (TICVADs) is not frequently used due to its low success rate. We compared the outcomes of CV cut-down using preoperative ultrasonography (US) performed by experienced surgeons versus surgical residents. *Patients and Methods:* From December 2015 to December 2017, 10 surgeons implanted 212 TICVADs using CV cut-down with preoperative US. The surgeons were divided into two groups of five each: surgical residents (Group A, n=124 procedures) and experienced surgeons (Group B, n=88 procedures). Duration of operation time, completion rate, and complications were retrospectively analyzed. *Results:* The completion rate was significantly higher in Group A (98.4% versus 92.0%, $p=0.04$). Duration of operation time (45.2 ± 14.5 versus 42.0 ± 13.1 minutes, $p=0.22$), rates of early complications (1.6% versus 1.1%, $p=0.77$) and late complications (3.2% versus 2.3%, $p=0.68$) were equivalent between the two groups. No fatal complications occurred in either group. *Conclusion:* CV cut-down can be safely performed by surgical residents under the use of preoperative US.

Totally implantable central venous access devices (TICVADs) are used in patients who require long-term therapy and nutritional support for oncologic or other

diseases (1). The most frequently used veins for placement of TICVADs are the internal jugular vein (IJV) and subclavian vein (SV), using the Seldinger technique with or without ultrasonography (US); however, these approaches can cause complications, including pneumothorax, hemothorax, and arterial injury (2-6).

Cephalic vein (CV) cut-down (2-4, 7-12), in addition to external jugular vein (EJV) cut-down (5, 6, 13) for TICVADs, is reportedly safe with a lower fatal complication rate. However, CV cut-down is associated with a low completion rate (82%-97%) (2, 4, 6-9, 11, 12), technical limitations (9), and a requirement for more advanced surgical expertise (10).

We have previously reported the usefulness of preoperative US in terms of shortening the duration of operation time and increasing the completion rate in TICVAD implantation, using the CV cut-down technique (2). Following that study, we used CV cut-down as the first-choice technique and performed preoperative US for all TICVAD implantation procedures with the CV cut-down approach. Although surgical residents perform TICVAD implantations with CV cut-down in our institution, only few reports have described the outcomes of TICVAD implantation with CV cut-down performed by surgical residents. The present study was performed to compare the safety and surgical outcomes of CV cut-down for TICVAD implantation performed by surgical residents *versus* experienced surgeons.

Patients and Methods

This retrospective study was approved by the institutional review board of our hospital, and the requirement for informed consent was waived. The ethics approval number was 537.

From December 2015 to December 2017, we implanted 371 TICVADs in 367 patients at The Japanese Red Cross Nagasaki Genbaku Hospital. We excluded 156 TICVADs from 152 patients

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whose existing central vein catheters had been used as replacements and 3 TICVADs in 3 patients who had undergone implantation using the IJV puncture approach because their CVs were unsuitable for cut-down. Finally, we analyzed the outcomes of 212 TICVAD implantation procedures in 212 patients using CV cut-down in the present study.

We divided the surgeons into two groups of five each: i) surgical residents (3-5 years following graduation; Group A, n=124 procedures) and ii) experienced surgeons (>10 years following graduation; Group B, n=88 procedures). No surgeons in Group A were board-certified surgeons, and all surgeons in Group B were board-certified surgeons. Operation data including i) the completion rate, ii) the duration of operating time, and iii) the complication rate were retrospectively compared between Groups A and B.

Three types of TICVADs were used: i) the open-ended 6.0-Fr single-lumen X-Port™ isp (Bard Access Systems, Salt Lake City, UT, USA) [n=155 (73.1%)], ii) the closed-ended 8.0-Fr single-lumen PowerPort® M.R.I.® isp (Bard Access Systems) [n=30 (14.2%)], and iii) the closed-ended 8.0-Fr single-lumen MicroNeedle Port (Covidien Japan, Tokyo, Japan) [n=27 (12.7%)].

Preoperative US. The US and cut-down techniques have been described in our previous report (2) (Figure 1A and B). In all cases, preoperative US was performed to check the depth and diameter of the bilateral CVs at 3 cm below the inferior margin of the clavicle immediately before the operation. We also checked the venous convergence of the axillary vein (AV). The CV is located in the fat pad below the fascia between the deltoid muscle and the major pectoral muscle.

