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Original Research

Beyond the Block: Development of an Assessment Tool to Evaluate Periprocedural and Communication Skills in Regional Anesthesia

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Introduction

The Objective Structured Clinical Examination (OSCE) has been used to assess fundamental clinical skills in health care education since first described in 1979.[1-4] An OSCE serves as a reliable tool to assess multiple components of medical education including clinical diagnosis,[5] technical skills,[2,5] and communication skills.[6,7] Several governing bodies have introduced OSCEs as a part of board certification in anesthesiology, including the United Kingdom,[8] Israel,[9] Canada,[10] Australia and New Zealand,[11] and the United States.[12,13] These assessments test candidates' competence in different areas thought to be important for effective practice in anesthesiology. The governing board of medical education in the United States, the Accreditation Council for Graduate Medical Education (ACGME), defined 6 core competencies to assess residents' development. These competencies are subdivided into milestones assessing clinical knowledge, procedural skills, interpersonal skills, and communication, among other skills.[14] Objective assessments of trainee performance in subspecialty areas such as regional anesthesia serve a vital role in preparing residents to meet these milestones and pass certification exams.

Educators previously surveyed US-based anesthesiology residency programs regarding current and prospective plans to prepare residents for the American Board of Anesthesiology (ABA) APPLIED Exam. For those programs without an OSCE, the challenges cited included lack of time (faculty and residents), expertise in OSCE development and assessment, and funding.[15] Additional studies have also emphasized the prohibitive cost and logistical challenges associated with OSCEs.[16] These barriers present an even bigger challenge for using OSCEs for assessment of subspecialty competencies in areas such as regional anesthesia given the limited time spent by trainees in these areas compared with general anesthesia training. In addition, technical aspects of peripheral nerve blocks such as needle insertion, advancement, and identification by ultrasound and injection of local anesthetics have traditionally been the focus of objective assessments. The objective of this pilot project was to design and implement a more holistic, reliable, reproducible, cost-effective, and feasible OSCE in regional anesthesia to assess core competencies with focus on periprocedural and communication skills including the ability to obtain informed consent, select appropriate equipment, and manage complications. The tool also included assessment of technical aspects of regional anesthesia but there was no needle advancement or injection of local anesthetic. We present the design and implementation of this novel clinical examination and assessment tool, following the SQUIRE-EDU (Standards for Quality Improvement Reporting Excellence in Education) report guidelines.[17]

Materials and Methods

Needs Assessment

A search of the current literature was conducted to identify tools used to evaluate resident performance in periprocedural and communication skills related to regional anesthesia. Four assessment tools using objective and structured assessment in regional anesthesia were identified.[18-21] Three of these tools[18-21] used an already-published global rating scale developed to assess performance of surgical procedures[2] and created their own objective checklist for a variety of peripheral nerve blocks. Watson et al evaluated the psychometric properties of the Australia and New Zealand College of Anaesthetists Direct Observation of Procedural Skills tool.[11] Wong et al[22] modified the scoring tool of Cheung et al[20] and evaluated its validity and reliability. Four of these projects involved evaluation of trainee performance by experts via video-based assessments,[12,19,21,22] whereas the other used in-person assessments.[18] All these tools evaluated tasks involved with preparation, performance, and assessment of peripheral nerve blocks, but emphasis was given to technical skills. They offered a limited focus on the periprocedural and

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communication skills required for safe and effective practice mentioned previously.

At the time of this study, our institution assessed resident performance via verbal and written feedback. Readiness for graduation was determined by the program's clinical competency committee through review of resident evaluations and feedback from faculty and the regional anesthesia rotation director. This committee reviewed resident performance bi-annually to determine overall milestone achievement and the need for remediation. No objective assessments were used at the time to assess regional anesthesia competency, highlighting the opportunity to develop and introduce another tool to measure resident regional anesthesia performance and readiness for independent practice. In addition, the tool would help to prepare trainees for the regional anesthesia component of the ABA APPLIED Exam as scenarios that are commonly used test the ability to obtain informed consent, discuss complications, and demonstrate application of ultrasonography.

Setting and Administration

This study received an exemption by the institution's institutional review board (IRB) (University of North Carolina Office of Human Research and Ethics, reference ID 309818, September 16, 2020). The OSCE was conducted at the University of North Carolina at Chapel Hill in Chapel Hill, NC, during the 2020–2022 academic years in an unused preoperative patient room. Three scenarios, a script for a proctor and a standardized patient (SP), and a grading tool for raters were developed by content experts, including 3 fellowship-trained regional anesthesiologists with experience in medical education, an anesthesiologist previously involved with the development of the ABA APPLIED Exam, and an expert in psychometrics and educational assessments. Participants included were residents undergoing their first regional anesthesia rotation. Residents with prior regional anesthesia experience or other learners such as regional anesthesia fellows were excluded. A single resident volunteered and participated in each administration. As this study was exempt by the institution's IRB because of its educational nature, written consent was not recorded. However, each participant was provided a copy of the informed consent document approved by the IRB and provided verbal consent after discussion of the project goals and methods. Each administration contained the same 3 scenarios and was proctored by the same examiner with an SP.

Video-based assessment was used to provide an objective, repeated evaluation in which multiple clinical faculty members could assess the residents on their own schedule.[23] We used equipment owned by the department. A camera (camera 1, PowerShot SX620 HS Black, Canon, Inc) was used to record the examinee, SP, and audio. In addition, camera 1 was used to record ultrasound footage during the second scenario. A second camera (camera 2, GoPro HERO4 silver with wide-angle lens, GoPro, Inc) was positioned at the head of the bed for an additional angle to assess technique and block positioning. Figure 1 illustrates the setup of the exam room.

A preliminary study was completed with 5 trainees. The focus for the first 2 examinees was assessing the mechanics of the study, including videotaping and script readiness. The focus of the subsequent 3 evaluations was refining the scoring rubric and script. The examination was then given to 6 additional residents. Last, following the preliminary component with the first 5 students, administration of the OSCE was transitioned from the fourth, and final week, to the third week of the rotation to better allow for trainee feedback and subsequent practice modification while still on the rotation.

Scenario Development and Exam Optimization

Three scenarios were developed by content experts from our institution. They were structured to assess regional anesthesia–specific ACGME competencies and sub-competencies[24] and regional anesthesia topics included in the ABA Content Outline.[25] See Table 1 for specific items. A single trial examination of 3 scenarios was performed to gauge duration of setup, OSCE performance, and feedback with a goal of 1 hour. As a result, the script was condensed for the first 2 scenarios to reduce the duration of the examination. The third scenario, testing diagnosis and management of local anesthetic systemic toxicity, was converted into a brief question-and-answer oral examination between the proctor and the examinee without an SP, also to reduce duration.

Scenario 1 consisted of an SP-based encounter to assess residents' skills in history-taking, physical exam, and block eligibility in the setting of preexisting nerve injury. In addition, one objective evaluated the examinee's knowledge of, or ability to readily find, appropriate anticoagulation guidelines. The instructions given to the resident are shown in the Supplemental Online Material, Appendix A.

Scenario 2 consisted of 3 sections, all SP-based encounters. Competencies tested included ability and knowledge required to obtain informed consent, demonstrate an appropriate time-out procedure, select appropriate equipment, and describe sonoanatomy and procedural aspects such as needle trajectory and expected local anesthetic spread. In addition, there were block-specific checklist objectives for both an upper- and a lower-extremity block. There was no needle insertion or injection of local anesthetic during the assessment.

