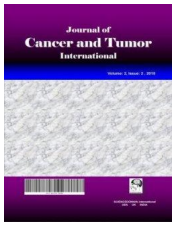

Journal of Cancer and Tumor International

7(3): 1-8, 2018; Article no.JCTI.42732
ISSN: 2454-7360

Use of Chemoports in a Comprehensive Cancer Care Center, a Retrospective Study

Manisa Pattanayak[1*], Anshika Arora[1], Sunil Saini[1], Akash Narayan Gaind[1], Upasana Baruah[2], S. K. Verma[3] and Meenu Gupta[4]

[1]Department of Surgery (Oncology), Cancer Research Center, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Jolly Grant, Dehradun-248140, India.
[2]Department of Gynaecology (Oncology), Cancer Research Center, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Jolly Grant, Dehradun-248140, India.
[3]Department of Medical Oncology, Cancer Research Center, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Jolly Grant, Dehradun-248140, India.
[4]Department of Radiation Oncology, Cancer Research Center, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Jolly Grant, Dehradun-248140, India.

Authors' contributions

This work was carried out in collaboration between all authors. Authors MP and SS designed the study. Author MP wrote the protocol and wrote the first draft of the manuscript. Authors AA and UB managed the analyses of the study. Authors ANG, SKV and MG managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JCTI/2018/42732
Editor(s):
(1) Dr. Bing Yan, Department of Oncology, Hainan Branch of PLA General Hospital, China.
Reviewers:
(1) Joseph Eldor, Theoretical Medicine Institute, Israel.
(2) Vincent Imieje, University of Benin, Nigeria.
(3) Rogelio González-González, Universidad Juárez del Estado de Durango, Mexico.
Complete Peer review History: http://www.sciencedomain.org/review-history/25574

Original Research Article

Received 4th May 2018
Accepted 11th July 2018
Published 16th July 2018

ABSTRACT

Aim of the Study: Treatment protocols that use intravenous cytotoxic agents need long term access to large veins, that can be maintained for a prolonged period in a sterile way. Use of implantable devices for this purpose have become the preferred choice these days, but they have their own set of problem s, starting from difficulties in cannulation to safely maintaining the access for a prolonged period of time in a sterile way. Moreover, the patient population undergoing these treatments are mostly immunosuppressed and prone to systemic infections making the care of any

**Corresponding author: E-mail: manisa.pattanayak@gmail.com;*

implanted device more difficult. The present study evaluates the experience of using chemoports in a comprehensive cancer care center.

Subjects and Methods: We retrospectively reviewed our experience in handling Chemoports inserted at our own hospital over a period of three years, as regards to difficulties during insertion and during administration of venotoxic agents. All patients who were advised more than 4 cycles of cytotoxic drugs were included and approval of the university research and ethics committee was taken prior to data analysis.

Results: Retrospective data of a total of 120 chemoports was evaluated for the study. The most common malignancy was breast cancer, and the commonest chemotherapeutic regimen was Adriamycin/Epirubicin and Cyclophosphamide followed by Taxanes. The preferred site of insertion was right subclavian vein in 52.5% of cases. The average time taken for the procedure ranged from 25 mins to 2 hrs. Procedural difficulties were documented in 48 [40%] insertions, the most common being multiple punctures for venous access. 3 patients developed hematoma during the procedure and, one patient had puncture of carotid artery. Passage of the catheter to the opposite jugular vein was an interesting happening and occurred in 3 patients. None of the patients who had subclavian vessel cannulation had pneumothorax. All the complications were managed conservatively. The median days of catheter life was 265 days. In the follow up period 30 patients [25%] had events related to difficulty of use and port related infection,12 patients had difficulties in canulation of the Chemo port reservoir and 6 Ports could not be used for further chemotherapy and were removed. Infectious complications were seen in 12 ports, the commonest being pocket site infection.

