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Ultrasound-Guided Peripheral Venous Access: An Objective Structured Clinical Examination (OSCE)

Christopher Smith

ULTRASOUND-GUIDED PERIPHERAL VENOUS ACCESS: AN OBJECTIVE STRUCTURED CLINICAL EXAMINATION (OSCE)

by

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A Doctoral Project
Submitted to the Graduate School,
the College of Nursing and Health Professions
and the School of Leadership and Advanced Nursing Practice
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Nursing Practice

Approved by:

Dr. Nina McLain, Committee Chair
Dr. Michong Rayborn, Committee Member

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ABSTRACT

Intravenous (IV) access is essential to anesthetic practice as it allows the provider to administer fluids, sedative agents, and resuscitation medications. There is, however, a large subset of patients in which IV access can be difficult to obtain due to confounding factors such as preexisting disease, body habitus, and volume status (Sabado & Pittiruti, 2019). Bedside ultrasonography is an effective tool that can be used to gain IV access in these difficult patient populations. The downside to this technology is that there is a learning curve associated with its use, and proper training in ultrasound-guided venous access techniques is crucial to the successful implementation of this technology.

An Objective Structured Clinical Examination (OSCE) was created to serve as a training tool for nurse anesthesia students learning ultrasound-guided peripheral venous access techniques in The University of Southern Mississippi's (USM) nurse anesthesia program (NAP). The OSCE was sent to an evaluation panel consisting of four USM NAP clinical instructors as well as two certified registered nurse anesthetists (CRNA). The OSCE was also sent to first and second-year USM NAP students for evaluation. A survey was used to determine the clarity, conciseness, effectiveness, and accuracy of the proposed OSCE. The doctoral project on evidence-based ultrasound-guided peripheral venous access was well received by the student respondents as well as the faculty in the USM NAP.

ACKNOWLEDGMENTS

I would like to sincerely thank my committee chair, Dr. Nina McLain, for her guidance, input, and encouragement as I completed this doctoral project. I would also like to thank Dr. Michong Rayborn for her support. Finally, I would like to thank Jeanne Stewart for her editorial oversight.

DEDICATION

To my fiancé, Julia, thank you for all of your love, support, and encouragement during this process. To my parents, thank you for instilling in me a strong work ethic from a young age. To my friends, thank you for being a source of support and a welcome distraction.

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LIST OF ABBREVIATIONS

AACN	American Association of Colleges of Nursing
CRNA	Certified Registered Nurse Anesthetist
DNP	Doctor of Nursing Practice
IRB	Institutional Review Board
IV	Intravenous
NAP	Nurse Anesthesia Program
OSCE	Objective Structured Clinical Examination
SRNA	Student Registered Nurse Anesthetist
USM	The University of Southern Mississippi

CHAPTER I – INTRODUCTION AND BACKGROUND

Intravenous (IV) access is a crucial aspect of anesthesia. IV access allows the provider to quickly and effectively administer fluids, sedative agents, and resuscitation medications. Unfortunately, in a large subset of patients, IV access can be difficult to obtain due to individual patient factors including preexisting disease, body habitus, and volume status (Sabado & Pittiruti, 2019). Difficult IV access can lead to many issues such as canceled surgeries, delayed care, decreased patient satisfaction due to multiple attempts and associated pain, usage of more invasive procedures such as central lines and intraosseous access, and damage to a patient's already frail venous system (Frank, 2019; Heinrichs et al., 2013; Sabado & Pittiruti, 2019).

The advent of affordable and reliable bedside ultrasonography has given the anesthesia provider an effective tool to combat difficult to access patients. Ultrasound technology allows the anesthesia provider to evaluate the patient's venous system, select an appropriate vein, and facilitate access of the vein, all in real-time (Sabado & Pittiruti, 2019). Verification of successful cannulation can be confirmed with the ultrasound as well. Although this technology is readily available, there is a learning curve associated with its use.

Problem Statement

Proper provider training and practice are crucial for the successful utilization of ultrasound technology when obtaining IV access. The review of the literature demonstrates that this training can be accomplished effectively in the classroom and lab using a combination of didactic and simulation resources (Moureau et al., 2013). This doctoral project was created to develop an Objective Structured Clinical Examination

(OSCE) to serve as a training and evaluation tool for students in The University of Southern Mississippi's (USM) Nurse Anesthesia Program (NAP).

Available Knowledge

Objective Structured Clinical Examination (OSCE)

The OSCE was introduced in 1975 by Harden and Gleeson as a new way to objectively assess the clinical competency of medical students (Harden, 2016; Zayyan, 2011). Since its introduction, the OSCE has become "the standard mode of assessment of competency" (Zayyan, 2011, p. 219) across medical schools in North America and the United Kingdom. During an OSCE, students go through a series of stations that are designed to assess their skill and competency in several areas of clinical importance. Each student is presented with the same scenario and is judged on a predetermined set of criteria that must be met for success at each station (Zayyan, 2011). OSCEs work well because they can be easily reproduced from student to student and the results are consistent across a wide range of examiners due to the standardized objectives (Zayyan, 2011). The objectivity of scoring is especially beneficial to students because it removes examiner bias and perception, allowing the student to have an unaltered assessment of their competence (Zayyan, 2011).

