Bedside Peripherally Inserted Central Catheter Tip Confirmation: A Direct Savings Analysis

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Abstract

Peripherally inserted central catheter use has increased dramatically over the past decade, parallel to health care costs. Traditional bedside peripherally inserted central catheter placement requires anthropometric measurements of estimated catheter length and confirmation of appropriate tip positioning via chest radiograph. Newer bedside technology, using magnet and electrocardiogram capabilities, seeks to replace the traditional method with equal efficacy but less overall cost. The need for follow-up chest radiograph can been removed, a significant cost savings in direct patient care. In this retrospective case control study, we examine costs related to these 2 tip confirmation methods while assessing overall cost savings to the health care industry.

Keywords: *central venous catheter, health care costs, cost savings*

Background

Use of peripherally inserted central catheters (PICCs) over the past decade has increased tremendously, particularly in inpatient settings. As far back as 2002, nearly 1 million PICCs per year were placed in the United States alone.[1] According to data from 2012, this number has reached approximately 3 million PICCs and is growing.[2] Historically placed by surgical or interventional radiology teams, increasing interest is growing in using dedicated bedside vascular access teams (VATs). Over the past 2 decades, nearly 70% of PICC procedures have been performed by nurses.[1-3] The benefits of VATs has been analyzed extensively, establishing that they provide decreased specialty workload, increased efficiency, improved patient care, fewer complication rates, and decreased cost—all elements that are more important than ever in the current US health care system.[1-6] A relatively new intervention, bedside catheter tip confirmation via electrocardiographic (EKG) technology, is reviewed here with the primary intent to determine cost savings and reduction in complications compared with traditional so-called blind bedside PICC placement utilizing anthropometric insertion measurements coupled with postprocedure radiographic tip confirmation.

PICCs have many advantages, including convenient bedside placement, ability for patient self-care, and safer insertion sites.[7] Important complications with PICC lines still exist—namely central line-associated bloodstream infection and deep vein thrombosis.[8-10] From the catheter insertion itself, malposition is a frequent issue, occurring in nearly 10% of placed PICCs.[11,12] This may, in turn, result in increased rates of thrombosis and inadequate medication delivery. If too short or coursing inappropriately, subsequent procedures are needed that raise costs, patient discomfort, and dissatisfaction.[12] Ensuring optimal tip placement is essential to timely and appropriate line use as well as to improving procedure and overall health care costs.

During the past decade, bedside tip confirmation of central venous catheter placement has become a topic of interest and has been implemented successfully across a variety of health care settings. The basis of this confirmation system is the stylet inside the PICC, which functions as an intracavitary EKG lead. Coupled with chest leads, as the PICC is advanced toward the cavoatrial junction the catheter tip location can be detected via maximal positive P-wave deflections (Figure 1).[13] Recently, this technology has been coupled with a magnetic guidance system to ensure proper curvature of the PICC into the superior vena cava along with appropriate location of tip termination—obviating the need for fluoroscopic guidance or postprocedure

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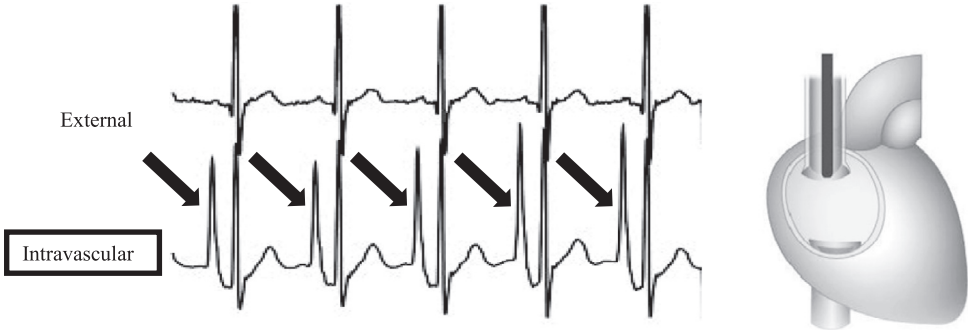