Primary approach of CV cut-down. Skin markings were made along the CV route (Figure 2), and the operations were then performed in the angiography suite under sterile conditions. Following administration of local anesthesia, a 3- to 6-cm skin incision was made along the skin, marking in the deltopectoral groove in the upper anterior chest wall. The CV was exposed, ligated distally, and encircled cranially with 3-0 silk (Nescosuture®; alfresa, Osaka, Japan). A catheter filled with heparin sodium solution (5,000 IU of heparin (Heparin Sodium 5,000 units/5mL for Inj.®; MOCHIDA, Tokyo, Japan) in 10 ml of isotonic saline (OTSUKA NORKAL SALINE®; Otsuka, Tokyo, Japan) was inserted into the CV through a transverse venotomy with a vein pick.

When the catheter could not be advanced into the central vein, the guidewire technique was used. A 0.064-mm-diameter guidewire (Radifocus®; Terumo, Tokyo, Japan) was inserted from the end of the catheter, and if the guidewire was advanced into the central vein, then the catheter was also advanced into the central vein. The tip of the catheter was positioned at the entrance of the right atrium under fluoroscopy. Following cranial ligation with 3-0 silk, the catheter was cut and connected to the reservoir. Using the same skin incision, a subcutaneous pocket was made on the pectoral fascia. The reservoir was fixed to the pectoral fascia with two absorbable sutures. Following skin closure, patency for blood withdrawal and leakage at infusion were tested by cutaneous puncture using a Huber needle enclosed in each device.

Secondary approach of CV cut-down. When the CV was too small we exchanged the device for a smaller open-ended catheter. When a 6.0-Fr open-ended catheter could not be inserted into the CV, either due to the CV not being found or the guidewire could not be



Figure 1. Preoperative ultrasonography to check the depth and diameter of the cephalic vein.

advanced into the central vein, we changed the approach to IJV or SV puncture with real-time US. Even when the approach was changed to IJV or SV puncture, the first incision was used to make a pocket for the reservoir.

A chart review was carried out. The follow-up period ranged from 1 to 952 days in our institution. We evaluated the operation time, completion rate, depth and diameter of the CV at 3 cm below the inferior margin of clavicle, convergence of the AV, and complications. We defined early and late complications as those occurring within 7 days and after 8 days, respectively.

Statistical analysis. Continuous data (e.g., age and operating time) are expressed as mean±standard deviation, while data representing rare occurrences, such as complications are expressed as a categorical value and percentage in each group. The statistical program JMP 14 (SAS Institute, Inc., Cary, NC, USA) was used to analyze the data. Continuous data were compared using Student's *t*-test, and categorical data were compared using the χ^2 test or Fisher's exact test, as appropriate. A *p*-Value of <0.05 was considered statistically significant.

Results

All patients' baseline and preoperative variables were similar between Groups A and B, including age (65.3±11.9 versus 68.1±9.4, years, respectively; *p*=0.06), sex (female, 57.0% versus 40.9%, respectively; *p*=0.10), body mass index (21.8±4.1 versus 22.6±4.5 kg/m², respectively; *p*=0.37), and the purpose of TICVAD implantation (chemotherapy, 91.9% versus 92.0%, respectively; *p*>0.99). The purpose of TICVAD implantation in most patients was chemotherapy [n=195 (92.0%)], which was administered for digestive tumors [n=80 (37.7%)], lung cancer [n=50 (23.6%)],

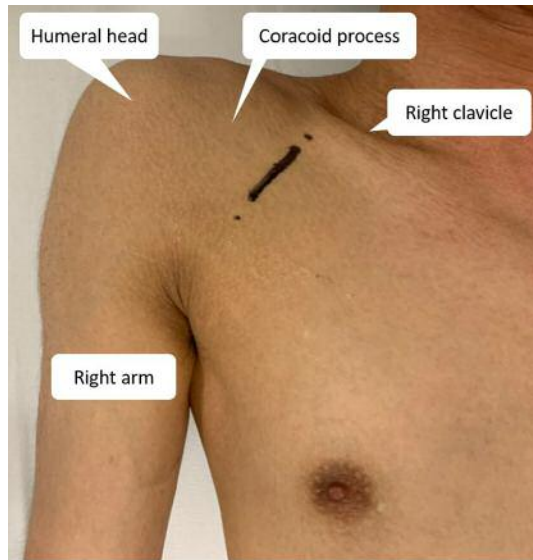


Figure 2. Skin markings along the cephalic vein route.

lymphoma/leukemia [n=21 (9.9%)], otorhinolaryngologic cancer [n=20 (9.4%)], breast cancer [n=20 (9.4%)], and gynecologic cancer [n=4 (1.9%)]. The remaining 17 patients (8.0%) underwent TICVAD implantation for nutritional support because of various conditions. There was no difference in the follow-up period [median (range), 287 (1-952) versus 342 (1-903) days] or mortality rate during the follow-up period (28.2% versus 28.4%) (Table I).