We had a policy of recommending removal of the chemoport 6 months after completion of the planned chemotherapy protocol or 2 years after placement of the port, whichever is earlier. At the end of the study period, 47 of the patients had their chemoports removed, 10 patients were lost to follow up and hopefully got the devices removed elsewhere.

Conclusion: The present day chemoports are simple to insert, and easy to manage with proper asepsis expected in an immunosupressed patient. However, a dedicated team of trained personnel viz. surgeons, anaesthesiologists, clinical oncologists and nursing staff, are necessary so that complications related to these devices are kept to a minimum. This is also important in resource poor countries where these costly devices are difficult to prescribe, so that once inserted, they can last till the end of chemotherapy.

Keywords: Chemoports; TIVAPs; complications; extravasation; catheter migration; infections; change of position; pinch off effect.

1. INTRODUCTION

The last few decades have seen a lot of changes in how we treat patients with cancer. From radical surgeries and radiation regimens, the oncologists now explore newer ways to preserve organs and avoid mutilation wherever possible. Addition of chemotherapeutic agents to existing treatment protocols, either to increase the efficacy of Radiation or to downsize tumours to make surgeries less mutilating is the order of the day. More and more evidence is coming up to incorporate these recommendations to existing treatment protocols.

Treatment protocols that use intravenous cytotoxic agents need long term access to large veins, that can be maintained for a prolonged period in a sterile way. Use of implantable devices for this purpose have become the preferred choice these days, but they have their own set of problems , starting from difficulties in cannulation to safely maintaining the access for a prolonged period of time in a sterile way. Moreover, the patient population undergoing these treatments is mostly immunosuppressed and prone to systemic infections making the care of any implanted device more difficult.Various devices for intravenous delivery of chemotherapeutic agents have come into vogue over the years, from simple IV canulas to Totally Implantable Venous Access Devices. Along with knowledge about new drugs, oncologists and nursing personnel dealing with intravenous chemotherapy also need to learn about the safe placement and handling of such devices. Failure to get adequate training about these devices may result in a broad spectrum of problems in these already compromised patients, ranging from the simple annoyance of multiple punctures to access the reservoir to a much more dangerous life threatening sepsis due to catheter infections. A totally implantable Venous Access port reduces these problems to a large extent and

has become the most preferred device for long term venous access in patients undergoing multiple cycles of chemotherapy [1,2].

A Totally Implantable Device is a subcutaneous port or reservoir with self-sealing septum that is tunneled beneath the skin and is accessed by a needle through intact skin. Popularly called a Chemo port, TIVAPS have gained acceptance as a standard clinical practice, in particular for patients with solid cancers, hematologic malignancies and chronic digestive diseases improving patient quality of life and reducing risk of infection [3].

We retrospectively reviewed our experience in the use of Chemo ports inserted at our institute over a period of three years, in reference to difficulties during insertion and handling of such devices during administration of cytotoxic agents.

2. MATERIALS AND METHODS

This is a retrospective observational study conducted at the Cancer Research Institute of Himalayan Institute of Medical Sciences, Dehradun. Approval of the University Research Committee and ethics committee was taken prior to the evaluation and analysis of data. [Reference no. : SRHU /HIMS/RC/2017/560 and SRHU /HIMS/ETHICS/2018/55] We included all patients who were advised Chemo port insertion and planned for treatment with more than four cycles of chemotherapy for any malignant tumor in the previous three years, from Jan 2015 to Dec 2017. All patients who had Chemoports implanted from any outside centers or patients who chose to undergo chemotherapy at any other Center after getting the device implanted were excluded from the study. Retrospective data was collected from the medical records division and Hospital Information System as per format approved by the university research committee. Data entry was made in MS Excel 2010 spreadsheet after anonymisation and analysis was done by appropriate statistical tools.

2.1 Procedure and Technique of Implantation

The Stimimplant 9.6 F Vygon chemoport device with a silicone catheter and titanium reservoir was implanted in all patients, and access to the reservoir was done by Bards huber needle.

