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Research Article

Totally implantable venous access devices: A restrospective analysis of morbidity and risk factors in a hospital with multi-technique approaches

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ABSTRACT

Background: Totally implantable venous central access devices (TIVADs) can be implanted by open surgery or by direct puncture in the subclavian (ScV), internal jugular (IJV) or cephalic (CephV) veins.
Methods: A retrospective study was conducted in 201 patients. Thirty-day follow-up data was analyzed to compare the outcomes of different techniques and evaluation of risk factors.
Results: Complications were reported in 3.8 % of the patients with no overall differences between different vascular accesses. Direct puncture was associated with more accidental arterial punction ($p = 0.01$). History of previous catheters was a risk factor for immediate complications ($p = 0.01$) and patients with history of thoracic disease had more early and late complications ($p = 0.03$ and $p = 0.04$, respectively). Late complications were more common in patients over 60 years old ($p = 0.04$) and with chronic pain ($p = 0.03$).
Conclusion: There was no difference in overall complication rates between the implantation techniques. Further prospective randomized controlled trials would clarify the most effective technique.

Introduction

Totally implantable venous central access devices (TIVADs) are widely used for their safety and simpler way of accessing the vascular system [1]. TIVADs serve several purposes, such as the infusion of chemotherapy drugs, parenteral nutrition or hemodynamic monitoring [2,3].

The most common insertion sites of TIVADs are the subclavian (ScV), the internal jugular (IJV) veins and the cephalic vein (CephV). TIVADs can be implanted by open surgery or by direct puncture. Most physicians rely on an x-ray confirmation after the procedure [4].

TIVADs have an overall complication rate between 2 and 14 % [4–7]. The most frequently reported complications are technical problems, such as difficulty to find or puncture the correct vein [7]. Other early complications include pneumothorax, hemothorax or arterial puncture [4,6,7]. Late complications occur in less than 6 % of the patients and include thromboembolism (catheter-related or deep vein thrombosis), TIVAD infection or catheter dysfunction (migration, port inversion or pinch-off syndrome) [4,7,8]. Otsuba et al. compared cut-down approach to direct puncture techniques and found that the overall rate of complication was similar (9.0 % *vs.* 10.7 %, respectively) [9]. Cut-down approach has been associated with a higher rate of late complications (such as infection or pinch-off syndrome) (5.7 % *vs.* 2.8 %) but less immediate or early complications (such as pneumothorax and arterial puncture) (0 % *vs.* 4.9 %) [9]. The major theoretical advantage of the cut-down approach is to eliminate the risk of complications associated with direct venous puncture, although impacted by a high rate of failure (6–20 %) [4,9,10]. Over the years, there has been a shift towards the *Seldinger* technique due to shorter procedure time and wide availability of ultrasound [4].

The improvement of the techniques and the wide use of ultrasound could decrease the rate of potential morbidity, especially of immediate complications. The aim of this study was to assess short- and long-term complications of TIVADs implantation, to compare the outcomes of different insertion techniques and evaluation of risk factors for secondary outcomes.

Material and methods

We conducted an observational retrospective study in a single-center cohort with experience in three different techniques of vascular access for implantation of TIVADs. We retrieved and evaluated consecutive

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cases submitted to TIVAD implantation between January 2019 and May 2020.

Before surgery, patients were inquired on age, body mass index, smoking habits, immunosuppression-associated clinical conditions (including diabetes, previous administration of chemotherapy, corticosteroids use, HIV infection, among others), usual medications (for diabetes, chronic pain, and chemotherapy) and past medical history (previous vascular access placement, ipsilateral thorax or shoulder surgery, orthopedic conditions or medical management of chronic pain).

