Acta Anaesthesiologica Taiwanica 53 (2015) 1–6

Contents lists available at ScienceDirect

Acta Anaesthesiologica Taiwanica

journal homepage: www.e-aat.com

Original Article

Objective and subjective comparison of the visibility of three echogenic needles and a nonechogenic needle on older ultrasound devices

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ARTICLE INFO

Article history:
Received 16 July 2014
Received in revised form
29 November 2014
Accepted 11 December 2014

Key words:
echogenic needle;
needle visibility;
ultrasound-guided nerve block

ABSTRACT

Objective: This study evaluated the visibility of echogenic needles with older ultrasound devices in an *in vitro* phantom study.
Methods: We compared three echogenic needles from B. Braun (BB), Unisis (UN), and Hakko (HK) with a nonechogenic needle. Each needle was inserted into an ultrasound phantom 10 times at 30° and 45° with the bevels up. The captured images of the needle and background contrast were digitally analyzed, and the median of 10 insertions for each angle was calculated to determine objective needle visibility. Needle images were also shown to 12 anesthesiologists to evaluate subjective visibility on a five-point Likert scale.
Results: The shafts of all the echogenic needles were significantly more objectively visible than the nonechogenic needles. Subjective visibilities of the BB and UN needles were significantly higher than that of the nonechogenic needle. Therefore, the BB and UN needles were judged to have more than fair subjective visibility. However, subjective visibility of the HK needle was consistently and significantly lower than that of the BB and UN echogenic needles. At 45°, the HK needle had nearly the same poor visibility as the nonechogenic needle.
Conclusion: The results of our study indicate that the BB and UN needles are more visible than non-echogenic needles in an ultrasound phantom, even on older devices.

Conflicts of interest: This work is from Kawaguchi Municipal Medical Center. The following support was not given on our behalf and did not affect our work. Therefore, although it may not be necessary to report these measures of support, they are being listed because there was no conviction. *Kiyotaka Nakagawa, Tomohide Kamiya, Sonoo Akiyama*: The Jikei University School of Medicine Department of Anesthesiology has not directly received money from B. Braun Aesculap Japan (Tokyo, Japan). The company supported the Jikei departmental workshop, which involved demonstration of ultrasound-guided nerve blocks twice in a 3-year period, by inviting and paying for the speaker and providing staff and nerve simulators. *Kazuo Arakawa, Katsuhiro Sakai*: In 2011, Department of Anesthesiology, the Nihon University School of Medicine, received a scholarship donation from B. Braun Aesculap Japan (Tokyo, Japan). This donation was not received for this work and was not given on our behalf. We belong to the department as part-time clinical associates and are employed full time at Kawaguchi Municipal Medical Center on behalf of the department. This work was supported by Kawaguchi Municipal Medical Center. Twelve anesthesiologists took part in our questionnaire survey. Neither they nor their close relatives received payment or service from a third party for any aspect of the submitted work. They have no financial relationships with any entities in the biomedical arena that could have been perceived to potentially influence the content of our submitted work. However, their institution (Department of Anesthesiology, Jikei University School of Medicine) has an association with the company, as mentioned above. As this support was not given on their behalf and did not affect our work, there are no conflicts of interest.

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http://dx.doi.org/10.1016/j.aat.2014.11.004

1. Introduction

Many echogenic needles, with a variety of textured needle surfaces designed to reflect the ultrasound waves back to the transducer, are available. We investigated whether echogenic needles maintain their high visibility when visualized with older ultrasonic devices.

Ultrasound guidance can significantly improve nerve block quality and help avoid complications associated with traditional nerve block procedures that are performed in a blinded manner and depend on surface anatomic landmarks or electrical stimulation.[1] It enables an anesthesiologist to accurately position the needle in the target nerves and surrounding tissue in real time. Recent advances in ultrasound devices are thought to have made ultrasound-guided nerve blocks safer because of the ability to obtain high-quality images. However, the newer ultrasound devices are prohibitively expensive for many institutions, and older devices are still used in many blockade procedures. As older devices produce grainy images, they cannot fully achieve the safety and reliability that are possible to attain in ultrasound-guided nerve block procedures when newer technology is employed. However, these shortcomings can be overcome by the use of an echogenic needle with high visibility.

There have been some studies on echogenic needle visibility,[2–7] but little has been reported from the viewpoint of their use with older ultrasonic devices. In this study, we investigated whether echogenic needles objectively and subjectively have better visibility than nonechogenic needles when used in older ultrasound devices.

2. Methods

2.1. Ultrasound device

Imaging was performed with an older portable all-purpose ultrasound device, the LOGIQ Book Xp (R2.1.2), which was manufactured in 2005, and a linear probe (8L-RS) that attached the needle guide bracket (H78162P) (GE Healthcare Clinical Systems, Wauwatosa, WI, USA). The ultrasonic conditions were for preset small parts and were not optimized. The preset conditions were as follows: frequency, 10 MHz; depth, 40 mm; gain, 62; and acoustic output, 100%. The focus was set at one point at 36 mm. All time-gain-compensation sliders were fixed at the center position.

