Peripherally Inserted Central Catheters: Use at a Tertiary Care Pediatric Center

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ABSTRACT

Purpose: To examine the use of peripherally inserted central catheters (PICCs) in a tertiary care pediatric setting.

Materials and Methods: An observational study of use and referral practices for PICCs in a tertiary care pediatric setting was performed with three distinct approaches: (i) in an institutional overview of trends, data between 2001 and 2012 were initially analyzed to identify high-level trends; (ii) an in-depth analysis of PICC referrals during 1 year was performed to determine details of referral patterns and clinical practices; and (iii) an electronic survey of the perception and understanding of referring clinical staff was conducted.

Results: During the past decade, there has been a steady increase in the number of PICC insertions and a decrease in median PICC dwell times. Discrepancies were identified between the anticipated versus actual dwell times. A large proportion of patients was found to have multiple PICC insertions, short dwell times, and premature PICC removals, potentially resulting in increasing risks of short- and long-term complications. Large percentages of the staff respondents valued the role of PICCs and had a good understanding of short-term complications, but underestimated the scale of the PICC service (numbers placed, resources involved) and several long-term complications associated with PICCs.

Conclusions: The number of PICCs inserted in children is increasing while PICC dwell times are decreasing. Better postprocedure care is important to minimize premature removals and avoid repeat insertions. Associated complications are not fully appreciated by the referring pediatricians. Further education and guidelines are needed.

ABBREVIATIONS

PICC = peripherally inserted central catheter, TPN = total parenteral nutrition

Peripherally inserted central catheters (PICCs) are minimally invasive devices for central venous access for weeks or months for vesicant medications, administration of fluids and blood products, or blood sampling, and may facilitate early hospital discharge and home therapy (1–3). Despite the many benefits of PICCs, "minimally invasive" does not equate to "minimal risk" for the pediatric patient at the time of insertion or during the PICC dwell time (2–15).

Technologic developments have resulted in a wide range of PICCs (varying in size, lumen number, and power technology) and a high rate of successful placements (current-day wires, sheath combinations, smaller/softer catheters) (4). Increasing reliance on PICCs may promote a perception of minimal risk among referring clinicians (3). However, PICCs are associated with important adverse sequelae (9–16). The concept of venous or vessel health is particularly important with increasing reliance on PICCs (17).

The purpose of the present study was to assess the current use of PICCs in a tertiary care pediatric facility in order to understand current practices and referral patterns and identify potential areas for improvement in regard to appropriateness criteria. We undertook the review by using a combination of three approaches: first, we undertook a high-level overview of trends during a 12-year period from 2001 to 2012 to understand (in broad terms) any changes in referral patterns; second, we undertook a more in-depth analysis of PICC referrals within one recent calendar year to provide greater detail for analysis regarding current practices and the fate of PICCs; and third, we undertook a survey of the opinions

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of the referring staff physicians to understand their perceptions and referral patterns.

MATERIALS AND METHODS

Study Setting

The study was undertaken at a 300-bed tertiary-referral pediatric institution with a catchment area of more than 13 million people. Interventional radiology personnel inserted PICCs in patients from premature neonates to 18 years of age, including inpatients, outpatients, and patients referred from outside institutions. In each case, the PICC chosen was of the smallest size, and had the fewest number of lumens, that would still meet the child's treatment needs.

Study Design

Institutional research ethics board approval was obtained for the present observational study, which comprised three distinct components:

Part 1: Trends. Data over the 12-year period from 2001 to 2012 from various hospital databases (as detailed later) were analyzed to identify changing trends in volumes, PICC dwell times, and costs.

Part 2: Referrals. A detailed audit of PICC-related activities (insertions, removals, exchanges, complications) during one calendar year was performed. Included were all patients who underwent an "over-the-wire" PICC placement or exchange in the interventional radiology unit between January 1, 2009, and December 31, 2009; the year 2009 was chosen to provide adequate opportunity to track PICCs with long dwell times. The PICC, not the patient, was the unit evaluated, and each PICC was evaluated separately. Non–image-guided PICC insertions at the bedside in the neonatal intensive care unit and failed attempted PICC insertions ($< 1\%$ failure rate at the authors' institution; unpublished data) were excluded. Any PICCs a patient received before 2009 were recorded. The source of referrals, clinical indications, anticipated duration of need, and actual dwell times were analyzed.

Part 3: Perceptions. The perceptions and understanding of referring staff physicians regarding PICCs were assessed through an anonymous nine-question electronic survey. The survey was sent to those physicians who had requested at least three PICCs in the preceding year.

Data Sources

Vascular Access Service Database. Indications, type of catheter, insertion and removal dates, actual dwell time, reason for removal, complications, and catheter-related consultations were collected from a dedicated vascular access service database. Details from diagnostic vascular ultrasound examinations for thromboses and microbiologic blood culture results were included in the database. This provided information for parts 1 and 2 of this study.

Interventional Radiology Database. A detailed interventional radiology database (www.esh.ca) provided information on all procedures performed in the interventional radiology suites. Data elements included (i) clinical demographics of patients (age, sex, weight, diagnosis, referring service); (ii) procedural data, sedation (administered by nurse or anesthesiologist, or general anesthesia obtained), staff involved in a case (nurse, technologist, radiologist, fellow, anesthesiologist), duration of procedure, and fluoroscopy time. Costs included materials, equipment, and labor components, and were calculated within the database functionality by using a business model of cost estimates that included individual salaries prorated with their hourly rate, room overheads, and consumable materials used. This provided information for parts 1 and 2 of the study.

Picture Archiving and Communication System. A picture archiving and communication system provided information on each patient's imaging records, the radiology requisition, dictated interventional radiology reports, number of previous PICCs in each patient, and difficulties/complications during PICC insertions and removals. The vascular access service database assessment form was scanned into the system specifying the referring service, anticipated duration of PICC dwell time, clinical indication, and if a PICC replacement was requested or anticipated (eg, removal and planned reinsertion for infection). This provided information for parts 1 and 2 of the study.

Electronic Patient Charts. The hospital's electronic patient chart system provided clinical details, patient progress notes, and clarification of complications. This provided information for part 2 of the study.

Survey. The electronic survey was emailed individually to all physicians who requested at least three PICCs in the previous year. The survey assessed their understanding or perceptions regarding PICCs (**Table 1**). It addressed issues of resources (total numbers, costs, time), clinical role (indications, dwell times, impact on care), and adverse events (procedural and postprocedural complications). This provided information for part 3 of the study.

Definitions and Data Elements

Indications. The documented indications for each PICC insertion were grouped as follows: medication/antibiotics, medications and total parenteral nutrition