Defining an Ultrasound-guided Regional Anesthesia Curriculum for Emergency Medicine

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ABSTRACT

Objectives: Ultrasound-guided regional anesthesia (UGRA) can be a powerful tool in the treatment of painful conditions commonly encountered in emergency medicine (EM) practice. UGRA can benefit patients while avoiding the risks of procedural sedation and opioid-based systemic analgesia. Despite these advantages, many EM trainees do not receive focused education in UGRA and there is no published curriculum specifically for EM physicians. The objective of this study was to identify the components of a UGRA curriculum for EM physicians.

Methods: A list of potential curriculum elements was developed through an extensive literature review. An expert panel was convened that included 13 ultrasound faculty members from 12 institutions and from a variety of practice environments and diverse geographical regions. The panel voted on curriculum elements through two rounds of a modified Delphi process.

Results: The panelists voted on 178 total elements, 110 background knowledge elements, and 68 individual UGRA techniques. A high level of agreement was achieved for 65 background knowledge elements from the categories: benefits to providers and patients, indications, contraindications, risks, ultrasound skills, procedural skills, sterile technique, local anesthetics, and educational resources. Ten UGRA techniques achieved consensus: interscalene brachial plexus, supraclavicular brachial plexus, radial nerve, median nerve, ulnar nerve, serratus anterior plane, fascia iliaca, femoral nerve, popliteal sciatic nerve, and posterior tibial nerve blocks.

Conclusions: The defined curriculum represents ultrasound expert opinion on a curriculum for training practicing EM physicians. This curriculum can be used to guide the development and implementation of more robust UGRA education for both residents and independent providers.

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The management of pain is a cornerstone of emergency medicine (EM) practice.[1] Ultrasound-guided regional anesthesia (UGRA) encompasses a variety of procedures that can effectively alleviate pain without use of oral, intravenous, or intramuscular pharmacotherapies such as opiate medications.[2] UGRA utilizes real-time ultrasound guidance to assist anesthetic medication injection near a peripheral nerve or associated facial planes to provide sensory blockade.[3] In addition to pain management, there are a number of potential advantages to using UGRA in the emergency department (ED). Utilizing UGRA in place of opioid-based systemic analgesia avoids the potentially dangerous side effects of opioid medications, particularly in geriatric patients and those with previous substance use issues.[2] For example, the femoral nerve and fascia iliaca blocks, both well-studied ED UGRA techniques, reduce complications and improve long-term functional outcomes for elderly hip fracture patients when compared to systemic opioid-based treatment.[4] UGRA can also provide a more timely and less resource-intensive alternative to procedural sedation.[5] Nerve blocks provide effective pain control for a variety of painful procedures including fracture and dislocation reductions.[6–8]

Despite the many potential benefits of UGRA, there is substantial variation in the utilization of these techniques in EM. While most academic EDs report performing UGRA, there is high variability in the frequency of use, quality assurances processes, and credentialing processes.[9] In addition, the education provided to EM physicians in these techniques is highly variable. In a recent survey of EM residency programs, nearly all program directors believed UGRA was necessary for all EM physicians to learn.[9] The Accreditation Council of Graduate Medical Education lists regional anesthesia performance as a core EM resident competency in the "Anesthesia and Acute Pain Management" milestone.[10] However, only 53% of programs reported providing UGRA-specific education to their residents.[11] There are online learning resources, textbooks, and review articles available on UGRA use by EM physicians; however, there is no published UGRA curriculum to meet this need. There is also no recommended knowledge base or set of nerve block techniques specifically defined for EM physicians.

The purpose of this study was to define the expert-recommended components of an UGRA curriculum that represents ideal knowledge and skills for all practicing EM physicians.

