Nurse Practitioner Use of Point-of-Care Ultrasound in Critical Care

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ABSTRACT

The use of point-of-care ultrasound (POCUS) is considered the standard of care in the management of patients in the intensive care unit (ICU). No current evidence demonstrates the ability of ICU NPs to accurately utilize POCUS. The purpose of this project was to determine ICU NPs' ability to accurately acquire and interpret POCUS images. NPs working in a surgical ICU obtained POCUS images of the inferior vena cava and documented their interpretation of the volume status of the patient based on the image. ICU NPs demonstrated 86% acquisition accuracy and 80.5% interpretation accuracy of POCUS images.

Keywords: acute care NP, critical care, intensive care unit, nurse practitioner, point-of-care ultrasound

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INTRODUCTION

Point of care ultrasound (POCUS) is defined as "a goal-directed, bedside ultrasound examination performed by a health care provider to answer a specific diagnostic question."[1] POCUS continues to become an increasingly popular means of hemodynamic monitoring of the critically ill patient in the intensive care unit (ICU). Simultaneously, the utilization of nurse practitioners (NP) in ICUs continues to increase with demonstration of efficacy and quality care in the setting of an intensivist shortage and resident hour restrictions.[2,3] Despite the correlation in increased use of these 2 aspects of critical care, minimal evidence exists in supporting NP use of POCUS in the ICU.

According to the National Health Interview Survey,[4] nearly 23 million people in the United States experienced an overnight hospital stay during the 12 months preceding the survey. The most recent published data showed that approximately 27% of hospital stays involve an ICU stay at some point during the patient's course of care.[5] Utilization of NPs on multidisciplinary critical care teams has been shown to reduce ICU costs and increase patient satisfaction.[3] POCUS has also been demonstrated to improve the quality of ICU care and improve the diagnostic ability of ICU providers.[6,7] Despite evidence supporting both the use of NPs and POCUS in improving ICU patient outcomes, no evidence exists to support NPs performing POCUS in the ICU setting. The purpose of this project was to evaluate the effectiveness of NP use of POCUS in the ICU setting. This project had 2 primary objectives: to evaluate the ability of the NP to acquire specific, accurate ultrasound images, and the ability of the NP to interpret those same images correctly. The overall goal was to build evidence around the use of POCUS by NPs in the ICU.

BACKGROUND

The pathophysiology of the critically ill is dynamic and complex, requiring both continuous and frequent assessment of hemodynamics. The advent of a flow-directed balloon-tipped catheter, also known as a pulmonary artery (PA) catheter, in the late 1960s revolutionized hemodynamic monitoring of critically ill patients. The PA catheter allowed for continuous, invasive hemodynamic monitoring of critically ill patients in the ICU.[8] The use of PA catheters remained the standard of care for hemodynamic monitoring in the ICU until the early 2000s. Between 2005 and 2006, multiple studies

demonstrated that routine use of PA catheters did not reduce mortality, nor did they decrease hospital length of stay.[9–11] This remains the most recent evidence to date regarding outcomes related to use of PA catheters. Out of concern for lack of outcome-directed benefits, health care providers began to seek additional methods of hemodynamic monitoring in the ICU, including POCUS.

Medical ultrasonography first started in the 1950s and was performed primarily by radiologists, cardiologists, and obstetricians.[1] Ultrasonography experienced slow growth after its advent until improvement in size and portability of equipment allowed for the advent of POCUS.[1] While formal ultrasound is a comprehensive exam that evaluates all anatomic aspects of the organ system within the ordered study, POCUS is a goal-directed study that aims to rule in or rule out life-threatening conditions.[1,12,13] While formal ultrasound provides more comprehensive information, POCUS avoids the significant time delay with ordering, performing, and interpreting formal ultrasounds.[12] POCUS solved many of the issues associated with PA catheters, including decreasing the need for invasive insertion of a medical device, minimal risk with performance of ultrasound, and increased acquisition of dynamic variables of hemodynamic monitoring.[14]

A review of the literature was performed utilizing the PubMed and Google Scholar databases. Search terms included *critical care* and *bedside /point of care ultrasound,* limiting the search for articles published in the last 10 years, in the English language, and including only an adult population. Routine use of the PA catheter for hemodynamic monitoring in the ICU is not recommended, and POCUS is now regarded as the standard of care of hemodynamic monitoring in the ICU.[12,13,15–17] POCUS allows non-cardiology physicians to develop a shorter, more accurate list of differential diagnoses in a shorter amount of time and improve diagnostic certainty.[6,7]

With the advent of POCUS, an increased number and variety of health care providers implemented this skill into their practice. Studies have demonstrated the ability for medical students, resident physicians, and physicians in fellowship training to acquire and interpret POCUS images.[18,19] A major gap in the literature is the lack of evidence about the use of POCUS by advanced practice providers. Only 1 study demonstrated emergency department (ED) NP competency in obtaining and interpreting POCUS images.[20] Limited studies exhibited the ability for specially trained registered nurses to acquire POCUS images, but no studies examined to ability for nurses to interpret the ultrasound images.[21,22] This project attempted to address the gap in the literature regarding advanced practice providers' ability to obtain and interpret POCUS images.

METHODS

Design

This prospective, quality improvement project aimed to evaluate the effectiveness of NP use of POCUS in the ICU setting by evaluating the NP's ability to obtain specific, accurate ultrasound images and interpret those images correctly. The POCUS exam evaluated the ability of the NP to acquire images of the inferior vena cava (IVC) and interpret the patient's intravascular volume status. A goal of obtaining and interpreting 50 images for this project was selected. Institutional review board approval was obtained before initiation of this project.

Sample/Setting

The sample obtained through convenience sampling included 8 acute care NPs currently employed and working in the 22-bed surgical intensive care unit (SICU) at a quaternary, urban academic medical center in Tennessee. Exclusion criteria included no training or experience with POCUS before the information session for this study. Previous training included a range from informal, on-the-job training to formal, multi-day POCUS courses. Baseline demographic data of the sample regarding clinical and POCUS experience was obtained through the utilization of Research Electronic Data Capture (REDCap) hosted by Vanderbilt University Medical Center (Nashville, TN), a secure, Web-based application that allows for online collection of data for research studies.[23] Demographic data for the sample was obtained before project data collection. Inclusion criteria for patients eligible to receive POCUS included active consultation for surgical critical care services or admission to the SICU team. Exclusion criteria included patients with an open abdomen or

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