Scenario 3 was designed to test management of local anesthetic systemic toxicity in a question-and-answer format between the examiner and examinee (not SP-based). All scenarios are summarized in the Supplemental Online Material, Appendix B.

Script

The SP followed a written script that provided background information and suggestions to guide the examinee toward the resolution of the scenario. Our regional anesthesia nurse was able to fill the role of SP but the script was written for an SP without training in regional anesthesia. The script was reviewed with the SP at the beginning of the project and with each revision, and additional training was not required. The script given to the SP and used by the proctor to guide each scenario is shown in the Supplemental Online Material, Appendix C.

Raters

Raters included faculty experts (regional anesthesiologists) regularly involved in the

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resident regional anesthesia rotation. They were provided access to video footage of the OSCE and a grading sheet. The grading tool was reviewed with raters before grading trainees. No further training was provided and feedback about the ease of use of the grading sheet was requested, although none was received.

Scoring Instrument (Grading Sheet)

OSCEs may be scored by several methods, most commonly a checklist and/or global rating tool. The ABA APPLIED Exam uses a global rating method and relies on examiners' familiarity and long-standing experience with this rating scale.[14] For our study, the investigators decided that a combination method would best evaluate the objectives of this OSCE. More specifically, the checklist objectives would allow for specific and individualized feedback on actionable items, and the global rating scale would gauge overall performance and readiness for independent practice. Each scenario had a designated number of checklist objectives, graded dichotomously whether objectives were performed or not. A scale of 1 to 3 was used for the global ratings, with 1 being "needs improvement," 2 as "target score," and 3 as "advanced." The available published regional anesthesia assessment tools[12,18-22] were used to guide development of some of the more procedural-specific objectives such as objectives for positioning, ultrasound handling, image acquisition, and assessment of local anesthetic spread.

Revisions were made during the preliminary component of 5 examinations, including changes to checklist objective wording to improve clarity and rater ease of use and introduction of additional checklist objectives. The total checklist objectives increased from 53 to 64. This was the result of several objectives being expanded to increase specificity. Therefore, no new subject matter was tested with these changes, maintaining the integrity of the global scores. The final scoring tool is shown in the Supplemental Online Material, Appendix D.

Following each examination, the proctor used the scoring instrument to provide the resident with objective and targeted feedback. Missed checklist objectives and overall performance by scenario and section were reviewed. Additional scanning of the SP was performed as necessary for clarification.

Statistical Analysis

Data from 11 residents, 3 ratings each, were analyzed to evaluate the OSCE and grading tool. Six examinees were tested with the final versions of the scenarios, script, and grading tool. This tool's reliability was assessed by measuring the interrater reliability of the checklist objectives and global scores and internal consistency reliability within each scenario. Statistical analysis was performed using R statistical software (version 4.2.2, R Core Team, 2021). Fleiss' kappa was used to measure the interrater reliability of individual checklist objectives, as these were dichotomous items and more than 2 raters were used. For the assessment tool presented here, it was decided to use kappa values of 0 to 0.59 to represent weak agreement, 0.60 to 0.69 to represent fair agreement, and values ≥0.70 to represent moderate to strong agreement.[26,27] The Supplemental Online Material, Appendix E, details the rationale behind the measures and models used for analysis of interrater and internal consistency reliability.

Intraclass correlation coefficient (ICC) analysis was used to assess the interrater reliability of the non-dichotomous items within the checklist. These included the total checklist score and global score at the level of each scenario and each section within scenarios, as well as for the entire OSCE and the summative individual block objectives (upper-extremity and lower-extremity block from 0 to 5). ICC was based on McGraw and Wong's convention for ICC.[28] ICC estimates and their 95% confidence intervals were calculated based on a 2-way random effect model with absolute agreement and single rater–type model. The reliability of the global scores was graded based on interpretation parameters suggested by Koo et al[28] for clinical research, where "ICC values less than 0.5 are indicative of poor reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability."

Internal consistency reliability of checklist objectives and global ratings within each scenario was evaluated with Cronbach's alpha using the average scores of all raters. Downing's criteria[29] for evaluating reliability assessments in medical education were used to interpret the results of the internal consistency reliability analysis. Being a low-stakes formative assessment, an alpha value of ≥ 0.70 was selected to indicate appropriate reliability, as this tool was not designed to be a higher-stakes examination such as a year-end summative examination (suggested alpha ≥ 0.80) or a licensure examination (suggested alpha ≥ 90).

Results

This study resulted in the development of 3 scenarios (Appendix C), corresponding grading tool (Appendix D), script (Appendix A), and examinee instructions sheet (Appendix B). The final version of the grading tool included 64 checklist objectives and 5 global rating scores (1 score for scenarios 1 and 3, and 1 score for each of the 3 sections of scenario 2).

The interrater reliability results of the checklist items are summarized in Table 2. Of the 64 individual checklist objectives, 39 demonstrated moderate to strong reliability (kappa ≥ 0.70), 2 demonstrated fair reliability (kappa 0.60-0.69), and 23 demonstrated weak reliability (kappa 0-0.59). Individual item performance is summarized in the Supplemental Online Material, Appendix F. All total checklist and global scores met criteria for at least moderate agreement (ICC ≥ 0.50) (Table 3). Most checklist objectives (4 of 5 sections and summative score) and global scores (3 of 5 sections and summative score) achieved good reliability. The summative score of the upper-extremity and lower-extremity block objectives (from 0 to 5 each) also showed at least moderate reliability, with an ICC of 0.95 (95% confidence interval [CI], 0.81-0.99) and 0.73 (95% CI, 0.32-0.95), respectively.

The internal consistency reliability analysis results are summarized in Table 4. All scenarios achieved an adequate reliability score of ≥ 0.70.

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Discussion

The assessment tool created during this project provides a reproducible and cost-efficient means to evaluate anesthesia residents during their regional anesthesia rotation in some of the fundamental competencies required for planning a safe and effective regional anesthetic. Although the effectiveness of the OSCE for resident evaluation has been well documented, the number of OSCE-related publications in anesthesiology training, and in regional anesthesia specifically, is limited. As a procedural subspecialty, evaluation of regional anesthesia performance has traditionally concentrated on procedural and technical skills. This project provides a novel assessment tool to also evaluate periprocedural and communication competencies in regional anesthesia. As of the writing of this article, there are no known OSCEs designed to test these competencies. This study provides a blueprint for developing and implementing a new OSCE into residents' curricula. The advantages of the tool presented here include its novelty, validity, reliability, and feasibility (cost-effectiveness and time-efficiency). Furthermore, this could serve as a valuable tool for educational curriculum assessment and improvement.