METHODS

A literature review was performed with the assistance of a librarian and a list of specific UGRA concepts and techniques was assembled. This included items from published peer-reviewed manuscripts and textbooks in EM and anesthesia literature.[12–26] Online resources and resources that were not subject to peer review were not reviewed for possible curriculum elements. A multi-institutional expert panel of 13 EM physicians with advanced ultrasound training was assembled via a convenience sample. Of the panelists, 11 were ultrasound fellowship trained, six were ultrasound directors at their institutions, and four were ultrasound fellowship program directors. The panel was formed with consideration for geographic diversity with three panelists from the east, four from the midwest region, three from the south, and three from the west. Panelist demographics are described in Table 1.

We then used a modified Delphi technique to build consensus on core UGRA curriculum elements. The research team included two ultrasound fellowship–trained experts and an educational expert with extensive modified Delphi experience to help with methodology and obtaining validity evidence. This educational expert assisted with data collection but was not a participant during any round of the Delphi process.

The Delphi technique is a well-established theory-driven educational method that uses expert opinion to build agreement.[27,28] A questionnaire with the full list of UGRA techniques was sent out to the expert panel via the Qualtrics online survey platform. This platform is able to receive and track distinct information from individual respondents and confidentially store data.

Table 1
Expert Panelist Demographics

Sex	
Female	7
Male	6
Years of faculty experience, mean (range)	8 (1–18)
Practice type	
Academic	8
Community	1
Country	3
Multisite	1
Geographic region	
East	3
Midwest	4
South	3
West	3

Table 2
Consensus Curriculum Elements

I. Background knowledge
1. Patient benefits
a. Decrease opioid medication use
b. Avoid risks of opioid pain medications
c. Avoid risks of procedural sedation
d. Pain relief
e. Decrease disease complications like pneumonia
2. Provider benefits
a. Relieving pain for patient
b. Develop needle tracking skills
3. Risks
a. Intravascular injection
b. Intraneural injection
c. Allergy to anesthetic
d. Phrenic nerve blockade
e. Importance of continuous monitoring
f. Recognize signs of local anesthetic systemic toxicity
g. Management of local anesthetic systemic toxicity
h. Indications for use of Intralipid
i. Dosing of Intralipid
4. Indications
a. Fracture and dislocation reduction
b. Laceration repair
c. Facilitation of procedures
d. Pain control
5. Contraindications
a. Abnormal neurovascular examination
b. Risk of compartment syndrome
c. History of allergy to local anesthetics
d. Presence of soft tissue infection
6. Local anesthetics
a. Weight-based dosing
b. Calculation of maximum allowable dose
c. Pediatric specific dosing
d. Properties of ropivacaine
e. Properties of bupivacaine
f. Properties of lidocaine
g. Use of epinephrine
7. Sterile technique
a. Skin sterilization
b. Use of sterile gloves
c. Use of ultrasound probe cover
8. Ultrasound skills
a. Probe selection
b. Depth
c. Gain
d. Appearance of nerve tissue
e. Appearance of muscle tissue
f. Appearance of adipose tissue
g. Appearance of blood vessels
h. Appearance of fascial planes
i. Anisotropy
j. Reverberation artifact
k. Probe manipulation
l. In and out of plane needle tracking techniques
m. Hydrodissection technique
9. Procedural skills
a. Identification of anatomic structures
b. Optimal patient positioning
c. Informed consent process
d. Discussion with consultants
e. Documentation of complete neurovascular examination
f. Placing patient on continuous monitoring
g. Needle trajectory
h. Knowing the risk and severity of complications
i. Knowing how to manage complications
j. Performing repeat neurovascular examination after procedure
k. Knowing documentation requirements
10. Educational resources
a. Organizational guidelines
b. Landmark studies
c. Use of phantoms
II. Ultrasound-guided regional anesthesia techniques
1. Upper extremity
a. Interscalene brachial plexus block
b. Supraclavicular brachial plexus block
c. Radial nerve block at the level of the forearm
d. Median nerve block at the level of the forearm
e. Ulnar nerve block at the level of the forearm
2. Thoracic, lumbar, and abdominal
a. Serratus anterior plane block
3. Lower extremity
a. Fascia iliaca plane block
b. Femoral nerve block
c. Popliteal sciatic nerve block
d. Posterior tibial nerve block

This study was reviewed by the institutional review board and granted exempt status.

