A retrospective study of central venous catheters GCRI experience

Sachin A. Jain,
Shilin N. Shukla,
Shailesh S. Talati, Sonia K. Parikh,
Shivani J. Bhatt, Vinayak Maka

Department of Medical and Pediatric Oncology, Gujarat Cancer and Research Institute, Ahmedabad, Gujarat, India

Address for correspondence:
Dr. Sachin A. Jain,
DM Medical Oncologist
Assist. Professor, GMCH
Udaipur - 313 002,
Rajasthan, India.
E-mail: drsachinjain29@rediffmail.com

ABSTRACT

Background: The use of central venous catheters (CVCs) has greatly improved the quality-of-care in cancer patients, yet these catheters may cause serious infectious and thrombotic complications. The aim of this retrospective study was to study the various types of CVCs and their complications. **Materials and Methods:** We studied retrospectively 213 cases of CVCs in our institute with their indications, type and complications from August 2010 to July 2011. **Results:** A total of 213 CVCs were inserted in patients with hematological (62%) and solid organ malignancies (38%). Ninety-eight patients (46%) had peripheral inserted central catheter (PICC), 90 (42%) patients had Hickman catheters and 25 (12%) had a port. The median duration of retention of Hickman catheters was 104 days (3-365 days), for the peripherally inserted central catheters was 59 days (3-100 days) and for the port it was 280 days (45-365 days). Non-infective complications were more than infective (12% vs. 7%). The most common complication was non-infective occlusion and thrombophlebitis. In one patient with PICC thrombosis occurred in the cephalic, radial and ulnar vein and in one patient with port thrombosis occurred in the superior vena cava. Organisms were isolated in 60% (12 out of 20) of cultures. Common organisms isolated were *Pseudomonas aeruginosa* in 5 (42%), *Staphylococcus aureus* in 2 (16%), *Escherichia coli* in 2 (16%) and *Aspergillus* in 3 (25%) patients. 7 out of 12 infected patients had negative blood cultures within 7 days of antibiotic treatment, 5 patients remained positive for more than 7 days with antibiotics. In 155 patients (73%), the desired treatment protocol was completed and at present there are still 28 patients (13%) with catheters. 5 patients (2.3%) died of febrile neutropenia and septicemia with multi-organ failure. In 5 patients (2.3%), the catheters (1 Port, 1 Hickman and 3 PICC) were prematurely removed because of thrombosis. **Conclusion:** CVCs are better options to facilitate the long-term vascular access provided infection is prevented with meticulous care and treated promptly with proper antibiotics. Most CVCs is acceptable to patients.

Key words: *Central venous catheter, chemo port, Hickman central venous catheter, peripheral inserted central catheter*

INTRODUCTION

Cancer patients require frequent intravenous administration of chemotherapy, antibiotics, blood components, etc., for a considerable period of time. Repeated venipunctures are poorly tolerated by these patients. The introduction of central venous catheters (CVCs) in the 1980s significantly improved the quality-of-life of oncology patients.[1,2] However; the use of these CVCs has been associated with mechanical, infectious and thrombotic complications.

Access this article online

Quick Response Code:

Website: www.ijmpo.org

DOI: 10.4103/0971-5851.125234

Central venous devices are of various types like open-ended tunnelled catheters, tunnelled valve catheters and implanted subcutaneous ports, non-tunneled external catheters (CVCs and peripheral inserted central catheters (PICCs)).

Relative contraindications are bleeding disorders, anticoagulation or thrombolytic therapy, combative patients, distorted local anatomy, cellulitis, burns, severe dermatitis and vasculitis.

Selection of the device is based on the number of factors such as disease, number and type of solutions, osmolality,

flow required and duration of use- days versus months, preference of physician and patient and cost of the device.

Complications are acute or delayed. Acute are: (1) procedure related: Dysrhythmias, catheter knotting or malposition, nerve injury, pneumothorax, hemothorax, hydrothorax, hemomediastinum; (2) vascular: Air embolus, arterial puncture, arteriovenous fistula, hematoma, blood clot; (3) infectious: sepsis, cellulitis, osteomyelitis, septic arthritis. Delayed like postinsertion phlebitis, extrinsic compression, i.e., pinch off, kink, catheter occlusion by precipitate, thrombus, fragmentation and infection.

AIMS AND OBJECTIVES

Aims

To study the profile of patients with CVCs and types of CVCs with respect to their complications.

