Clinical application of totally implantable venous access ports in patients with breast cancer

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Abstract

Background Totally implantable venous access port (TIVAP) has become an effective approach for venous access chemotherapy in cancer treatment. We aimed to show the important procedures of clinical application of TIVAP and complications management in breast cancer.

Patients and Methods From January 2013 to December 2017, patients with breast cancer who took TIVAP operation were investigated. The key procedures of TIVAP conduct and its complications were evaluated in this study.

Results One hundred and ten ports were applied to 110 patients with breast cancer. All ports were successfully implanted in all patients including 108 male and 2 male patients. Patients were followed for an average of 275 days.

Conclusion It is safe and effective of TIVAP implantation by blind puncture applied in patients with breast cancer. Chemotherapeutic drugs delivery on the placement day seems safe and showed no more complications.

Introduction

In recent years, totally implantable venous access port (TIVAP) is increasingly applied in the patients' chemotherapy which was usually involved in cancer treatment.[1] It is necessary for some patients with breast cancer to undergo chemotherapy more than six months.[2] In chemotherapy for breast cancer, some drugs are toxic to the veins particularly peripheral veins.[3] So the implantation of a TIVAP is required as its advantage of easy access of central veins.[4] Generally, in TIVAPs implantation, we use the basilic vein, subclavian vein, external jugular vein, or the internal jugular vein (IJV) as puncture sites. Since some patients with breast cancer may receive ipsilateral radiation treatment, the veins and chest wall of the contralateral side are the suitable choices for TIVAP implantation.[5] From January 2013, the TIVAP implantation with IJV or subclavian vein as puncture site has been launched in our department. The chamber of the port has been placed into the chest wall of the healthy side and the catheter has been introduced to the superior vena cava (SVC). In this study, we would like to investigate and analyze the key procedures and complications of TIVAPs implanted by blind puncture or preoperative ultrasonic marker point. We aim to assess the safety of TIVAP implantation via blind puncture and evaluate the several common complications management in breast cancer.

Patients And Methods

We collected 110 cases for this study. Of the 110 patients with breast cancer, 2 cases were male and the rest 108 cases were female. They had a median age of 52.28 years (range, 34–72 years). All patients received chemotherapy after TIVAPs implantation. Between January 2013 and December 2017, 110

patients with breast cancer underwent TIVAPs implantation by blind puncture or preoperative ultrasonic marker point in our department. The operation time was measured from the time when the patient received local anaesthesia to the time when the patient left the operation table. Early complications were defined as the complications occurred in 3 days after TIVAPs introduction and late complications were defined as the complications arose after 3 days after operation. All patients were followed up until the TIVAPs were removed.

Procedure for TIVAP implantation

The patient was arranged in the supine position with his/her head turned to the other side when the vein and chest wall of healthy side were chosen as operation fields. The IJV was chosen as the first site for puncture in the first and the most important procedure of TIVAP implantation. If it failed, the subclavian vein was chosen as puncture site for the following catheter introduction. After subcutaneous injection of 1% lidocaine, the target vein was punctured using the blind puncture or preoperative ultrasonic marker point. A 2 cm long incision was made and a chamber was created for port placement. The inserted catheter was introduced and connected to the chamber using subcutaneous method. About 15 ml heparinized saline solution (50 IU/ml) was used to flush the port system after operation. The chest X-ray examination was arranged for location confirmation of port implantation. The suitable position of the tip of infusion set was the joint area of lower third of the SVC.

For most patients who required long-term chemotherapy, the needle and infusion line set were changed every cycle of treatment and the port system was flushed with heparinized saline (50 IU/ml) every month.

Statistical analysis

Data was analyzed with SPSS 17.0 software (SPSS Inc., Chicago, IL, USA). A P-value of < 0.05 was supposed to be significant difference. A Pearson's test or Fisher test was used in statistical analysis.

Results

Characteristics of patients

As shown in Table 1, a total of 110 patients with breast cancer were included in our study: 2 males and 108 females. The mean age of them was 52.28 years (range, 34–72 years). All TIVAPs were implanted for cancer chemotherapy. The mean time of TIVAP placement was 47.5 min (33-95 min). The locations of TIVAPs on the right upper chest walls were observed in 73 cases (66.36%) and 37 cases were found on the left upper chest walls (33.64 %). The inserted vein was the IJV in 83 cases (75.45 %) and the subclavian vein chosen as puncture site was observed in 27 cases (24.55 %).

Comparison of achievement ratio

All TIVAPs were successfully implanted in our department. As shown in table 2, the technique of the blind puncture was applied to 98 patients (100.00% success rate) and the method of preoperative ultrasonic marker was used in the remaining patients (100.00% success rate). No significant difference was found between two groups (p>0.05).