Importance of Intravenous Access

IV access is the act of gaining access to the intravascular space of a patient and maintaining that access with a hollow IV catheter. IV catheters are important because they give clinicians a safe and effective way to administer medications and fluids to treat patient conditions (Frank, 2019). Examples of medications given through IV catheters are antibiotics, pain medications, and sedation medications. Some medications work better

when given intravenously, and IV access is invaluable during certain situations, such as cardiac arrest, when life-saving medications and blood must be given quickly and efficiently (Frank, 2019).

Normal IV Access Technique

The standard technique for initiating IV access involves the clinician placing an IV catheter in a palpable or visible peripheral vein, usually in the upper extremities. Veins are dilated with a tourniquet placed proximally on the extremity to enhance the ability of the clinician to palpate the vein and insert the catheter (Frank, 2019). Once a proper vein is identified, the clinician cleanses the area, inserts the IV catheter into the vein, and secures the IV in place. Although upper extremities are used most frequently, IV catheters can also be placed with standard techniques in the lower extremities, neck, and scalp of infants (Frank, 2019). Experienced clinicians are often very adept at placing IV catheters using standard techniques. However, some patient populations prove challenging when attempting IV access. These patients include obese patients, dehydrated patients, dialysis patients, patients with frail veins from chemotherapy, and IV drug users (Frank, 2019).

History of Ultrasound

Modern medical ultrasound was derived from early military applications that used ultrasonic waves to detect submarines in the early 1930s (Vogel, 2014). Ultrasound was not used as a diagnostic medical tool until 1949 (Vogel, 2014), and the single probe designs that are familiar today were not introduced until 1957 (Kline, 2019). Real-time ultrasound, known as *B-scanner* has been in use since 1965, and its first reported use for anesthesia applications was in 1978 when La Grange and colleagues used it to identify

the subclavian artery for a peripheral nerve block (New York School of Regional Anesthesia [NYSORA], 2019).

Ultrasound Physics

Ultrasound imaging utilizes ultrasonic sound waves in the 2-15 MHz range (Kline, 2019). These sounds waves are generated by applying an electrical current to a piezoelectric material, causing the material to vibrate and send out the waves. In modern equipment, the piezoelectric material is contained in a probe that directs the ultrasound waves into human tissue. Structures in the body absorb and reflect these waves at different rates, and the reflected waves are received back by the probe and turned into a digital image on a screen (Kline, 2019). Structures with more density, such as bone, appear white on the image because they reflect more of the sound waves back to the transducer. These structures are said to be *hyperechoic.* Less dense structures, such as hollow organs and blood vessels appear black because they absorb more sound waves and reflect fewer sound waves back to the transducer. These structures are said to be *hypoechoic* (Kline, 2019). Different sound wave ranges are used to image structures at different levels in the body. High-frequency waves in the 8-15 MHz range do not penetrate very far but produce a very sharp image that is useful for superficial imaging of vasculature and nerves. Lower frequency waves in the 2-5 MHz range penetrate deeper but do not produce as sharp of an image. These waves are useful for imaging deeper structures such as abdominal organs, deep vasculature, and the heart (Kline, 2019).

Ultrasound Machine

Many manufacturers produce a portable bedside ultrasound machine that is suitable for IV access applications. The USM NAP utilizes the Sonosite S-Nerve™

system in its lab. The S-Nerve™ ultrasound system is a portable, all-digital system designed to provide highly detailed, real-time images for a variety of clinical uses including vascular access (Sonosite, 2019). Sonosite (2019) designed this unit to be user friendly and resources for its proper use are available on their company website. The system in use at USM is outfitted with a 9 cm, 10-5 MHz transducer that is suitable for vascular access applications. All USM NAP students have direct, unencumbered access to this machine for familiarization and training purposes.

Ultrasound Views

Two different views are utilized when gaining IV access under ultrasound guidance. The transverse, or short axis, view places the ultrasound transducer perpendicular to the path of the vessel and results in a cross-sectional view of the target vessel (Kline, 2019; Sabado & Pittiruti, 2019). This view is utilized for an *out-of-plane* approach in which only the needle tip is visualized during the insertion of the IV (Kline, 2019). The longitudinal, or long axis, view places the ultrasound transducer parallel to the path of the vessel and allows the provider to use an *in-plane* approach, which allows visualization of the whole needle as it is introduced into the vein (Kline, 2019). Both techniques, as well as a combination of the two techniques, are appropriate to use when gaining IV access using ultrasound. Provider skill and preference ultimately dictate which method is used; however, the literature does note that the *out-of-plane* approach is usually easier to learn for the beginner (Kline, 2019; Sabado & Pittiruti, 2019).