A flow chart of all cases is shown in Figure 3. Among all 212 procedures, 203 (95.8%) were successful without the need to change the procedure (including 5 procedures in which the guidewire technique was used). We experienced nine unsuccessful cases (4.2%) because the CV was too small (5 cases) and the catheter could not be advanced into the central vein even with the use of a guidewire (4 cases). The CV could be detected in all cases. A secondary approach was attempted in the nine unsuccessful cases. The IJV and SV puncture approach with real-time US on the same side as in the first CV approach was used in eight cases and one case, respectively. No complications were observed in any case that was changed to a secondary approach.

The mean diameter and depth of the CV measured during preoperative US were 3.3 ± 0.9 mm (n=116) and 11.2 ± 5.1 mm (n=81) on the right and 3.3 ± 1.0 mm (n=62) and 12.1 ± 6.0 mm (n=48) on the left. There was no significant difference in the diameter ($p=0.66$) or depth ($p=0.45$) between the two sides. The recorded venous convergence of the AV was 102/104 (98.1%) on the right and 47/50 (94.1%) on the left side ($p=0.33$) (Table II).

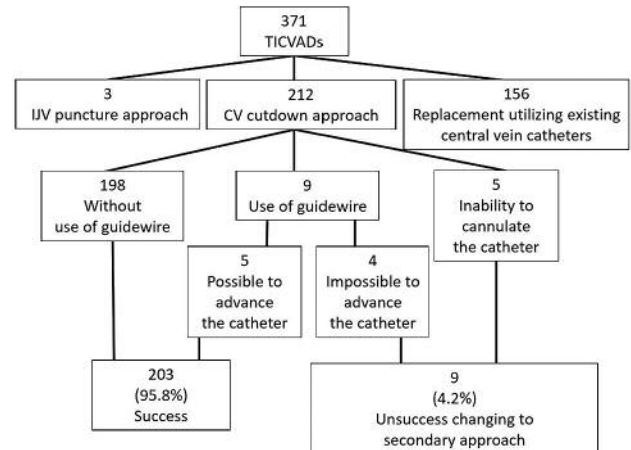


Figure 3. Flow chart of all cases. TICVADs: Totally implantable central venous access devices, IJV: internal jugular vein, CV: Cephalic vein.

The operation data of both groups are summarized in Table III. The right CV was chosen in 109 (87.9%) patients in Group A and 77 (87.5%) patients in Group B ($p=0.22$). There was no significant difference in the duration of the operating time between Groups A and B (45.2 ± 14.5 vs. 42.0 ± 13.1 min, respectively; $p=0.22$). The completion rate was higher in Group A compared to B (98.4% vs. 92.0%, respectively; $p=0.04$). The lack of success in Group A was due to the inability to advance the guidewire into the central vein in two cases (1.6%). The lack of success in Group B was due to a too-small CV in five cases (5.7%) and the inability to advance the guidewire into the central vein in two cases (2.3%).

The postoperative early and late complication rates in both groups are summarized in Table IV. Wound healing disorders occurred in one (0.8%) patient in Group A and one (1.1%) patient in Group B. Wound infection occurred in one (0.8%) patient in Group A. Catheter-associated bloodstream infection occurred in one (0.8%) patient in Group A and two (2.3%) patients in Group B. Reservoir pocket infection and catheter tip dislocation occurred in two (1.6%) and one (0.8%) patient in Group A, respectively. The two groups showed no significant difference in the early (1.6% vs. 1.1%, $p=0.77$) or late complication rate (3.2% vs. 2.3%, $p=0.68$).

The completion rate of CV cut-down for TICVAD implantation was 95.7% (178/186) on the right and 96.2% (25/26) on the left side, with no significant difference between the two sides ($p>0.99$). The early and late complication rates on the right side were 4.8% and 0.0%, respectively ($p=0.60$).