In the first round of the modified Delphi, participants were presented with each of the UGRA items and rated them on a scale of how important knowledge of this skill or topic would be for EM physicians at all levels of training to learn regardless of place of practice (i.e., community or academic site). Items were rated on a 5-point Likert scale following standard modified Delphi technique (1 = absolutely do not include/not important; 2 = not very important; 3 = kind of

important; 4 = important; 5 = definitely include or very important).

After the initial round, the research team pulled the results from Qualtrics and generated a detailed report that was sent back to each participant, which included the participant's score as well as the group's mean score, standard deviation (SD), and level of agreement for each item. Levels of agreement were assessed for each item based on a method described by de Loe[29] to analyze modified Delphi results.[30] When using this methodology, a high level of agreement occurs when > 80% of responses fall on two contiguous points on the 5-point scale, medium level of agreement occurs at 70% to 80%, and low level of agreement occurs when there is less than 70%. Following this standard, we rated items as high agreement when > 80% of responses were either a 4 or 5, medium agreement when 70 to 79.99% of responses were either a 4 or 5, and low agreement if less than 70% of responses were either a 4 or a 5.

Following the first round, results were distributed to each participant as noted above, and the expert panel met to discuss the results of the first round. Members of the panel were allowed to ask questions of other members to explain their scores and ask clarifications about questions. Different viewpoints were shared, and we emphasized discussion on the items with medium agreement and low agreement with high means as these items had potential to achieve high agreement for consensus after the second round.

Following the meeting, we then distributed the questionnaire to the expert panel for the second round of the modified Delphi process. The expert panel responded again to the questionnaire via Qualtrics. The data were analyzed using the de Loe method described above to assess mean, SD, and level of agreement and provided the results to the expert panel during a second meeting. All topics that had a high level of agreement after the second round were included in the final curriculum. The items that did not achieve high agreement after the second round were excluded from the final curriculum table.

RESULTS

The initial list of 178 curriculum elements consisted of 110 background knowledge elements and 68 individual UGRA techniques. The background knowledge elements were categorized by our research team into the following sections: benefits to providers, benefits to patients, risks of UGRA procedures, indications for UGRA procedures, contraindications for UGRA procedures, ultrasound knowledge and skills, equipment and materials, local anesthetics, procedural knowledge, sterile technique, educational resources, and institutional factors. The UGRA technique elements were divided into four categories by anatomic region, head/neck, upper extremity, thoracic/lumbar/abdominal, and lower extremity.

All of our expert panelists voted in the first round. A total of 117 items achieved low agreement for inclusion in a final curriculum, 17 achieved medium agreement, and 44 had high agreement. These results are available in Data Supplement S1 (available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1002/aet2.10557/full). During the discussion after the first round, five elements were revised based on participant comments for clarity from round 1 group discussion, which included compartment syndrome, soft tissue infection, informed consent, local anesthetics, and visualization of needle tip. We also provided the opportunity to add additional items that the expert panel felt might be missing and important to include in a UGRA curriculum. None were added.

All panelists then voted in the second round. After the second round of voting, 75 items achieved a high level of agreement for inclusion in UGRA curriculum, nine items had medium agreement, and 94 had low agreement (results available in Data Supplement S1). The consensus list of 75 UGRA elements for inclusion in the curriculum is shown in Table 2. Consensus was achieved by the expert panel on 65 background knowledge and 10 UGRA technique elements. At least one element from each background category section and each regional category was included on the final list, with the exception of the "institutional factors" section and the "head/neck" UGRA technique category.