The site and side of insertion was decided prior to the procedure by the surgical team. Under local anaesthesia with 2% plain xylocaine, the anaesthesiologist inserted the chemoport catheter into the vein by Seldinger technique and fluoroscopic guidance [4,5]. A subcutaneous pocket was made on the anterior chest wall for the titanium reservoir and the silicone catheter was tunneled and connected to it. Position of the tip of the catheter was confirmed by fluoroscopy and patency checked by insertion of the Huber needle that came packaged with the chemoport kit. The port was allowed to be used for chemotherapy after 12-24 hrs of insertion.

2.2 Follow Up

Post insertion, the patient was adviced for ensuring heparinisation of the port at every chemotherapy cycle and every six weeks after completion of chemo. Insertion of Huber needle and heparinisation was done by resident doctors and senior nursing staff in the day care ward under all available aseptic precautions, and documentation of difficulties in handling and nonfunctional Ports was done.

The surgical team remained the same over the period of three years, however the anaesthesiologists and nursing staff handling the devices after insertion were on rotation basis and had different levels of expertise.

We used the Infectious Diseases Society of America (IDSA) guidelines [6] to classify the complication of port site infections which are defined as follows

1. Exit site infection - Clinical signs of infection (erythema, induration, tenderness, and/or pus formation) developing in the skin after the needle puncture or microbiological evidence of a micro-organism.
2. Tunnel infection- Clinical signs of infection along the subcutaneous tract of a catheter.
3. Pocket infection- Infected fluid collection in the subcutaneous pocket of a totally implanted intravascular device, often associated with clinical signs of infection with or without spontaneous rupture or drainage.
4. Blood stream infection- Catheter-related bacteremia or fungemia in a patient who has an intravascular device and more than one positive result of culture of blood samples obtained from the peripheral vein, clinical manifestations of infection (e.g., fever, chills, and/or hypotension), and no

apparent source for bloodstream infection (with the exception of the catheter)

3. RESULTS

Data of a total of 120 chemoports inserted in the period of study for patients undergoing more than four cycles of chemotherapy for solid tumours was evaluated retrospectively. The patient and disease profile is described in Table 1. The most common malignancy for which chemoports was adviced was breast cancer, considering that chemotherapy traditionally was not given in the veins of the operated side, leaving only one side for use. Colorectal malignancies formed the next major group because of the prolonged duration of chemo (4-5 days continuous) and the 2 weekly regimens. The commonest chemotherapeutic regimen followed for breast cancer was Adriamycin/ Epirubicin and Cyclophosphamide followed by Taxanes [Table 3]. The preferred site of insertion was right subclavian vein in 52.5% of cases [Table 4]. Left subclavian vein was chosen in patients who had breast surgery on the right side or where right subclavian vein could not be canulated after multiple attempts. The average time taken for the procedure ranged from 25 minutes to 2 hrs. Procedural difficulties were documented in 48 [40%] insertions, the most common being multiple punctures for venous access. 3 patients developed hematoma during the procedure and, one patient had puncture of carotid artery. Passage of the catheter to the opposite jugular vein was an interesting happening and occurred in 3 patients. None of the patients who had subclavian vessel cannulation had pneumothorax. All the complications were managed conservatively.

In the follow up period of chemoport use for chemotherapy, a total of 30 patients [25%] had events related to difficulty of use and port related infection [Table 5]. 12 patients had difficulties in canulation of the chemoport reservoir, manifested by inability to heparinise or loss of backflow. 6 out of these ports could still be used for chemotherapy after reinsertion of needle. Position of these ports was checked by chest X Ray in all cases. 6 Ports could not be used for further chemotherapy and were removed. In 4 patients, a change of position of the patient helped in better flow rates.

Infectious complications were seen in 12 ports, the commonest being pocket site infection. Extravasation of prechemo medications was found in one patient which was managed conservatively by stopping immediately. One patient had extravasation of chemotherapy and skin necrosis, requiring debridement and removal of the port.