A wide variety of psychometric properties can be evaluated to assess the utility and performance of competency-based assessment tools. The most important of these are validity and reliability.[30] Validity represents the assessment's ability to measure what it sets out to measure. Components of this property include its ability to measure content (ie, content assessment) and differentiate between inexperienced and experienced clinicians (ie, relations to other variables). This newly developed assessment meets an acceptable level of content validity. First, the investigators include experts in the field of regional anesthesia, psychometrics, and educational assessment. Second, regional anesthesia–specific components of the ACGME milestones and the ABA Content Outline were used in the development of the tool. Finally, the scoring rubric was developed by adapting and adding to previously published assessment tools in regional anesthesia.[18-22]

The reliability of an assessment tool measures its reproducibility, or how consistently a set of results is obtained with standard conditions such as setting and subject. External reliability, or the consistency of grading of an examinee's performance among multiple raters, is often cited as the most important component of reliability in the clinical setting, as it mirrors the way trainees are typically assessed during medical training.[30] Our tool achieved overall acceptable reliability as measured by interrater reliability. Almost two-thirds of checklist items achieved fair or better reliability (41 of 64), most of which (39 of 64) achieved moderate to strong reliability. The ICC scores for all sections and overall scores demonstrated moderate or better agreement and most (9 of 12) achieved good to excellent agreement (Table 3). Finally, internal consistency was calculated at the level of each scenario and section, and all achieved an appropriate level of reliability (Table 4).

Limitations of this project include the small sample size and lack of power calculation, as well as the single-institution participant population. This was an OSCE development project with a preliminary assessment of the reliability of the assessment and grading tools. Further validity evidence still needs to be evaluated (ie, experienced vs inexperienced examinees, comparison with already-validated tools, etc). In addition, this OSCE only uses 3 scenarios without needle insertion or advancement, which cannot fully assess the skillset required for the field of regional anesthesia. Finally, some of the content may not be applicable to other institutions, as certain objectives reflect practices at our institution (ie, time-out procedure, concentration of local anesthetics for analgesic blocks, etc), although assessment can be adapted for local use.

Future directions include refinement of the scenarios and scoring instrument based on the results of this study to further improve this educational technique. Specifically, the checklist objectives that achieved weak reliability will be analyzed and modified to improve item performance. For instance, the wording of specific objectives can be modified to make the wording more explicit and further instructions can be included with the grading tool to improve clarity for raters. The script also can be modified to help the SP or proctor prompt examinees about a certain objective. Last, any objectives deemed to be repetitive can be removed or combined with another objective. Finally, we plan to implement this OSCE as a formal component of our regional anesthesia curriculum and develop methods for incorporating feedback from resident performance into improvements in the curriculum. It is our hope that this OSCE can be used by many other residency programs and ultimately further validated as a multi-institutional project.

One of the goals of this project was to maximize the generalizability of our tool and this was considered throughout the design of this assessment. The script was designed to be used by an SP without background in regional anesthesia, eliminating the need for specialized SPs and intensive training. The grading tool was designed and revised to maximize rater ease of use and minimize mental strain. No special training apart from a background in regional anesthesia, and perhaps general anesthesiology, is required for raters to adopt this tool. Despite this, logistical limitations such as time and cost still need to be considered.

The use of OSCEs for medical education is widespread but is constrained by cost and logistical limitations. This raises questions regarding the feasibility of administering this kind of assessment in smaller residency programs or during subspecialty rotations.[16] Although cost and time required to perform examination were not objectively analyzed, the exam introduced here is cost- and time-effective compared with existing OSCE's,[18-21] and can be administered without major logistical challenges. The lack of a need for dedicated testing space and SPs considerably reduces cost. In fact, in our service, the regional anesthesia nurse was able to serve as SP without adding time to their daily duties. However, this role is not available in every institution and personnel cost is certainly a consideration, as time performing the OSCE may detract from other tasks, depending on the setting and clinical volume. Although video recording

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was used for validation of this tool, it may not be necessary for implementation into a regional anesthesia training curriculum, further reducing cost. The time for performance of the OSCE was between 25 and 40 minutes. The time required for setup and feedback was not specifically measured but typically amounted to around 15 to 25 minutes. Without the time required for setup of video equipment, each individual scenario could be given at different times depending on clinical and time constraints. The result of this project is a feasible (in cost and time) OSCE that can be incorporated into a wide variety of regional anesthesia training programs.

Additional benefits of this regional anesthesia OSCE are the ability to provide immediate feedback to the trainee and to evaluate the institution's educational curriculum. Previous research has shown that immediate feedback can increase performance in this type of examination and generally creates a positive reaction from examinee and examiners.[3] Residents' performance on this assessment can be used to objectively measure the strengths and weaknesses of the educational experience provided during regional anesthesia rotations and help guide introduction of curriculum changes.

Conclusions

In this report, we describe a model to develop and implement OSCEs in regional anesthesia training. The tool developed during this project provides a practical, cost- and time-effective method to evaluate important skills necessary for successful practice in regional anesthesia. Our tool concentrates on assessing periprocedural competencies that are not measured with existing regional anesthesia evaluation tools, including the knowledge base, communication skills, and ability to effectively prepare the patient and equipment for a safe and satisfactory peripheral nerve block. This assessment provides a valid, reliable, and reproducible instrument for assessment and feedback of resident performance and effectiveness of the educational curriculum.

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References

1. Harden RM, Gleeson FA. Assessment of clinical competence using an objective structured clinical examination (OSCE). *Med Educ*. 1979;13:41-54.
2. Martin JA, Regehr G, Reznick R, et al. Objective structured assessment of technical skill (OSATS) for surgical residents. *Br J Surg*. 1997;84:273-8.
3. Sloan DA, Donnelly MB, Schwartz RW, et al. The use of objective structured clinical examination (OSCE) for evaluation and instruction in graduate medical education. *J Surg Res*. 1996;63:225-30.
4. Newble D. Techniques for measuring clinical competence: objective structured clinical examinations. *Med Educ*. 2004;38:199-203.
5. Stewart CM, Masood H, Pandian V, et al. Development and pilot testing of an objective structured clinical examination (OSCE) on hoarseness. *Laryngoscope*. 2010;120:2177-82.
6. Chipman JG, Beilman GJ, Schmitz CC, Seatter SC. Development and pilot testing of an OSCE for difficult conversations in surgical intensive care. *J Surg Educ*. 2007;64:79-87.
7. Hodges B, Turnbull J, Cohen R, Norman G. Evaluating communication skills in the OSCE format: reliability and generalizability. *Med Educ*. 1996;30:38-43.
8. Bromley LM. The Objective Structured Clinical Exam - practical aspects. *Curr Opin Anaesthesiol*. 2000;13:675-8.
9. Berkenstadt H, Ziv A, Gafni N, Sidi A. Incorporating simulation-based objective structured clinical examination into the Israeli National Board Examination in Anesthesiology. *Anesth Analg*. 2006;102:853-8.
10. Blew P, Muir JG, Naik VN. The evolving Royal College examination in anesthesiology. *Can J Anesth*. 2010;57:804-10.
11. Watson MJ, Wong DM, Kluger R, et al. Psychometric evaluation of a direct observation of procedural skills assessment tool for ultrasound-guided regional anaesthesia. *Anaesthesia*. 2014;69:604-12.
12. Wang T, Sun H, Zhou Y, et al. Construct validation of the American Board of Anesthesiology's APPLIED examination for initial certification. *Anesth Analg*. 2021;1:226-32.
13. Warner DO, Isaak RS, Peterson-Layne C, et al. Development of an objective structured clinical examination as a component of assessment for initial board certification in anesthesiology. *Anesth Analg*. 2020;130:258-64.
14. Nasca TJ, Philibert I, Brigham T, Flynn TC. The next GME accreditation system–rationale and benefits. *N Engl J Med*. 2012;15:1051-6.
15. Isaak RS, Chen F, Arora H, et al. A descriptive survey of anesthesiology residency simulation programs: how are programs preparing residents for the new American Board of Anesthesiology APPLIED certification examination? *Anesth Analg*. 2017;125:991-8.
16. Patrício MF, Julião M, Fareleira F, Carneiro AV. Is the OSCE a feasible tool to assess competencies in undergraduate medical education? *Med Teach*. 2013;35:503-14.
17. Ogrinc G, Armstrong GE, Dolansky MA, et al. SQUIRE-EDU (Standards for QUality Improvement Reporting Excellence in Education): publication guidelines for educational improvement. *Acad Med*. 2019;94:1461-70.
18. Sultan SF, Iohom G, Saunders J, Shorten G. A clinical assessment tool for ultrasound-guided axillary brachial plexus block. *Acta Anaesthesiol Scand*. 2012;56:616-23.
19. 19. Naik VN, Perlas A, Chandra DB, et al. An assessment tool for brachial plexus regional anesthesia performance: establishing construct validity and reliability. *Reg Anesth Pain Med*. 2007;32:41-5.
20. Cheung JJH, Chen EW, Darani R, et al. The creation of an objective assessment tool for ultrasound-guided regional anesthesia using the Delphi method. *Reg Anesth Pain Med*. 2012;37:329-33.
21. Chuan A, Graham PL, Wong DM, et al. Design and validation of the Regional Anaesthesia Procedural Skills Assessment Tool. *Anaesthesia*. 2015;70:1401-11.
22. Wong DM, Watson MJ, Kluger R, et al. Evaluation of a task-specific checklist and global rating scale for ultrasound-guided regional anesthesia. *Reg Anesth Pain Med*. 2014;39:399-408.
23. Isaak R, Stiegler M, Hobbs G, et al. Comparing real-time versus delayed video assessments for evaluating ACGME sub-competency milestones in simulated patient care environments. *Cureus*. 2018;4:2267.
24. Anesthesiology Milestones. The Accreditation Council for Graduate Medical Education. https://www.acgme.org/globalassets/pdfs/milestones/anesthesiologymilestones.pdf. Accessed July 1, 2024.
25. Initial Certification In Anesthesiology. The American Board of Anesthesiology. https://www.theaba.org/wp-content/uploads/2023/01/Initial_Certification_Content_Outline-4.pdf. Accessed July 1, 2024.
26. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159-74.
27. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb)*. 2012;22:276-82.
28. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med*. 2016;15:155-63.
29. Downing SM. Reliability: on the reproducibility of assessment data. *Med Educ*. 2004;38:1006-12.
30. Chuan A, Wan AS, Royse CF, Forrest K. Competency-based assessment tools for regional anaesthesia: a narrative review. *Br J Anaesth*. 2018;120:264-73.