In our cohort, 201 patients underwent surgery for TIVAD placement. Sixty percent were women. Patients' age ranged between 20 and 79 years old (mean 60 ± 11.3) and 54.7 % were overweight. All the patients had TIVAD implanted for chemotherapy, being breast cancer treatment (35.8 %) the main indication. Forty point three percent of patients were immunosuppressed at the time of the procedure, while 37,3 % had smoking habits. Only 4 % had history of previous catheters. Approximately one fifth (21.4 %) underwent previous neck, shoulder or thorax surgeries that might change normal anatomy, 11.4 % had been diagnosed with orthopedic problems (previous shoulder or clavicle fractures, rotator cuff tendinitis and chronic pain syndrome) and 12.9 % had chronic pain treated with opioids. Patient demographics and characteristics are presented in Table 1.

All TIVADs used were *Mini-Sitimplant (Vygon*™, France*)* and open-ended 7 Fr single lumen. They were implanted in the operating room under local anesthesia (lidocaine 1 %) and mild sedation. Before the procedure, the catheter was flushed with a heparin sodium solution (5000 IU of heparin in 10 ml isotonic saline). Three different techniques were used in this procedure: cutdown technique in the CephV, direct puncture by anatomical landmarks in the ScV or ultrasound-guided in the IJV.

In the cutdown technique, a 5 cm incision is performed along the deltopectoral groove and the CephV is exposed. The vein is then ligated distally, the catheter is inserted through a transverse venotomy and a cranial ligation of the vein is performed (Fig. 1A [11]). Fluoroscopy is then used to confirm the position of the tip of the catheter. If the CephV vein is not identified or if its caliber is too small, venous puncture of ScV or IJV should be attempted. The technique of direct puncture is performed according to *Seldinger* technique [12]. In the ScV approach, the puncture point is located between the lateral and middle third of the clavicle and the needle is aimed toward the suprasternal notch (Fig. 1B [13]). In the IJV approach, the puncture site is defined by intraoperative ultrasound use (in-plane approach) with a 10–5 MHz frequency linear probe (Acuson X300, ©Siemens, Berlin) (Fig. 1C [14]). After the insertion of the catheter, a subcutaneous pocket is prepared over the pectoral fascia and the reservoir may be sutured to prevent rotation. Patency is tested by cutaneous puncture with a *Huber* needle.

Table 1
Patients' characteristics.

Demographics		*n* (%)
Female		121 (60,2 %)
Age (years)*		60 ± 11.3
BMI (kg/m^2)	<25	91 (45.3 %)
	25–29.9	72 (35.8 %)
	≥30	39 (18.9 %)
Smoking habits		75 (37.3 %)
Current disease		
Underlying disease	Esophageal and Gastric cancer	42 (20.9 %)
	Colorectal cancer	37 (18.4 %)
	Breast cancer	72 (35.8 %)
	Lung cancer	11 (5.5 %)
	Other cancer	39 (19.4 %)
Immunosuppression		81 (40.3 %)
Chronic pain		26 (12.9 %)
Past medical history		
Previous catheters		8 (4 %)
Orthopedic pathology		23 (11.4 %)
Previous shoulder, thorax or neck surgery		43 (21.4 %)
Blood analysis		
Platelets <100.000/mm^3		2 (1.1 %)
INR >1.2		5 (2.9 %)

BMI: body mass index; INR: international normalized ratio.
* Mean ± Standard Deviation.