Exit site infections were found in 3 patients who also had Tunnel infection. One patient had features of systemic sepsis (fever) after flushing of the Port, requiring removal. The days of use in these patients where the port had to be removed due to infections ranged from 25 to 265 days. We had a policy of recommending removal of the chemoport 6 months after completion of the planned chemotherapy protocol or 2 years after placement of the port, whichever is earlier. At the end of the study period, 47 of the patients had their chemoports removed, 10 patients were lost to follow up and hopefully got the devices removed elsewhere.

Table 1. Demographics of the study population [n = 120]

Characteristics	Value	Percentage
Male/Female	25/97	20.8/ 80.8
Median age (years)	55	
Age range (years)	22–73	
Less than 40 yrs of age	21	17.5
40-49 yrs	25	20.8
50-59 yrs	37	30.8
60-69 yrs	23	19.1
More than 70 yrs	14	11.6
Diagnosis		
Breast cancer	84	70
Colorectal	24	20
Ovary	4	3.3
Sarcomas	3	2.5
Others	5	4.1
Follow-up period, days		
Median days of the catheter use	265, (11- 763, SD)	

Table 2. Stage at insertion

Stage	Value	Percentage
I	12	10.0
II	32	26.6
III	41	34.1
IV	35	29.1

Table 3. Type of chemotherapy regimen

Chemo protocol	Value	Percentage
AC + T	33	27.5
Trastuzumab based	16	13.3
TEC	20	16.6
FEC	7	5.8
FOLFOX	19	15.8
FOLFIRI	5	4.1
CapOx	6	5.0
Others	14	11.6

Abbreviations: AC +T : Adriamicin(Doxorubicin) + Cyclophosphamide + Taxol, TEC : Taxol + Epirubicin + Cyclophosphamide, FEC : Fluorouracil + Epirubicin + Cyclophosphamide, FOLFOX: Folinic acid(leucovorin) + Fluorouracil + Oxaliplatin, FOLFIRI : Folinic acid(leucovorin) + Fluorouracil + Irinotecan, CapOx : Capacitabine + Oxaliplatin, Others :Gemcitabine + Cisplatin, Ifosphamide + Adriamicin, Cyclophosphamide + doxorubicin + vincristine +Prednisone + Rituximab (R-CHOP), Ifosphamide + Carboplatin + Etoposide (ICE)

Table 4. Site of insertion

	Right side (%)	Left side (%)	Total (%)
Subclavian	52.5	11.6	64.16
Internal Jugular	23.4	12.4	35.84

Table 5. Difficulties during chemotherapy

Loss of Backflow but usable	6	5%
Loss of backflow and removed	6	5%
Positional flow	4	3.3%
Extravasation	2	1.6%
Exit site infection	3	2.5%
Tunnel infection	4	3.3%
Pocket infection	4	3.3%
Systemic sepsis	1	0.8%
Total	30	25%

4. DISCUSSION

Long term venous access devices or Chemo ports, as they are popularly called, have revolutionised drug delivery in patients undergoing cytotoxic chemotherapy [7]. They are easy to use, concealed, easy to maintain, and convenient to the patient. Various studies have evaluated the efficacy of the totally implantable devices [8,9,10].

Practical difficulties during the process of insertion of chemoports can easily be minimised by simple attention to details and training of the surgical and anaesthetic team. Although USG guided cannulation of preferred vein for puncture has been reported to have lesser complications than blind punctures in a number of studies [11,12,13] we did not have facilities available for the same in our operation theater. The numbers of attempts during blind punctures were observed to be lesser with more experienced anaesthesiologists. Documentation of this could not be possible because the study used Retrospective data analysis and the point was not always mentioned in the patient files. The Cancer Institute being a part of the University Medical College setup, younger members of the anaesthesia team were also allowed to do the procedure as part of their training [14,15,16].