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Abstract

Background: The Objective Structured Clinical Examination (OSCE) allows for residency training programs to assess clinical competencies. OSCEs can assess periprocedural skills but are challenging to implement because of their cost and time-intensive nature, especially in subspecialty areas such as regional anesthesia. The objective of this pilot project was to develop and implement an OSCE to assess important competencies in the field of regional anesthesia with focus on periprocedural and communication skills such as the ability to obtain informed consent, select appropriate equipment, and manage complications.

Methods: Three scenarios were developed after a needs assessment of the institution's regional anesthesia curriculum. No injections were performed, and focus was given to competencies required for effective and safe regional anesthesia practice outside of procedure-specific and technical competencies. We describe the development of the scenarios, exam format, setting and performance, and development of the scoring tool. Statistical analysis was performed to evaluate the reliability of the project by measuring interrater reliability and internal consistency reliability.

Results: Three scenarios were developed with a grading tool containing 64 checklist items and 5 global rating scores. Sixty-one percent of checklist items (39 of 64) showed moderate or better interrater reliability and all global rating scores showed moderate or better agreement. All scenarios showed moderate or better internal consistency reliability.

Conclusions: This pilot project details the development of a regional anesthesia OSCE that offers a valid, reliable, reproducible, cost-effective, and feasible method to assess periprocedural and communication competencies required for successful regional anesthesia practice.

Keywords: Anesthesia conduction, anesthesiology education, checklist, educational measurement, psychometrics, reproducibility of results

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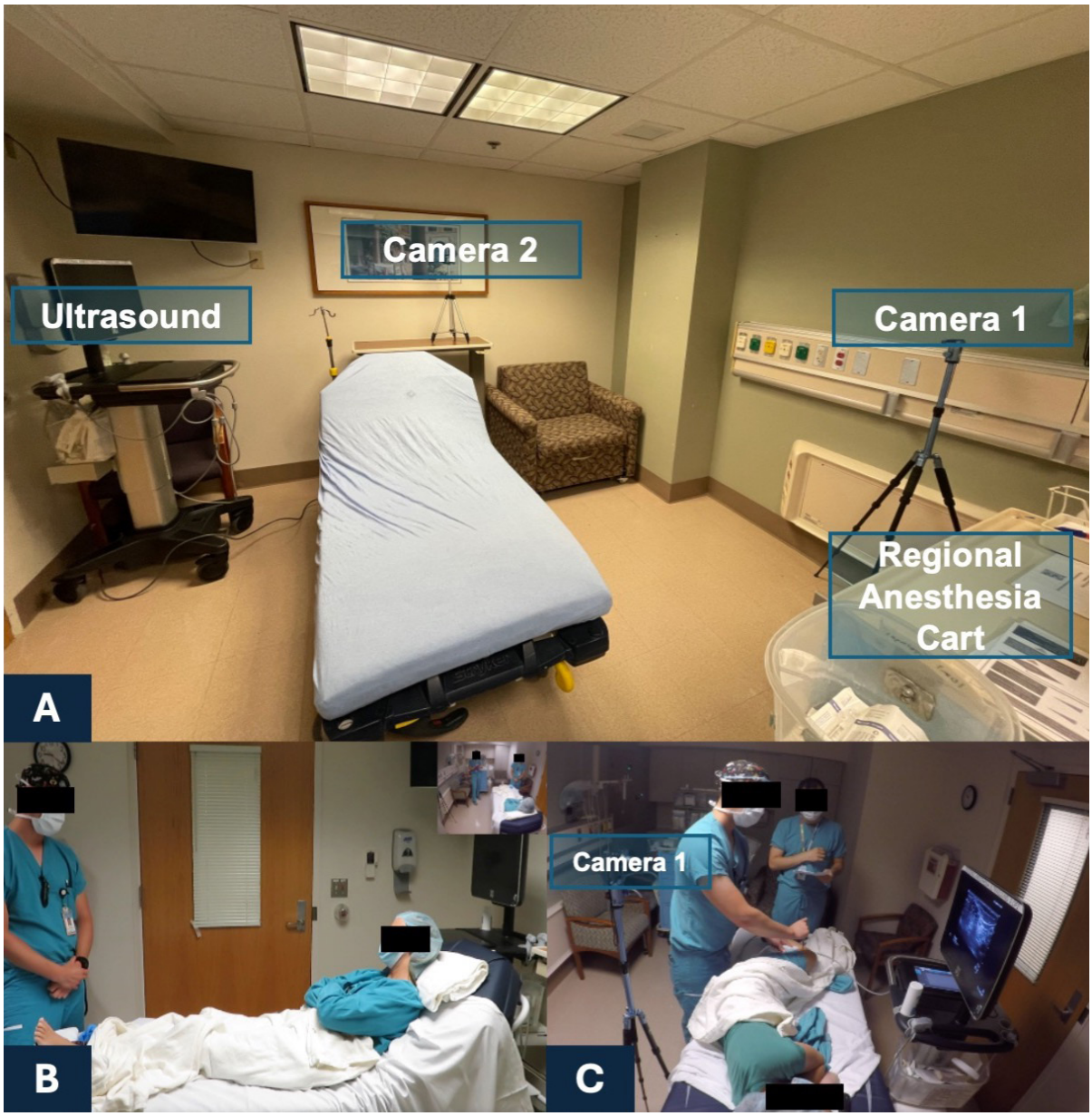
Figure