Common Probes

Three different probes are commonly used for bedside ultrasound examination and these include the linear, curvilinear, and phased array/cardiac probe (Kline, 2019).

The linear probe produces a rectangular beam in the 8-15 MHz range that is ideal for imaging superficial vasculature and nerves (Kline, 2019). The curvilinear and phased array probes produce a curved beam in the 2-5 MHz range that are better suited to wide fields of view and deeper structures such as abdominal organs and the heart (Kline, 2019). The linear probe is the probe that was used during the completion of this OSCE.

Relevant Anatomy

Successful IV cannulation using ultrasound is largely dependent on knowing the relevant venous vasculature of the targeted extremity (Kline, 2019). In the upper extremity, common sites are the cephalic and basilic veins that run laterally and medially respectively along the bicep in the upper arm before merging in the antecubital fossa (Kline, 2019). If neither of these veins is found suitable for cannulation, more veins can be found by scanning the forearm (Kline, 2019). Once a suitable vessel has been found, it is important to correctly identify the vessel as a vein. Veins are easily compressible with the ultrasound probe, whereas arteries do not compress easily and exhibit pulsatile walls when compression is attempted (Sabado & Pittiruti, 2019).

IV Access Under Ultrasound

Many principles from the standard technique for initiating IV access remain the same when using ultrasound for venous cannulation, and only a few extra steps are needed to complete the process. Sabado and Pittiruti (2019) tell us that a tourniquet is again placed proximal to the vessels to be cannulated to help dilate and identify a suitable vessel. The ultrasound is then used to locate a suitable vessel for cannulation. Once the vessel is identified, the ultrasound probe is covered with a sterile barrier device (e.g. sterile sleeve, Tegaderm™, or similar device), and the skin is cleansed. The targeted vein

should be centered on the screen in either a transverse or longitudinal view. Once the skin is punctured, the tip of the needle should be followed by the ultrasound transducer and directed toward the vein. Once the vein is punctured, blood return should be noted as either flashback in the hub of the needle or by aspiration with a syringe. The cannula of the IV should then be advanced into the vein and the IV secured in the normal manner. After securing the IV, successful cannulation can be verified under ultrasound examination (Sabado & Pittiruti, 2019).

Rationale

IV access is a critical part of patient care as it allows the anesthesia provider to administer routine and life-saving medications to a patient quickly and effectively. As mentioned above, there is a large subset of patients in which gaining IV access using standard techniques is difficult due to individual patient factors such as preexisting disease, body habitus, and fluid volume status. Given the clinical importance of IV access, it stands to reason that the prudent provider should be well versed in multiple methods of gaining this access. Bedside ultrasound is well documented as one of the premier adjuncts to obtaining IV access in the difficult to access patient (Heinrichs et al, 2013). Ultrasound has been proven to reduce the number of attempts for successful venous access as well as reducing the time to successful cannulation (Heinrichs et al., 2013; Sabado & Pittiruti, 2019). Ultrasound guidance for IV access has also shown no increased incidence of complications from standard techniques (Sabado & Pittiruti, 2019). The main barrier to successful use of the ultrasound for IV access is a lack of training in its use which can lead to poor technique and unsuccessful attempts (Sabado & Pittiruti, 2019). Proper provider training is imperative prior to any real-world application

of ultrasound-guided venous access not only to ensure a successful procedure but also to maintain patient safety. The OSCE has been in use since the 1970s to evaluate the clinical readiness of providers and has proven to be a reliable indicator of a provider's ability to perform a skill in a real-world setting (Zayyan, 2011). The OSCE model can potentially lend itself well to determining the competence of an anesthesia student in performing IV access using ultrasound guidance.

Specific Aims

The purpose of this doctoral project was to create an OSCE to serve as a training tool as well as an evaluation tool for USM NAP students. A review of literature has shown the utility of ultrasound in obtaining IV access in the difficult to access population; however, proper training is crucial to the successful integration of this tool into clinical practice. The specific aim of this doctoral project was to create a standardized tool to familiarize the student with the proper techniques for initiating IV access using ultrasound guidance. This doctoral project could also be used as a means for clinical instructors to determine a student's competency in this skill before performing the procedure in a real-world setting. The OSCE was created with the assumption that the student has a basic knowledge of normal intravenous access techniques as well as basic knowledge of ultrasound usage.

DNP Essentials

The Doctor of Nursing Practice (DNP) degree is a terminal degree that prepares recipients to perform at the highest level in their chosen field of practice. As such, the American Association of Colleges of Nursing (AACN) has outlined eight Essential competencies that must be met by all DNP graduates, regardless of which advanced

practice degree is sought. The AACN describes these Essentials as "foundational competencies that are core to all advanced nursing practice roles" (American Association of Colleges of Nursing [AACN], 2006, p. 8). All eight Essentials were met with this doctoral project. Essentials I and VI were used extensively. The eight Essentials are outlined in Appendix A.