Objectives

- Indications for various types of CVCs.
- Complications and their management overview.

MATERIALS AND METHODS

A retrospective study of function and complication rates of CVCs ($n = 213$) placed in children (112) and adults (101) at our institute over a 1 year period (August 2010 till July 2011) was done. We retrieved case files from the medical record department and reviewed for demographic profile, indication of insertion, any immediate, acute and late-onset complications. Indications of removal of catheter such as infection, occlusion and completion of treatment were noted.

Study population

Patients who were admitted to medical and pediatric oncology department underwent catheterization for various purposes were studied. The CVCs used were peripherally PICC, Hickman CVC (HC) or a chemo port (CP). A total of 458 CVCs were inserted. Patients with short-term catheter cavafix and subclavian/internal jugular vein (IJV) certofix (145) were excluded from the study. Patient with incomplete data (100) regarding CVC removal, lost to follow-up and catheter insertion outside the Gujarat Cancer Research Institute (GCRI) were also excluded from the study.

RESULTS AND ANALYSIS

In our study, median age of pediatric patients was 4 year (6 month to 14 year) and for adults 40 years (>14-65 year). The 112 (52.6%) CVCs were inserted in pediatric patients and 101 (47.4%) were in adult patients. Hickman was preferred in pediatric group, out of 112 CVCs, 68 (61%) were Hickman, 32 (28%) were PICC and 12 (11%) were port. Although in adults PICC was commonly used. Out of 101 CVCs, 66 (65%) were PICC, 22 (22%) were Hickman and 13 (13%) were port [Figures 1, 2, and Table 1].

Overall 62% CVCs were used in hematological malignancies and 38% were used in solid malignancies. In pediatric patients, acute lymphoblastic leukemia was most common indication others were Ewing sarcoma, rhabdomyosarcoma, retinoblastoma, hepatoblastoma, neuroblastoma, wilms' tumor and germ cell tumor. In adults most common indication was acute myeloblastic leukemia, others were breast cancer, colorectal cancer, head and neck cancer and non-Hodgkin's lymphoma.

Overall median duration of CVCs was 89 days, for PICC 59 days, Hickman catheter 104 days and for port it was 280 days.

Catheter related complications were seen in 40 (19%) CVCs. Non-infective complications (12%) such as thrombophlebitis, malposition, swelling and occlusion were more common than infective (7%).

Blood cultures and/or catheter tip cultures were send in 20 cases. Organisms were cultured in 12 (60%) specimens. Most common organism was *Pseudomonas* (five cases) while *Aspergillus* (3), *Staphylococcus aureus* (2) and *Escherichia coli* (2) were found in others. 7 out of 12 infected patients had negative blood cultures within 7 days of antibiotic treatment while 5 patients remained positive. In 155 patients (73%), the desired treatment protocol was completed and at present there are still 28 patients (13%) with catheters. 5 patients (2.3%) died of febrile neutropenia and septicemia with multi-organ failure. In 5 patients (2.3%), the catheters (1 Port, 1 Hickman and 3 PICC) were prematurely removed because of thrombosis.

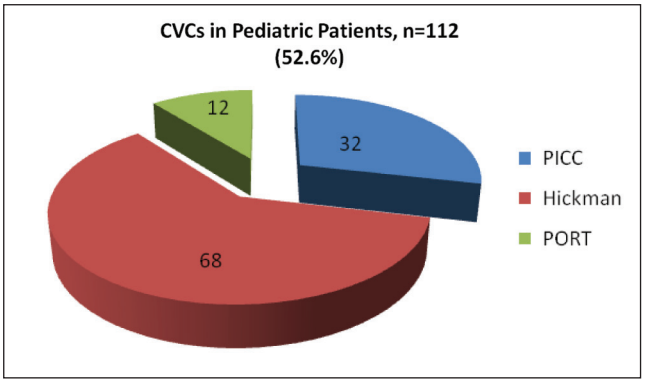

Figure 1: Number of pediatric patients with different central venous catheters

DISCUSSION

CVCs have a paramount role throughout the management of cancer patients, as they are needed in the initial phases for surgery or chemotherapy, in the advanced stage for chronic treatment and in the last stage for palliative measures. Central venous access is commonly attempted in the IJV, subclavian vein, femoral vein or arm veins.[3]