The other reported procedural difficulties in available literature include cardiac arrhythmias and hematomas [10,17]. We used the ECG changes on the digital monitor as a guide for the proper site of placement of the guide wire. Minor hematomas observed in patients with multiple attempts of puncture were managed by simple application of pressure. One patient who had an inadvertent puncture of the common carotid artery during access of the Internal Jugular vein of the same side was also managed conservatively and the procedure was abandoned. We noticed an interesting event where the guide wire travelled from the initial site of entry in the subclavian vein to the opposite IJV instead of the ipsilateral SVC.

Catheter occlusion during chemotherapy happens commonly because of improper heparinisation of the reservoir at the end of chemotherapy. This results in the formation of a small blood clot which may cause a ball valve effect that allows fluid to be pushed in, but not aspirated. An occlusion rate of 3.2–21.5% has been reported in various studies [18]. Biffi et al. in a randomized study of 376 patients noted the inability to draw blood in 2% cases where a standard open-ended catheter was used [19]. We noted that in 5% of our patients, the port had to be removed because neither fluid/blood can be pushed nor aspirated. Jie et al. in their center infused 10,000 IU heparin over 24 hours into the port system for 3 days via a perfusion system,

after which they were able to use it again [18]. Apart from changing the Hubers needle and personnel concerned, we did not try any such measures but were still able to continue using the ports in 5% of cases.

We noted that a change in position (lying down/ sitting up/lifting the shoulder) facilitates the flow in a group of patients who otherwise had a partial occlusion of the catheter. This was noted more in obese female patients where the catheter tip was placed in the subclavian vein and the chest wall reservoir was pulled down by the sagging breast tissue. This possibly causes the catheter to be trapped between the clavicle and the first rib causing a "pinch -off effect" [10,18]. Jie et al reported 3 patients out of 492 [0.61%] to have this complication. In order to prevent this complication, more lateral access of the subclavian vein is recommended [20].

The pinch-off effect has also been the reported to cause catheter fracture.We had a single case of catheter fracture in our study, but we attributed it to a manufacturing defect in the catheter itself.

We also observed a single case of catheter migration in our study that was detected only while planned removal of the chemoport. The patient had the port in place for 257 days and had completed chemotherapy 10 months back. The reservoir was removed under local anaesthesia and the migrated catheter was removed by the cardiologist under fluoroscopic control. This rare but potentially serious complication has been seen in 1.22% to 2.1% of cases in literature [18,20,21-25] which also mentions that more than 50% of fractured ports were clinically asymptomatic, and present as accidental findings during scheduled port removal. The authors opine that the natural history of the catheter damage cannot be adequately predicted, and the risk that these asymptomatic fractures might lead to more severe events cannot be excluded [21,22].

Infectious complications in chemoports in the range of 4.8–8.8% have been reported in the literature [26,27]. In a prospective study of 680 patients between June 1987 and May 1989 at Memorial Sloan-Kettering Cancer Center, followed up until port removal, death, or a maximum of 1960 days, infectious complications were noted in 8.8% of patients, half of which were surgical site infections and rest were systemic sepsis [26]. Biffi et al. in a study of 376 patients found 3 patients who suffered from port-related bacteremia (0.8%, 0.016/1000 days of use) [19]. In our study, 12 patients (10%) had infectious complications leading to removal of the port. Two of these patients had a documented incidence of extravasations leading to subsequent infection of the chest wall pocket [16,28].

As chemoports are completely subcutaneous, the risk of extraluminal colonization is low and mostly occurs during insertion. Once the device is inserted, contamination may occur during repeated punctures with Huber needles, if the skin has not been completely cleaned, therefore leading to intraluminal colonization that can spread from the port to the catheter tip. Since frequency of TIVAP handling is one of the major risk factor identified for port infections, it is not surprising to observe that coagulase-negative staphylococci (CoNS), which are frequent colonizers of the human skin, is one of the leading pathogens responsible [27]. In an article from the Pasteur Institute of Paris, the authors found that out of 29 cases, 57% were caused by coagulate negative staphylococcus (CoNS), 20% by Gram-negative rods (GNR), 7% by *S. aureus* and 3% by *C. albicans* [27]. As part of protocol, we sent the catheter tips of all patients who required removal of Chemoports during the study period for aerobic culture and sensitivity. The most common organism isolated was *Staph aureus*.