Essential I

Scientific Underpinnings for Practice focuses on taking the body of knowledge gained through scientific research and implementing that knowledge into the nursing profession. This doctoral project met that Essential by creating an OSCE using relevant scientific literature.

Essential VI

Interprofessional Collaboration for Improving Patient and Population Health Outcomes involves communicating and collaborating with other professionals to implement the best possible patient care. This doctoral project met that Essential by using input from students and faculty to develop an OSCE that focuses on an important area of patient care.

Summary

IV access is an essential aspect of anesthesia and provides the conduit through which providers are able to administer important medications to their patients. Gaining this access is normally a very routine procedure, and many clinicians are experts at initiating IV access using standard techniques on a multitude of patients. However, there are certain subsets of patients in which it is difficult to gain adequate IV access due to individual factors such as preexisting disease, body habitus, and volume status (Sabado &

Pittiruti, 2019). Fortunately, the development of modern bedside ultrasound has given the provider a tool to aid with this type of patient. The ultrasound allows the provider to visualize a vein and guide an IV catheter to that vein using a real-time image (Sabado & Pittiruti, 2019). Ultrasound is very effective for IV access, but successful implementation requires proper provider training.

Assessing the readiness of a provider to perform a clinical skill is imperative for the safety of patients. The OSCE model for training and assessment has been used in medical schools since the 1970s and has become the gold standard for testing provider competency (Zayyan, 2011). This doctoral project developed an OSCE that can potentially be used as a training tool as well as an evaluation tool for USM NAP students in the performance of ultrasound-guided IV access.

CHAPTER II – METHODOLOGY

As mentioned previously, IV access is a crucial aspect of anesthesia. IV access allows the provider to quickly and effectively administer fluids, sedative agents, and resuscitation medications. Unfortunately, in a large subset of patients, IV access can be difficult to obtain due to individual patient factors such as preexisting disease, body habitus, and volume status (Sabado & Pittiruti, 2019). This doctoral project consisted of the development of an OSCE that will allow clinical instructors to evaluate the readiness of a nurse anesthesia student to obtain IV access in the difficult to access population using ultrasound before performing the procedure in a real-world setting. The doctoral project was submitted to The USM Institutional Review Board (IRB) for approval (IRB Protocol Number 20-227). The IRB approval letter can be found in Appendix B.

Context

A targeted review of the literature was performed to obtain current best practice procedures for gaining IV access using ultrasound. IV access using ultrasound is well documented in the literature as a viable technique for obtaining venous access in the difficult to access population. Benefits include reducing the number of attempts for successful venous access as well as reducing the time to successful cannulation, without an increase in complications from standard techniques (Heinrichs et al., 2013; Sabado & Pittiruti, 2019). The major downfall of this technique is a lack of provider training, leading to unsuccessful cannulation and a delay in care. This doctoral project bridged the gap in knowledge by developing an OSCE that serves as a training tool for nurse anesthesia students preparing to enter clinical. This OSCE also serves as an effective

evaluation tool for the clinical instructor in determining the student's readiness to perform this skill on a real patient.

Design

OSCE Development

After IRB approval, the OSCE was developed. Using research and evidence-based practice guidelines, an OSCE template (Appendix C) was developed including information about the OSCE, steps to complete the OSCE, simulation patient information, and a standardized grading rubric with critical steps that must be met to pass. The author also filmed the correctly completed OSCE for review. After development, the OSCE template was evaluated for thoroughness and use of evidence-based practice by an evaluation committee consisting of four USM NAP faculty members and two certified registered nurse anesthetists (CRNA). The OSCE was also evaluated by first and second-year student registered nurse anesthetists (SRNA) in the USM NAP. A standardized grading rubric outlining crucial objectives that must be met by the student during the OSCE simulation was developed and approved by the evaluating committee (Appendix D).

Participant Recruitment

The evaluation committee, as well as the first and second-year USM NAP students, were recruited via email. Separate emails were sent out to the USM NAP instructors (Appendix E), CRNAs (Appendix F), and SRNAs (Appendix G). The emails stated that volunteers were being sought to provide feedback on a clinical skill simulation briefing in the form of an OSCE related to ultrasound-guided intravenous access. The emails also contained a disclaimer assuring the participants of their anonymity and

confidentiality of the data being collected. Participants were assured that participation was completely voluntary, and that non-participation would not result in any repercussions.

Evaluation

Evaluation of the OSCE was carried out by the author, the evaluation committee consisting of four USM NAP faculty members and two CRNAs, and first and second-year USM NAP students. These evaluators were presented with the OSCE template and supporting materials via email. The evaluators reviewed the provided materials and determined the validity, objectiveness, and effectiveness of the proposed OSCE. A survey was developed and uploaded to Qualtrics™. The survey link was sent to the evaluators via email. The evaluators were asked to complete the anonymous survey after evaluating the OSCE. There was also an opportunity during the survey for the evaluators to ask questions about the OSCE or to propose changes to the OSCE.

