Complications of chemoport in children with cancer: Experience of 54,100 catheter days from a tertiary cancer center of Southern India

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Abstract

Background: Chemoport is an essential part of the management of children with cancer and provides long-term venous access. There are few studies from resource poor countries reporting complications of chemoport. **Aims:** This study was aimed at describing the complications of chemoport in patients with cancer. **Materials and Methods:** This retrospective observational study analyzed 200 patients <15 years of age who underwent chemoport insertion. The medical records of these patients were reviewed for the patient characteristics, diagnosis, nature of port use, port-related complications and their management. **Results:** A total of 209 ports were implanted in 200 patients and 24 ports were removed due to port-related complications. There were 122 boys and 78 girls whose ages ranged from 4 months to 13 years (median age 2.5 years). About72% of patients were <2 years old. The cumulative duration of catheterization was 54,100 days. Of 209 ports, there were 36 complications that led to the removal of 21 ports. Port-related infection was the most common infection observed in our study (0.66/1000 catheter days and 11.9%). Mechanical complications were seen in 9 patients. Venous thrombosis and skin necrosis occurred in one patient each. **Conclusions:** Use of chemoport is safe and is a boon for children with cancer in developing countries with incidence of complications similar to Western countries. Although use of chemoport is associated with complications, they are easily managed. With stringent catheter care by trained personnel, some complications can be prevented.

Key words: Bloodstream infection, chemoport, implantable venous access device, internal jugular vein

Introduction

Childhood cancers have become highly curable with the availability of aggressive chemotherapy regimens and improved supportive care. Prolonged access to venous system can be accomplished with a peripherally inserted central venous catheter, an externalized tunneled catheter or an implantable venous access device (IVAD). IVAD is variously known as indwelling central venous access devices, totally implantable central venous access devices, port-A-cath, port or chemoport. Insertion of chemoport requires general anesthesia in children and the device is more expensive compared to central venous catheters. However, chemoport offers many advantages over a central venous catheter like less risk of catheter-related sepsis,[1] less requirement of maintenance, less interference with activities of the patient.[2] Hence, there would be lesser treatment delay due to catheter-related sepsis, lesser investment on antibiotics, lesser duration of hospitalization and minimal maintenance to keep the device patent. There are few Indian studies reporting complications of chemoport. This retrospective study was carried out to evaluate the complications of chemoport in children with malignancies.

Materials and Methods

This retrospective observational study was undertaken to evaluate chemoport-related complications in children with malignancies. A total of 200 consecutive patients who underwent chemoport insertion in our institute between January 2009 and January 2014 were analyzed. Chemoport was implanted by the pediatric surgeons.

Technique of chemoport insertion

All of the procedures were performed under general anesthesia. All patients received antibiotic prophylaxis prior to port insertion. Platelet count <60,000; absolute neutrophil count <500/mm3; INR above 1.5 were considered as contraindications.

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Percutaneous Seldinger's technique was used in 195 patients. Open cut down technique was used in 14 patients in whom percutaneous techniques failed. Patients received intravenous antibiotic for 3 days. The port was accessed for chemotherapy from the 3rd day unless dictated by local condition.

Catheter care

Chemoports were cared for by trained nurses, including cleaning the insertion site and changing the insertion site dressing once in 5 days. If the port was not used for a long time, the port was flushed every 4 weeks. Ports were flushed with 10 ml of 0.9% saline and locked with 4–8 ml heparinized saline (100 IU/ml) every 4 weeks postinsertion and each time after access to prevent blockage.

The medical records of these patients were reviewed for the patient characteristics, diagnosis, nature of port use, port-related complications and their management. The timing of infectious complications was defined as either early (≤30 days after port placement) or late (>30 days after port placement). Complications were classified as local skin infection, bloodstream infection (BSI) (defined as positive blood culture from a line-related organism), thrombotic and mechanical complications (like line displacement or a catheter fracture). Statistical analysis was performed with SAS software for Windows, release 9.2, (SAS Institute Inc., Cary NC, USA).

Results

A total of 209 ports were implanted in 200 patients, and 24 ports were removed due to port-related complications. There were 122 boys and 78 girls whose ages ranged from 4 months to 13 years (median age 2.5 years). Conditions requiring chemoport insertion were Acute lymphoblastic leukemia (50.5%), Acute myeloid leukemia (5.5%), non-Hodgkin lymphoma (9.5%), Hodgkin lymphoma (4.5%), Wilms tumor (9.5%),

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Neuroblastoma (8%), Ewings sarcoma/Primitive Neurectodermal tumor (3%), Germ cell tumor (2.5%), Hepatoblastoma (2%), Brain tumor (2%), Osteosarcoma (1.5%) and Rhabdomyosarcoma (1.5%).

