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## Surgeon, not technique, defines outcomes after central venous port insertion

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### ABSTRACT

**Background:** Although central venous access for port placement is common and relatively safe, complications and poor resource utilization occur. We hypothesized that despite the simplicity of port placement, surgeon and/or resident performance—rather than technique—is associated with clinical outcomes and operating room efficiency.

**Materials and methods:** Medical records of 1200 patients who underwent port placement between 2012 and 2015 at our institution were retrospectively reviewed. Insertion route (subclavian, internal jugular, cephalic cutdown), individual surgeon (A-G), surgeon volume, body mass index, patient age, and resident presence were evaluated to determine their association with operating room time, complications, and need for alternate insertion route.

**Results:** On univariate analysis, operating room times were significantly different among individual surgeons, with surgeons E and F having the longest operating room times (50 and 63 versus 31–40 min;  $P < 0.01$ ) and switching to an alternate method more frequently (13.5% and 21.3%, versus 0%–10.3%,  $P < 0.01$ ). On multivariate analyses, operating time was increased with elevated body mass index, resident presence, and switching to an alternate method. Individual surgeons had varied effects on operating time with two surgeons found to be the predominant drivers (OR 19 and 27;  $P < 0.01$ ). With residents excluded, these two surgeons continued to increase operating times (OR 15 and 29;  $P < 0.01$ ) and procedural complications (OR 3.2 and 5.9;  $P < 0.05$ ).

**Conclusions:** Although port placement is ostensibly simple, individual surgeon performance is the primary driver of patient outcome and operative efficiency. In an era requiring optimized resource utilization and outcomes, these data demonstrate potential for enhanced programmatic organization and case distribution.

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## Introduction

Since its description by Niederhuber,<sup>1</sup> port placement for the purpose of central venous access has become a common surgical procedure performed by both general and specialty-trained surgeons. Despite the appearance of simplicity, a great deal of variation exists in regard to insertion method and complication rates, as the number of practitioners placing these implantable access devices has broadened substantially (including nonsurgeons).<sup>2</sup> In this era of focus on quality and resource utilization, seeking out the sources of variation in surgical care and outcomes is important as a step toward improving patient care. Identifying the best means of placing these devices is crucial for maintaining quality of life for individual patients.<sup>3,4</sup>

The role of insertion method and technique on patient outcomes has been well studied. The three most widely used methods include ultrasound-guided percutaneous catheterization of the internal jugular vein, catheterization of the subclavian vein via a blind approach while using anatomic landmarks, and surgical cut-down technique for catheterization of the cephalic vein. Although clinical guidelines make no specific recommendations regarding insertion method,<sup>5,6</sup> studies have shown conflicting results with regard to speed, success rates, and complication rates.<sup>2,7-12</sup>

And while the influence of method and anatomical site of insertion have been well documented, the role of provider-specific factors has been unexplored, and differences in provider skill and/or training may account for observed variability in the operative outcomes. Furthermore, how these procedural variations impact operating room time and efficiency is unknown. We hypothesized that individual surgeon—with and without resident presence—is the strongest predictor of complication rate, operating room time, and operating room efficiency (i.e., need to switch to an alternate method of insertion) than is method of insertion.

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## Materials and methods

After approval by the University of Cincinnati's Institutional Review Board, the medical records of all patients ( $n = 1378$ ) who underwent port placement for the purpose of central venous access between October 2012 and March 2015 at the University of Cincinnati Medical Center and its affiliated hospitals were reviewed. All duplicate entries and those patients without a complete operative note recorded in the system were excluded ( $n = 178$ ); the final cohort consisted of 1200 patients.

To identify differences due to insertion method, patients were first grouped according to subclavian, internal jugular, or cephalic cut-down approach. A second analysis was performed, stratifying the study cohort by individual surgeon, with and without resident presence. The seven highest volume surgeons over the 3-y period (labeled A-G, performing between 76 and 324 procedures) were individually compared, with the remaining surgeons pooled into a "low-volume surgeon" group and analyzed jointly. All data for this study were drawn from individual patient medical records and included

patient characteristics, surgical technique, individual surgeon(s), resident presence, operative time, and complications occurring within 2 wk of the procedure. Complications included pneumothorax, hospital admission, need for replacement, central line infection, and malfunction of port.

Univariate analyses were performed using a Wilcoxon rank-sum test, with method of insertion as the class variable and the following three measures as outcome variables: complication, operating room time, and need to switch to an alternate method. Statistical significance was determined by a  $P$  value less than 0.05. Multivariate linear and logistic regression analyses were then performed to identify predictors of the three dependent variables to include complication (analyzed as a dichotomous variable for each patient), operating room time (analyzed as a continuous variable), and need to switch to an alternate method (analyzed as a dichotomous variable). Independent variables with a  $P < 0.10$  on univariate analysis were used in multivariate analyses. Predictor variables included patient age, body mass index (BMI), complications of port placement, resident presence at the initial procedure, and individual surgeon. Subanalyses were performed to further evaluate the influence of resident presence on the aforementioned outcome measures. Because individual surgeon preference dictated a specific route of insertion, this variable was not included in multivariate analyses to minimize confounding.

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## Results

Patient- and procedure-specific characteristics according to insertion method are shown in [Table 1](#). Ports placed via the cut-down approach had the longest operating room times and were more likely to require switching to an alternate method intraoperatively (all  $P < 0.01$ ). Those placed via ultrasound-guided percutaneous catheterization of the internal jugular vein were fastest, least likely to require switching to an alternative method, and required fewer access attempts before cannulation (all  $P < 0.01$ ). Those placed via the subclavian approach had the highest rate of pneumothorax ( $P = 0.04$ ), were most likely to require multiple attempts prior to establishing access, and were more frequently performed with residents present ( $P < 0.01$ ).

Patient- and procedure-specific characteristics according to individual surgeons are shown in [Table 2](#). Surgeons differed significantly based upon patient age, BMI, total operating room time, need to switch to an alternate method, multiple access attempts, and whether a resident was present during the procedure. Of note, Surgeon E and F were found to have the longest operating room times and the highest rates of switching to alternate methods. Surgeon A was found to have the shortest operating room time, the lowest rate of switching to an alternate method, and was the highest volume surgeon.

On multivariate analyses, individual surgeon factors were found to be the strongest predictors for all three endpoints (surgeon A was found to have the most favorable outcomes on univariate analysis and was therefore used as the reference for individual surgeon covariables). Six of the seven individual surgeons were found to be independent predictors of

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