The evaluators were given a two-week timeframe in which to complete the survey. After the allotted time, the results of the survey were analyzed. Based on the feedback from the survey, necessary changes were made to the OSCE template and submitted to the evaluation committee for review.

Implementation

After committee approval, the completed OSCE was presented to the USM NAP administration for adoption into their OSCE curriculum. The completed doctoral project was also presented to the public at the Fall 2020 USM School of Leadership and Advanced Nursing Practice DNP Scholarship Day.

Summary

After IRB approval, information gathered from a review of the literature was utilized to develop an OSCE on ultrasound-guided peripheral venous access. An evaluation committee, as well as first and second-year USM NAP students were recruited via email to evaluate the OSCE. After reviewing the OSCE template, they were asked to complete an anonymous survey to help determine the quality of the OSCE. Necessary changes were made to the OSCE based on survey feedback and submitted to the evaluation committee for review. The completed OSCE was presented to the USM NAP administration for inclusion in their OSCE curriculum.

CHAPTER III - RESULTS

The goal of this doctoral project was to create an OSCE that could be used as a training tool as well as an evaluation tool for the USM NAP students in the performance of ultrasound-guided peripheral venous access. An OSCE template was developed utilizing evidence-based literature and was disseminated to the evaluation committee as well as first and second-year USM NAP students. The OSCE template and supporting materials were sent in email form to the evaluation committee and USM NAP students. The email also included a link to a Qualtrics™ survey regarding the content and steps within the OSCE (Appendix H). The evaluation committee was comprised of four USM NAP faculty members who are also practicing CRNAs in the state of Mississippi, as well as two CRNAs who have experience with ultrasound-guided peripheral venous access. First and second-year USM NAP students were also asked to evaluate the OSCE. A total of 28 responses to the survey were gathered. Survey demographics are included in Figure 1.

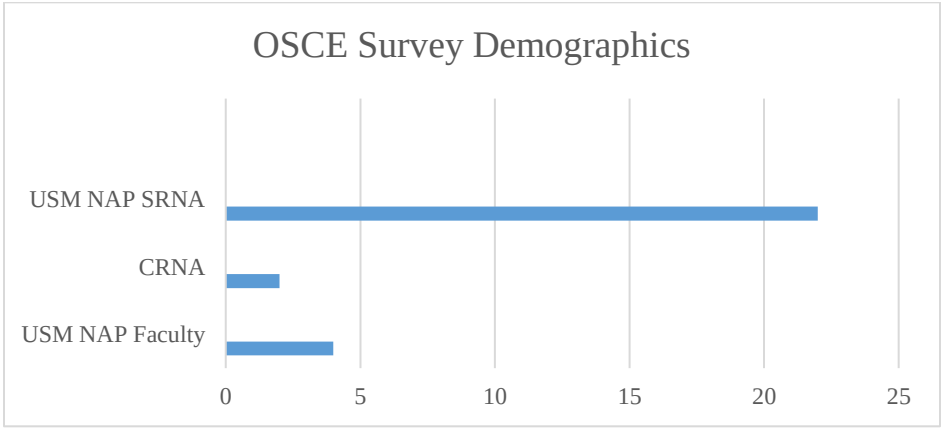

Figure 1. *Survey Demographics*

The survey asked four questions to determine the clarity, conciseness, effectiveness, and accuracy of the proposed OSCE. Question one asked: Are the objectives of the OSCE clear? This question aimed to determine if the materials and instructions included with the OSCE were easy to understand and follow. Question two asked: Is the OSCE an appropriate length? This question was used to determine not only if the OSCE covered enough material, but also to determine if it would be feasible to implement the OSCE simulation into allotted class time. Question three asked: Does the OSCE properly evaluate the stated procedure? This question's purpose was to identify how well the OSCE covered the specified topic. Question four asked: Is the OSCE evidence-based on current literature? This question was utilized to verify the accuracy of the provided information. The participants were also given the opportunity to leave a comment or suggestions regarding the OSCE. The results of the survey, as well as the comments, can be seen in Table 1.

Table 1

Survey Results

Question	Answer
Are the Objectives of the OSCE Clear?	**Yes:** 28 **No:** 0
Is the OSCE an appropriate length?	**Yes:** 28 **No:** 0
Does the OSCE properly evaluate the stated procedure?	**Yes:** 28 **No:** 0
Is the OSCE evidence based on current literature?	**Yes:** 28 **No:** 0
Do you have any comments or suggestions regarding the OSCE?	**Comment 1:** "I feel that the utilization of US for difficult PIV would be great for SRNAs. This would also be helpful for SRNAs in becoming familiar with the US before taking on bigger challenges, such as central line placement and nerve blocks. **Comment 2:** "Great videos." **Comment 3:** "Quality information." **Comment 4:** "Perhaps a video that shows the whole process."

