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Technical communication: A low-cost, high degree of difficulty model for simulation of ultrasound-guided nerve block

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Purpose: This paper examines a low-cost, high degree of difficulty model for the simulation of ultrasound-guided nerve block.

Background: Various models have been developed for simulating ultrasound-guided procedures. Ultrasound phantoms are available commercially. In addition, ultrasound phantoms can be made from readily available materials such as meat, agar, and gelatin. The target for needle placement in these models varies, such as an olive in a turkey breast, metal rod, various food items and surgical glove tips filled with saline, and penrose drains filled with fluid. These targets are often technically easy to image and therefore cannot adequately simulate difficult nerve blocks. In some situations the target for an ultrasound-guided nerve block may be best imaged in a very narrow and precise plane. Deviation from this narrow and precise plane may prevent simultaneous imaging of both the needle and the target. As a result, we sought to develop a simulation model for ultrasound-guided regional anesthesia with a very precise needling target which is difficult to keep in the ultrasound image.

Methods: Kilicaslan et al have described a feed-back based simulation model for ultrasound-guided regional anesthesia. Their model consists of a simple electrical circuit with a lighted buzzer. The electrical circuit is completed when a block needle touches the bare metal rod which has been inserted into a beef phantom. Because a bare metal rod is used, needle contact at any point on the rod can be viewed as successful by the trainee. During a real block, it is desirable to contact the target in the precise plane of the ultrasound image. When the rod is viewed in short axis, the target is very long. As such, it can be seen in a nearly infinite number of ultrasound planes. This situation differs markedly from some difficult ultrasound-guided blocks, where the target may only be seen within a narrow ultrasound window. A more difficult and clinically relevant model, can be produced by using a 4" 18 Ga insulated Tuohy continuous nerve block needle (Contiplex, B Braun) as the target. In our model, the ground wire of the insulated Tuohy needle was cut and connected to the positive terminal of a 9V lithium battery. The negative battery terminal was attached a 12 V DC mini buzzer (273-055 A RadioShack). The other wire from the mini buzzer was then connected to a 2" 22 Ga insulated block needle. This simple electrical circuit will produce an audible buzz only when the non-insulated tip of the 22 Ga needle enters the non-insulated tip of the 18 Ga Tuohy needle. Block needle contact on the insulated shaft will not complete the circuit. This Tuohy needle target can be placed in any type of ultrasound phantom, be it homemade or commercially available. The target is identified by imaging the tip of the Tuohy needle in cross-section or long-axis. In a long-axis view, the tip is easy to identify. In a cross-section view, the tip is indentified by scanning distally along the needle shaft until it disappears. The transducer is then moved slightly proximally along the needle shaft until it just reappears. Once the tip is visualized in the ultrasound image, the block needle can be placed in an in-plane or out-of-plane fashion. The goal is to continuously visualize the target while placing the block needle into the tip of the target Tuohy needle (as indicated by an audible buzz).

Discussion: We feel this model is sufficiently difficult that it can be used to simulate difficult nerve blocks. The model can be produced at a low cost with readily available materials and it is compatible with any type of ultrasound phantom. The target for needle placement in this model is very small and, as a result, can only be visualized within a narrow ultrasound window. With this model, it is technically challenging to keep the both the target and block needle in view during needle placement. In order to complete the task, the operator must be skilled.

Biography

Stephen Howell graduated Summa Cum Laude with a degree in biochemistry from Virginia Tech. He completed medical school and anesthesiology residency at West Virginia University where he is currently an Assistant Professor in the Department of Anesthesiology. He has extensive experience in ultrasound-guided regional anesthesia and serves as the Director of Regional Anesthesiology at Ruby Memorial Hospital in Morgantown, West Virginia.

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