The completion rate of CV cut-down for TICVAD implantation was i) 95.8% (148/155) using the X-Port™ isp, ii) 100% (30/30) using the PowerPort® M.R.I.® isp, and iii) 92.6% (25/27) using the MicroNeedle Port. The reasons for

Table I. Comparison of patients' characteristics.

	Group A (n=124)	Group B (n=88)	Total (n=212)	p-Value
Age	65.3±11.9	68.1±9.4	66.9±10.6	0.057
Gender (M/F)	65/59	36/52	101/111	0.1
Body Mass Index (kg/m ²)	21.8±4.1	22.6±4.5	22.2	0.37
Purpose for TICVADs				
Chemotherapy	114 (91.9%)	81 (92.0%)	195 (92.0%)	>0.99
Digestive tumors, n (%)	57 (46.0%)	23 (26.1%)	80 (37.7%)	
Lung cancer, n (%)	36 (29.0%)	14 (16.0%)	50 (23.6%)	
Lymphoma/Leukemia, n (%)	9 (7.3%)	12 (13.6%)	21 (9.9%)	
Otorhinolaryngologic cancer, n (%)	9 (7.3%)	11 (12.5%)	20 (9.4%)	
Breast cancer, n (%)	2 (1.6%)	18 (20.4%)	20 (9.4%)	
Gynecologic cancer, n (%)	1 (0.8%)	3 (3.4%)	4 (1.9%)	
Nutrition, n (%)	10 (8.1%)	7 (8.0%)	17 (8.0%)	
Follow-up period, days (mean, range)	287 (1-952)	342 (1-903)	310 (1-952)	0.1
Death in the follow-up period, n (%)	35 (28.2%)	25 (28.4%)	60 (28.3%)	0.98

Group A: surgical residents (3-5 years after graduation); Group B: experienced surgeons (>10 years after graduation); TICVADs: totally implantable central venous access devices.

Table II. Comparison of ultrasound findings on both sides.

	Right (n=212)			Left (n=212)			p-Value
The diameter of the Cephalic vein (mm)	3.3±0.9 (n=116)			3.3±1.0 (n=62)			0.66
	Group A	Group B	p-Value	Group A	Group B	p-Value	
	3.3±0.9, (n=65)	3.2±0.9, (n=51)	0.57	3.4±1.0 (n=29)	3.3±1.0 (n=33)	0.9	
The depth of the cephalic vein (mm)	11.2±5.1 (n=81)			12.1±6.0 (n=48)			0.45
	Group A	Group B	p-Value	Group A	Group B	p-Value	
	11.3±5.9 (n=45)	11.2±3.8 (n=36)	0.89	12.2±7.7 (n=24)	12.1±3.8 (n=24)	0.89	
Venous convergence for axially vein	102/104 (98.1%)			47/50 (94.1%)			0.33
	Group A	Group B	p-Value	Group A	Group B	p-Value	
	49/51 (96.1%)	53/53 (100%)	0.24	19/21 (90.5%)	28/29 (96.6%)	0.56	

Group A: surgical residents (3-5 years after graduation); Group B: experienced surgeons (>10 years after graduation).

the lack of success using the X-Port™ isp were a too-small CV in five cases and the inability to advance the guidewire into the central vein in two cases, while the reason for the lack of success using the MicroNeedle Port was the inability to advance the guidewire into the central vein in two cases.

Discussion

In this study, 212 TICVAD implantation procedures were performed in 212 patients with preoperative US, and the

overall completion rate was 95.8%. We divided the surgeons into two groups: surgical residents and experienced surgeons. The completion rate in the surgical residents group was significantly higher compared to the experienced surgeons group. There was no difference in the duration of operating time, early complication rate, or late complication rate.

A previous retrospective study showed that TICVAD implantation, mainly attempted by the CV cut-down procedure, performed by residents alone or with help of a senior resident or an attending surgeon was safe with respect

Table III. Operation data in both groups.