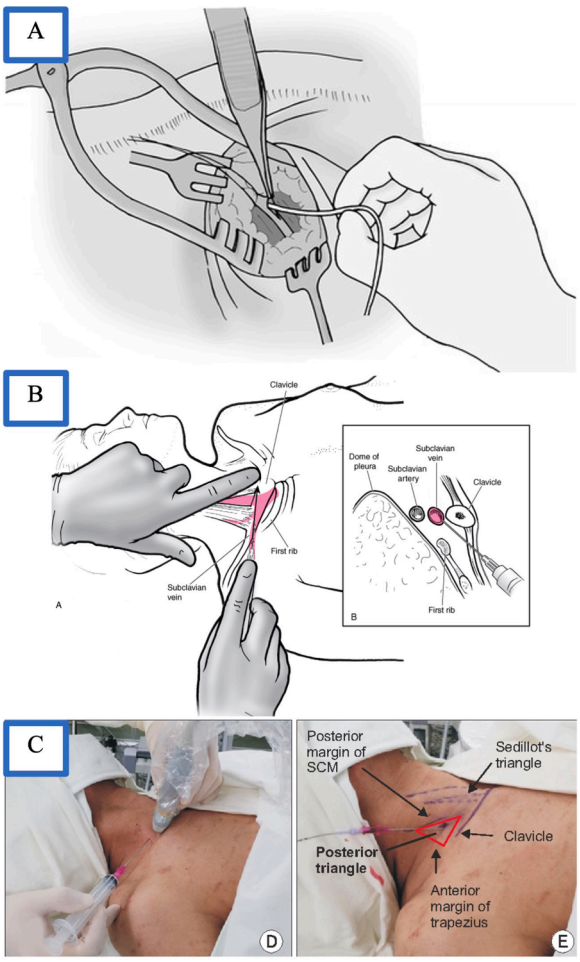

Fig. 1. (A) Cutdown technique in cephalic vein: a 5 cm incision is performed along the deltopectoral groove and the vein is exposed and ligated distally, the catheter is inserted through a transverse venotomy and a cranial ligation of the vein is performed (Adapted from Laiber et al. [11]) (B) In the subclavian approach, the puncture point is located between the lateral and middle third of the clavicle and the needle is aimed toward the suprasternal notch (Adapted from Emergency Medicine Procedures 3rd edition13) (C) In the internal jugular vein approach, the puncture site is defined by intraoperative ultrasound use (in-plane approach) (Adapted from Aithal et al. [14]).

Thirty-day follow-up of all patients was retrieved from hospital's records. We divided complications in three categories: intra-operative, early complications (between days 1 and 7 after surgery) and late complications (between days 7 and 30). Pneumothorax or hemothorax were defined as immediate complications diagnosed through dyspnea or thoracic pain or in routine x-ray performed after the procedure. Technical difficulties comprised difficulty to find, puncture or progress through the correct vein [7]. When it was impossible to find or progress through the correct vein, we chose other site for puncture and classified the patient with the technique performed. Local infection was defined as wound inflammatory signs that led to treatment with antibiotics. Port pocket infection was defined as the presence of local inflammation around the subcutaneous portion of the port with occasional purulent drainage that leads to removal of the port and systemic antibiotic therapy [15]. We used the 2016 revised definition of sepsis (a life-threatening organ dysfunction caused by a dysregulated host

response to an infection [16]) not related to an infection at another site [17]. Vein thrombosis was diagnosed by ultrasound with doppler when patients presented with arm swelling or pain. Mechanical problems is a category that was defined by the impossibility of administration of chemotherapy within the TIVAD and includes migration or port rotation and pinch-off syndrome (when the catheter is comprised between the clavicle and first rib) [18].

This study was approved by the Hospital Ethical Committee. Statistical analysis was performed using both Microsoft Excel and SPSS Statistics Version 26.0 from IBM®. Continuous variables are expressed as means due to their normal parametrical distribution, while dichotomic data are expressed as frequencies and percentages. We transformed some continuous variables into dichotomic data according to international scores (such as BMI) or cut-offs of risk factors described in literature (such as platelets and coagulation) [4,17]. For statistical purposes, larger subgroups of cancer sites were created according to anatomical proximity. Categorical data were compared using the chi-square test or Fisher's exact test when appropriate. *P*-values < 0.05 were considered significant.

Results

TIVADs were implanted by open cutdown technique in the CephV in 110 patients (54.7 %) and by direct puncture in the IJV or ScV, in 14.9 % and 30.3 % of cases, respectively. The latter two techniques were performed with the aid of ultrasound alone in 9 cases (4.5 %), ultrasound and X-ray in 24 (11.9 %) or with only X-ray confirmation in most cases (87.1 %). In one patient, TIVAD was placed accidentally in the subclavian artery without imagiological confirmation. Seventy-nine percent of ports were secured to the subcutaneous cell tissue. More than a half (53,2 %) of TIVADs were placed by residents under consultants' supervision. Sixty-three percent of patients had their first chemotherapy cycle scheduled within the first 7 days after the procedure. Procedure's features are presented in Table 2.