At the end of the study period, 63 patients had their chemoports in place and the devices are being used for chemotherapy.

5. CONCLUSION

Totally implantable Venous Access devices or chemoports have changed the landscape of intravenous chemotherapy drastically and in a good way. Both patients and physicians now have an alternative to reduce and escape the annoyance of attempting to locate a good vein in the day care and the morbidities of extravasation of toxic drugs. The present day devices are simple to insert, and easy to manage with proper asepsis expected in an immunosupressed patient. However, a dedicated team of trained personnel viz.surgeons, anaesthesiologists, clinical oncologists and nursing staff, are necessary so that complications related to these devices are kept to a minimum. This is also important in resource poor countries where these costly devices are difficult to prescribe, so that once inserted, they can last till the end of chemotherapy.

CONSENT

Written consent for the procedure was taken from all patients. University approval for auditing data retrospectively was taken [REF. NO.: SRHU /HIMS/RC/2017/560].

ETHICAL APPROVAL

Taken from University Ethics committee [REF. NO. : SRHU /HIMS/ETHICS/2018/55].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Biffi R, Orsi F, Pozzi S, et al. 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. 2009;20:935–40.
2. Narducci F, et al. Totally implantable venous access port systems and risk factors for complications: A one-year prospective study in a cancer centre. Eur J Surg Oncol; 2011.
3. Osawa H, Taura Y, Akashi H, Endo H, Shiobara H, et al. Commentary: Totally implantable venous-access ports complications associated with cancer patients. J Cancer Clin Trials. 2017;2:133.
4. Ma L, Liu Y, Wang J, Chang Y, Yu L, Geng C. Totally implantable venous access port systems and associated complications: A single-institution retrospective analysis of 2,996 breast cancer patients. Molecular and Clinical Oncology. 2016;4(3):456-460.
5. Hsu CCT, Kwan GNC, Evans-Barns H, Rophael JA, van Driel ML. Venous cutdown versus the Seldinger technique for placement of totally implantable venous access ports. Cochrane Database of Systematic Reviews. 2016;8. Art. No.: CD008942.
   DOI: 10.1002/14651858.CD008942.pub2
6. Leonard A. Mermel, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 Update by the Infectious Diseases Society of America CID. 2009;49:(1):1-45.
7. Bassi KK, Giri AK, Pattanayak M, Abraham SW, Pandey KK. Totally implantable venous access ports: Retrospective review of long-term complications in 81 patients. Indian J Cancer. 2012;49:114-8.
8. Hooda B, Lalani G, Fadoo Z, Billoo G. Implantable port devices are catheters of choice for administration of chemotherapy in pediatric oncology patients-a clinical experience in Pakistan. Ann N Y Acad Sci. 2008;1138:43-6.
9. Johansson E, Engervall P, Björvell H, Hast R, Björkholm M. Patients' perceptions of having a central venous catheter or a totally implantable subcutaneous port system–results from a randomised study in acute leukaemia. Support Care Cancer. 2009;17:137-43.
10. Barbetakis N, Asteriou C, Kleontas A, Tsilikas C. Totally implantable central venous access ports. Analysis of 700 cases. J Surg Oncol. 2011;104:654-656.
11. Ahn SJ, Kim H-C, Chung JW, An SB, Yin YH, Jae HJ, et al. Ultrasound and fluoroscopy-guided placement of central venous ports via internal jugular vein: Retrospective analysis of 1254 port implantations at a single center. Korean J Radiol. 2012;13:314-323.
12. Plumhans C, Mahnken AH, Ocklenburg C, Keil S, Behrendt FF, Günther RW, et al. Jugular versus subclavian totally implantable access ports: Catheter position, complications and intrainterventional pain perception. Eur J Radiol. 2011;79:338-342.
13. Seiler CM, Frohlich BE, Dorsam UJ, Kienle P, Buchler MW, Knaebel H-P. Surgical technique for totally implantable access ports (TIAP) needs improvement: A multivariate analysis of 400 patients. J Surg Oncol. 2006;93:24-29.
14. Silas AM, Perrich KD, Hoffer EK, McNulty NJ. Complication rates and outcomes of 536 implanted subcutaneous chest ports: Do rates differ based on the primary operator's level of training? Acad Radiol. 2010;17:464-467.
15. Hajime M, Tomohiko A, Toru I, Takashi H, Hiroki M, Manpei Y, et al. Analysis of the outcomes in central venous access port implantation performed by residents via the internal jugular vein and subclavian vein. J Surg Educ. 2017;74(3):443-449.
16. Wen-Cheng Wei, Ching-Yang Wu, Ching-Feng Wu, Jui-Ying Fu, Ta-Wei Su, Sheng-Yueh Yu, et al. The treatment results of a standard algorithm for choosing the best entry vessel for intravenous port