	Group A (n=124)	Group B (n=88)	p-Value
Completion rate of CV cutdown approach, n (%)	122 (98.4%)	81 (92.0%)	0.04
The reason of lack of success			
Thinness of the vein, n (%)	0 (0.0%)	5 (5.7%)	
Guidewire not passing, n (%)	2 (1.6%)	2 (2.3%)	
Operation time, min	45.2±14.5	42.0±13.1	0.1
Use of guidewires, n (%)	6 (4.8%)	3 (3.4%)	
Success, n (%)	4 (3.2%)	1 (1.1%)	
Failure, n (%)	2 (1.6%)	2 (2.3%)	

Group A: surgical residents (3-5 years after graduation); Group B: experienced surgeons (>10 years after graduation); CV: cephalic vein.

Table IV. Early and late complications in both groups.

	Group A (n=124)	Group B (n=88)	p-Value
Early complication (within 7 days), n (%)	2 (1.6%)	1 (1.1%)	>0.99
Wound healing disorder, n (%)	1 (0.8%)	1 (1.1%)	
Pneumothorax, n (%)	0 (0.0%)	0 (0.0%)	
Arterial puncture, n (%)	0 (0.0%)	0 (0.0%)	
Hematoma, n (%)	0 (0.0%)	0 (0.0%)	
Wound infection, n (%)	1 (0.8%)	0 (0.0%)	
Late complication (after 8 days), n (%)	4 (3.2%)	2 (2.3%)	>0.99
Catheter associated blood stream infection, n (%)	1 (0.8%)	2 (2.3%)	
Reservoir pocket infection, n (%)	2 (1.6%)	0 (0.0%)	
Dislocated catheter tip, n (%)	1 (0.8%)	0 (0.0%)	

Group A: surgical residents (3-5 years after graduation); Group B: experienced surgeons (>10 years after graduation).

to major complications, but it required a longer operating time (14). In that study, 147 of 760 cases (19.3%) required a secondary SV puncture approach. The usefulness of preoperative US for CV cut-down approach improved the completion rate and shortened the operation time in 2015, based on data from our institution (2). This is the first study to compare the safety of CV cut-down using preoperative US between cases performed by experienced surgeons and surgical residents.

CV cut-down is reportedly safe with respect to avoiding fatal complications including pneumothorax, hemothorax, and arterial injury (2-4, 8-11) compared to the IJV or SV puncture approaches, using the Seldinger technique with or without US. Although nine patients (4.2%) developed complications in the present case series, no fatal complications occurred.

Although CV cut-down has a low completion rate (80%-94%) (2-4, 6-9, 11, 12, 14), we have previously reported that preoperative US can result in a shortened operating time and have confirmed that convergence of the CV and AV can be significantly related to the low technical failure rate (2). Since

the publication of our above-mentioned report, we have been routinely performing preoperative US evaluation. In the present study, IJV puncture with US was chosen as the first approach in three patients. Among these three patients, two had too-small bilateral CVs and one had a too-small left CV and an undetectable right CV on preoperative US. Cut-down was avoided because the CV was <2 mm, corresponding to the diameter of a smaller catheter (6.0 Fr). Performing preoperative US in all cases enabled avoidance of the difficult side or of bilaterally difficult cases and thus resulted in a high completion rate. To further improve the completion rate, a guidewire can be used during CV cut-down when the catheter cannot be advanced into the central vein (10).

The EJV may also be used for the cut-down approach (5, 6, 13). This vein reportedly has a high completion rate, a very low incidence of complications, and high patient satisfaction and compliance based on questionnaires (13). However, EJV cut-down requires two skin incisions and a subcutaneous tunnel for the catheter. We consider that CV cut-down has two advantages over the use of other veins. First, the first incision can be used to make a pocket for the

reservoir in case of the surgeon needs to change to the IJV or the SV puncture approach, and this is cosmetically acceptable. Second, the incision and subcutaneous route of the catheter cannot be easily detected when the patient is wearing ordinary clothes, including short sleeves.

In this study, the surgical residents showed equivalent safety results and a higher completion rate compared to those of the experienced surgeons. No cases were incomplete because of vessel injury or an undetectable CV. Based on the preoperative evaluation of the diameter of the CV and convergence of the CV and AV, the operator could choose the more suitable side for CV cut-down and avoid implantation in patients with a too-small CV or a CV without convergence with the AV.