Description of immediate, early and late complications

Overall, 55 complications (3.8 %) were reported in this study. On the course of the procedure, 8 unintended arterial punctures (4 %) were described and there were technical difficulties in 16 cases, the most common being wrong progression of the guide wire or failure to find or puncture the correct vein. Major complications described earlier, such as pneumothorax or hemothorax, did not occur in our cohort. Immediate complications are shown in Table 3.

Early and late complications are also described in Table 3. During the first week after the procedure, 8 patients (4 %) resorted to Emergency Department for pain, 2 (1 %) due to wound bleeding, and local infection was drained and treated with antibiotics in one patient (0,5 %). Vein thrombosis was diagnosed in 6 patients (3 %). Sepsis or mechanical problems with port pocket were not registered.

Late complications included local infection (2 %) and sepsis (0,5 %) requiring use of antibiotics or local drainage. Anticoagulation with heparin was initiated in 2 patients (1 %) with vein thrombosis and continued for 3 to 6 months after which they were switched to oral anticoagulants. Three patients (1.5 %) had mechanical problems with port pocket, 2 of which had catheter disconnection and the other, rotation of the port. The definitive treatment of these complications consisted of TIVADs removal in the cases of sepsis or mechanical problems. Catheter removal was discussed on an individual basis.

Table 2
Procedure features.

Features	Subgroups	*n* (%)
Access route	Internal jugular vein	30 (14.9 %)
	Subclavian vein	61 (30.3 %)
	Cephalic vein	110 (54.7 %)
Method	Open cutdown technique	110 (54.7 %)
	Percutaneous technique	91 (45.3 %)
Confirmation	X-ray	167 (83.1 %)
	Ultrasound	9 (4.5 %)
	X-ray + ultrasound	24 (11.9 %)
Surgeon experience	Consultant	94 (46.8 %)
	Resident	107 (53.2 %)
Fixation of port	Yes	159 (79.1 %)
	No	42 (20.9 %)
Time of first cycle of chemoterapy	$\leq$ 7 days	128 (63.7 %)
	>7 days	73 (36.3 %)

Table 3
Immediate, early and late complications and morbidity according to vascular access.

	Overall *n* (%)	Internal Jugular vein *n* (%)	Subclavian vein *n* (%)	Cephalic vein *n* (%)	*p* value
Immediate		4 (13.3 %)	10 (16.4 %)	8 (7.3 %)	0,17 (0.07[Δ])
Accidental arterial punction	8 (4 %)	4 (13.3 %)	4 (6.6 %)	–	**0,01 (0,02[#]) (0,01[Δ])**
Pneumothorax or hemothorax	0 (0 %)	–	–	–	
Pain	2 (1 %)	–	1 (1.6 %)	–	0,45
Wound bleeding	1 (0.5 %)	–	1 (1.6 %)	–	0,45
Technical difficulties[*]	16 (8 %)	3 (10.0 %)	6 (9.8 %)	7 (6.4 %)	0,62
Early		1 (3.3 %)	2 (3.3 %)	10 (9.1 %)	0,35
Pain	8 (4 %)	1 (3.3 %)	1 (1.6 %)	6 (5.5 %)	0,62
Wound bleeding	2 (1 %)	–	–	2 (1.8 %)	0,67
Local Infection	1 (0.5 %)	–	–	1 (0.9 %)	0,70
Vein thrombosis	6 (3 %)	1 (3.3 %)	1 (1.6 %)	4 (3.6 %)	0,86
Mechanical problems port pocket[+]	1 (0.5 %)	–	–	1 (0.9 %)	0,70
Late		1 (3.4 %)	1 (1.6 %)	4 (3.6 %)	0,90
Local Infection	4 (2 %)	–	1 (1.6 %)	3 (2.7 %)	1.0
Sepsis	1 (0.5 %)	–	–	1 (0.9 %)	1.0
Vein thrombosis	2 (1 %)	–	–	2 (1.8 %)	0,67
Mechanical problems port pocket[§]	3 (1.5 %)	1 (3.3 %)	–	2 (1.8 %)	0,11
Total	55 (3.8 %)	6 (20.0 %)	12 (19.7 %)	20 (18.3 %)	0,97