Figure 1. *Objective Structured Clinical Examination room setup. (A) Physical arrangement of exam room showing 2 video cameras, one across the stretcher from the ultrasound and the other at the head of the bed, an ultrasound, and regional anesthesia supply cart. (B) View from camera 1, a narrow-angle camera. (C) View from camera 2, a wide-angle camera. Camera 1 was positioned to capture ultrasound screen footage during scenario 2.*



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Tables

Table 1. *Summary of ACGME Milestones and ABA Content Outline Topics Used for Scenario Development*

ACGME Milestones	**Relevant Scenario**
Patient Care 10: Regional (Peripheral and Neuraxial) Anesthesia (independently developing regional anesthesia plan, performing peripheral nerve blocks and managing complications)	1, 2, 3
Interpersonal and Communication Skills 1: Patient- and Family-Centered Communication	1, 2
ABA Content Outline	
I.A.4.d.5 Local Anesthetic Side Effects	2, 3
I.B.2 Regional Anesthesia (including positioning, complications, and indications and contraindications)	1, 2, 3
II.B.1 Regional Anesthesia (including complications, implications of anticoagulants, and diagnosis and management of local anesthetic systemic toxicity)	1, 2, 3
II.D.1.a.1 Acute Pain	1, 2
I.D.2.c Informed Consent (principles, components)	1, 2
II.E.4.b.1 Principles of Informed Consent and Shared Decision Making	1, 2
II.E.6.c.5 Preoperative and Procedural Checklists	2, 3

Abbreviations: ABA, American Board of Anesthesiology; ACGME, Accreditation Council for Graduate Medical Education.

Table 2. *Interrater Reliability of Individual Checklist Items*[a]

Total Items	64
Weak	23
Fair	2
Moderate to Strong	39

[a] Checklist items analyzed by Fleiss' kappa.

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Tables *continued*

Table 3. *Interrater Reliability of Global and Total Checklist Scores*[a]

ICC (95% CI)	Total Checklist Scores	Global Scores
Scenario 1	0.95 (0.84-0.99)	0.67 (0.22-0.94)
Scenario 2 Section 1	0.82 (0.47-0.97)	0.50 (0.04-0.89)
Scenario 2 Section 2	0.93 (0.64-0.99)	0.89 (0.58-0.98)
Scenario 2 Section 3	0.60 (0.10-0.94)	0.91 (0.71-0.99)
Scenario 3	0.89 (0.52-0.98)	0.85 (0.54-0.97)
Overall	0.89 (0.43-0.99)	0.76 (0.33-0.96)

[a] Interrater reliability at the level of each scenario, sections within scenario 2, and entire Objective Structured Clinical Examination as analyzed by intraclass correlation coefficient (ICC) with 95% confidence intervals (CIs). Moderate agreement is defined as ICC ≥ 0.50.

Table 4. *Internal Consistency Reliability*[a]

	Cronbach's Alpha (95% CI)
Scenario 1	0.70 (0.12-0.95)
Scenario 2 Section 1	0.82 (0.49-0.97)
Scenario 2 Section 2	0.91 (0.74-0.99)
Scenario 2 Section 3	0.74 (0.24-0.96)
Scenario 3	0.74 (0.26-0.96)

Abbreviation: CI, confidence interval.

[a] Internal consistency reliability of checklist and global scores at the level of eaw ch scenario and sections within scenario 2. An alpha value ≥ 0.70 indicates appropriate reliability.

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Appendix A. Examinee Instructions

Regional Anesthesia Resident Objective Structured Clinical Examination (OSCE)

Scenario 1

You are the regional anesthesia attending at the ambulatory care center and you go see the next patient on the schedule. The patient is Jane Doe, a 62-year-old female who presents for revision of a left ankle fracture. The patient suffered a bimalleolar fracture in a motor vehicle accident 6 months ago but developed hardware failure and has had progressively worsening pain. The surgeon requests regional anesthesia for postoperative analgesia.

Past medical history: The patient has a past medical history of hypertension, insulin-dependent diabetes, atrial fibrillation, and hypothyroidism. She has no history of problems with anesthesia.

Airway exam: reassuring

Medications: metoprolol, apixaban, glargine insulin, levothyroxine

Your colleague has already consented the patient for the rest of the anesthetic plan except for the regional anesthesia component.

Objective: Perform a focused history and physical exam and describe your regional anesthesia plan.

Scenario 2

John Smith, a 20-year-old male, presents for repair of a left-sided wrist fracture (closed, non-displaced radial and ulnar fractures) he suffered playing ultimate frisbee. He has no medical

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problems and takes no medications. He mentions that his brother had a nerve block when he broke his arm and highly recommends it. The surgeon requests regional anesthesia for postoperative analgesia. The patient does not take any medications, has no medication allergies, and has no nerve deficits from his injury. You and your medical student go to meet the patient.

Objectives:

1. Consent the patient for regional anesthesia and discuss the benefits, risks and alternatives of undergoing a nerve block

   (You do not need to consent patient for the rest of the anesthetic and you do not need to perform a physical exam)

2. Explain your reasoning for block selection
3. Describe what equipment and medications you would use and why
4. Describe ultrasound images, needle trajectory, and site(s) of injection
5. You will then demonstrate the performance of a different peripheral nerve block

Scenario 3

Mrs Osce is a 58-year-old, 80-kg, female who presents for xenografting of a left lateral lower leg full-thickness burn. You perform a popliteal nerve block and place a peripheral nerve catheter. As you are cleaning up, the patient complains that she feels "funny" and has a weird taste in her mouth. Soon after, the patient loses consciousness. The electrocardiogram monitor shows a wide-complex rhythm. You suspect local anesthetic systemic toxicity (LAST).

Objectives:

1. Describe signs and symptoms of LAST
2. Describe treatment of LAST

You may use any visual/cognitive aids that you would normally use.

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Appendix B. Scenarios

Regional Anesthesia Resident Objective Structured Clinical Examination (OSCE)

- Materials
    - Resident instruction sheet
    - Script for standardized patient and proctor
    - Grading sheet for examiners if applicable
- Personnel:
    - Standardized patient
    - Proctor
- Equipment:
    - Stretcher
    - Camera(s) and tripod(s)
    - Adjustable-height table for camera at head of bed
    - Regional anesthesia cart
    - Ultrasound
    - Selection of needles
    - Selection of local anesthetics
    - Pointer (to point out relevant structures on screen)
    - Empty syringe with capped needle (to simulate block needle)
- Location
    - Empty preoperative/postoperative patient room

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Scenario 1: Patient History, Physical Exam, and Block Eligibility

You are the regional anesthesia attending at the ambulatory care center and you go see the next patient on the schedule. The patient is Jane Doe, a 62-year-old female who presents for revision of a left ankle fracture. The patient suffered a bimalleolar fracture in a motor vehicle accident 6 months ago but developed hardware failure and has had progressively worsening pain. The surgeon requests regional anesthesia for postoperative analgesia.