Early complications

As shown in table 3, hematoma occurred in 1 patient (0.91%) and retreated by local treatment. Bleeding was found in 1 patient (0.91%) and healed immediately after local hemostasis. Cardiac arrhythmia was observed in 1 patient (0.91%) and its possible cause was that the catheter of the port was inserted too deeply. The symptom disappeared after port relocation. The total rate of early complications was 2.73% in all.

Late complications

Late complications occurred in 8 cases (7.27%). As shown in table 4, 8 patients were involved in late complications, which occurred 3 days after operation, including infection in 2 cases (ports were removed), cutaneous necrosis in 1 case (port was removed and necrotic tissue was cleaned out), turn-over of the chamber in 1 case (external relocation) and venous thrombosis in 4 cases (3.64%). The overall rate of late complications was 7.27%.

Comparison of complications by two means of puncture

As shown in table 5, in 98 cases by blind puncture, 10 patients were found to be involved in complications (10.20%). One patient was observed to be involved in complication in 12 cases (8.33%). It is no significant difference between two groups (p>0.05).

Port removal for complications

As table 6, the TIVAPs in 5 patients (4.55%) were removed due to the complications of ports implantation in this study. The remaining 105 cases were removed after finishing the whole chemotherapy cycle.

Comparison of complications by different port application day

In our investigation, 7 cases were found to be involved in complications in the group of port application on TIVAP implantation day and 4 patients were observed to have complications in the group of port application 7 days after TIVAP implantation day. There was on significant difference between two groups (p>0.05).

Length of the catheter

Length of the catheter differs according to the different puncture site. As table 8, in our department, the mean length of the catheter was 16.98 □ in right internal jugular puncture, 18.60 □ in left internal jugular puncture, 13.33 □ in right subclavian puncture and 13.86 in left subclavian puncture.

Discussion

Chemotherapy plays a key role in adjuvant treatment of breast cancer. For some patients, a whole chemotherapeutic cycle may be more than 6 moths. It was well known that chemotherapeutic drug particularly cell toxic medicine was involved in the venous injury. Frequent punctures are associated with venous injury as well. TIVAPs are applied in clinic as its advantage of easy access of central veins. It was reported that there were significant less complications in TIVAPs than what in other accesses for chemotherapy and it could be used in entire treatment cycle safely.[6]

In this article, we showed the clinical application of TIVAP in patients with breast cancer. The IJV and the subclavian vein are easy to be identified. So, it was feasible that the procedure of TIVAP implantation via blindly puncture. In the beginning period of application of TIVAP implantation, ultrasonic guide can increase the accuracy rate of vein puncture and decrease the incidence rate of relative complications.[7] In our clinical experience of TIVAPs implantation, every operation was conducted successfully. Chemotherapeutic drugs were infused into central venous on the operation day or later. It was reported that hematoma and cardiac arrhythmia are the two most common early complications. They occurred in 2 patients (1.82%) and the incidence rate was much lower than in other reports.[8, 9] To avoid the occurrence of cardiac arrhythmia, port placement should be conducted carefully. Particularly, the tip of catheter should not be introduced too deeply. In our department, hematoma occurred in one case due to artery injury during blind puncture. Compression was the effective method for hematoma. Skin infection was found in 2 cases (1.82%). The similar incidence rate of this complication was shown in other reports.[10, 11] After anti-infection treatment, those two ports were removed.

It was reported that catheter insertion itself has a risk of venous thrombosis.[12, 13] In our study, catheter-associated venous thrombosis was observed in 4 cases (3.64%). The incidence rate of venous thrombosis in other reports ranges from 0.5–25%.[14–19] For prevention and treatment of venous thrombosis, no consistent procedure was formulated. Some researcher showed that the incidence rate of venous thrombosis was not lower in patients with dalteparin than in other group.[20] But most surgeons suggested that anticoagulation therapy was very import and should be used as convention treatment for

venous thrombosis.[21, 22] In our clinical application, 2 TIVAPs were used effectively even if venous thrombosis exist by anticoagulant therapy with warfarin or levasaban. With the treatment of anticoagulant, all venous thrombosis were identified to dissolve in ultrasonic examination.

In our investigation, infection was another complication which has been involved in the application of TIVAP for patients with breast cancer. Two cases were found to suffer TIVAP related infection in our department. The rate of this complication (1.82%) was much lower than which was reported in previous studies.[9, 11, 23–25] As most reports, anti-infection medicine and port removal are two main methods to resolve this problem. The two patients in our study were cured by anti-infection and port removal as above methods.

The optimal position of the tip of catheter is the junction of the right atrium and SVC. The accurate length of the catheter has not been reported in previous studies. The length of the catheter varied in different puncture site. In brief, the catheter in left puncture site was longer than which in right site. In our department, the mean length of the catheter in left internal jugular site was 1.5 □longer than which in right internal jugular site. And meanwhile, the mean length of the catheter in left subclavian site was 0.5 □ longer than which in right subclavian site.