[*] Comprised difficulty to find, puncture or progress through the correct vein.
[§] Impossibility of administration of chemotherapy within the TIVAD and includes migration or port rotation and pinch-off syndrome.
[#] Internal jugular vein *vs* Cephalic vein.
[Δ] Subclavian vein *vs* Cephalic vein.

Analysis of morbidity according to vascular route and patients' characteristics

The group of TIVAD placed by IJV access had a total of 10 different complications in 6 patients (20.0 %). As for ScV access group, there were a total of 14 complications in 12 patients (19.7 %), and the CephV group totalized 31 complications in 20 patients (18.3 %). We found no significant difference in early, immediate or late complications between different vascular accesses.

Immediate complications tended to be more common when using direct puncture techniques, especially when comparing ScV to CephV (16.4 % *vs.* 7.3 %; $p = 0.07$). An accidental arterial puncture occurred in 4 patients in which the IJV (13.3 %) and the ScV (6.9 %) were used. No accidental arterial puncture was reported while using CephV ($p = 0.01$). Technical difficulties were reported in 3 patients (10.0 %) using the IJV,

6 patients (9.8 %) using the ScV and 7 patients (6.4 %) using the CephV ($p = 0.62$).

We found no statistically significant difference between early complications regarding different vascular access, although we noticed a slight tendency for higher complication in the CephV (9.1 % *vs.* 3.3 % of IJV and ScV, together). Comparison of late complications between different techniques was also similar. When analyzing different complications (pain, bleeding, mechanical problems, infection, and thrombosis) regardless the timeline of its diagnosis, we also found no difference between vascular routes. An extensive description of complications related to vascular access is presented in Table 3. For each outcome we observed the differences between the three routes and made dichotomic comparisons of the outcomes amid the routes. Only the most significant results are conveyed in Table 3.

Regarding the analysis of morbidity and patients/procedures characteristics, patients over 60 years old presented with more late complications ($p = 0.04$). History of previous catheters was associated with immediate complications ($p = 0.01$) and patients with previous history of thoracic disease (breast or lung cancer) had significantly more early and late complications ($p = 0.03$ and $p = 0.04$). We did not find an association between previous history of thoracic disease and immediate complications. Late complications were more common in patients with history of chronic pain ($p = 0.03$). Previous orthopedic pathology or previous local surgeries were the only factor that significantly raised the rate of both immediate, early and late complications. There was no difference in patients with BMI superior to 25 or with smoking habits. Surgeon experience or the use of ultrasound did not influence the rate of complications in any of the periods studied. These results are detailed in Table 4. In a further analysis of risk factors, not presented in the tables, we found a higher rate of thrombosis in patients who had their first cycle of chemotherapy one week after the procedure *vs.* within the first week (6.8 % in 73 patients vs 1.6 % in 128 patients), although not statistically significant ($p = 0.1$). We were not able to establish an association between history of chronic pain and pain after the procedure.

When comparing the most important individual complications regardless the time they occurred (infection, pain, mechanical problems, and thrombosis), we found no difference between techniques (Table 5).

Table 4
Morbidity according to patients' characteristics and procedure features.

