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# Tunneled central venous catheters in pediatric intestinal failure: a single-center experience



Kathryn Tinsley Anderson, MD, MPH, Marisa A. Bartz-Kurycki, MD, Robert Martin, BA, Essam Imseis, MD, Mary T. Austin, MD, MPH, Allison L. Speer, MD, Kevin P. Lally, MD, and Kuojen Tsao, MD\*

Department of Pediatric Surgery, Center for Surgical Trials and Evidence-based Practice, McGovern Medical School, The University of Texas Health Science Center, Houston and Children's Memorial Hermann Hospital, Houston, Texas

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## ABSTRACT

**Background:** Parenteral nutrition for intestinal failure (IF) often requires a tunneled central venous catheter (CVC). The purpose of this study was to characterize complications after CVC placement and contributors to line loss in pediatric IF patients.

**Methods:** An institutional review board–approved retrospective review of pediatric (<18 y) IF patients who had a silicone tunneled CVC newly inserted or exchanged from 2012 to 2016 in an IF center was conducted. Patient demographics, procedure service (surgery versus interventional radiology), procedure type (new versus exchange), vessel, and complications related to CVCs were evaluated. Complications included dislodgement, infection, break, occlusion/malfunction, and others. An ethanol-lock protocol for silicone CVCs in IF patients was instituted in January 2012.

**Results:** Twenty-nine IF patients with tunneled CVCs were identified with 182 lines and 18,534 line d. Median age at line insertion was 17.1 mo (interquartile range [IQR] 7.6–31.5) with a median of five catheters (IQR 2–8) per patient. There were 19.2 complications per 1000 line d. Occlusions/malfunctions were the most common complication (6.0/1000 line d) followed by breaks (5.6/1000 line d). Median life of catheters was 51.5 d (IQR 21–129). On regression, adjusting for age, insertion service, and procedure type, shorter line life was associated with younger age ( $P = 0.04$ ) and placement by interventional radiology ( $P < 0.01$ ). Dislodgement was associated with newly placed lines relative risk 6.5 (95% CI 2.2–28.8).

**Conclusions:** CVCs in pediatric IF patients have frequent complications and short line lifetimes. Dislodgement of CVC was an unexpectedly common complication with loss of access in newly placed lines. There may be modifiable processes to mitigate CVC complications.

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\* Corresponding author. Department of Pediatric Surgery, McGovern Medical School, The University of Texas Health Science Center at Houston, 6431 Fannin Street, Suite 5.254, Houston, TX 77030. Tel.: +1 713 500 7305; fax: +1 713 500 7296.

E-mail address: [kuojen.tsao@uth.tmc.edu](mailto:kuojen.tsao@uth.tmc.edu) (K. Tsao).

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## Introduction

Intestinal failure (IF) limits the amount of nutrition that can be obtained through the gastrointestinal tract. Pediatric IF patients often require a tunneled central venous catheter (CVC) for parenteral nutrition to supplement the limited absorptive capacity of their bowel. Long-term catheter use is associated with a myriad of complications including catheter infection, occlusion, vascular thrombosis, and malfunction of the CVC. Catheter-related complications can be life-threatening in this medically compromised group.

There are several ongoing efforts at national data collection on home parenteral nutrition patients including the Sustain registry in the United States, the OASIS registry in Canada, and the Copenhagen IF database in the Netherlands.<sup>1-3</sup> However, most of these databases are composed primarily of adult patients. Many pediatric studies of CVCs in IF patients have focused on catheter-related infection (CRI). However, CRI is only one type of CVC complication. The frequency and morbidity of other CVC-associated complications in IF patients are unknown.

Identifying risk factors for CVC complications in the pediatric IF population may assist clinicians in developing interventions to reduce the morbidity and high use of health care resources associated with CVCs. The purpose of this study was to characterize complications after CVC placement and contributors to line loss in IF pediatric patients.