Figure 1. **Intravascular lead demonstrating maximum positive P-wave (bold arrows), corresponding to tip position at the cavoatrial junction.**

chest radiography, thereby minimizing procedure-related cost.[14,15] Several comprehensive models exist on the market that show great efficacy and accuracy of tip placement (up to 98%) and avoidance of the aforementioned complication of tip misplacement.[16-18] We aim to look at the savings implications of using such a system in real-time clinical practice.

Methods

PICCs in our institution are primarily placed at the bedside by members of a VAT that is part of a dedicated bedside medical procedure service (MPS) team. Ultrasound guidance is employed for all procedures. The VAT is composed of 1 nurse practitioner with support from 4 attending hospitalists and rotating housestaff who in total constitute the MPS. PICCs are placed largely on inpatients; however, outpatients are serviced upon special request of a clinical provider. The VAT currently covers a single site—a large, urban safety-net teaching institution. All PICCs are requested via electronic medical record order entry and the MPS determines appropriateness and timing upon review of available information and discussion with ordering clinical provider. All PICC placements are done under the direct guidance of ultrasound without exception at the patient's bedside. Over the past 10 years, an average of 650 PICCs have been placed annually, ranging from 535-757 procedures per year. A small portion of the total PICCs placed hospitalwide (10-20 per year) are placed under fluoroscopic guidance for specific reasons; however, those procedures were excluded from this data collection.

We retrospectively gathered all PICC requests sent to our dedicated MPS from June 2015 to February 2016 (Figure 2). From a total of 460 requests over this time, 373 were determined to be appropriate PICC requests with defined indications. The remainder of requests had either an ultrasound-guided peripheral catheter or midline placed for routine peripheral access. PICC requests were then divided evenly into 2 blocks using case–control methodology. The first block (CXR group), the control group, had 187 requests from June through September 2015. The placement of these PICCs was performed via the traditional anthropometric catheter length measurement coupled with radiographic tip confirmation via portable chest film. In October 2015, our VAT was trained for 2 weeks in the use of bedside tip confirmation technology (Bard Sherlock 3CG Tip Confirmation System; Bard Access Systems, Salt Lake City, UT). Thereafter, all PICC placements were performed using the 3CG

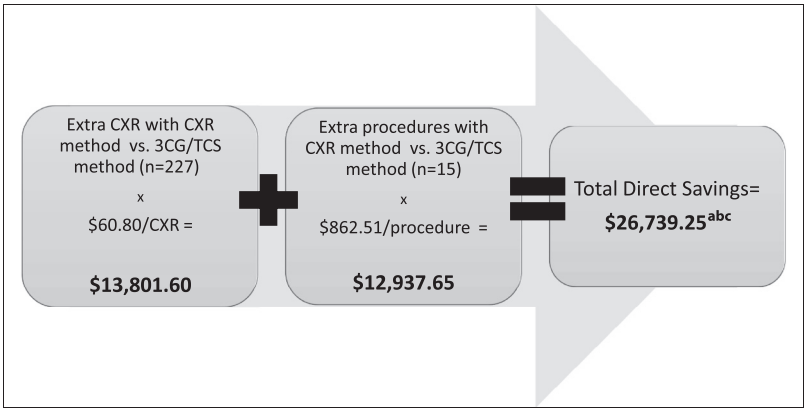

Figure 2. **Direct procedural costs savings. [a]The actual cost savings calculated spans 4 months, the time frame that the 3CG/TCS system was deployed. [b]Projected annual savings = $80,217.75. [c]Projected savings per patient per year = $150. 3CG/TCS = Bard Sherlock 3CG Tip Confirmation System (Bard Access Systems, Salt Lake City, UT); CXR = Chest radiograph.**