The cumulative duration of catheterization in this study was 54,100 days. The mean duration of catheterization per patient was 270 days ranging from 15 to 956 days. The cumulative venous access was 17,062 patient days. The mean access time per patient was 85.31 days ranging from 0 to 320 days. No death occurred because of any port-related complication.

Of 209 ports, there were 36 complications (0.67/1000 catheter days). Totally, 21 ports were removed due to complications (0.38 port removal/1000 catheter-days) [Table 1].

Infectious complications occurred in 25 ports (0.46/1000 catheter days). Of the 16 BSI, 7 occurred within 30 days after port insertion (43.7%) and were considered as implantation related [Figure 1]. Early BSI occurred after a mean duration of 25.14 days. Mean age of patients was 2.4 years, and male/female ratio was 0.75. All patients had hematological malignancies. Majority of the early BSI were caused by Gram-positive organisms, Methicillin resistant *Staphylococcus aureus* (2), Enterococci (2), *Enterococcus fecium* (1), *Streptococcus sanguis* (1) and *Klebsiella* (2). 9 BSI developed 30 days after port insertion (56.3%). Late BSI developed after a mean duration of 174.7 days. Mean age of patients was 1.61 years and male/female ratio was 2. Totally, 7 patients had hematological malignancies and 2 had solid tumors. Organisms causing late BSI were both Gram-positive and Gram-negative, *Klebsiella* (1), *Burkholderia cepacia* (3), *Enterobacter aeruginosa* (1), Methicillin sensitive *S. aureus* (1), Methicillin resistant *S. aureus* (1) and *Enterococcus* (2). Of 7 early and 9 late BSI, 6 ports each were removed. Patients, whose ports were removed, recovered promptly after removal of the ports. The remaining patients recovered after treatment with intravenous antibiotics and in such patients ports were salvaged.

Local skin infections were seen in 9 ports. Early skin infections occurred after a mean duration of 12.4 days after port insertion. Mean age of patients was 2.25 years, and male/female ratio was 4. All patients had hematologic malignancies. Of 5 early skin infections(55.5%), Gram positive organisms predominated with staphylococcus *aureus* isolated in 4 patients and coinfection with proteus mirabilis and *enterobacter cloacum* in 1 patient. One port was removed, and rest were salvaged with antibiotic use. Four late skin infections (45.5%) occurred after a mean duration of 87.25 days. Mean age of patients was 1.75 years, and all 4 patients were boys. A total of 3 patients had hematologic malignancies and 1 had solid tumor. Organisms isolated were *E. fecium* (3) and pseudomonas (1). One port was removed due to late skin infection.

Table 1: Complications of chemoport

Complication	Type of complication	Numbers (*n*=36)	Port removal (*n*=21)
Infections	Bloodstream infection		
	Early (mean duration-25.14 days)	7	6
	Late (mean duration-174.7 days)	9	6
	Skin infection		
	Early (mean duration-12.4 days)	5	1
	Late (mean duration-87.25 days)	4	1
Mechanical problems	Catheter line displacement	1	0
	Twisted port hub	3	0
	Catheter fracture with leakage	2	2
	Catheter fracture with line migration	2	2
	Catheter fracture with embolization	1	1
Venous thrombosis		1	1
Skin necrosis		1	1

Mechanical problems requiring port revision were catheter line displacement (1/209) and twisted port hub (2/209). Catheter fracture manifesting as leakage without displacement (3/209) and catheter fracture with line migration (2/209) required port removal. In one patient, catheter tip was fractured with embolism of the fractured tip to right ventricle. Port was removed, and the fragment in the right ventricle was retrieved by the cardiothoracic surgeon.

An infant with acute lymphoblastic leukemia developed venous thrombosis of right iliac, right superficial femoral and right proximal popliteal veins associated with chemoport after 462 days of catheterization. Patient was started on low molecular weight heparin and chemoport was removed.

Necrosis of skin at needle site occurred in a 4-year-old girl with acute lymphoblastic leukemia after 128 days of catheterization and led to port removal.

Discussion

The implantable vascular access device, also called a port or a chemoport, is a small reservoir connected to a venous catheter and is positioned in the subcutaneous tissue. Niederhuber *et al*. introduced the currently used type of port system into clinical use in 1982.[3] Chemoport is useful in providing prolonged venous access in chronic diseases.[4-7] Chemoport has the advantage that the puncturing needle can be removed after each infusion and the skin covering the port reservoir serves as a natural protection against infection whereas in Open, tunneled central venous catheter systems one end of the catheter remains outside the body increasing the risk of infection. Compared to central venous catheters, chemoport is more expensive and involves surgical procedure under general anesthesia. In spite of this initial investment, it turns out more cost effective because of its long life and due to lower risk of sepsis. The use of chemoport may be associated with some complications, most of which can be effectively managed.

