The Interpretation of Ultrasound Images: Evaluating a Novel Assessment Tool to Determine Levels of User Proficiency

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Introduction
A comprehensive knowledge of anatomy and the ability to interpret sonoanatomy are generally regarded as vital for the successful conduct of peripheral nerve blocks (e.g. Winnie 1983). Training courses in ultrasound guided regional anaesthesia are numerous, and emphasise that the ability to interpret ultrasound imagery is a critical skill in its own right. As part of the RASimAs project (www.rasimas.eu), we sought to evaluate a spectrum of expertise in this skill across a range of medical professionals attending KU Leuven’s 31st International Winter Symposium (2016). An aim of the RASimAs project has been to assist in the training and acquisition of expertise in ultrasonographic imagery via novel software developed for this purpose.

Objective(s)
We opportunistically surveyed attendees (N=55) at KU Leuven’s 31st International Winter Symposium (2016) with a task designed to evaluate relationships between the ability to interpret ultrasound imagery and prior experience of ultrasonography / possession of formal training in USGA-PNB.

Method(s)
Participants viewed a still image of the inguinal femoral region of a human left leg, prominently displaying the femoral artery. The image was an interactive web page; participants were required to use an on-screen cursor to draw around the outline of the femoral nerve as they perceived it. Participants were told they were viewing the lateral aspect of the left leg, and were allowed to take as much time as needed and to amend their outline until they were satisfied.

After submitting their outline, participants were asked if they had been previously trained in USG for PNB. Our sample image was evaluated by two experienced consultant clinicians; we compared participants’ annotations of the nerve boundary using an objective measure of the percentage of overlapping pixels in the images between consultants and participants.

Result(s)
Agreement between the experts and all participants was determined by the Dice-Sørensen coefficient, expressing the pixels common to each participant’s response and the experts’ annotation as a percentage.

Possession of formal training significantly differentiated participants’ overlap coefficients (t(53)=3.172, p=0.003, Cohen’s D = 0.857)

Brighter yellow heatmap colouration indicates higher overlap concentrations, with consultant expert annotations outlined in green.

Overlaps were also significantly correlated with raw scores for prior training (r(ho)=0.428, p=0.001), prior PNB experience (r(ho)=0.376, p=0.002) and frequency of PNB conduct (r(ho)=0.437, p=0.001).

We also weighted scores to bias for self-reported expertise, where highest scores were obtained for daily PNB performance and >50 prior PNBs performed. “Expert” participants were those with larger prior experience, high regular frequency of PNB conduct and formal training from their self-declarations. “Novices” were untrained with low experience and frequency of PNB conduct. “Intermediates” fell between these scores. There were 11 “experts”, 18 “intermediates” and 26 “novices”. We randomly discarded novice and intermediate participants to match the 11 experts for a total N=33. A strong positive correlation remained between weighted relative experience and overlap score percentages (r(ho)=0.463, p=0.001).

A one-way ANOVA showed significant overlap score differences in the reduced population (F(2,30)=3.845, p=0.033, eta²=0.203). Tukey post-hoc scores (p=0.027) showed these differences due to Expert (52% mean overlap) vs. Novice (22% mean overlap) scores.

Conclusion(s)
- The use of the Dice-Sørensen overlap score with our questionnaire displays a high degree of internal and logical consistency, highlighting the importance of training and experience in the conduct of PNB procedures.
- Practitioners’ ability to resolve the location of the femoral nerve from an ultrasound image was reliably correlated with their individual levels of experience with the procedure, the possession of prior formal training in USG, and the frequency with which they conducted PNBs. In all cases, as self-reported levels of expertise rose, so did their overlap score with an expert judgement of the image.
- After scores were weighted to favour practical experience, results remained consistent with overlap score differences between expert and novice practitioners remaining statistically significant even in a reduced population.
- The heatmap + overlap score method may be a useful metric in evaluating levels of experience and ability in anaesthetists acquiring expertise in PNB procedures.

References

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