“Peripherally Inserted Central Catheters: Our Experience from a Cancer Research Centre”

Deepak Sundriyal · Nikhil Shirsi · Ruchi Kapoor ·
Sushil Jain · Gyanendra Mittal · Jayesh Khivasara ·
Suraj Manjunath · K. M. Parthasarthy

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Abstract Peripherally inserted central catheter (PICC) is a modern drug delivery system utilised in oncology practice. The purpose of this study was to determine the complications associated with PICCs within a one year study period. PICCs inserted in patients registered at Dharamshila Cancer Hospital and research centre from 1st July 2012 to 30th June 2013 were studied. Data was retrieved from the procedure room records, medical records department, department of radiology and department of microbiology. Data was collected by oncology residents and procedure team. A total of 246 PICCs were inserted during the one year period. Complete data was not available in 23 patients. 223 results were included in the final analysis. USG guidance was required in 14 patients (6.3%). Optimal PICC duration was achieved in 151 patients (67.7%). 28 patient developed culture positive infective complications (12.5%). 44 patients developed mechanical complications (19.7%). Our study shows a relatively higher rate of infective

complications. PICC is an acceptable means of drug delivery system.

Keywords PICC · Malposition of catheter · PICC thrombosis

Introduction

A stable venous access is an integral component of care for the patients with cancer who are on chemotherapy. PICC is an established venous access device which serves various purposes. Ease of administration at the bedside makes it an acceptable venous access option for patients. PICC has an increased dwell time, avoids frequent cannulation and serves as a multipurpose device for delivering chemotherapy, antibiotics, parenteral nutrition, analgesia, blood components transfusion and frequent blood sampling. Moreover, the vesicant action of many chemotherapeutic agents is avoided.

D. Sundriyal (✉) · N. Shirsi
Department of Medical oncology, Dharamshila Hospital & Research
Centre, Vasundhara Enclave, New Delhi 110096, India
e-mail: drdeepaksundriyal@gmail.com

N. Shirsi
e-mail: nikhils15@gmail.com

D. Sundriyal
Department of Medical oncology, Dharamshila Hospital &
Research Centre, 79, Sector 12, Dwarka, New Delhi 110078,
India

R. Kapoor
Department of Anesthesiology and Critical Care, North Delhi
Municipal Corporation Medical College, Bara Hindu Rao,
New Delhi 110006, India
e-mail: rudoc@rediffmail.com

S. Jain · G. Mittal · J. Khivasara · S. Manjunath
Department of Surgical Oncology, Dharamshila Hospital & Research
centre, New Delhi 110096, India

S. Jain
e-mail: drsushiljain@gmail.com

G. Mittal
e-mail: g20_mittal@yahoo.com

J. Khivasara
e-mail: jkivasara9@gmail.com

S. Manjunath
e-mail: reachsuraj@rediffmail.com

K. M. Parthasarthy
Department of Medical oncology, Dharamshila Hospital & Research
Centre, Vasundhara Enclave, New Delhi 110096, India
e-mail: Mitrarp@gmail.com

Materials and Methods

This was a retrospective study. All PICCs inserted between 1st July 2012 and 30th June 2013 were studied. The data was retrieved from the procedure room records, medical records department, department of microbiology and the department of radiology. Patients with incomplete data and those lost to follow up were removed from the analysis of results. PICC placement rather than the individual patient was counted as an event as 34 patients had more than one PICC insertion during the study period. Data extracted included requirement of ultrasonographic guidance for insertion, infective and non-infective complications and optimal PICC duration. Optimal PICC duration was arbitrarily defined as completion of chemotherapy via a single PICC or a catheter stay of 12 months, whichever was earlier [1]. Data was analysed as a descriptive study.

PICC placement at our institute is done by either oncology residents or trained oncology nurses as a fixed protocol. Universal precautions are followed while inserting and maintaining the catheter. Ultrasonographic guidance is utilised if the initial attempts are unsuccessful or the appropriate calibre vein is not identified. PICC is secured to skin by either sutures or statlock. Position of the catheter tip is confirmed in the superior vena cava by a chest skiagram. Accordingly, malposition if any is corrected. The date of insertion, date of removal and all events related to PICC complications are noted in the patient's hospital record file. The Groshong (Bard access system) single lumen catheter is utilised at our institute. A 4 French catheter is commonly used as blood transfusion can easily be done through this catheter. Bard access system is a single use device and should never be re-implanted. The institutional protocol for the maintenance of the PICC includes using aseptic precautions whenever the catheter lumen is opened or connected to other devices and flushing of the catheter with normal saline prior to use. The catheter is flushed with saline also after each sampling, blood products transfusion and total parenteral nutrition infusion. Care of the PICC is explained and a care sheet is provided to the patient. This include information regarding aseptic techniques while touching the catheter, weekly dressing and flushing of the catheter when not in use and avoiding unnecessary handling of the catheter.

Results

Data for 223 PICCs were available for the analysis [Table 1]. These included only 16 insertions for haematological malignancies. USG guidance was required in 14 cases (6.3 %). Malposition of the catheter tip was observed in 11 patients (4.93 %). Most common site of Malposition was in ipsilateral internal jugular vein (6 cases) followed by right ventricle (4