Port-related infection was the most common infection observed in our study (0.66/1000 catheter days and 11.9%). The infection rate of indwelling venous catheters has been reported to range between 0.09 and 2.8/1000 catheter days and 0.8–7.5% in different pediatric oncology case series.[8-12] The 4 major risk factors associated with catheter-related infections are host factors, catheter type, duration of use, and catheter maintenance and management. The incidence of catheter-related BSI in resource

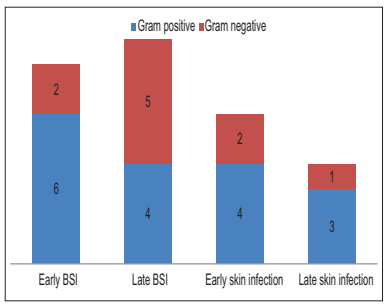

Figure 1: Infectious complications of chemoport

poor countries is much higher than that in developed countries due to lack resources, appropriate medical supplies, and sufficient skilled manpower.[13] However, infection rate observed in our hospital was similar to that reported by other investigators, which may be due to meticulous catheter care with trained personnel.

One of the most interesting observations of our study was the preponderance of infections in children <2 years old. This striking result could be either due to the vulnerability of infants to infections in general or due to a skewed sample, as 72% of patients were <2 years old. This is one of the few studies with such large number of patients <2 years old. Our study has brought out the fact that the use of chemoport is safe and effective even in such young children.

Among the BSI, Gram-positive organisms predominated in early BSI whereas Gram-negative organisms were more frequently isolated in late BSI. In general, Gram-positive organisms are the most common cause of BSI in patients with ports.[1] It is possible that normal skin flora grow down the outside of the needle, leading to colonization and early onset BSI. In our center, patients of acute leukemia are hospitalized during the initial phases of induction and consolidation because of poor compliance due to socioeconomic reasons. It could be hypothesized that with prolonged hospitalization, the normal Gram-positive skin flora might get replaced by Gram-negative pathogenic organisms from the hands of medical personnel during catheter manipulation or proximity of the catheter hub to the nappy area in young infants. Most of the Gram-negative pathogens were in fact the organisms causing nosocomial infections.

Among the skin infections at exit site, Gram-positive organisms were the most common in both early and late onset infections. Another interesting observation of the study was that both early onset BSI and early onset skin infections occurred exclusively in patients with hematologic malignancies whereas late onset BSI and skin infection occurred in patients with both hematologic and solid malignancies. In general, patients with hematologic malignancies are known to have higher rate of infections compared to patients with solid tumors due to immune suppression. The absence of early onset infections in patients with solid tumors could be due to their preserved immunity, which could lead to slower rate of adherence and colonization of the catheter lumen with microorganisms.

Mechanical complications were the second most common complication. In various series, mechanical problems have emerged as an important cause of morbidity and port removal.[14] Selecting the right port system, proper installation of the port chamber and efficient handling and maintenance of the port by trained staff could prevent these complications.

Chemoport-related venous thrombosis occurred in one patient in our study. Though it is a well-known complication in adult patients with malignancies, there is paucity of data regarding venous thrombosis associated with chemoport in children. In a study of totally IVAD in children with cystic fibrosis by Deerojanawong *et al*.,[6] symptomatic venous thrombosis occurred in 9% of patients. Patients with malignancies have various nonspecific thromboembolic risk factors (age, malignancy, hypercoagulability, chemotherapy, infections, and immobility) and specific risk factors such as catheter material, multiple placement attempts, catheter size and length, number of lumens, and catheter tip localization.

Skin necrosis at port site occurred in one patient. The exact cause of this complication is not known. Malnutrition could be a risk factor since the body tissue will not hold the port and the skin over the port may get necrosed.

The strength of the study is that it has unraveled the safety and efficacy of chemoport usage in a developing country. This calls for more frequent use of chemoports even in resource poor countries because of its cost effectiveness and very few complications. With trained nursing staff dedicated for the care of the chemoport, complications are minimal and can be easily managed. In addition, our study has proven the safety and effectiveness of chemoport in children <2 years old.

Conclusion

Use of chemoport is a boon for patients with cancer in developing countries with an incidence of complications similar to the western countries. Although the use of chemoport is associated with some complications such as blood-stream and local skin infections, mechanical complications, venous thrombosis and skin necrosis, they are easily managed. With stringent catheter care by trained personnel, some complications can be prevented.

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Conflicts of interest

There are no conflicts of interest.

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