implantation. Medicine (Baltimore). 2015; 94(33):e1381
17. Sonobe M, Chen F, Fujinaga T, Sato K, Shoji T, Sakai H, et al. Use of totally implantable central venous access port via the basilic vein in patients with thoracic malignancies. Int J Clin Oncol. 2009;14: 208-212.
18. Jie Zhou, Shikun Qian, Weixing He. Implanting totally implantable venous access port via the internal jugular vein guided by ultrasonography is feasible and safe in patients with breast cancer. World J of Surg Oncol. 2014;378.
19. Biffi R, Pozzi S, Agazzi A, Pace U, Floridi A, Cenciarelli S, et al. Use of totally implantable central venous access ports for high-dose chemotherapy and peripheral blood stem cell transplantation: Results of a monocentre series of 376 patients. Ann Oncol. 2004;15:296-300.
20. Dal Molin A, Rasero L, Guerretta L, Perfetti E, Clerico M. The late complications of totally implantable central venous access ports: The results from an Italian multicenter prospective observation study. Eur J Oncol Nurs; 2010. (Article in press)
21. Paolo B, Giulia G, Ilaria DF, Samuel KE, De Gaudio, Cecilia P. Fractures of totally implantable central venous ports: More than fortuity. A three-year single center experience. J Vasc Access. 2014;15(5): 391-395
22. Kazushi F, Hajime K, Toshihiko S, Koichiro T. Four-dimensional CT-guided transcatheter removal of a fractured migrated catheter of a totally implantable venous access port. BMJ Case Reports; 2017.
DOI: 10.1136/bcr-2017-221445
23. Klotz HP, Schöpke W, Kohler A, Pestalozzi B, Largiadèr F. Catheter fracture: A rare complication of totally implantable subclavian venous access devices. J Surg Oncol. 1996;62:222-5.
24. Lam AW, Chen YM, Yang KY, Tsai CM, Perng RP. Disconnection of a venous Port-A-Cath followed by embolization after saline flush: Rare case report. J Clin Oncol. 1999;29:643-5.
25. Di Carlo I, Fisichella P, Russello D, Puleo S, Latteri F. Catheter fracture and cardiac migration: A rare complication of totally implantable venous access devices. J Surg Oncol. 2000;73:172-3.
26. Schwartz R, Groeger J, Coit D. Subcutaneously implanted central venos access devices in cancer patients A prospective analysis. Cancer. 1997;79(8): 1635-1640.
27. Lebeaux D, Fernández-Hidalgo N, Chauhan A, Lee S, Ghigo. Management of infections related to totally implantable venous-access ports: Challenges and perspectives. Lancet Infectious Diseases; Elsevier. 2014;14(2):146-159.
28. Kurul S, Saip P, Aydin T. Totally implantable venous-access ports: Local problems and extravasation injury. Lancet Oncol. 2002;3:684-92.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/25574