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Original Article

# Complications of long and intermediate term venous catheters in cystic fibrosis patients: A multicenter study☆,☆☆,★

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**Abstract**

*Background:* Totally implantable venous access devices (TIVADs) or peripherally inserted central venous catheters (PICCs) are commonly used in the care of patients with cystic fibrosis (CF), but they are associated with various complications, including thrombosis, infection, and insertion site symptoms.
*Methods:* We conducted a retrospective review of PICC and TIVAD use in adults and children with CF over an 8-year period at 3 accredited care centers. Patient attributes included CFTR genotype, comorbidities, lung function, body mass index, use of anticoagulation, and respiratory tract microbiology. Catheter data included line type, caliber, and lumen number. We assessed practice variation by surveying physicians.
*Results:* In a population of 592 CF patients, 851 PICC and 61 TIVADs were placed between January 1, 2003 and July 1, 2011. Larger catheter caliber and increased lumen number were risk factors for PICC complications in adults. Patient-related risk factors for PICC complications

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included poor nutritional status, infection with *Burkholderia cepacia* spp., and having ≥ 5 lines inserted during the study period. The probability of a PICC complication varied across centers (2.6% to 14.1%, p = 0.001) and remained significant after adjustment for patient-and line-related risk factors. The median complication-free survival of TIVADs, however, did not vary significantly by center (p = 0.85).

*Conclusions:* This is the first longitudinal, multicenter assessment of complication rates for PICCs and TIVADs in a large cohort of adults and children with CF. Specific patient- and catheter-related characteristics were associated with increased risk of complications. Center effects on complication rates were observed for PICCs.



*Keywords:* Central line; Infectious complications; Pulmonary exacerbation; CFF Patient Registry

## 1. Introduction

For more than 25 years, intravenous (IV) antibiotics have played an instrumental role in treating cystic fibrosis (CF) pulmonary exacerbations (PEx). According to data from the U.S. CF Foundation Patient Registry (CFFPR), approximately 25% of children and 45% of adults are treated for PEx each year [4]. In 2015, this translated to 20,286 care episodes [4]. Medication is typically administered through a peripherally inserted central catheter (PICC) or totally implantable venous access device (TIVAD) [5].

While PICCs and TIVADs facilitate treatment of PEx, case series have identified deep venous thrombosis (DVT), infection, superior vena cava stenosis, pneumothorax, and other mechanical dysfunction as complications of these devices in CF patients [6–11]. Complications during PEx treatment may interfere with completion of therapy and expose patients to repeated vascular access procedures and risks associated with systemic anticoagulation in cases of thrombosis. These adversities may discourage patients from subsequently accepting IV antibiotics. Therefore, it is critically important to identify patient- and device-related attributes associated with increased likelihood of complications and to devise strategies to minimize these risks.

PICC-associated DVT in CF patients ranges from 2 to 8% [12,13] and TIVAD complication rates range from 0.463 to 0.905 per 1000 catheter days [9,11]. Recognized risk factors for complications in CF patients include larger catheter size, anticoagulation use, use of the catheter for blood sampling, catheter composition and duration of catheter use [13,14]. However, these data are largely derived from short-term, single-center experiences and subject to institutional bias. Moreover, sample sizes have generally been insufficient for multivariate modeling. To date, no multicenter study has addressed PICC and TIVAD complications in both pediatric and adult CF patients. Furthermore, little is known about the effect of these complications on the rate of subsequent events. Until now, no systematic inquiry into center effects on complication rates has been performed in CF.

We hypothesized that specific patient and catheter characteristics would associate with TIVAD and PICC complication rates in adult and pediatric CF patients and that following adjustment for patient and catheter-related risk factors, there would still be significant variation in event frequency among treatment centers. Some of the findings have been previously presented in abstract form [1–3].

## 2. Methods

This is a multicenter, retrospective cohort study involving Maine Medical Center, Dartmouth-Hitchcock Medical Center, and the University of Vermont Medical Center. The study incorporated two phases. Initial data collection in 2006 captured patients from January 2003–June 2006. The second period captured patients from June 2006–July 2011. Studies were approved by the Institutional Review Board at each center with a waiver of informed consent.

### 2.1. Patients

The trial included CF patients (pediatric patients, < 18 years of age; adults, ≥ 18 years of age) seen at least once in the inpatient or outpatient setting at each of the centers during the study period. Patients were identified and demographic data collected using the CFFPR. Demographic data were collected at the start of the study period, at the end of the study period, and with each exacerbation event. Specific information about the line utilized for administering IV antibiotics was determined by chart review. For patients who moved between centers during the study period, the location of the initial patient visit was kept as the study center.

Body mass index (BMI) was converted into nutritional risk categories as follows: For pediatric patients, BMI of < 10th, 10th–25th, and > 25th percentile were considered high, medium, and low risk, respectively and for adult patients absolute BMI of < 20, 20–21, and > 21 kg/m$^2$ were considered high, medium, and low risk, respectively [15]. Forced expiratory volume in one second (FEV1) was converted into functional impairment categories. FEV1 ≥ 70% predicted, FEV1 40–69% predicted, and ≤ 40% predicted were considered mild, moderate and severe impairment, respectively [4].

### 2.2. Line data

Each patient's chart was reviewed for hospital admission, use of an existing line or placement of a new line, and line specifics. In the first phase of the study, line specifics were not routinely recorded and therefore not available for many patients. In the second phase, line data were not collected for adult patients at Center 2 and for pediatric patients at Center 3. For lines still in

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