Feedback

Overall, the survey provided the desired feedback on the quality of the proposed OSCE. Only one respondent proposed a change to the OSCE. This respondent indicated that a video showing the whole process would be helpful. A video of the author correctly completing the OSCE has been included with the completed doctoral project.

Summary

An OSCE was developed to serve as a training and evaluation tool for USM NAP students in the performance of ultrasound-guided peripheral venous access. The OSCE was presented to an evaluation committee as well as first and second-year USM NAP

students. These evaluators were asked to complete an anonymous survey to determine the clarity, conciseness, effectiveness, and accuracy of the proposed OSCE. The survey feedback indicated that the OSCE was of high quality and would be well received by instructors and students in the USM NAP.

CHAPTER IV – DISCUSSION

The ability of the anesthesia provider to quickly and effectively gain IV access is of paramount importance to the safe and effective implementation of modern anesthesia. The literature supports the use of ultrasound guidance as an adjunct in the difficult to access population. However, one major barrier to the implementation of this technology is a lack of proper provider training in its use (Sabado & Pittiruti, 2019). This doctoral project aimed to create an OSCE that could be used to train nurse anesthesia students at USM in ultrasound-guided IV techniques as well as determine their readiness to perform the procedure in a clinical setting. The completed OSCE will be submitted to the USM NAP administration for adoption into their OSCE curriculum.

Limitations

Limitations to this doctoral project include the fact that this OSCE and survey were only distributed to nurse anesthesia students and faculty at USM. No other nurse anesthesia programs were included in this survey. Also, the small size of the expert panel limits the amount of input and suggestions that could have been made regarding the OSCE. A larger sample size from nurse anesthesia programs across the country, as well as a larger evaluation committee, could potentially lead to the discovery of areas to improve this doctoral project.

Considerations

IV access is a fundamental skill required to be a successful nurse anesthetist. Learning advanced techniques to facilitate this access is a natural progression as the student works toward becoming an effective provider. This OSCE provides a tool to aid

in this progression, as well as set the groundwork for future OSCE scenarios that require the use of ultrasound for venous access such as central line placement.

Summary

This doctoral project's goal was to create an OSCE that could be used to train and evaluate USM NAP students in the performance of ultrasound-guided peripheral venous access. An OSCE template was developed utilizing evidence garnered from a review of the literature. The OSCE was reviewed by students at USM as well as an evaluation committee including CRNAs and USM faculty members. Data gathered from the anonymous survey suggests that this OSCE met the aims and objectives defined at the outset of this doctoral project. The evidence-based ultrasound-guided peripheral venous access doctoral project was well received by the student respondents as well as the faculty in the USM NAP.

APPENDIX A – DNP Essentials

DNP Essentials	Clinical Implications
Essential One: Scientific Underpinnings for Practice	Identification of the need for a practice-based competency for ultrasound-guided IV access.
Essential Two: Organizational and Systems Leadership for Quality Improvement and Systems Thinking	Interaction and collaboration with USM NAP staff, USM NAP students, and CRNAs to develop OSCE.
Essential Three: Clinical Scholarship and Analytical Methods for Evidence-Based Practice	Review of the literature to determine best practice for an area of competency.
Essential Four: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care	This doctoral project integrates ultrasound technology to improve patient outcomes by providing training and competence assessment of a USM NAP student's ability to place an IV under ultrasound guidance.
Essential Five: Health Care Policy for Advocacy in Health Care	This doctoral project recommends that this training and competence be added to the pre-clinical curriculum.
Essential Six: Interprofessional Collaboration for Improving Patient and Population Health Outcomes	This doctoral project utilized collaboration between several professions including professional educators and CRNAs.
Essential Seven: Clinical Prevention and Population Health for Improving the Nation's Health	This doctoral project aims to produce a competent provider in an advanced IV access skill that will improve patient outcomes, decrease unnecessary procedures, and increase patient satisfaction.
Essential Eight: Advanced Nursing Practice	Synthesis of peer-reviewed data and best practice recommendation, OSCE development, and assessment of OSCE effectiveness.

APPENDIX B – IRB Approval

Office *of*
Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

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NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- **The risks to subjects are minimized and reasonable in relation to the anticipated benefits.**
- **The selection of subjects is equitable.**
- **Informed consent is adequate and appropriately documented.**
- **Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.**
- **Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.**
- **Appropriate additional safeguards have been included to protect vulnerable subjects.**
- **Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident template on Cayuse IRB.**
- **The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.**
- **FACE-TO-FACE DATA COLLECTION WILL NOT COMMENCE UNTIL USM'S IRB MODIFIES THE DIRECTIVE TO HALT NON-ESSENTIAL (NO DIRECT BENEFIT TO PARTICIPANTS) RESEARCH.**

PROTOCOL NUMBER: IRB-20-227
PROJECT TITLE: Ultrasound Guided Peripheral Venous Access: An OSCE
SCHOOL/PROGRAM: School of LANP, Leadership & Advanced Nursing
RESEARCHER(S): Christopher Smith, Nina Mclain

IRB COMMITTEE ACTION: Approved
CATEGORY: Expedited

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

PERIOD OF APPROVAL: May 8, 2020

Donald Sacco Jr.