DISCUSSION

The expert panel came to consensus on 65 background items and 10 UGRA techniques for a UGRA curriculum. During our panel discussions after each round, many important ideas emerged pertinent to this final list. Importantly, the panel clarified that the inclusion of an element in the final curriculum did not imply the relative importance of that element to others or how much time that element should take to

teach in the curriculum. For example, while hand hygiene is a critical and necessary step prior to initiating a procedure, the amount of time spent on teaching this may not be as substantial as time spent on learning and practicing one of the UGRA techniques. Panelists also agreed that learners may enter into the curriculum with previous knowledge of one of more of the elements and may not need additional instruction in those areas. For example, identification of different types of tissues using ultrasound. Additionally, there are items that were not included in the curriculum that panelists discussed as important prerequisites to enter into a UGRA curriculum. For example, the ability to track a needle using ultrasound is considered a prerequisite and was not included on our list as a skill that would be taught in this curriculum.

After the second round was complete the expert panelists assembled again to discuss results. It was noted that the consensus list contained far more background knowledge elements than UGRA techniques (65 compared to 10, respectively). The group again emphasized that the list did not prescribe the relative importance of each element, but rather that learners should have knowledge of each of these elements at the time they would complete a curriculum in UGRA. While there is heavy emphasis on background knowledge, this is appropriate given the introductory nature of the proposed curriculum. Additionally, building a foundational knowledge of UGRA could be applied to a wide array of UGRA techniques not included on the consensus list for this curriculum. Despite only 10 of 60 UGRA techniques being included in the consensus list, more techniques could be added to a curriculum without a need to add additional background knowledge elements, and this provides the groundwork for the development of more advanced UGRA courses in the future.

There were some items that were absent from the final list due to less than high level of agreement despite having a high mean. For example, the "Vascular injury and bleeding" element from the "Risks of UGRA procedures" was omitted from the final consensus list despite having a mean of 4.08. Upon discussion with the panelists, it was felt that elements elsewhere, like "Recognizing appearance of blood vessels" in the "Ultrasound knowledge and skills" subsection provided sufficient emphasis to address this topic. Similarly, "Billing for UGRA procedures" in the "Procedural knowledge" subsection had a mean of 3.85 but did not make the consensus list. Panelists noted that the "Documentation requirements" element from the same subsection was included and this was sufficient. The "Sterile field" element from the "Sterile technique" subsection was also not included despite a mean of 3.92. There was substantial disagreement among the panelists that a sterile field including a sterile drape should be used for every UGRA procedure. None of the elements in the "Institutional factors" subsection made the consensus list, although the "Interdepartmental politics" element scored a mean of 3.85. Several panelists felt that this section contained elements outside the scope of an introductory curriculum. There were no elements in the "UGRA techniques" section that scored above a mean of 3.80 and were not included in the consensus list.

Future work could develop new curricula to expand on the list of UGRA procedures. A list of UGRA procedures could be selected after completion of an introductory curriculum and adapted to an institution depending on the needs of the patients at that institution. In this way, a learner could progress through more advanced training by adding additional UGRA techniques. After implementation, learner outcomes such as assessment of procedural competency and development of a procedural competency assessment tool would be useful for measuring the success of the course. Additional work could also measure patient outcomes such as the number of patients who undergo blocks after the training curriculum is implemented and then measure perceived pain as well as potentially the reduction of opiate use. Ideally, provider comfort and competency would be assessed as well as patient reported efficacy of the procedure and patient safety data.

LIMITATIONS

Despite a thorough search of the literature with the help of a librarian, the list of curriculum elements voted on by the panel may not have been exhaustive. We did not include sources such as online blogs that sometimes have novel techniques that could be useful for this course. We attempted to mitigate this by giving panelists the opportunity to suggest additions to the list during the round 1 discussion.

There are also inherent limitations to the use of a Delphi panel with regard to bias. We attempted to ensure that the panel was composed of a large number of individuals from diverse geographic locations, practice environments, and roles within their institutions

to allow for diverse opinions. However, the opinions of our panel may not be representative of all EM physicians in the United States given that they have may have different levels of experience with UGRA. Further, our panel consisted of ultrasound faculty members and did not include trainees, program directors, department chairs, or others who may have interest in the training of their faculty and residents.

