# Evaluation of a Computer-Based Educational Module for Improving Anesthesiology Resident Knowledge in Ultrasound-Guided Regional Anesthesia

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## Abstract

**Background:** With the dramatic increase in the total number of outpatient surgeries over the last 20 years, utilization of regional anesthesia as an anesthetic modality has expanded for a variety of surgical procedures providing for better postoperative pain control and reduction of postoperative nausea and vomiting. Thus, there is a need to develop an easily accessible, multimodal, interactive curriculum capable of teaching regional anesthesia and ultrasound-guided techniques to anesthesiology resident physicians.

**Methods:** To avail anesthesiology residents in learning regional anesthesia the opportunity to make it part of their daily practice, a computer-based interactive learning program was created. As part of the learning pathway, a pretest, assessing the individual learner's current level of knowledge in the area of regional anesthesia begins the learning session. The program itself is broken down into 2 upper extremity regional anesthesia modules, which instruct about the anatomy, indications, limitations, and clinical pearls involved in each individual approach by utilizing a variety of modalities including text and multimedia (still photos and cine ultrasound images of actual regional anesthetic techniques). A post-test questionnaire follows to assess each learner's assimilation of the material, which acts as a form of continuing medical education activity. In addition, a final questionnaire surveys each learner's individual method(s) of learning, assesses the program's effectiveness and allows feedback for improvements to future versions of the program.

**Results:** The program targeted resident anesthesiologists at the University of Florida. Data from this cohort of medical professional learners (n=68) utilizing the program was collected from the pretest, post-test and survey questionnaires. Response rate was 21%. Data from pretests and post-tests showed that resident knowledge of the anatomy of the brachial plexus was only correct about 55% of the time in the pretest but improved to 82% in the post-test. Also, data from the pretests showed the resident knowledge of ultrasound was only correct 58% of the time in the pretest but improved to 85% in the post-test. Of the respondents, 84% agreed that the computer-based format worked well for them as a learning tool and 92% would like to see further teaching in this format. Interestingly, only 31% agreed that they learned best from a textbook on the subject and only 46% agreed that they learned best from lecture format.

**Conclusions:** The first version of the computer-based learning program was welcomed by the responding resident anesthesiologists at the University of Florida as a learning tool for regional anesthesia training. Many insightful suggestions were received as to how to improve the didactic nature of the program from this same group of residents. Future improvements and adjustments will continue as the hope is to make the program available online to anesthesia professionals outside the University of Florida where it will receive evaluation from these professionals as they use the program.

## Introduction

During the past two decades, both patients and surgeons have been demanding more regional anesthesia for their surgeries. Surgeons are increasingly realizing the benefits of regional anesthesia with respect to postoperative analgesia, reduced nausea and vomiting, and increased patient safety. Patients have also noticed the multitude of advantages including reduced postoperative pain, less need for narcotic analgesics, earlier ambulation and shorter hospitalizations.

Even though the utilization of regional anesthesia as an anesthetic technique has increased in the United States from 21.3% in 1980 to 30.2% in 2000, 40% of graduating anesthesiology residents are not completely comfortable performing peripheral nerve blocks (1). In the United States the Accreditation Council on Graduate Medical Education (ACGME) makes attempts to improve Graduate Medical Education in Anesthesiology by implementing standardized education performance objectives (i.e., competencies) and establishing minimum regional anesthesia block numbers. However, it has been estimated that forty percent of residents still lack adequate exposure for proficiency in peripheral nerve blockade (2).

In view of this data it becomes evident that even fulfilling the ACGME requirements on peripheral nerve blocks may not be sufficient to allow proficiency by the end of residency for a given block. Thus, it becomes clear that multiple teaching modalities might allow the realization of successful performance of regional anesthesia, which combines manual skills and theoretical knowledge. Since exact anatomic knowledge is essential for performing successful peripheral nerve blocks, teaching these concepts to residents becomes critical. Surveys of participants in cadaver workshops for regional anesthesia showed that two-thirds of participants were self-confident in performing regional anesthesia because of the increased knowledge of clinical anatomy (3). Virtual computer three-dimensional models for peripheral nerve blockade have been developed for the interscalene block (4). Anesthesiologists who observed the three-dimensional video clip were surveyed and reported that the presentation enhanced their understanding of the anatomical and technical principles of the interscalene block. This didactic teaching method is especially effective in less advanced trainees with little to moderate experience, while more interactive teaching methods like video filming may be more appropriate for advance trainees.
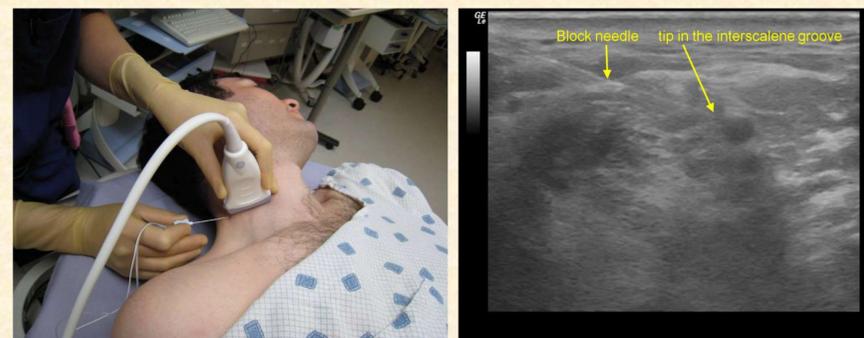
Recent studies have shown that ultrasound-guided regional anesthesia can improve the quality and avoid the complications of peripheral nerve blocks and neuraxial techniques. One such study by Marhofer et al. (5) demonstrated the improvement in the quality of nerve blocks with a reduction in the dose of local anesthetic, faster sensory and motor onset time, longer duration, and the avoidance of side effects like intraneural and intravascular injection, as well as better patient comfort through avoidance of painful muscle contractions during nerve stimulation. Over the past decade this study group has performed more than 4000 ultrasound-guided nerve blocks with a success rate approaching 100%. Considering all of the advantages of ultrasound-guided nerve blocks, all anesthesiologists wishing to become proficient should acquire the skills of ultrasound. In summary, ultrasound-guided teaching leads to a higher rate of success and increases the knowledge of anatomy and therefore the confidence of residents.