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

APPENDIX C – OSCE Template

ANESTHESIA OBJECTIVE STRUCTURED CLINICAL EXAM

Ultrasound-Guided Peripheral Venous Access

LEARNER OUTCOMES:

1. Be able to identify patients who present challenges with IV access.
2. Select appropriate ultrasound equipment and settings for ultrasound-guided IV access.
3. Differentiate between veins and arteries using ultrasound.
4. Perform venous access utilizing the ultrasound for guidance.

DOMAINS: Clinical skill, Performance Assessment.
PURPOSE: Demonstrate the ability of the USM NAP student to utilize ultrasound-guidance for peripheral IV access.

LEARNER OBJECTIVES:

1. Describe which patients present challenges with IV access.
2. Demonstrate the ability to utilize ultrasound-guidance for peripheral IV access.
3. Analyze technique and learn from mistakes.

INDIVIDUAL OR GROUP OSCE: Individual
REQUIRED READING and ASSOCIATED LECTURES:

1. Kline, J. P. (2019). *Peripheral nerve blocks & ultrasound guidance for anesthesia providers*.
   Chapters: 9 & 14

REQUIRED VIDEOS:
Sonosite, Inc. Peripheral Venous Access under Ultrasound Guidance Parts 1 & 2
https://www.youtube.com/watch?v=lREUPXCpK8Y
https://www.youtube.com/watch?v=riizCYcXhRU

REQUIRED PARTICIPANTS: USM NAP student, NAP faculty examiner, clinical skills lab staff.
VENUE: USM NAP clinical skills lab.
STUDENT LEVEL OF OSCE: Semester 1-4
TIME ALLOTTED: 20 minutes
RECOMMENDED PRACTICE PRIOR TO EXAMINATION: 20 minutes x 4 attempts = 80 minutes.

CONTENT OUTLINE

CONTEXT: (Background/story)

You are asked to come to the pre-op area to start a peripheral IV on a patient scheduled for surgery. The patient is a 53-year-old female scheduled to undergo a laparoscopic cholecystectomy. Health history is significant for hypertension and type II diabetes. She is 5' 6", 240 lbs., with a BMI of 38.7. The patient has been NPO for 12 hours and has complained of nausea and vomiting for the past two days. Vital signs are as follows: HR 108, B/P 103/52, RR 22, SPO2 97%, T 99F.

Nurses in the pre-op area have attempted IV access x 3 with no success. The patient reports difficulty with IV access in the past and says that they used some sort of *machine* to start her IV last time.

Gather the correct supplies to perform IV access utilizing ultrasound guidance.

EQUIPMENT& SUPPLIES:
Portable ultrasound machine
High-Frequency Linear Probe
Ultrasound gel
ChloraPrep™ (or similar antiseptic)
IV catheter
Tegaderm™
1" Plastic tape
Saline Lock
Saline Flush
Human Volunteer
Ultrasound compatible IV access simulation model

SITE SELECTION: IV access locations for this OSCE will be limited to the upper extremities.

TASK STATEMENT: Your task is to discuss several patient populations that can present problems for IV access, demonstrate the use of the ultrasound in differentiating veins from arteries on a human volunteer, and start an IV on the simulation model using ultrasound guidance.

PROCESS:

1. Prepare the appropriate equipment (IV and ultrasound equipment).
2. Discuss patients that commonly have difficult to access vasculature (dialysis, diabetes, obese, volume-depleted, etc.).
3. Demonstrate proper usage of the ultrasound in scanning upper extremity vasculature.
4. Correctly differentiate an artery from a vein on a live OSCE patient by clinical indicators (non-compressible and pulsatile = artery; non-pulsatile and compressible = vein).
5. Properly cleanse the simulation model for IV puncture.
6. Verbalize cleansing and proper preparation of probe (aseptic policies will vary by institution).

7. Insert IV catheter at the proper angle for the depth of the vein.
8. Follow the needle tip of the IV catheter and advance into the vein.
9. Properly secure IV.
10. Evaluate the patency of the IV.

DEBRIEFING FORM:

Student Debriefing Form

1. What could you have done better?

2. What did you do well?

3. Do you have any comments or questions about the exercise/OSCE?

ASSESSMENT

Rubric for Ultrasound-Guided IV Access

QUESTION & DEMONSTRATION STATION:

	TASKS	PASS	FAIL	COMMENTS
*	1. Prepares and selects appropriate equipment			
	2. Discuss patients that commonly have difficult to access vasculature (dialysis, diabetes, obese, volume-depleted, etc.)			
*	3. Demonstrates proper use of ultrasound machinery in scanning upper extremity vasculature			
*	4. Correctly differentiate artery from a vein on a live OSCE patient by clinical indicators (non-compressible and pulsatile = artery; non-pulsatile and compressible = vein).			

