Robotic assistance with needle guidance


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Editor—We read with interest the recent article by Morse and colleagues’ describing the use of novel robot assistance for ultrasound-guided peripheral nerve block (USgPNB). In this article the authors reported that robot-assisted needle advancement, in a bench model of USgPNB, resulted in faster needle skill acquisition compared with a manual needle advancement technique. This conclusion was based on the fact that procedural time for the robot-assisted needle guidance lessened at a faster rate than the manual technique.

We would like to highlight a number of fundamental issues that limit the validity of the authors’ conclusion. First, the term USgPNB refers to a complex set of cognitive and psychomotor skills that combine to permit (1) the performance of ultrasonography, (2) the continuous interpretation of dynamic ultrasound imagery, and (3) the guidance of needle advancement toward a target nerve, avoiding contact with surrounding structures (blood vessels, pleura, etc.). In this study, the authors chose to study one isolated task relevant to USgPNB. The task described is not a component of any ultrasound-guided nerve block procedure. To use a driving analogy, it would be as relevant to evaluate a student driver in rotating a steering wheel 20 degrees clockwise. The task only has meaningful relevance when carried out in context. To this end the authors did not conduct USgPNB procedure characterisation or task deconstruction, which informs us as to the cognitive or psychomotor skill necessary to perform the associated task. The task selected does not constitute a distinct element of the USgPNB procedure, and therefore does not support the initial (cognitive) stage of learning.

The ‘skill’ assessed was out-of-plane needle advancement, to an endpoint ‘within’ a phantom nerve structure embedded in a commercially available gel model. The endpoint was assessed by one of the investigators, also a study subject. There was no clear objective description of this outcome measure. The needle endpoint used by the authors deviates significantly from accepted best clinical practice and has been associated with nerve injury. There is mounting evidence that simple needle–nerve contact is not desirable given histological evidence of inflammatory neuritis in animal models. Out-of-plane needle guidance provides little, if any, information to the operator regarding needle tip location and has been associated with a higher rate of needle–nerve contact than in-plane needle guidance. If, as the authors conclude, the study examines skill acquisition in needle guidance, then the needleling outcome evaluated is insufficient. The outcome was based only on the completion point of the operation (i.e. needle tip in nerve). Again in a student driver analogy, we would know only that a car has reached its destination—we can infer nothing about how it got there. Therefore the bench model described above neither reflects a valid simulation environment for teaching USgPNB, nor does it use appropriate assessment metrics to validate any element of performance or learning. Therefore no meaningful conclusions can be drawn within the context of USgPNB.

The time taken to perform a task, as an assessment metric of procedural proficiency, is questionable from the perspective of both assessment of learning and procedure-related outcomes.

Although the time taken to perform specific tasks has been associated with higher procedural proficiency in some surgical settings,7 the actual relationship between the time taken to perform tasks relevant to USgPNB is unknown. We find it difficult to reconcile that although the average time taken to perform manual needle guidance was a fraction of the time taken to perform robot-assisted guidance, the authors concluded that robot assistance resulted in faster ‘needle guidance skill’. It could be argued, looking at time in isolation, that manual guidance resulted in participants reaching peak performance very early in the study, with subsequent attempts showing no improvement in time-related metrics. It could therefore be argued that this manual ‘skill’ was mastered more rapidly and that the slope implies that individuals had already reached a plateau. Conversely, their learning of robot assistance may have been on the steep part of the curve and therefore more likely to demonstrate improvement in time-based metrics with repeated practice. It is plausible that aspects of learning robot assistance are more difficult. The two-dimensional display in the robot ‘cockpit’ limits cues used for depth perception and spatial orientation. There was also no accounting for the cognitive load of learning to control the robot arm remotely with a joystick, apart from a very brief 5 min demonstration. We would argue that ensuring appropriate procedural steps have been carried out without the occurrence of error is of much greater clinical significance.

There is no doubt that technology will continue to evolve to assist clinicians with procedural skills. Nerve localisation technology using bioimpedance, optical spectroscopy, and needle guidance using three-dimensional positioning systems (Sonix GPS; Esato) are under evaluation in both experimental and clinical settings. Technological integration into procedural skills in anaesthesia must (1) solve a real and appropriately characterised clinical need, (2) be based on a valid description of the procedure, (3) lessen the cognitive burden of the anaesthetist, (4) improve procedure-related outcomes, and (5) not adversely affect patient outcome. Perhaps robotics may have a future role in assisting anaesthetists to perform USgPNB. We urge those invested in this field of investigation to apply the full rigours of investigative science to appropriately evaluate these new and potentially game-changing devices.

Declaration of interest

None declared.

References

Are the obese difficult to intubate?

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Editor—I read with interest the study of Dixit and colleagues1 regarding difficult intubation in the obese population. While providing information on an at-risk patient group, I feel the authors have inadvertently highlighted some important points.

1. Persistent intubation attempts: the incidence of three or more attempts at intubation was 2.7% (3.2% of 93 obese patients (3 patients) and 1.9% of 54 superobese patients (1 patient)). In this case, one has to question why the study protocol allowed persistent intubation attempts (three or more) with, among other complications, the potential to cause airway oedema. This is all the more important in light of the fact that all patients were obese to varying degrees and therefore already had a risk factor for difficult bag mask ventilation. Many reports2 3 have highlighted the risk of repeated intubation attempts and an increased rate of airway complications.

2. Lack of a backup plan. While most patients were intubated in less than three attempts, in those that weren’t, what does three or more mean? It would seem sensible in a clinical trial at this point to opt for a backup plan, i.e. fibre-optic intubation through a laryngeal mask airway, or waking the patient up, after all, this was an elective procedure. Backup plans, and the utilisation of algorithms such as the Difficult Airway Society algorithm,4 should be part of everyday practice, and persistent attempts using the same method are unlikely to yield success.3 4

3. Optimal intubating conditions. While the mean time to intubation was 1.39 min, what was it for those that required three or more attempts at intubation? One would expect it to be longer (and if so by how much?), and was the muscle relaxation achieved from a single dose of suxamethonium still providing ideal intubating conditions at this time, potentially confounding the difficulty?

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References

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Perioperative management of severe anorexia nervosa

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Editor—we read with great interest the article by Hirose and colleagues1 on the perioperative management of severe anorexia nervosa. We have had some recent experience with a patient who presented to our intensive care unit with a BMI of <20 kg m⁻² and a long history of extreme restrictive dieting with excessive exercise and self-induced vomiting. Following admission with malaise and...