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Identifying and reducing early complications of surgical central lines in infants and toddlers



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ABSTRACT

Background: Hospitalized infants >1 y old often require central venous catheters (CVC) for prolonged therapy. There are limited data describing the complication profile for this young population. The purpose of this study was to review outcomes associated with CVC insertion in this high-risk group and compare them to those in older children to develop directed quality improvement projects.

Materials and methods: Patients receiving their first CVC, a tunneled central line or port-a-cath, from 2007–2010 were included. Femoral, non-tunneled, and hemodialysis catheters were excluded. Patients aged 0–12.0 mo (infants) were compared with those 12.1–36 mo (toddlers). Complications (<30 d) included infection, malposition, malfunction, intra-operative, and the need for operative exchange. Statistical analysis included Student t-test, chi-square, and a Kaplan–Meier survival analysis.

Results: We identified 115 infants and 129 toddlers who underwent CVC insertion during the study period. Complication rates were higher in the infant group than in the toddler group, as was the operative exchange rate. Higher infection rates in the infant group appeared to contribute to the difference in early complications and exchange rates. A survival analysis indicated improved catheter duration in toddlers ($P = 0.001$).

Conclusions: In this cohort study, infants had a higher early complication rate, mostly attributable to infection, than their older counterparts. This difference could be explained by increased use of a tunneled central line for daily total parenteral nutrition in infants with gastrointestinal anomalies, as opposed to port-a-cath for chemotherapy infusion in older children. These data have prompted a number of targeted quality improvement initiatives to address relevant complications in this infant population.

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1. Background

Central venous catheter (CVC) insertion, either with a tunneled central line (TCL) or a port-a-cath (PAC), is a relatively common procedure for the pediatric surgeon. Indications include prolonged need for total parenteral nutrition (TPN) administration, chemotherapy, and frequent infusions or laboratory draws. Generally, these lines are placed less frequently in younger children, particularly in the infant and toddler groups. There are fewer indications for more permanent central lines in these patients, who can often receive adequate treatment through a peripherally inserted central catheter (PICC).

Line placement is more technically challenging in these younger patients, as smaller vessel lumen diameter can result in increased difficulty with vein access and catheter insertion. The fragile patients of this age group who typically require more long-term central access often have other serious underlying disease processes and are less tolerant of complications as a result of their line placement.

Despite challenges and potential difficulty in infant and toddler line placement, data detailing the complication profile in this particular patient population are sparse. To better counsel the patient's family and the neonatal intensive care unit about the risk-to-benefit ratio of line insertion and to better focus quality improvement efforts, a more detailed understanding of this profile is required. The purpose of this study was to review outcomes associated with CVC insertion in this high-risk infant group and compare these outcomes with those in older children to develop directed quality improvement projects.

2. Methods

2.1. Patient population

All patients at our institution aged 1 d–3 y who had either a TCL or PAC placed from 2007–2010 were included in this institutional review board-approved retrospective study. Patients aged 1 d–12 mo (infants) were compared with patients aged 12.1–36 mo (toddlers). If a patient had multiple catheters placed during that time frame, only the initial catheter insertion was included in the analysis, and subsequent line placements were recorded as exchanges. A pediatric surgeon performed all line insertions; TCL or PAC is rarely placed by the interventional radiologists at our institution. Patients who had non-tunneled, femoral, hemodialysis, or PICC lines were excluded from this analysis.

2.2. Surgical technique

All CVC in this study were placed in the operating room by a pediatric surgeon. Fluoroscopy was used intraoperatively to ensure correct placement. In instances where the internal jugular vein was accessed, ultrasound guidance was routinely used. A modified Seldinger technique was used for catheter insertion. In this series, 3-French to 7-French TCL (Cook Medical, Bloomington, IN) and either 5-French or 6.6-French PAC (Angiodynamics, Latham, NY) were placed, based on the patient's size.

2.3. Study design and statistical analysis

The infant and toddler groups were compared for baseline demographics, type of CVC placed, site of insertion (internal jugular versus subclavian vein), and indication for insertion. Early complications were defined as those occurring within 30 d of placement of the initial catheter. Late complications occurred >30 d after catheter placement. Complications included infection, malposition (fracture, dislodgement, or migration), malfunction or leak, or operative (complication during placement, wound infection). A line was considered infected if the patient had positive blood cultures, excluding contaminants, treated with either antibiotics or line removal. A line was not considered infected if antibiotics were started during a sepsis workup with subsequent negative blood cultures. A patient was labeled as requiring an operative exchange if the complication resulted in removal and replacement of a subsequent CVC because of continued need for central access. If a catheter was removed due to a complication, and no further access was needed, this was categorized as a complication, but not an operative exchange.

The infant and toddler groups were compared using a chi-square analysis for categorical variables, and a Student t-test for continuous variables. The catheter survival between the infants and toddlers was assessed using a Kaplan–Meier curve with a log-rank test. If a patient had multiple catheters placed, only the initial line was considered. An event was defined as the need for operative exchange. A logistic regression analysis using the covariates of age, gender, and type of catheter was performed to evaluate for predictors of early complications.

3. Results

3.1. Patient characteristics and operative details

We identified 115 infants and 129 toddlers who underwent either TCL or PAC insertion during the study period. The

Table 1 – Patient characteristics and operative details.

Variable	Infants (N = 115)	Toddlers (N = 129)	P value
Male gender (%)	59	50	0.16
Mean weight at surgery (kg)	6.1 (2.5)	12.4 (2.7)	0.001
Indication for placement			
Cancer (%)	35.7	81.4	0.001
GI condition (%)	22.6	3.9	0.001
Immunodeficiency (%)	15.7	7.8	0.07
Other disease (%)	26.1	7.0	0.001
Catheter type (TCL/PAC) (%)	68.7/31.3	24.0/76.0	0.001
Subclavian insertion (%)	82	95	0.001
Median number of catheter d	68 (0–1941)	157 (0–1989)	0.001

GI = gastrointestinal.

The bolded characters highlight the statistically significant values from the non-statistically significant values.

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