Table 1 Clinical profile and outcome of PICCs inserted at our centre

Clinical profile and outcome	No of patients (%)
Total PICCs inserted	246
Data available for analysis	223
More than 1 catheter required	34 (15.2)
Patients with solid tumor	207 (92.7)
Patients with haematological malignancies	16 (7.17)
Successful blind cannulation	209 (93.7)
Ultrasonographic guidance required	14 (6.3)
PICC Malposition	11 (4.93)
Ipsilateral internal jugular vein	6
Right ventricle	4
Contralateral subclavian vein	1
Infective complications	28 (12.5)
Klebsiella pneumoniae	6
Staphylococcus aureus	6
Pseudomonas aeruginosa	4
Citrobacter species	2
Coagulase negative Staphylococcus aureus	2
Escherichia coli	1
Candida albicans	7
Mechanical complications	44 (19.7)
Catheter thrombosis	30
Catheter leakage	8
Catheter blockage	3
Fracture-embolization of catheter	1
Accidental removal of catheter	2
Premature removal of catheter	68 (30.49)
Optimal PICC duration	151 (67.7)

cases) [Fig. 1] and contralateral subclavian vein (1case). Premature removal of catheter was required in 68 patients (30.49 %). 28 patients (12.5 %) developed culture positive sepsis. Removal of the catheter was required in 24 patients. Most commonly identified organisms were Klebsiella

Fig. 1 Malpositioned catheter tip in the right ventricle

pneumoniae and *Staphylococcus aureus* each in 6 cases, *Pseudomonas aeruginosa* in 4 cases, *Citrobacter* species and Coagulase-negative *Staphylococcus aureus* each in 2 cases, *Escherichia coli* in 1 patient and *Candida albicans* in 7 patients. 44 patients developed mechanical complications. These included PICC thrombosis in 30 patients, leakage of the catheter in 8 patients, blocked catheter in 3 patients and fracture-embolization of the PICC in 1 patient. 2 patients had accidental removal of the catheter. Infective complications were mostly seen in initial 3 months following insertion. Mechanical complications were wide spread during the entire life of catheter. 151 patients (67.7 %) either completed their chemotherapy on a single PICC or were maintaining the catheter for more than 1 year at the time of analysis.

Discussion

Results from our study show a very high success rate for blind cannulation (93.7 %) as USG guidance was required in only 6.3 % of patients. The rate of malpositioning of the catheter in our study is also very low (4.93 %). This is due to the clinical skill and experience of the person and appropriate technique used. A previous study of the analysis of tip malposition of PICC by Trerotola SO et al. have shown a 70 % success rate of initial cannulation attempts. Malposition of the catheter tip was observed in 10 % of the cases in their study [2]. In another study, malposition was seen in 7.87 % of the PICCs [3]. The use of USG to guide the insertion of PICCs is already established in oncology practice [4]. Results of our study show that in expert hands, the high success rate of blind cannulation can easily obviate the need for USG and cut down the cost. USG guidance may be required in those cases, where initial cannulation attempts have failed, appropriate calibre vein is not identified or in patients presenting with anasarca.

Infective complications were observed in 12.5 % of the patients. Catheter was removed in 24 patients with positive blood cultures as fever did not subside even after 48 h of appropriate antibiotics administration. Most blood stream infection can be effectively controlled without removal of catheter in cancer patients. However, fungemia or bacteremias with *Bacillus* species, *Corynebacterium jeikeium*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, or *Stenotrophomonas maltophilia* and nontuberculous mycobacteriae often persist despite appropriate antibiotics and they require catheter removal. Catheter removal should also be considered when blood cultures remain positive after 48 h of antibiotics treatment if no other site of infection has been identified or if bacteremia recurs shortly after completion of a course of antibiotics [1]. Previous studies have shown a variable rate of infective complications. Walshe LJ et al. reported 7.4 % rate of catheter related blood stream infections while another study from India has reported an incidence rate of 7 % for infective complications [5, 6]. A study done by Barrier A

et al. reported the incidence of infective complications in PICCs as 11.1 %, while Chen W et al. reported the incidence of infections associated with PICCs as 17.6 % [7, 8]. The low incidence of infective complications in the study of Jain SA et al. from India can be explained on the basis of comprehensive evaluation of all central venous catheters including Hickman catheters and chemoports which have a low incidence of infectious complications thus confounding the results for PICCs. Higher rate of infectious complications can be explained by the fact that PICC is a non-tunnelled device whose connector protrudes from the vein outside the body. It is thus exposed to improper hygiene outside the institutional setup.

The incidence of mechanical complications is 19.7 % in our study. Venous thrombosis involving the catheter was seen in 30 patients (13.45 %). All of the patients presented with pain and swelling of the involved arm. Catheter removal was done in all of these cases after confirming the diagnosis. Low molecular weight heparin therapy was instituted followed by oral anticoagulation. A study done by Patel GS et al. revealed the incidence of venous thrombosis associated with PICCs as 25 % while another study by Ahn DH et al. reported venous thrombosis associated with PICC in 15 % of the patients [9, 10]. Jumaní K et al. described the incidence of mechanical complications in 16.4 % of the cases [11]. Mechanical complications were seen in 12 % of the patients in the study of Jain SA et al. from India. A systemic review of the literature done by Johansson E et al. has shown that PICCs have an increased risk towards venous thrombosis, however, evidence supporting any advantage or disadvantage of PICC when compared with other central venous access devices is sparse [12]. Various factors have been described which may contribute to mechanical complications like turbulence, blood flow rate, non-central location of the catheter tip and increasing catheter dwell time [11, 13].

Leakage of the catheter was seen in 8 patients (3.58 %) while blockage developed in 3 patients (1.3 %). None of these catheters could be repaired and required removal. Fracture of the catheter was seen in only one patient in whom the distal segment embolized to the pulmonary vessels. It was removed successfully with the help of interventional radiologist.

Conclusion

PICC is a convenient mode of venous access in modern oncology practice. It is cost-effective as more than 67 % of our patient achieved optimal PICC duration. USG guidance for insertion can simply be omitted in skilled and experienced hands. Complication rates are little higher with PICC. This may be due to subsequent poor handling of the PICCs after insertion and poor emphasis on PICC care at home by the patient. Education regarding PICCs insertion and subsequent care needs to be improved.

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