	Immediate complications	Early complications	Late complications
	n (%; *p* value)	n (%; *p* value)	n (%; *p* value)
Age > 60 years	16 (14.0 %; 0.11)	8 (7.0 %; 0.75)	6 (5.2 %; **0.04**)
BMI ≥ 25 kg/m^2	13 (11.8 %; 0.68)	10 (9.1 %; 0.10)	4 (3.6 %; 0.69)
Thoracic disease (breast or lung cancer)	8 (9.6 %; 0.60)	9 (10.8 %; **0.03**)	0 (0 %; **0.04**)
Imunosuppressed*	13 (16.3 %; 0.05)	5 (6.2 %; 0.89)	4 (4.9 %; 0.22)
Smoking habits	9 (12 %; 0.72)	4 (5.3 %; 0.61)	2 (2.7 %; 1.00)
Previous catheters	3 (13.6 %; **0.01**)	1 (12.5 %; 0.48)	1 (12.5 %; 0.11)
Orthopedic pathology or previous local surgeries	11 (18 %; **0.04**)	7 (11.5 %; 0.06)	5 (8.2 %; **0.01**)
Chronic pain	5 (19.2 %; 0.15)	1 (3.8 %; 0.56)	4 (15.4 %;**0.03**)
Surgeon experience	14 (14.9 %; 0.10)	8 (8.5 %; 0.27)	4 (4.3 %; 0.42)
Ultrasound	4 (12.1 %; 0.82)	1 (3.0 %; 0.38)	1 (3.0 %; 0.99)
Time of first CT cycle >7 days	6 (8.2 %; 0.34)	8 (11.0 %; 0.05)	3 (5.5 %; 0.19)

BMI: body mass index.
* Diabetes, previous administration of chemotherapy, corticosteroids use, HIV infection, among others.

Table 5
Risk factors for immediate, early and late complications.

	Immediate complications	Early complications	Late complications
	OR (95 %CI) *p*	OR (95 %CI) *p*	OR (95 %CI) *p*
IJV	1.36 (0.43–4.35) 0.60	0.48 (0.06–3.80) 0.48	1.19 (0.12–10.6) 0.87
ScV	2.08 (0.84–5.10) 0.11	0.40 (0.09–1.85) 0.24	0.45 (0.51–3.94) 0.47
CephV	0.44 (0.17–1.10) 0.08	2.93 (0.78–11.0) 0.11	1.68 (0.30–9.39) 0.56
Previous catheters	5.46 (1.21–24.7) **0.03**	1.09 (0.11–10.9) 0.94	2.27 (0.18–28.8) 0.53
Orthopedic pathology or previous local surgeries	2.93 (1.16–7.42) **0.02**	2.63 (0.77–8.96) 0.12	3.80 (0.65–22.4) 0.14
Surgeon experience	2.14 (0.86–5.37) 0.10	2.05 (0.62–6.75) 0.24	2.36 (0.39–14.4) 0.35

OR (odds ratio), CI (confidente interval), IJV (internal jugular vein), ScV (subclavian vein), CephV (cephalic vein).

Discussion

In our cohort there were 3.8 % of patients with complications (in a total of 55 complications), which are comparable rates to the ones described in the literature (2–14 %) [4,19].

In this study, we could not establish superiority of one catheter implantation technique over the others. Each of them has its pros and cons and most of the published evidence show no difference in the overall complication rate when comparing different techniques and vascular access [2,6,20]. Nevertheless, when ultrasound is used to guide the placement of TIVAD in IJV or ScV it has been associated with fewer complications and operative time [4]. For this reason, there has been fewer publications and cohorts addressing the surgical cutdown CephV technique, although it is extensively used in our hospital due to long time experience.

The surgical cutdown technique using the CephV has usually less immediate complications but at the cost of a higher technical failure rate [4]. In our cohort, we observed a trend to less immediate complications with CephV access, especially when comparing ScV to CephV access ($p = 0.07$). This difference is even more marked for accidental arterial punction alone, with no cases counted when using the cutdown technique, which is coincidental with the literature, for it allows to visualize the vein minimizing the risk of arterial puncture [20]. CephV technique's failure rate was not higher than the others (ScV and IJV), although we observed a trend towards that. Our results can be misleading since six patients (3 %) in which we changed the approach due to failure of progression on CephV were classified according to the final technique (all in ScV). Techniques that use ultrasound to guide the placement of TIVAD in VJI or ScV are also associated with fewer immediate complications and operative time [4]. We were not able to confirm these results probably due to the small cohort of patients in which we used ultrasound and due to the fact, that using ultrasound-guided techniques might place a challenge to residents.