PMH: The patient has a past medical history of hypertension, insulin-dependent diabetes, atrial fibrillation, and hypothyroidism. She has no history of problems with anesthesia.

Airway exam: reassuring

Medications: metoprolol, apixaban, glargine insulin, levothyroxine

Your colleague has already performed a preoperative evaluation and consented the patient for the rest of the anesthetic except for the regional anesthesia component.

Objective: Perform a focused history and physical exam and describe your regional anesthesia plan.

Personnel:

- Standardized patient
- Proctor

Equipment

- Stretcher
- Camera(s) and tripod(s)
- Adjustable-height table for camera at head of bed

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Scenario 2: Informed Consent, Time-Out, Equipment Selection, and Block Performance

John Smith, a 20-year-old male, presents for repair of a left-sided wrist fracture (closed, non-displaced radial and ulnar fractures) he suffered playing ultimate frisbee. He has no medical problems and takes no medications. He mentions that his brother had a nerve block when he broke his arm and highly recommends it. The surgeon requests regional anesthesia for postoperative analgesia. The patient does not take any medications, has no medication allergies, and has no nerve deficits from his injury. You and your medical student go to meet the patient.

Objectives:

1. Consent the patient for regional anesthesia and discuss the benefits, risks, and alternatives of undergoing a nerve block

    (You do not need to consent patient for the rest of the anesthetic and you do not need to perform a physical exam)

2. Explain your reasoning for block selection

3. Describe what equipment and medications you would use and why

4. Describe ultrasound images, needle trajectory, and site(s) of injection

5. You will then demonstrate the performance of a different peripheral nerve block

- Personnel:
    - Standardized patient
    - Proctor
- Equipment:
    - Stretcher

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- Camera(s) and tripod(s)
- Adjustable-height table for camera at head of bed
- Regional anesthesia cart
- Ultrasound
- Selection of needles
- Selection of local anesthetics
- Pointer
- Empty syringe with capped needle

Scenario 3: Local Anesthetic Systemic Toxicity (LAST)

Mrs. Osce is a 58-year-old, 80-kg, female who presents for xenografting of a left lateral lower leg full-thickness burn. You perform a popliteal nerve block and place a peripheral nerve catheter. As you are cleaning up, the patient complains that she feels "funny" and has a weird taste in her mouth. Soon after, the patient loses consciousness. The electrocardiogram monitor shows a wide-complex rhythm. You suspect local anesthetic systemic toxicity (LAST).

- Personnel:
  - Proctor
- Equipment:
  - Camera(s) and tripod(s)
  - Regional cart

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Appendix C. Script

Scenario 1: Patient History, Physical Exam, and Block Eligibility			**Setting: Preoperative Area**	
State	**Examinee = Regional Anesthesia Attending**	**Actor Role = Patient**	**Proctor Role = Block Nurse**	**Room Setup/Cameras**
Initial Interaction	Examinee introduces him/herself, performs hand hygiene and begins discussion of anesthetic.			• Regional cart • Ultrasound • Selection of needles • Selection of local anesthetics • Overhead view camera at head of bed • Second camera at foot of bed focused on examinee of angle is narrow
Response	When asked about health history (PMH given in stem)	• Atrial fibrillation, diabetes, hypertension, hypothyroidism • I had a **left** ankle fracture after car accident 6 months ago and I have had constant pain ever since		
Response	When examinee asks about Eliquis	• I stopped Eliquis 4 days ago, is that long enough?	• Registered nurse (RN) asks examinee where to find anticoagulation guidelines • Can prompt with a question such as "if this was a deep block…?"	
Response	Examinee should ask about anesthesia for prior ankle fracture	• I was asleep so I do not know.		

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	repair and prior experience with regional anesthesia (nerve block)	• **They told me I could not have a block** but I don't remember why. ****Patient has nerve injury**. Redirect examinee toward this subject. Do not allow examinee to describe the block in detail or discuss other risks in detail.		
Response	Examinee asks about numbness	• The side of my calf feels weird, I don't know how to describe it.		
Response	Examinee should ask about other issues with ankle beside pain	• I have been having trouble picking up my foot when I walk. It feels like it drags on the ground a lot of the time. (If examinee does not ask, standardized patient [SP] can volunteer information) • I cannot tell if the weakness is getting better or worse. It is just there.		
Response	Physical exam	• SP to simulate **weakness** of dorsiflexion (**pointing toes and foot towards ceiling**)		

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		and foot eversion (**difficulty tilting ankle so that sole of foot points to the outside of the leg**) • Normal strength with plantar flexion ("press on the gas") and foot inversion (sole to the inside of the leg) • SP to simulate having numbness over the outside of the calf and front of the foot • Normal sensation on the sole of the foot		
Response	Examinee should now tell patient that due to preexisting nerve deficits, a regional block is contraindicated			
Response	If examinee does decide to proceed with block:	• Is it safe to do the block if I already have weakness? • What are the chances that the block can make my numbness and weakness worse?		
Response	Examinee should explain alternatives to block	• SP should give examinee opportunity to discuss alternative modes of analgesia	• RN can prompt discussion about multimodal analgesics, early	

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		without prompting. If not: • Is it going to hurt? • What if I wake up in a lot of pain?	recovery after surgery	
Resolution	Examinee should either end conversation OR if still offering block, SP should end encounter	• Thank you but I don't want to risk it, I'll just take the pills.		
Scenario 2: Consent, Time-Out, Equipment Selection and Block Performance			**Setting: Preoperative area**	
State	**Examinee = Regional Anesthesia Attending**	**Actor Role = Patient**	**Proctor Role = Medical Student**	**Room Setup**
Section 1				
Initial Interaction	Examinee introduces himself, performs hand hygiene and starts conversation about regional anesthesia. May ask some more history.	• **Left** wrist fracture • My brother broke his arm and they gave him a block and he was very happy with it. He told me to ask for it too. • Have never had nerve block • No weakness or numbness, 3/10 pain at baseline • No allergies or anticoagulation • No medical problems, no diabetes • Nausea after general anesthesia in the past		• Regional cart • Ultrasound • Selection of needles • Selection of local anesthetics • Overhead view camera at head of bed • Second camera at foot of bed focused on examinee of angle is narrow

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Response	Examinee explains benefits and risks of regional anesthesia	• What are the chances I get nerve damage? • Do most people get a block? • My brother had shortness of breath afterward, am I going to get that?		
Response	Examinee should ask about allergies, nerve deficits after injury	• No allergies or anticoagulation • No weakness or numbness		
Response	Examinee should offer options such as postop block as needed, or oral and/or intravenous analgesics	• What are my other options if I don't get the block? • Do we have to do it before the surgery? • Can I wait to see how I feel afterward?		
Response	Nerve catheter	• They gave my brother a ball to take home. Do you recommend that? • I don't like the idea of carrying that around. Do I have to have it?		
Response	Examinee to explain differences between single-shot block and catheter	• How long does the single injection last? • What if I take the pain ball home and I		