The specific time of port application is controversial. Some doctor thought that chemotherapeutic drugs were given by port system on a port implantation day appeared safe without increasing any complication.[18] However, Narducci F et al. reported that chemotherapy via port system after at least 8 days could decrease the rate of complications.[26] In our study, the overall rate of complication 10.00% was lower than which in previous reports.[7, 27–29] Our study showed that chemotherapeutic drugs transfusion was safe on the TIVAP implantation day.

In clinical experience from our department, the mean time of TIVAP system follow-up was 285 days and during follow-up, the port system was flushed by heparinized saline at 28 days intervals. No complications of malfunction of TIVAP system were found in our department.

Conclusion

Our investigations show that TIVAP implantation via IJV or subclavian puncture without ultrosonic guide is safe and feasible for the breast cancer patients during adjuvant treatment and follow-up. Chemotherapeutic drugs giving on the port implantation day was safe without an increased risk of acute and chronic complications. Optimal length of catheter can be made before TIVAP implantation operation.

Clinical Practice Points

·TIVAP implantation via blind puncture is safe and feasible.

·Chemotherapy application on port implantation day is safe.

·Accurate length of catheter can be confirmed before TIVAP implantation.

Declarations

Disclosure Statement

The authors declare that they have no competing interests.

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Statement of Ethics

This research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. We declare that all patients have given their written informed consent and that the study protocol was approved by the institute's committee on human research.

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Funding sources of this study was not available.

Author Contributions

Peng Zhang, Xueli Mo and Jun Du were responsible for study design, data collection, statistical analysis, manuscription preparation and funds collection. Changsheng Fan was responsible for data collection and funds collection. Jie Dong and Dong Han were responsible for data interpretation and literature search. Zhenhua Fan and Qikang Zhao were responsible for data collection.

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Tables

Table 1

Characteristics of patients

Characteristics	Values	percentage
Median age (years)	52.28 ± 11.05	
Age range (years)	34-72	
Cancer location		
Right/Left	48/62	43.64/56.36
Puncture position		
Right IJV	61	55.45
Left IJV	22	20.00
Right subclavian vein	12	10.91
Left subclavian vein	15	13.64
Chamber location of TIVAP		
Right chest wall	73	66.36
Left chest wall	37	33.64
Follow-up period(days)		
Mean days of the catheter	285.23 ± 152.37	
Range	35–752	

Table 2

TIVAPs implantation sites and achievement ratio

Implantation site	No.(n=110)	Achievement ratio, (No./total)
Blind puncture	98	
Right internal jugular	57	100.00 (57/57) *
Left internal jugular	20	100.00 (20/20)
Right subclavian	10	100.00 (10/10) *
Left subclavian	11	100.00 (11/11)
Preoperative ultrasonic marker	12	
Right internal jugular	4	100.00 (4/4) *
Left internal jugular	2	100.00 (2/2)
Right subclavian	2	100.00 (2/2) *
Left subclavian	4	100.00 (4/4)

* $p>0.05$

Table 3

Early complications

Parameters	No. (%)	Actions taken
Hematoma	1(0.91%)	Local treatment
Bleeding	1(0.91%)	Local treatment
Cardiac arrhythmia	1(0.91%)	Port relocation
Total	3(2.73%)	

Table 4

Late complications

Complications	No. (%)	Action taken
Infection	2(1.82%)	Antibiotics and port removal
Cutaneous necrosis	1(0.91%)	Tissue debridement and port removal
Turn-over of chamber	1(0.91)	External adjustment
Venous thrombosis	4(3.64%)	Anticoagulant treatment and/or port removal
Total	8(7.27%)	

Table5

Comparison of complications

	Blind puncture	Preoperative ultrasonic marker
n	10	1 *
N	98	12

n: number of cases who was involved in complications;

N: total number of cases;

*p>0.05

Table 6

Complications for ports removal

Complications	No.	Percentage
Catheter occlusion	1	0.91%
Infection	2	1.82%
Venous thrombosis	2	1.82%
Total	5	4.55%

Table 7.

Comparison of complications by different port application day

	On implantation day	7 days after implantation day
n	7	4 *
N	72	38

n: number of cases who was involved in complications;

N: total number of cases;

*p>0.05

Table 8.

Length of the catheter

Implantation site	No.(n=110)	Length of the catheter（cm）
Right internal jugular	61 (55.45%)	16.98 ± 3.12
Left internal jugular	22 (20.00%)	18.60 ± 3.98
Right subclavian	12 (10.91%)	13.33 ± 1.56
Left subclavian	15 (13.64%)	13.86 ± 1.74