Original Article
Improvement in Care and Maintenance of Port-A-Cath Following the Introduction of Care” Bundle

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ABSTRACT

Background: Port-a-cath is a type of indwelling central venous catheter used to manage pediatric patients who require long-term intravenous therapy.

Objectives: The objective of this study was to improve the care and maintenance of port-a-cath among the nursing staff by introducing a care bundle.

Materials and Methods: Pretraining and posttraining designs using PDSA (Plan, Do, Study, Act.) model were followed. We observed two sets of 30 procedures for accessing of port-a-cath by the nursing staff. Following the initial 30 observations of port-a-cath handling, a “care bundle” was designed as per the set standards of the maintenance of port-a-cath. It involved education and training and live audio-visual sessions. Two months after the initiation of the care bundle, the second set of 30 procedures was observed.

Results: Following the introduction of the care bundle, the observed efficacy on obtaining verbal consent improved to 100% from 83%, arrangement of drugs and instruments before insertion to 100% from 90%, not touching the needle while inserting from 60%, administration of adequate amount saline flush from 83.3% (25/30), heparin administration from 71.1%, and looking out for signs of extravasation to 100% from 80%. Two nursing staff involvement improved from 23% to 63%. A 100% efficacy in the management of nonbleeding back scenarios was observed. The cross-checking of drug expiry improved from an initial 26.6% to 89.3%. The port-a-cath infections have significantly come down (3 vs. 0) (P < 0.05).

Conclusion: Implementation of a “care bundle” has significantly improved the quality of handling of port-a-cath and reduction in infections.

KEYWORDS: Central line, chemoprot, childhood cancer, infection, port-a-cath

INTRODUCTION

Port-a-cath is an indwelling central venous access device used in patients requiring prolonged intravenous access.[¹] It is placed subcutaneously and made up of two parts, namely catheter and port.[²] The most dreaded complication regarding indwelling central line is central line-associated bloodstream infections (CLABSIs). CLABSIs play an important role in increased mortality, morbidity, expenses, and hospital stay.[³] It is one of the four main causes of hospital-acquired infections in the United States of America.[⁴] Different central venous catheters have varying incidences of infections.[⁵] Wagner et al. in 2015 reported 4% CLABSI among the 48 children with port-a-cath.[⁶,⁷] The CLABSI-related mortality could be much more than reported in developing nations due to underreporting or not identifying CLABSI cases.

Central line bundles have been put into practice significantly after Pronovost et al. implicated their usage.
in a significant reduction in CLABSI.\textsuperscript{[8]} Reduction of CLABSI to 2.5/1000 catheter days from the initial 6.4/1000 catheter days after the implementation of bundles was reported in recent research.\textsuperscript{[9]} CLABSI among port-a-cath patients can be significantly reduced by proper care and assessment by the nursing staff. The frequent development of port-a-cath-related complications such as blockages, infections, and extravasations led to the development of a care bundle to improve the care and maintenance in our institution.

**Materials and Methods**

This quality improvement project (QIP) was conducted in KMC Hospital, a tertiary care hospital located in Mangaluru, India. We have dedicated pediatric hematology-oncology wards and separate day care with trained nursing staff handling central lines for our patients undergoing chemotherapy. A chest X ray is done in all patients after the procedure and reviewed by the individual who performed the procedure. The tip of a central venous access device should be verified on CXR before use, and the exact location of the tip should be documented in the medical notes. All children undergoing chemotherapy with port-a-cath in situ were the subjects, and all the nursing staff operating oncology wards were eligible to participate in the audit. This QIP examined the knowledge among nursing staff regarding the care and assessment of port-a-cath, which was directly observed by the residents of the pediatric oncology department. The resident doctors have been handling port-a-cath for the past 2 years and were trained by the pediatric oncologist who has been trained and doing this for the past 10 years. Preintervention and postintervention designs using PDSA (Plan, Do, Study, Act) model were followed \[Table 4\].\textsuperscript{[10,11]} The audit period was from January 13, 2021, to February 16, 2021, and reaudit was done from April 15, 2021, to May 21, 2021. All the children with port-a-cath in situ admitted to the pediatric hematology-oncology wards were included in the study.\textsuperscript{[15]}

**Standards**

This QIP was based on the NHS trust hospitals’ standard care and maintenance of port-a-cath (children).\textsuperscript{[1,10,11]} A “care bundle approach” was designed, which consisted of assessment pro forma \[Table 1\], audio-visual aids, and training sessions to the nursing staff by the doctors of the pediatric hematology-oncology unit. A total 30 observations of port-a-cath handling by nursing staff in patients with ongoing chemotherapy were done \[Table 2\]. Pre- and postintroduction of care bundle was done.