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		• don't like how it feels? • What happens when the medicine runs out?		
Response	Examinee to allow patient to choose	• Ok I will do the pain ball		
Section 2 - Upper Extremity Block				
Setup	Proctor asks examinee to stand in front of regional cart and asks to identify choice of: • block (If examinee selected catheter, can test, ie, axillary vs supraclavicular) • block needle (Proctor: "Let's assume you will perform a single-shot block") • medications (Remind examinee that block is only for postoperative analgesia) • ultrasound probe (Can ask further information if deep block chosen, ie, infraclavicular block)			• Second camera next to bed focused on regional cart and examinee
Transition	Proctor asks examinee to perform a time-out			**Examinee should not touch ultrasound. They should verbalize what settings they would like to change and examiner can adjust. • Overhead view camera at head of bed • Second camera at foot of bed focused on examinee and patient to assess positioning and probe handling
Response	Time-out	• John Smith, January 1, 2002 • No allergies • No blood thinners • No nerve deficits • 3/10 pain		
Transition	Proctor: "You can position the patient and start scanning" Once positioned: "I can make any adjustments to the ultrasound settings that you need and I can freeze the image if you would like. Please use this pointer to point to relevant structures."			
Response	Block performance	Proctor asks examinee to scan with ultrasound, assessing: • Positioning • Ultrasound handling		

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		Proctor can adjust gain, depth, and freeze ultrasound view if examinee desires, then ask about: • Relevant structures (See attached objectives below) • Screen orientation (laterality) • Needle insertion in relation to ultrasound probe • **Ask examinee to hold ultrasound probe how they would hold when performing the block** • **No need to continue scanning for best image; just assess needle insertion relative to probe** • Needle trajectory • Site(s) of injection • Local anesthetic spread • **See individual block objectives in Grading Sheet and prompt as needed**	
Resolution	Scenario ends when examinee goes to inject local anesthesia		
Section 3 – Lower-Extremity Block No patient interaction needed except for positioning. No time-out done.			
Setup	Proctor describes second block: "We are going to transition to a different block. Your next patient presents for debridement of a lateral ankle/calf burn without medial involvement and the surgeon requests a block for postoperative analgesia." Proctor asks examinee to stand in front of regional cart and asks to identify choice of: • block • block needle (Proctor: "Let's assume you will perform a single-shot block") • medications (Remind examinee that block is only for postoperative analgesia) • ultrasound probe		• Second camera next to bed focused on regional cart and examinee
Transition	Proctor: "You can position the patient and start scanning" Once positioned:		

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	"I can make any adjustments to the ultrasound settings that you need and I can freeze the image if you would like. Please use this pointer to point to relevant structures."		
Response	Block performance	Proctor asks examinee to scan with ultrasound, assessing: • Positioning • Ultrasound handling Proctor can adjust gain, depth, and freeze ultrasound view if examinee desires, then ask about: • Relevant structures (See attached objectives below) • Needle insertion in relation to ultrasound probe • Screen orientation (laterality) • **Ask examinee to hold ultrasound probe how they would hold when performing the block** • **No need to continue scanning for best image; just assess needle insertion relative to probe** • Needle trajectory • Site(s) of injection • Local anesthetic spread • **See individual block objectives in Grading Sheet and prompt as needed**	**Examinee should not touch ultrasound. They should verbalize what settings they would like to change and examiner can adjust. • Overhead view camera at head of bed • Second camera at foot of bed focused on examinee and patient to assess positioning and probe handling
Resolution	Scenario ends when examinee goes to inject local anesthesia		
Scenario 3: Local Anesthetic Systemic Toxicity (LAST)		**Setting:** Preoperative area	
Only question-and-answer session between examinee and examiner. Examiner can say something like "you can use any resources or visual aids that you would normally use."			
Question 1	What are some symptoms that are indicative of LAST? Objective: Identifies initial signs and symptoms of LAST (at least 3 out of the following) Tinnitus, perioral numbness, metallic taste, dizziness, lightheadedness, disorientation, loss of consciousness		
Question 2	What are the most concerning manifestations of LAST?		
	Objective: seizures AND cardiac arrest		
Question 3	Ask examinee to find American Society of Regional Anesthesia and Pain Medicine (ASRA) LAST checklist (physical or electronic)		
Question 4	How do you want to treat the patient? What medication(s) is specifically indicated?		
Question 5	Ask examinee to find intralipid		
Question 6	What is the loading dose of intralipid? How quickly do you want to give it?		
Question 7	What is the maintenance dose of intralipid?		
Question 8	What are some of the differences in ACLS when treating a patient with LAST Things to ask about if examinee does not know how to respond: • Epinephrine dosing • Contraindicated medicines (vasopressin, beta blockers, calcium channel blockers, other local anesthetics)		
Question 9	How do you control seizures associated with LAST?		

Abbreviation: ACLS, advanced cardiovascular life support.

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Appendix D. Grading Tool

Regional Anesthesia Resident Objective Structured Clinical Exam Grading Sheet			
Scenario 1	**Performed**		
Objectives	**Yes**	**No**	**Comments**
Obtains appropriate history			
Preexisting nerve deficits			
Anticoagulation			
Prior experience with regional anesthesia			
Performs focused physical exam			
Tests strength in appropriate muscle groups			
Tests sensation to light touch in appropriate dermatomes			
Recognizes preexisting nerve injury as a contraindication to regional anesthesia			
Illustrates knowledge of guidelines for regional anesthesia for patients on anticoagulation and/or can quickly access guidelines Phone app, computer, other visual aid, etc.			
Provides alternative plans for postoperative analgesia without prompting			
Global Score (1 = Needs Improvement, 2 = Appropriate, 3 = Advanced)	__ / 3		
Scenario 2			
Section 1	**Performed**		
Objectives	**Yes**	**No**	**Comments**
Obtains informed consent and explains risks and benefits clearly including:			
Risks			
Infection			
Bleeding			
Nerve damage including motor deficits			
Local anesthetic systemic toxicity AND/OR allergic reaction			
Block failure			
Benefits			
Improved analgesia			
Reduced opioid consumption			
Effectively explains differences between single-shot block and peripheral nerve catheter			

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Sets appropriate expectations in term of analgesia and duration of block			
Discusses alternative analgesic modalities			
Section 1 Global Score (1 = Needs Improvement, 2 = Appropriate, 3 = Advanced)	__ / 3		
Section 2 – Upper Extremity Block			
Selects appropriate block			
Selects appropriate block needle			
Selects appropriate medication(s)			
Selects appropriate ultrasound probe			
Demonstrates ergonomic positioning			
Patient			
Equipment (ultrasound)			
Proceduralist			
Performs thorough time-out that includes:			
Patient information (name, date of birth)			
Allergies			
Anticoagulation			
Confirms surgery and laterality			
Confirms anesthesia and surgery consents are signed			
Prior nerve deficits			
Baseline pain			
Properly stabilizes ultrasound probe (with hand, against patient, etc)			
Confirms ultrasound probe orientation and image on screen			
Selects appropriate depth and gain			
Optimizes nerve image by probe manipulation and nerve localization techniques			
Describes appropriate needle insertion in relation to ultrasound probe			
Describes appropriate needle trajectory and site(s) of injection			
Describes expected local anesthetic spread			
Individual block objectives (See attached rubric)	__ / 5		
Section 2 Global Score (1 = Needs Improvement, 2 = Appropriate, 3 = Advanced)	__ / 3		
Section 3 – Lower-Extremity Block			
Selects appropriate block			
Selects appropriate block needle			

