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Programmatic change leads to enhanced resource utilization and efficiency in port placement

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ABSTRACT

Background: Central venous port (CVP) placement is performed by a variety of surgeons in different subspecialties, and our previous work suggests that individual surgeons—regardless of training—are the strongest predictor of outcomes. We sought to prospectively evaluate a programmatic shift toward a resource-conscious, patient-focused algorithm for this common and simple surgical procedure.

Materials and methods: After implementation of a systems-level program for efficient CVP placement, 78 CVPs were placed by a single surgeon. Primary outcomes were procedure time, total operating room (OR) time, total facility time, and procedure-related complications. These prospective data were compared with retrospective cohorts of surgically placed and interventional radiology–placed CVP. Demographic data were analyzed by chi-square analysis, whereas time data were analyzed by the Wilcoxon rank-sum test.

Results: The programmatic delivery (prospective) set showed significantly shorter procedural (median 16 min *versus* 26-40, $P < 0.05$), OR times (median 36 min *versus* 46-70, $P < 0.05$), and facility times (median 235 min *versus* 299-319, $P < 0.05$) except for the interventional radiology facility time (median 187 *versus* 235, $P < 0.05$). The range of OR time savings with the prospective *versus* comparison groups was 10-34 min, representing 22%-49% reductions in OR time ($P < 0.05$). Complication rates were not significantly different ($P = 0.13$).

Conclusions: Through a programmatic change emphasizing efficiency and patient-centered outcomes, procedural/OR/facility time can be reduced greatly without changing complication rates. These data provide compelling evidence that common and ostensibly simple operative procedures can be substantially improved upon with thoughtful, data-driven systems-level enhancements.

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Introduction

Central venous port (CVP) placement is a common and ostensibly simple procedure for patients being treated with chemotherapy and serves to reduce patient risk and improve quality of life when repeated venous access is required.[1] Although other more complex procedures have been studied to examine the key features leading to quality outcomes,[2-6] CVP placements have largely been studied only in the context of method of entry. To that end, the literature reports conflicting data regarding whether entry via the internal jugular vein or subclavian vein is optimal.[7-9] Ultimately, however, consensus is building that ultrasound (US) guidance results in fewer complications than an anatomic landmark-guided approach.[10-12]

Our previous work suggests that the most significant variability in CVP placements arises not from the method of entry or patient demographics, but instead the performance of an individual surgeon.[13] These data showed that even certain high-volume surgeons had higher operating room (OR) times for CVP placement, whereas resident presence had a negligible effect. Identification of this variability—resulting from differences in human performance that can either be modified or minimized by programmatic direction—is an important first step in improving patient-centered, cost-effective care.

With dedication to resource-wise, patient-friendly care delivery, significant opportunity exists to improve the outcomes and resource utilization associated with this simple procedure (and others) that have not been examined in depth. Arteriovenous fistula creation for hemodialysis, for example, has been studied by associating technique-associated improvements in fistula patency with outcomes,[14-19] by comparing outcomes between trainees and attending surgeons,[20-22] and by relating procedure volume/experience and outcomes.[23] Furthermore, total knee arthroplasties number over 600,000 annually and have been studied in the context of technique[24,25] and hospital/center volume and surgeon volume,[26-28] but prospective studies of the effect of efficient surgeons on cost and resource utilization have not been performed.

With the demonstration that provider- and systems-level factors are critical to patient outcomes and resource utilization, we noted the opportunity for a systematic approach to improve CVP placement. Specifically, our institution elected to better match acuity of the procedure and facility by consistently performing this procedure in an outpatient OR, while also streamlining the referral process. We hypothesized that an efficient surgeon in a high-throughput, outpatient OR with dedicated time set aside for CVP placements and using standardized, US-guided venous access could reduce complications and resource utilization associated with the procedure.

Materials and methods

After approval from the University of Cincinnati Institutional Review Board, we prospectively studied 78 patient cases of CVP placement performed in an efficiency-focused fashion. Patient charts were accessed to confirm cases of CVP placement, various times associated with the encounter, and any complications arising from the procedure. In addition, 78 cases performed by interventional radiology (IR) were examined, and specific samples of retrospective data on CVP placements were similarly selected for comparison.[13]

Terminology and cohort creation

"Standard of Care" (SoC) refers to the retrospective data set of CVP placement, reflecting cases from November 2012 to March 2015 at the University of Cincinnati. Cases were performed primarily in the inpatient setting, although occasionally in an outpatient surgery environment. This set of cases represents the previous practice pattern—a variety of surgeons using surgical approaches per their preference between cephalic vein cut-down, US-guided internal jugular vein, and anatomic landmark-guided subclavian vein access. Residents were present for a number of the cases, which was previously found to add 6 min (on average) to each procedure.[13]

"Programmatic delivery" (PD) refers to the prospective data set of CVP placement. These 78 cases were performed in outpatient, high-throughput surgery facilities affiliated with the University of Cincinnati. All cases were performed by a dedicated port surgeon at these outpatient facilities, with a standardized patient setup and internal jugular vein approach attempted routinely. In addition, US-guidance and intraoperative fluoroscopy were utilized every time to ensure correct placement, with a postoperative chest x-ray performed to confirm the absence of pneumothorax. The dedicated port surgeon had time set aside in his/her schedule for a high volume of these cases, which were all scheduled by a single nurse to implement a seamless process from referral to efficient CVP placement with minimal delay.

The IR set refers to the 78 most recent cases (2013-2016) of CVP placement by interventional radiologists at the University of Cincinnati IR suites. All cases were performed in similar fashion to the PD set, primarily accessing the internal jugular vein with US-guidance and intraoperative fluoroscopy used during the procedure with a chest x-ray performed afterward. Only cases that were performed by the attending radiologist or both attending radiologist and IR fellow were included; cases with diagnostic radiology residents were excluded. There were six interventional radiologists whose cases were included in this cohort.

The SoC cohort is divided into two samples: a sample of 78 random cases (16 unique surgeons), SoC:Random, and a sample of the 78 most recent cases of the dedicated port surgeon, SoC:SingleSurgeon. These samples were chosen to assist in comparisons representative of the previous care delivery pattern (SoC:Random) and of the effect of the prospective changes independent of surgeon (SoC:SingleSurgeon). The IR set was included as detailed previously, and each of these samples was compared with the PD set individually.

Variable definitions and clinical outcomes

Procedure-specific variables included procedural time, OR time, facility time, referral delay, and percentage of cases with referral delay of no more than 7 d. Demographic data