	5. Properly cleanse simulation model for IV puncture			
	6. Verbalize cleansing and proper preparation of probe (aseptic policies will vary by institution)			
	7. Insert IV catheter at the proper angle for the depth of the vein			
*	8. Follow needle tip of IV catheter and advance into the vein			
	9. Properly secure IV			
	10. Evaluate patency of IV			

Steps with ***** Must be properly completed. All steps must be completed/passed to receive a passing grade.

The OSCE performed by the student demonstrates foundational knowledge and correct use of the ultrasound machine in obtaining IV access: (Circle one) PASS FAIL

Does the student need to repeat this OSCE at a later date to satisfy learning requirements? (Circle one) YES NO Date to return for evaluation: _____

EXAMINER: _____ DATE: _____

APPENDIX D – Standardized Grading Rubric

	TASKS	PASS	FAIL	COMMENTS
*	1. Prepares and selects appropriate equipment			
	2. Discuss patients that commonly have difficult to access vasculature (dialysis, diabetes, obese, volume-depleted, etc.)			
*	3. Demonstrates proper use of ultrasound machinery in scanning upper extremity vasculature			
*	4. Correctly differentiate artery from a vein on a live OSCE patient by clinical indicators (non-compressible and pulsatile = artery; non-pulsatile and compressible = vein).			
	5. Properly cleanse simulation model for IV puncture			
	6. Verbalize cleansing and proper preparation of probe (aseptic policies will vary by institution)			
	7. Insert IV catheter at the proper angle for the depth of the vein			
*	8. Follow needle tip of IV catheter and advance into the vein			
	9. Properly secure IV			
	10. Evaluate patency of IV			

Steps with * Must be properly completed. All steps must be completed/passed to receive a passing grade.

APPENDIX E – Instructor Recruitment Email

The survey presents no more than minimal risk of harm to subjects and involves no procedures for patients or participants. Data being collected is confidential and anonymous, and 100% voluntary with no repercussions for non-participation. This doctoral project has been approved by the University of Southern Mississippi Institutional Review Board**.**

Dear USM NAP Faculty,

I am seeking volunteers to provide feedback on an educational experience developed as a part of my doctoral project. The volunteers will be asked to review a clinical skill simulation briefing in the form of an Objective Structured Clinical Examination (OSCE), as well as view a video of the simulation being completed. The volunteers will then be asked to fill out an anonymous and confidential survey related to the simulation information and video. The content of the simulation will be related to ultrasound-guided peripheral venous access. Volunteers must be clinical faculty. Participation in this survey is voluntary. There are no repercussions for non-participation. Please respond to this email if you choose to participate. If you have any questions, please contact me at the information below.

Thanks so much for your help!

Christopher Smith

APPENDIX F – CRNA Recruitment Email

The survey presents no more than minimal risk of harm to subjects and involves no procedures for patients or participants. Data being collected is confidential and anonymous, and 100% voluntary with no repercussions for non-participation. This doctoral project has been approved by the University of Southern Mississippi Institutional Review Board.

Dear CRNA,

I am seeking volunteers to provide feedback on an educational experience developed as a part of my doctoral project. The volunteers will be asked to review a clinical skill simulation briefing in the form of an Objective Structured Clinical Examination (OSCE), as well as view a video of the simulation being completed. The volunteers will then be asked to fill out an anonymous and confidential survey related to the simulation information and video. The content of the simulation will be related to ultrasound-guided peripheral venous access. You must be familiar with this topic to participate. Participation in this survey is voluntary. There are no repercussions for non-participation. Please respond to this email if you choose to participate. If you have any questions, please contact me at the information below.

Thanks so much for your help!

Christopher Smith

APPENDIX G – SRNA Recruitment Email

The survey presents no more than minimal risk of harm to subjects and involves no procedures for patients or participants. Data being collected is confidential and anonymous, and 100% voluntary with no repercussions for non-participation. This doctoral project has been approved by the University of Southern Mississippi Institutional Review Board.

Dear SRNA,

I am seeking volunteers to provide feedback on an educational experience developed as a part of my doctoral project. The volunteers will be asked to review a clinical skill simulation briefing in the form of an Objective Structured Clinical Examination (OSCE), as well as view a video of the simulation being completed. The volunteers will then be asked to fill out an anonymous and confidential survey related to the simulation information and video. The content of the simulation will be related to ultrasound-guided peripheral venous access. Participation in this survey is voluntary. There are no repercussions for non-participation. If you have any questions, please contact me at the information below.

Thanks so much for your help!

Christopher Smith

APPENDIX H – Qualtrics™ Survey Questions

1. Are the objectives of the OSCE clear?
    a. Yes
    b. No

2. Is the OSCE an appropriate length?
    a. Yes
    b. No

3. Does the OSCE properly evaluate the stated procedure?
    a. Yes
    b. No

4. Is the OSCE evidence based on current literature?
    a. Yes
    b. No

5. Do you have any comments or suggestions regarding the OSCE?

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