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## Methods

A retrospective chart review of pediatric (<18 y) IF patients who had a silicone tunneled CVC newly inserted or exchanged over a wire from 2012 to 2016 in a tertiary children's hospital was conducted. Institutional review board approval was obtained before initiation of the review (HSC-MS-17-0431) and was granted a waiver of consent for retrospective chart review. Pediatric patients were included if they had IF and a CVC placed during the study period. IF was defined as the inability to maintain normal growth due to reduced functional intestinal mass.<sup>4,5</sup> Patients who died with a functioning CVC were excluded ( $n = 2$ ). In the academic children's hospital where patients were treated, there is a multidisciplinary IF team made up of gastroenterologists, pediatric surgeons, neonatologists, and dietitians. This team sees IF patients on inpatient rounds and at a special outpatient clinic. An ethanol-lock protocol for silicone CVCs in IF patients was instituted in January 2012. Patients presenting to clinic or the emergency department with a line complication are evaluated by pediatric emergency department physicians, and if further assessment is required, pediatric surgery or interventional radiology is consulted. The service consulted is not standardized and is at the discretion of the initial treating physician. Interventional radiology and surgery both used silicone catheters. Specific models could not be reliably identified from available data; however, products included Broviac, Hickman, and MedComp catheters. In this study, only CVCs were reviewed. Of note, our institution frequently uses peripherally inserted central catheters (PICCs) as well. PICCs are primarily

used while neonates are inpatients in the neonatal intensive care unit. These PICCs are typically 1.9 Fr in diameter and therefore serve as a bridge to a large, more stable tunneled CVC when these neonates are discharged home if they still require parenteral nutrition. A silicone single lumen tunneled CVC is our multidisciplinary IF team's preferred line of choice for pediatric IF patients when they are discharged home. These lines can be ethanol-locked and single lumen CVCs have a decreased CRI rate compared to multilumen CVCs. Larger diameter PICCs are used in some older children who are outpatients. The decision to use a PICC versus a CVC remains at the discretion of the primary physician and is not standardized.

Patient demographics, procedure service (surgery or interventional radiology), procedure type (new insertion or exchange over wire), vessel (internal jugular, subclavian, femoral, or other vein), and all complications related to CVCs were evaluated. Complications included, but were not limited to dislodgement, infection, break, occlusion/malfunction, and other. Complications were evaluated through medical record note descriptions. Other complications included those for which a line was replaced or removed without documentation of a specific issue. Dislodgements included movement or migration of the catheter within the vessel or at the level of the skin. Unintentional removal of a CVC was also considered dislodgement. Line infections (CRI) were defined as treatment for suspected infection, regardless of culture results. Breakage complications were those in which a tear or hole was identified in the surface catheter or if any component of the CVC apparatus such as the hub was cracked or broken. If a CVC was treated with thrombolytics for occlusion or was otherwise nonfunctional without obvious dislodgement or break, it was deemed an occlusion/malfunction.

Descriptive statistics as well as t-test, ANOVA, and chi square test were used to evaluate patient demographics and line characteristics. Medians (line lifetime) between groups were compared by Wilcoxon rank-sum test (2 comparators) or the Kruskal-Wallis rank test ( $\geq 2$  comparators). Linear regression was used to evaluate the association between line lifetime and independent variables. Multinomial logistic regression was used to analyze the different complication types.

Data were analyzed with STATA 14.0 software (College Station, TX).

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## Results

In 29 IF patients, there were 182 lines, with 18,534 total line d, available for analysis. Patients had a median age of 17.1 mo (interquartile range [IQR] 7.6-31.5) at the time of line insertion and had a median of five catheters (IQR 2-8) placed during the study period (Table 1). Necrotizing enterocolitis was the most common etiology of IF (48%).

Overall, there were 19.2 complication events per 1000 line d. Occlusions and malfunctions were the most common complication (6.0 events/1000 line d) followed by line breaks (5.6 events/1000 line d) (Table 2). The median time to first

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