### Table 1: Care bundle

| Characteristics | Methods |
|-----------------|---------|
| Identification  | Name    |
| Vitals          | Hospital ID |
| Blood pressure  | Verbal consent |
| Heart rate      | Procedure explained to the patient and kin |
| Respiratory rate| Instruments |
| Oxygen saturation| Cross-checking of the drug expiry date |
| Communication   | Cross-checking |
| Aspesis techniques | Aspesis by the care provider |
| Needle insertion techniques | Aspesis on the patient |
| Identification of the insertion site | Identification of the port-a-cath hub |
| priming of the needle with saline | perpendicular insertion of the needle |
| Bleeding back   | Bleeding back checked |
| Nonbleeding back| Positive pressure administration during flushing |
| Positional changes | Adequate amount of normal saline flush administered |
| Heparin (Hep-lock) administration | Heparin (Hep-lock) administration |
| Urokinase (U-frag 5000 IU) administration | Urokinase (U-frag 5000 IU) administration |
| Chest X-ray to look for the position of the catheter tip | Chest X-ray to look for the position of the catheter tip |
| Removal techniques | Aspesis to be followed |
| Local reactions  | Skin changes |
| Extravasation from port-a-cath site | Proper disposal |

### Care bundle

The standards for care and maintenance are described in Table 1.

### Definitions

1. Port-a-cath: Port-a-cath is a small medical device that is installed beneath the skin. It comprises two
parts: (a) catheter, which is a soft, thin, hollow plastic tube. The tube is tunneled under the skin, with the tip sitting just outside the heart. (b) A port or disc is inserted in the chest and attached to the tube.

2. (CLABSI, line infections): According to the Centers for Disease Control and Prevention, CLABSI is defined as a laboratory-confirmed bloodstream infection where the central line was in place for > 2 calendar days on the date of the event, with a day of device placement being on day 1, and the line was also in place on the date of the event or the day before.

3. Blockage of line: It is defined as nonbleeding back from a port-a-cath while checking for its patency before drug administration.

This QIP was registered with the quality department (KMCH/108/2021) in KMC Hospital, Ambedkar Circle, Mangaluru.

**Analysis**
A descriptive analysis was performed for the relevant variables. We used paired $t$-test to determine whether our intervention showed any improvement in care and maintenance and reduction in CLABSI of port-a-cath lines. $P < 0.05$ was considered statistically significant. The primary exposure was intervention effect measured as pre- and postintervention of QI initiative. For analysis, the SPSS software version 19.0 was used.

**Results**

**Preintervention**
Thirty procedures of nurse’s handling of port-a-cath among seven solid/hematological malignancy patients were observed by the resident doctors in day care or the oncological ward [Table 2]. Significant failure to meet the standards was observed across the multiple parameters assessed. A total of 83% (25/30) efficiency was noted in obtaining verbal consent from the patient/kin and explaining the procedure to the patient/kin. A 100% efficiency was observed in handwashing practices and the use of alcohol-based hand rub before accessing the port-a-cath. The trolley preparation by arranging the required materials and drugs before accessing the central line was observed in 90% (27/30) procedures. Two nursing staff involvement and cross-checking of drug expiry date before handling the port-a-cath reported the lowest values of 23% and 26%, respectively. Adequate volume of saline flush was given after each access of the central line only in 83.3%, and the Huber needle was not touched in 60% of cases. The correct technique of positive pressure saline flush administration was observed in 83.3%. Nurses checked the backflow from port-a-cath in 93.3% of cases, and backflow was observed only in 63.3%. In 80% (24/30) of procedures, local skin changes or signs of extravasation were observed.

**Postintervention**
After the introduction of the care bundle, 30 observations of handling port-a-cath among eight children receiving chemotherapy through port-a-cath [Table 2] were noted. A significant improvement was observed in the overall performance of nursing staff in handling the port-a-cath. The involvement of the second nursing staff before loading and administration increased to 63% from the initial 23% ($P = 0.000$). There was 100% efficiency regarding communication and obtaining consent regarding the procedure from the patient and kin. Similarly, 100% efficiency was continued in care and hygiene while accessing the port-a-cath. Cross-checking of drug expiry before its use increased from 26.6% to 89.3% ($P = 0.000$). Administration of adequate saline flush after each accessing of port-a-cath improved to 100% from 83.3% ($P = 0.023$).