Physicians must determine the individualized catheter type by considering various factors such as catheter duration, technique, compliance, complications, cost and efficacy. CVCs are classified by tip position, technical features or materials. They can be classified in terms of short-term, medium-term or long-term access. Because superior vena cavas (SVCs) are a non-tunneled catheter, the expected duration was generally short and they have a known disadvantage of infection. The PICC is also a non-tunneled catheter and is useful for a relatively longer duration. The CP is a tunneled catheter and is useful for the long term. Tunneled catheters and PICCs[4,5] and are held to have lower infection rates, but no randomized controlled trials have demonstrated this contention to date.[6] Additionally, thrombosis occurs more often with a PICCs than other catheters due to the influence of multifactorial phenomenon.[7]

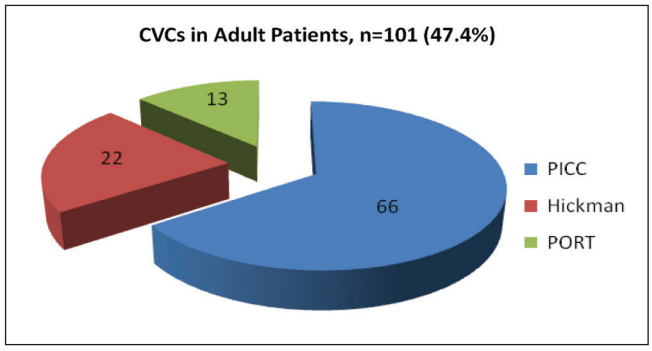

Figure 2: Number of adult patients with different central venous catheters

Table 1: Patient data

Total no. of patient	**213**
Median age	
Pediatric	4 years (6 months to 14 years)
Adult	40 years (>14-65 years)
Indication (%)	
Solid malignancy	81 (38)
Hematological malignancy	132 (62)

Table 2: Median duration of different devices

Median duration		
Types	**Range (days)**	**Median (days)**
PICC	3-100	59
Hickman	3-365	104
Port	45-365	280
All	3-365	89

PICC – Peripheral inserted central catheter

The incidence of catheter related complication was 19% in our study with 12% non-infected such as occlusion, malposition and swelling while 7% infected. In the study by Kim,[8] they had 18.3% non-infected complication like malposition, thrombosis, bleeding and 12.8% infected complications. In a prospective study by Nirni,[9] infection was found in 30% of cases with 26% culture positive, mainly for *S. aureus*. Jatin *et al*.[10] found infection in 16% cases. In the study by Winter *et al*.[11] 13% had a non-infective complication while only 1% had infective complication. The incidence of documented thrombosis was 2.3% in our study, which was relatively low despite not using prophylactic anticoagulation. One patient with acute myeloid leukemia (AML) developed thrombosis in the cephalic, radial and ulnar vein (PICC). Other two patients with PICC thrombosis were AML induction (1) and acute lymphocytic leukemia (ALL) consolidation (1). While one patient with ca breast on adjuvant chemotherapy developed thrombosis in SVC (Port) and another patient with ALL consolidation developed thrombosis in HC. The thrombosis incidence rate tended to be more frequent (three cases) in patients with PICCs than Hickman and CPs. Nirni and Kim *et al*. noticed 2% and 4.5% incidence of thrombosis in their studies respectively. In our study incidence of complications are less, probably secondary to proper counselling, strict aseptic precautions and proper cath flush. Furthermore, we have separate CVC care service and dedicated nursing staff.

We found one catheter-related immediate-onset complication in AML induction patient in the form of hemothorax after IJV insertion, that patient also had PICC related thrombosis and pulmonary embolism and was expired. No other immediate complication like pneumothorax, except bleeding was found. Most cases were performed by an expert anesthetist or by expert oncology resident. Majority of PICC insertion were without using ultrasound (USG) or fluoroscopic guidance. A study has also reported that USG is not beneficial for reducing catheter-related complication.[12] However, it is optimal to insert catheters using USG or fluoroscopic guidance if facility available to reduce the immediate-onset complication rate.