This study represents an initial determination of curriculum elements for introductory instruction in UGRA for EM physicians. Our list requires further validation and feasibility testing, possibly through development of individual training curricula as well as input from learners. The curriculum elements were intended for learners at all levels of experience in UGRA, however, may need adjustments for an optimal training experience at a particular level of experience.

There may be barriers to implementation of a curriculum containing these elements depending on individual practice environments. There may be limitations on the types of UGRA procedures performed in the ED based on EM physician privileges, EM experience with these techniques, or institutional guidelines. ED and hospital leadership may not be supportive of all UGRA procedures in this curriculum being performed by EM physicians, but having an established training program in UGRA with a record of safety may aid in expanding the scope of practice in these scenarios.

CONCLUSIONS

This study found consensus support by point-of-care ultrasound experts for the components of a curriculum in ultrasound-guided regional anesthesia for emergency medicine physicians. This list emphasized the importance of background knowledge elements to build a strong foundation of knowledge in ultrasound-guided regional anesthesia. Implementation of a curriculum containing these elements would place patient safety at the forefront and may have additional benefits such as reduction of opiate use. The consensus list includes 10 ultrasound-guided regional anesthesia techniques most likely to be useful to emergency medicine practice. The findings of our study can be used by training programs to develop curricula that meet the needs of emergency medicine physicians as well as other providers at all levels of experience with ultrasound-guided regional anesthesia. These elements can serve as a guide for each institution to tailor their curriculum to match their practice environment and ensure that their patients receive the many benefits of ultrasound-guided regional anesthesia.

References

1. Cantrill SV, Brown MD, Carlisle RJ, et al. Clinical policy: critical issues in the prescribing of opioids for adult patients in the emergency department. Ann Emerg Med 2012; 60:499–525.
2. Wilson C. Feeling blocked? Another pain management tool in the emergency department. Ann Emerg Med 2018;72:120–6.
3. Gray AT. Atlas of Ultrasound-Guided Regional Anesthesia. 3rd ed. Philadelphia, PA: Elsevier, 2019.
4. Guay J, Parker MJ, Griffiths R, Kopp S. Peripheralnerve blocks for hip fractures. Cochrane Database Syst Rev 2017;(5):CD001159.
5. Neal JM, Brull R, Horn JL, et al. The Second American Society of Regional Anesthesia and Pain Medicine Evidence-Based Medicine Assessment of Ultrasound-Guided Regional Anesthesia: Executive Summary. Reg Anesth Pain Med 2016; 41:181–94.
6. Blaivas M, Adhikari S, Lander L. A prospective comparison of procedural sedation and ultrasound-guided interscalene nerve block for shoulder reduction in the emergency department. Acad Emerg Med 2011;18:922–27.5.
7. Liebmann O, Price D, Mills C, et al. Feasibility of forearm ultrasonography-guided nerve blocks of the radial, ulnar, and median nerves for hand procedures in the emergency department. Ann Emerg Med 2006;48:558–62.6.
8. Stone MB, Wang R, Price DD. Ultrasound-guide supraclavicular brachial plexus nerve block versus procedural sedation for the treatment of upper extremity emergencies. Am J Emerg Med 2008;26:706–10.
9. Amini R, Kartchner JZ, Nagdev A, Adhikari S. Ultrasound-guided nerve blocks in emergency medicine practice. J Ultrasound Med 2016;35:732–6.
10. The Accreditation Council for Graduate Medical Education. Emergency Medicine Core Competencies. Available at: http://www.acgme.org/acgmeweb/Portals/0/PDFs/FAQ/110_emergency_medicine_FAQs_07012013.pdf. Accessed Jun 26, 2020.
11. Wilson CL, Chung K, Fong T. Challenges and variations in emergency medicine residency training of ultrasound-guided regional anesthesia techniques. AEM Educ Train 2017;1:158–64.
12. Farag E, Mounir-Soliman L, Brown DL. Brown's Atlas of Regional Anesthesia. Philadelphia, PA: Elsevier, 2017.
13. Nagdev A, LeVine S, Mantuani D. Peripheral nerve blocks. In: Point-of-care Ultrasound. Philadelpha, PA: Elsevier, 2014:389–404.e4.
14. Herring AA. Local and regional anesthesia in the emergency room. In: Finucane B, Tsui B, editors. *Complications of Regional Anesthesia*. New York: Springer, 2017.