We found no differences in early and late complication between techniques. Although it could be clinically expected for CephV technique to produce more pain due to a more extensive dissection and longer operative time, we were not able to show this association. There are reports of higher rate of late complications with ScV access mainly due to mechanical problems such as pinch-off syndrome, which we observed only in a neglectable rate [9].

Regarding risk factors for immediate complications, history of local surgeries, orthopedic pathology or previous catheters were relevant

factors associated with accidental arterial puncture or technical difficulties. They may lead to fibrosis and tissue changes that might create an unfriendly environment for introducing TIVAD, especially in techniques which require anatomical orientation [2]. These risk factors associated with technical difficulties were found by Hammoudi et al., but others such as obesity, female gender, previous radiotherapy and lack of experience [2] had no contribution in our study. Thoracic disease could have also led to a higher rate blind direct puncture on the subclavian vein, but we did not find this association.

As for late complications, they occurred more often in patients older than 60 years old ($p = 0.032$). Voog et al. also identified age > 75 years as a risk factor for thromboembolic and infectious complications [6], probably due to higher rate of co-morbidities or medications leading to immunosuppressive state in these patients. Thoracic disease, history of orthopedic pathology or previous local surgeries were risk factors for late complications ($p = 0.04$ and $p = 0.01$, respectively). This could be explained by association of different variables: the degree of immunosuppression associated with treatments such as chemotherapy and corticosteroids, radiotherapy and anatomical distortion.

Furthermore, we tried to establish associations between the described risk factors and clinically important secondary outcomes. It would be expected that patients with chronic pain before the procedure had higher risk of pain as a major complication. Nevertheless, we could not establish this association. Our results are based on a retrospective consultation of medical records and not on standardized questionaries and the real incidence of pain after this procedure may have been underdiagnosed.

A prospective study from 2011 by Narducci et al., found an association between the rate of overall complications (especially local infection) and patients who had their first cycle of chemotherapy within the first week after the procedure [10]. In our study, patients who had their first session in the first seven days did not have a higher overall complication neither local infection. In fact, they showed less catheter thrombosis although not statistically significant. Undoubtedly, venous thrombosis is a well described complication of TIVADs with rates ranging from 1,5 % to 9 % [2,4,5,7]. We could hypothesize its association to longer periods without maintenance of the catheter, but further studies should assess this trend. We also found no association of venous thrombosis to other risk factors described in literature, such as history of chest irradiation, technical difficulties, or age beyond 65 years old [6,7].

Early and late local infection of TIVADs are relatively common complications with rates that go up to 6.5 % [21]. In our series, we registered significantly lower infection rates (0.5–2 %). Pneumothorax is a complication of TIVAD with reported a very low incidence of up to 1 % [8] in the literature, which is coincidental with our results of no cases of pneumothorax or hemothorax.

The main limitations of this study rely on its retrospective design, small sample, different sample size of the three techniques studied and use of confirmation imagiological techniques. Also, due to its retrospective nature, the results could be biased by lack or incorrectness of reporting of clinical data and complications. Nevertheless, our study provides a good overview of the advantages and disadvantages of the different techniques, although prospective randomized controlled trials with larger samples could help clarify the most effective TIVAD placement technique or help select the best technique for each patient.

Conclusion

The low rate of complications of insertion of TIVAD corroborates the safety and convenience of this procedure. No superiority relation was established between the different techniques of vascular accesses. However, it is important to be informed about the variety of possible complications associated with each technique.

Direct puncture in the ScV or IJV is associated with more accidental arterial punction comparing to cutdown approach in the CephV. Nevertheless, the latter is traditionally associated with a higher failure rate. History of previous catheters and shoulder orthopedic pathology or previous local surgeries are risk factors for immediate complications. Late complications appear more often in older patients and in the ones with history of thoracic disease (breast or lung cancer), chronic pain or shoulder orthopedic pathology or previous local surgeries. Further studies with larger samples could help clarify the most effective TIVAD placement technique or help select the best technique for each patient.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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