The median PICC life span was 59 days (3-100 days), for Hickman 104 days (3-365 days) and for port 280 days (45-365 days). Overall median duration was 89 days until study completed. In addition, a longer-term use of catheters occurred in patients with a solid malignancy than hematologic malignancy. Patients with a solid malignancy underwent a CP rather than another catheter type due to scheduled, intermittent long-term chemotherapy. Therefore, the CP was considered an

Table 3: Comparison of different studies

Author	Median duration (days)	Non-infected %	Thrombosis %	Infection %	Culture positivity %	Organism
Nirni *et al*. (*n*=50)	84	11	2	30	26	*S. aureus*
Jatin *et al*. (*n*=51)	90	5.6	NA	16	NA	*S. aureus*
Winter *et al*. (*n*=43)	153	13	NA	1	NA	NA
Kim *et al*. (*n*=219)	46	18.3	4.5	12.8	NA	NA
Present study (GCRI) (*n*=213)	89	12	2.3	7	40	*Pseudomonas*

S. aureus – *Staphylococcus aureus*; GCRI – Gujarat Cancer Research Institute

effective tool for long-term use in patients with cancer. In Kim study, the median catheter life span was 46 days and the CP was useful for the long term (median 269 days); however, the median life span of the PICC was 37 days. In studies by Nirni, Jatin *et al*. and Winter *et al*. had median duration of 84 days, 90 days and 153 days respectively.

CONCLUSION

CVCs are better options to facilitate the long term vascular access provided infection is prevented with meticulous care and treated promptly with proper antibiotics. Most CVCs are acceptable to patients.

The major problems related to CVCs were thrombosis, malposition or migration of the tip and infection. Port is an effective tool for long-term use in patients with cancer, while Hickman and PICC are feasible for few months. In addition, the insertion of CVCs with the image guidance is advisable and the fixation of the tip is important for the management of PICC.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Bharat J. Parikh (MD, Professor and Chief of Medical Oncology Unit 1, Gujarat Cancer and Research Institute, Ahmedabad), Dr. Asha N Anand (MD, professor Department of Medical and Pediatric Oncology, Gujarat Cancer and Research Institute, Ahmedabad), nursing staff and patients of Gujarat Cancer and Research Institute.

REFERENCES

1. Cameron GS. Central venous catheters for children with malignant disease: Surgical issues. J Pediatr Surg 1987;22:702-4.
2. Iannacci L, Piomelli S. Supportive care for children with cancer. Guidelines of the childrens cancer study group. Use of venous access lines. Am J Pediatr Hematol Oncol 1984;6:277-81.
3. Biffi R, de Braud F, Orsi F, Pozzi S, Mauri S, Goldhirsch A, *et al*. Totally implantable central venous access ports for long-term chemotherapy. A prospective study analyzing complications and costs of 333 devices with a minimum follow-up of 180 days. Ann Oncol 1998;9:767-73.
4. Scott WL. Central venous catheters. An overview of food and drug administration activities. Surg Oncol Clin N Am 1995;4:377-93.
5. Ryder MA. Peripheral access options. Surg Oncol Clin N Am 1995;4:395-427.
6. Pratt RJ, Pellowe CM, Wilson JA, Loveday HP, Harper PJ, Jones SR, *et al*. epic2: National evidence-based guidelines for preventing healthcare-associated infections in NHS Hospitals in England. J Hosp Infect 2007;65 Suppl 1:S1-64.
7. King MM, Rasnake MS, Rodriguez RG, Riley NJ, Stamm JA. Peripherally inserted central venous catheter-associated thrombosis: Retrospective analysis of clinical risk factors in adult patients. South Med J 2006;99:1073-7.
8. Kim HJ, Yun J, Kim HJ, Kim KH, Kim SH, Lee SC, *et al*. Safety and effectiveness of central venous catheterization in patients with cancer: Prospective observational study. J Korean Med Sci 2010;25:1748-53.
9. Nirni SS. Study of various types of central venous catheters with respect to their complications. Indian J Med Pediatr Oncol 2002;23:21-4.
10. Sarin J. Utility of central venous access devices in oncology. GCRI; 2004. (Unpublished data).
11. Winters V, Peters B, Coilá S, Jones L. A trial with a new peripheral implanted vascular access device. Oncol Nurs Forum 1990;17:891-6.
12. Mansfield PF, Hohn DC, Fornage BD, Gregurich MA, Ota DM. Complications and failures of subclavian-vein catheterization. N Engl J Med 1994;331:1735-8.

How to cite this article: Jain SA, Shukla SN, Talati SS, Parikh SK, Bhatt SJ, Maka V. A retrospective study of central venous catheters GCRI experience. Indian J Med Paediatr Oncol 2013;34:238-41.
Source of Support: Department of Medical and Pediatric Oncology and Department of Microbiology, Gujarat Cancer and Research Institute, Ahmedabad. **Conflict of Interest:** None declared.