In this study, there were no significant differences in the CV diameter, CV depth, or convergence of the AV and CV between the two sides. We selected the larger side of the CV for TICVAD implantation using CV cut-down. Although the optimal side for implantation of TICVADs using CV cut-down is unclear, when the CV diameter, CV depth, and convergence of the AV and CV are equivalent, we select the side same as the larger IJV or the side with the least overlap between the IJV and the carotid artery for CV cut-down. The right IJV has a much wider diameter and runs more superficially compared to the left (15). For cannulation, the right IJV is superior to the left one with respect to a shorter operation time and lower incidence of complications (16). The right side is also superior with respect to the incidence of puncture failure in the SV approach (17). Although the completion and complication rates of CV cut-down for both sides were equivalent in this study, some other studies have shown that left-sided insertion of central venous catheters can significantly increase the risk of thrombotic complications (18); the same is true for peripherally inserted central venous catheters (19). Furthermore, left-sided insertion of central venous catheters can be associated with a risk of azygos mal-positioning (20). Therefore, right-sided CV cut-down might reduce late complications; it might also reduce early complications when changing the approach to IJV or SV puncture when the diameter or overlap between the IJV and carotid artery are equivalent.

The first limitation of this case series is its retrospective design. Second, the diameter and depth of the CV were not recorded in all cases, especially in the unsuccessful cases. Further studies are needed to identify the factors associated with unsuccessful CV cut-down for TICVADs.

In conclusion, the results of this retrospective study demonstrate that CV cut-down with preoperative US is a safe procedure that helps to avoid fatal complications. The duration of operating time and complication rate were equivalent between surgical residents and experienced surgeons, and the completion rate was significantly higher in surgical residents. Therefore, CV cut-down with preoperative

US should be considered a valid approach for TICVADs for both surgical residents and experienced surgeons.

Conflicts of Interest

None.

Authors' Contributions

SH and RO were responsible for the study concept. All authors collaborated for the patient's medical care and approved the final manuscript for submission and agreed to be accountable for the work.

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References

- 1 Kock HJ, Pietsch M, Krause U, Wilke H and Eigler FW: Implantable vascular access systems: experience in 1500 patients with totally implanted central venous port systems. *World J Surg* 22(1): 12-16, 1998. PMID: 9465755.
- 2 Otsubo R, Hatachi T, Shibata K, Yoshida T, Watanabe H, Oikawa M, Matsumoto M, Yano H, Taniguchi H and Nagayasu T: Evaluation of totally implantable central venous access devices with the cephalic vein cut-down approach: Usefulness of preoperative ultrasonography. *J Surg Oncol* 113(1): 114-119, 2016. PMID: 26645575. DOI: 10.1002/jso.24100
- 3 Matiotti-Neto M, Eskander MF, Tabatabaie O, Kasumova G, Bliss LA, Ng SC, Tawa NE Jr, Murphy B, Critchlow JF and Tseng JF: Percutaneous *versus* cut-down technique for indwelling port placement. *Am Surg* 83(12): 1336-1342, 2017. PMID: 29336750.
- 4 Biffi R, Orsi F, Pace U, Bonomo G, Monfardini L, Della Vigna P, Rotmensz N, Radice D, Zampino MG, Fazio N, de Braud F, Andreoni B and Goldhirsch A: Best choice of central venous insertion site for the prevention of catheter-related complications in adult patients who need cancer therapy: a randomized trial. *Ann Oncol* 20(5): 935-940, 2009. PMID: 19179550. DOI: 10.1093/annonc/mdn701
- 5 Kagawa T, Ueyama S, Kobayashi T, Okabayashi H, Kuroda S and Fujiwara T: A novel "shrug technique" for totally implantable venous access devices via the external jugular vein: A consecutive series of 254 patients. *J Surg Oncol* 115(3): 291-295, 2017. PMID: 27813159. DOI: 10.1002/jso.24504
- 6 Cavallaro G, Sanguinetti A, Iorio O, D'Ermo G, Polistena A, Avenia N, Silecchia G and De Toma G: Ultrasound-guided vein puncture *versus* surgical cut-down technique in totally implantable venous access devices (Tivads): A prospective comparative study on safety, efficacy and complications. *Int Surg* 99(4): 475-478, 2014. PMID: 25058787. DOI: 10.9738/INTSURG-D-14-00008.1
- 7 Jablon LK, Ugolini KR and Nahmias NC: Cephalic vein cut-down versus percutaneous access: a retrospective study of complications of implantable venous access devices. *Am J Surg* 192(1): 63-67, 2006. PMID: 16769277. DOI: 10.1016/j.amjsurg.2005.11.012