| Age/sex | Malignancy                     | Duration (from the period of insertion) | Episode | Age/sex | Type of cancer                          | Duration (weeks) | Episodes |
|---------|--------------------------------|-----------------------------------------|---------|---------|-----------------------------------------|-----------------|---------|
| 1/female| Ewing’s sarcoma                | 8 weeks                                 | 10      | 1/female| Ewing’s sarcoma                        | 20              | 5       |
| 6/male  | Pre B Acute lymphoblastic leukemia | 48 weeks                             | 2       | 6/male  | Pre B acute lymphoblastic leukemia       | 56              | 2       |
| 15/male | Osteosarcoma                   | 20 weeks                                | 8       | 15/male | Osteosarcoma                           | 28              | 3       |
| 12/female| Primary mediastinal B-cell lymphoma | 5 days                               | 5       | 12/female| Primary mediastinal B lymphoma          | 16              | 4       |
| 8/male  | Anaplastic large B-cell lymphoma | 30 weeks                               | 1       | 8/male  | Anaplastic large B-cell lymphoma         | 36              | 1       |
| 7/male  | Pre B Acute lymphoblastic leukemia | 88 weeks                              | 2       | 4/male  | Pre B acute lymphoblastic leukemia       | 36              | 3       |
| 11/female| Ewing’s sarcoma                | 4 days                                  | 2       | 8/female| Pre B acute lymphoblastic leukemia       | 20              | 5       |
|         |                                |                                         |         | 4/male  | T-cell acute lymphoblastic leukemia      | 12              | 7       |
out of thirty observations reported line block, and urokinase (5000 IU) was administered in all cases of nonbleeding back from the port-a-cath. No new cases of CLABSI were reported to date after the intervention ($P = 0.000$). Comparisons of the pre- and postevaluation results were done [Table 3].

### Discussion

This QIP showed significant improvement in care and reduction in the infections following the introduction of the care bundle intervention. Wagner et al. reported 14 CLABSIs in 13 out of the 152 patients who had central venous catheters of multiple types. They reported minimal CLABSI in port-a-cath compared to other central lines, and the Broviac line reported the highest incidence of CLABSI. Two out of the 46 children in the hematology-oncology unit with port-a-cath reported CLABSI. Hussain et al., showed a significant reduction in CLABSI in neonatal intensive care unit from 10.3% to 3.7% after introducing a care bundle in children with central venous lines. Fisher et al. reported a 71% reduction in CLABSI across 13 neonatal intensive units with statistically significant sustainment over the subsequent year by proper maintenance reporting of central venous lines.

In our project, there has been no CLABSI after the care bundle intervention. Detection and management of port-a-cath-related complications such as occlusion, infection, and extravasation could be easily prevented by following the basic steps of checking blood backflow and observing the patient’s clinical signs. While there was a significant improvement in almost all the parameters assessed, involvement of the second nursing staff while accessing and administering medicines through the port-a-cath in all patients could not be achieved. This was due to the redistribution of nursing staff to work in other areas, especially in COVID-19 wards. This is the first project from India on improving the care and maintenance of indwelling central lines. The limitation of this project is its small sample size.

### Conclusion

This QI project demonstrates how proper training in care and maintenance of port-a-cath help in improving quality of health care and minimising the costs by preventing CLABSIs and extravasations. Further QI PDSA cycles should be implemented.

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### Conflicts of interest

There are no conflicts of interest.

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| Parameters                      | Preevaluation ($n=30$) | Postevaluation ($n=30$) | $P$  |
|---------------------------------|------------------------|-------------------------|------|
| Verbal consent obtained         | 25                     | 30                      | 0.023|
| Drugs and instruments arranged before the procedure | 27                     | 30                      | 0.083|
| Two nursing staff involvement  | 7                      | 19                      | 0.000|
| Drug expiry cross-check         | 8                      | 25 ($n=28$)             | 0.000|
| Needle not touch by the nurses during insertion | 6 ($n=10$)             | 14 ($n=14$)             | 0.037|
| Adequate amount of saline flush administered | 25                     | 30                      | 0.023|
| Positive pressure administration during saline push | 25                     | 30                      | 0.023|
| Signs of extravasation observed | 24                     | 30                      | 0.006|
| Line infections (CLABSI rate per 1000 catheter days) ($n=12$) | 3                      | 0                       | 0.000|

CLABSI: Central line-associated bloodstream infection
infections on the mortality of critically ill patients: A meta-analysis. Crit Care Med 2009;37:2283-9.

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