15. Johnson RL, Kopp SL, Jens K, Gray AT.Peripheral nerve blocks and ultrasound guidance for regional anesthesia. In: Miller's Anesthesia. Philadelphia, PA: Elsevier, 2019:1450–79.e3.
16. Situ-LaCasse EH, Amini R, Bain V, et al. Performance of ultrasound-guided peripheral nerve blocks by medical students after one-day training session. Cureus 2019;11:e3911.
17. Nagdev A, Dreyfuss A, Martin D, Mantuani D. Principles of safety for ultrasound-guided single injection blocks in the emergency department. Am J Emerg Med 2019;37: 1160–4.
18. Neal JM, Barrington MJ, Fettiplace MR, et al. The Third American Society of Regional Anesthesia and Pain Medicine Practice Advisory on Local Anesthetic Systemic Toxicity: Executive Summary 2017. Reg Anesth Pain Med 2018; 43:113–23.
19. Herring AA. Bringing ultrasound-guided regional anesthesia to emergency medicine. AEM Educ Train 2017;1:165–8.
20. Morrison RS, Dickman E, Hwang U, et al. Regional nerve blocks improve pain and functional outcomes in hip fracture: a randomized controlled trial. J Am Geriatr Soc 2016;64:2433–9.
21. Akhtar S, Hwang U, Dickman E, Nelson BP, Morrison RS, Todd KH. A brief educational intervention is effective in teaching the femoral nerve block procedure to first-year emergency medicine residents. J Emerg Med 2013;45: 726–30.
22. Stolz LA, Acuna JG, Gaskin K, et al. Echogenicity and ultrasound visibility of peripheral nerves of the upper extremity. Med Ultrason 2018;20:199–204.
23. Raeyat Doost E, Heiran MM, Movahedi M, Mirafzal A. Ultrasound-guided interscalene nerve block vs procedural sedation by propofol and fentanyl for anterior shoulder dislocations. Am J Emerg Med 2017;35:1435–9.
24. Sohoni A, Nagdev A, Takhar S, Stone M. Forearm ultrasound-guided nerve blocks vs landmark-based wrist blocks for hand anesthesia in healthy volunteers. Am J Emerg Med 2016;34:730–4.
25. Jackson SA, Derr C, De Lucia A, et al. Sonographic identification of peripheral nerves in the forearm. J Emerg Trauma Shock 2016;9:146–50.
26. Grabinsky A, Sharar SR. Regional anesthesia for acute traumatic injuries in the emergency room. Expert Rev Neurother 2009;9:1677–90.
27. Hauer KE, Kohlwes J, Cornett P, et al. Identifying entrustable professional activities in internal medicine training. J Grad Med Educ 2013;5:54–9.
28. Wijnen-Meijer M, van der Schaaf M, Nillesen K, Harendza S, Ten Cate O. Essential facets of competence that enable trust in graduates: a Delphi study among physician educators in the Netherlands. J Grad Med Educ 2013;5: 46–53.
29. de Loe RC. Exploring complex policy questions using the policy Delphi. Appl Geogr 1995;15:53–68.
30. van der Schaaf MF, Stokking KM. Construct validation of content standards for teaching. Scand J Educ Res 2011;55: 273–89.

Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1002/aet2.10557/full

Data Supplement S1. Complete survey results.