- 8 Di Carlo I, Cordio S, La Greca G, Privitera G, Russello D, Puleo S and Latteri F: Totally implantable venous access devices implanted surgically: a retrospective study on early and late complications. *Arch Surg* 136(9): 1050-1053, 2001. PMID: 11529829. DOI: 10.1001/archsurg.136.9.1050
- 9 Chang HM, Hsieh CB, Hsieh HF, Chen TW, Chen CJ, Chan DC, Yu JC, Liu YC and Shen KL: An alternative technique for totally implantable central venous access devices. A retrospective study of 1311 cases. *Eur J Surg Oncol* 32(1): 90-93, 2006. PMID: 16289481. DOI: 10.1016/j.ejso.2005.09.004
- 10 Chang HM, Hsieh HF, Hsu SD, Liao GS, Lin CH, Hsieh CB and Yu JC: Guidewire assisted cephalic vein cutdown for insertion of totally implantable access ports. *J Surg Oncol* 95(2): 156-157, 2007. PMID: 17262733. DOI: 10.1002/jso.20584
- 11 Povoski SP: A prospective analysis of the cephalic vein cutdown approach for chronic indwelling central venous access in 100 consecutive cancer patients. *Ann Surg Oncol* 7(7): 496-502, 2000. PMID: 10947017.
- 12 Granziera E, Scarpa M, Ciccarese A, Filip B, Cagol M, Manfredi V, Alfieri R, Celentano C, Cappellato S, Castoro C and Meroni M: Totally implantable venous access devices: retrospective analysis of different insertion techniques and predictors of complications in 796 devices implanted in a single institution. *BMC Surg* 14(1): 27, 2014. PMID: 24886342. DOI: 10.1186/1471-2482-14-27
- 13 Cavallaro G, Iorio O, Iossa A, De Angelis F, Avallone M, Massaro M, Mattia C and Silecchia G: A prospective evaluation on external jugular vein cut-down approach for TIVAD implantation. *World J Surg Oncol* 13(1): 243, 2015. PMID: 26264364. DOI: 10.1186/s12957-015-0663-x
- 14 Schreckenbach T, Münch I, Ei Youzouri H, Bechstein WO and Habbe N: The safety level of total central venous access port implantation performed by residents. *J Surg Educ* 76(1): 182-192, 2019. PMID: 30120065. DOI: 10.1016/j.jsurg.2018.07.005
- 15 Ishizuka M, Nagata H, Takagi K and Kubota K: Right internal jugular vein is recommended for central venous catheterization. *J Invest Surg* 23(2): 110-114, 2010. PMID: 20497014. DOI: 10.3109/08941930903469342
- 16 Sulek CA, Blas ML and Lobato EB: A randomized study of left versus right internal jugular vein cannulation in adults. *J Clin Anesth* 12(2): 142-145, 2000. PMID: 10818329.
- 17 Tsai YF, Ku YH, Chen SW, Huang WT, Lu CC and Tsao CJ: Right- and left-subclavian vein port-a-cath systems: comparison of complications. *Eur Surg Res* 49(2): 66-72, 2012. PMID: 22813785. DOI: 10.1159/000339308
- 18 Debourdeau P, Farge D, Beckers M, Baglin C, Bauersachs RM, Brenner B, Brillhante D, Falanga A, Gerotzafias GT, Haim N, Kakkar AK, Khorana AA, Lecumberri R, Mandala M, Marty M, Monreal M, Mousa SA, Noble S, Pabinger I, Prandoni P, Prins MH, Qari MH, Streiff MB, Syrigos K, Büller HR and Bounameaux H: International clinical practice guidelines for the treatment and prophylaxis of thrombosis associated with central venous catheters in patients with cancer. *J Thromb Haemost* 11(1): 71-80, 2013. PMID: 23217208. DOI: 10.1111/jth.12071
- 19 Mamejon T, Angelo D, Abu Abdou A and Gemmel D: Risk factors for upper extremity venous thrombosis associated with peripherally inserted central venous catheters. *J Vasc Access* 13(2): 231-238, 2012. PMID: 22266584. DOI: 10.5301/jva.5000039
- 20 Haygood TM, Malhotra K, Ng C, Chasen B, McEnery KW and Chasen M: Migration of central lines from the superior vena cava to the azygous vein. *Clin Radiol* 67(1): 49-54, 2012. PMID: 22070939. DOI: 10.1016/j.crad.2011.05.011

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