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Selects appropriate medications			
Selects appropriate ultrasound probe			
Demonstrates ergonomic positioning			
Patient			
Equipment (ultrasound)			
Proceduralist			
Properly stabilizes ultrasound probe (with hand, against patient, etc)			
Confirms ultrasound probe orientation and image on screen			
Selects appropriate depth and gain			
Optimizes nerve image by probe manipulation and nerve localization techniques			
Describes appropriate needle insertion in relation to ultrasound probe			
Describes appropriate needle trajectory and site(s) of injection			
Describes expected local anesthetic spread			
Individual block objectives (See attached rubric)	__ / 5		
Section 3 Global Score (1 = Needs Improvement, 2 = Appropriate, 3 = Advanced)	__ / 3		
Scenario 3	**Performed**		
Objectives	**Yes**	**No**	**Comments**
Identifies initial signs and symptoms of LAST (at least 3 out of the following) • Tinnitus, perioral numbness, metallic taste, dizziness, lightheadedness, disorientation, loss of consciousness			
Recognizes potential of progression to seizures AND cardiac arrest			
Is able to locate ASRA LAST checklist and/or other cognitive aid (physical and/or electronic resource)			
Identifies indication for intralipid			
Locates intralipid in block cart			
Knows or is able to find intralipid dosing			
Understands deviations from standard ACLS (with or without visual aid)			
Reduced dose of epinephrine (<1 µg/kg)			
Avoidance of vasopressin			
Identifies avoidance of medications such as beta blockers, calcium channel blockers and other local anesthetics			
Identifies likely need for prolonged resuscitation			
Knows appropriate initial management of seizures in the setting of LAST (benzodiazepines)			
Global Score (1 = Needs Improvement, 2 = Appropriate, 3 = Advanced)	__ / 3		
Other Comments for Trainee:			

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Appendix E. Statistical Analysis

Statistical Analysis

Fleiss' Kappa

Fleiss' kappa was used to measure the interrater reliability of individual checklist items as these were dichotomous items and more than 2 raters were used. Traditionally, a kappa value above 0.40 has been used to represent moderate agreement.[26] However, higher standards have been chosen in the field of medicine. A score of 0.40 may be too low of a threshold when using this tool in projects relating to patient care and medical education. Some authors have suggested a kappa of >=0.60 to represent moderate agreement.[27] When validating their regional anesthesia assessment tool, Chuan et al[21] set the value for moderate agreement at ≥0.70, though no justification was given for this decision.

Intraclass Correlation Coefficient

Intraclass correlation coefficient (ICC) was based on McGraw and Wong's convention for ICC.[28] ICC estimates and their 95% confidence intervals were calculated based on a 2-way random effect model with absolute agreement and single rater–type model. The 2-way random effect model was selected as all raters rated all the subjects and shared the characteristics of the target raters outside of the reliability analysis, namely, being regional anesthesiologists. Absolute agreement, rather than consistency, was selected, as the actual value given to each global score was important. Single measurement type was used, as multiple ratings from each rater would not be feasible when the Objective Structured Clinical Examination is put into large-scale use. Estimates of ICC based on a single measurement are also more conservative than those based on multiple measurements, preventing the overestimation of interrater reliability.

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Internal Consistency Reliability

Internal consistency reliability within each scenario was evaluated with Cronbach's alpha using the average scores of all raters. Both checklist and global items were included in this analysis as the rating of both was important in evaluating the competencies and skills tested in each scenario as well as overall performance. The first scenario measured the examinee's performance in communication and interpersonal skills as well as knowledge of contraindications to regional anesthesia. All of these competencies were necessary for the successful resolution of the scenario, so the alpha of all of the checklist objectives of the first scenario was deemed appropriate to evaluate the internal consistency reliability of the whole scenario. All 3 sections of the second scenario measured different competencies, so they were analyzed separately for internal consistency rather than combining all 3 sections. The first section of the second scenario measured communication and interpersonal skills. Sections 2 and 3 measured knowledge of proper equipment selection, positioning, ultrasound handling, and individual nerve block objectives. However, section 2 also included performance of a time-out. As the time-out procedure was not included in section 3, it was decided to analyze the internal consistency of the 2 sections separately. Finally, scenario 3 measured knowledge of diagnosis and treatment of local anesthetic systemic toxicity so all checklist items and global scores were analyzed together for internal consistency.

References

21. Chuan A, Graham PL, Wong DM, et al. Design and validation of the Regional Anaesthesia Procedural Skills Assessment Tool. *Anaesthesia*. 2015;70:1401-11.

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26. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159-74.

27. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb)*. 2012;22:276-82.

28. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med*. 2016;15:155-63.

Appendix F. Kappa Results of Individual Checklist Items

Item	Kappa (n/a = Complete Agreement)
Moderate to Strong Agreement	
S1_1_hx_nerve_def	n/a
S1_3_prior_reg	1
S1_4_motor_ex	1
S1_5_sensory_ex	1
S1_6_RA_contraind	1
S1_7_AC_guidelines	0.78
S2_1_1_IC_infec	n/a
S2_1_2_IC_bleed	n/a
S2_1_4_IC_LAST	1
S2_1_6_Ben_analgesia	n/a
S2_2_3_UE_med	n/a
S2_2_5_TO_pt_info	n/a
S2_2_6_TO_allerg	1
S2_2_7_TO_AC	1
S2_2_8_TO_surg_and_side	n/a
S2_2_10_TO_nerve_inj	0.78
S2_2_11_TO_bl_pain	1
S2_2_12_UE_pos_pat	n/a
S2_2_14_UE_pos_examinee	1
S2_2_17_UE_depth_and_gain	1
S2_2_18_UE_image	1
S2_2_20_UE_needle_traj	0.72
S2_2_21_UE_spread	0.78

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S2_3_1_LE_block_sel	1
S2_3_4_LE_probe	1
S2_3_5_LE_pos_pat	n/a
S2_3_6_LE_pos_eq	n/a
S2_3_8_LE_US_handling	n/a
S2_3_11_LE_image	1
S2_3_12_LE_needle_ins	n/a
S2_3_13_LE_needle_traj	n/a
S2_3_14_LE_spread	n/a
S3_3_LAST_checklist	1
S3_4_rx_intralipid	n/a
S3_5_locate_intralipid	1
S3_6_intralipid_dose	n/a
S3_8_no_vaso	1
S3_9_meds_avoid_LAST	1
S3_11_LAST_sz_tx	n/a
Fair agreement	
S2_2_1_UE_block_sel	0.68
S2_2_9_TO_consents	0.67
Weak agreement	
S1_8_alternative_analg	-0.2
S2_1_3_IC_nerve_inj	0.1
S2_1_5_IC_fail	0.33
S2_1_7_ben_less_opioid	0.45
S2_1_8_SS_v_cath	0.36
S2_1_9_block_dur	0.17
S2_1_10_alternative_analg	0.33
S2_2_2_UE_needle	−0.11
S2_2_15_UE_US_handling	0.5
S2_2_16_UE_orient	0.25
S2_3_2_LE_needle	0.036
S2_3_3_LE_meds	−0.13
S2_3_7_LE_pos_examinee	0.1
S2_3_9_LE_orient	0.36
S2_3_10_LE_depth_and_gain	0.46
S3_1_LAST_sx	−0.13
S3_2_LAST_comp	−0.11
S3_7_less_epi	−0.13
S1_2_anticoag	−0.07
S2_2_4_UE_probe	0.44
S2_2_13_UE_pos_eq	−0.59
S2_2_19_UE_needle_ins	−0.071
S3_10_long_resusc	−0.059