2.2. Study needles

The following echogenic needles (22-gauge) are widely available in Japan (Fig. 1): Stimuplex Ultra (B. Braun, Melsungen, Germany), hereafter referred to as the BB needle; the Uniever echogenic neural blockade needle (Unisis Corporation, Tokyo, Japan), referred to as the UN needle; and the Sonolect Needle USG (ultrasound guide) type CCR (corner cube reflector) (Hakko Co., Ltd, Nagano, Japan), referred to as the HK needle.

The nonechogenic needle was a 22-gauge neural blockade needle from Hakko Co., Ltd with a stylet. Only the nonechogenic needle had a stylet. We used the same conditions as those employed for clinical use. Only the BB needle was insulated.

2.3. Ultrasonic phantom

An ultrasonic phantom was specially made to strictly mimic the acoustic properties of soft tissue (OST, Chiba, Japan). The phantom properties were as follows: 1.6×10^6 kg/m^2 s acoustic impedance, 0.4 dB/cm/MHz attenuation coefficient, 1540 m/s ultrasonic velocity, 10 kPa hardness (Young's modulus), and $140 \times 100 \times 100$ mm^3 rectangular parallelepiped, prepared with a high-polymer hydrogel.[8–10]

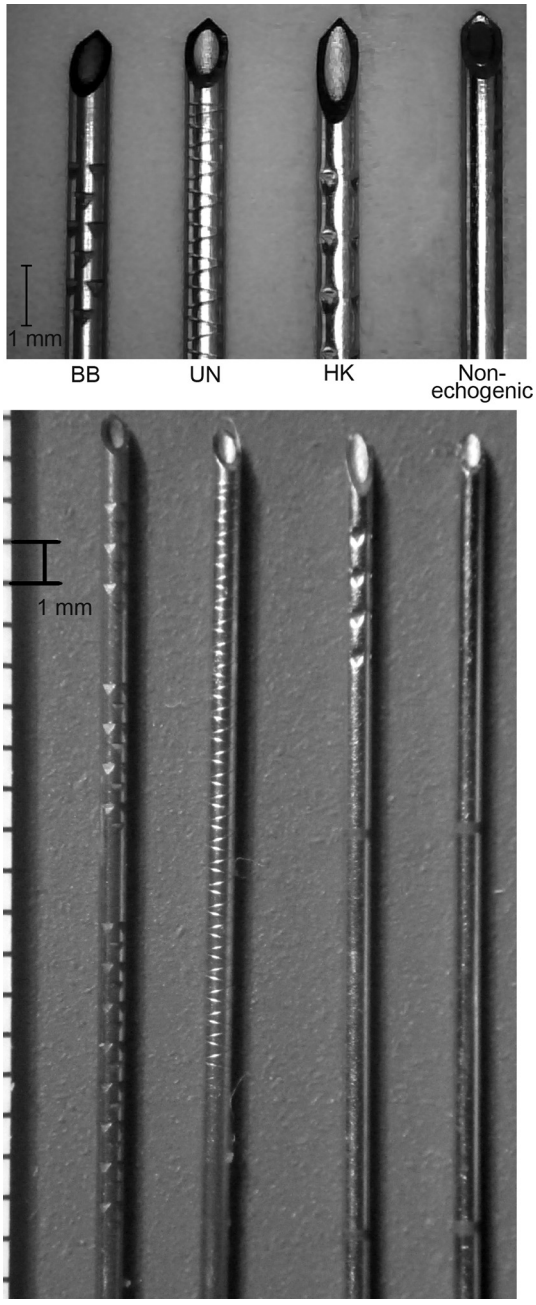

Fig. 1. Microscopic images of the four needlepoints. The insulated coating of the BB needle was exfoliated by burning. Each echogenic needle had a surface notch: a triangle pattern edging in the BB needle, an engraving in the UN needle, and a CCR in the HK needle. The notches strongly reflected the ultrasound beams. Lengths of the echogenic regions of the BB, UN, and HK needles were approximately 18 mm, 15 mm, and 4 mm, respectively. The echogenic portion of the BB needle was spaced, while those of the UN and HK needles were continuous. The region 1–2 mm from the needlepoints of the echogenic needles contained nonechogenic portions. Only the nonechogenic needle had a stylet. This image was edited to clarify all needle surfaces. BB = B. Braun; CCR = corner cube reflector; HK = Hakko; UN = Unisis.

2.4. Objective visibility

For the needle guide setting at a shallow 30° insertion angle against the phantom surface, the needles were inserted to a depth