## Methods

A computer-based PowerPoint module was developed to introduce the core content items using anatomical drawings, photographic surface anatomy, ultrasound images taken from the real-time practice of regional anesthesia and the literature. The program is self-paced and includes opportunities for knowledge application and learner self-assessment. The learning modules were limited to two upper extremity blocks: interscalene and supraclavicular approaches to the brachial plexus (representative images from the PowerPoint module are shown below). The PowerPoint module was tested with resident physicians in the University of Florida Anesthesiology residency program (n=68). A detailed study protocol was developed and received UF IRB approval.

In brief, participants included all of the UF anesthesiology residents at all levels of training (CA-1 through CA-3). Study participants were provided with a CD containing the computer-based PowerPoint learning module. At the beginning of the module, study participants were asked to complete an ultrasound and regional anesthesia knowledge pretest. Since no validated evaluation instruments for this particular assessment were available and were beyond the scope of this project to develop and validate, the pre- and post-tests were adapted from examples from the ABA In-Training Exam, the literature, the guidelines for regional anesthesia fellowship training.

Since no previous study like this appears to be available for comparison, only descriptive statistical analysis can be used to report the baseline characteristics of the survey participants. For both the pretest and the post-test, answers to questions posed were recorded as correct or incorrect. The percentage of correct answers were reported as percent correct. Survey questionnaire answers were recorded using a Likert scale.



Local anesthetic surrounding the brachial plexus at the supraclavicular (division) level.
Block needle
Subclavian artery
First rib
Brachial plexus



Block needle    tip in the interscalene groove

## Results

- Of the 68 study packets distributed to UF Anesthesiology residents, only 21% (n=14) of the residents completed the forms to participate in the study.

- Pretest questions which specifically addressed knowledge of the brachial plexus anatomy demonstrated that only 55% of respondents answered those questions correctly. For pretest questions which probed resident knowledge in the area of ultrasound physics and application to regional anesthesia, 58% of the respondents answered the questions correctly.

- Post test questions, addressing essentially similar brachial plexus anatomy questions as the pretest, showed that residents answered the questions correctly 82% after viewing the PowerPoint CD module. Post-test questions probing ultrasound knowledge in the same areas as the pretest showed that residents answered the questions correctly 85% after viewing the PowerPoint CD.

- Survey results showed that 84% of respondents agreed that the computer-based learning format worked well for them and 92% would like to see further teaching in that format. It is clear that the residents are very technology-oriented since 100% of respondents liked having the CD for their own use and 92% would like to see the format on an internet website. Not surprisingly, only 31% of these same respondents felt they learned best from textbooks and only 46% agreed that they learned best from a lecture format. 85% of responding anesthesiology residents agreed that they learn best from a one-on-one teaching format.

## Conclusions

Evidence suggests that while the long established apprenticeship model for teaching anesthesiology residents regional anesthesia is the traditional method from which residents continue to learn, it is no longer sufficient to ensure competency in regional anesthesia. The emergence of ultrasound-guided regional anesthesia has introduced new challenges for regional anesthesia educators. New educational systems need to be developed to ensure competency in all the traditional methods as well as the newer technologies utilized in the performance of regional anesthesia. The present study would suggest that current anesthesiology residents at the University of Florida favor an asynchronous computer-based learning methodology for ultrasound-guided regional anesthesia over textbook or lecture format in addition to the ongoing one-on-one teaching at the patient's bedside.

## References

1. Kopacz DJ, Neal JM. Residency training: the year 2000. Reg Anesth Pain Med 2002; 27:9-14.
2. Smith MP, Sprung J, Zura, A, Mascha E, Tetzlaff JE. A survey of exposure to regional anesthesia techniques in American anesthesia residency training programs. Reg Anesth Pain Med. 1999; 24:11-16.
3. Lirk P, Colvin JM, Biebl M, et al. Evaluation of a cadaver workshop for education in regional anesthesia. Anaesthetist 2005; 54:327-332.
4. Lim MW, Burt G, Rutter SV. Use of three-dimensional animation for regional anaesthesia teaching: application to interscalene brachial plexus blockade. Br J Anaesth 2005; 94:372-377.
5. Marhofer P, Greher M, Kapral S. Ultrasound guidance in regional anesthesia. Br J Anaesth 2005; 94:7-17.