Micro Air Bubble in Psoas Muscle

Is It Psoas Muscle Abscess or Nerve Block?

To the Editor:

In a recent issue of the journal, Liu and Mei reported the efficacy of using micro air bubbles for the visualization of needle tips in ultrasound-guided peripheral nerve blocks, especially those located deep inside the body trunk, such as lumbar plexus block.[1] At first glance, the air bubble appears to provide an alternative for normal saline in the hydrolocalization technique.[2] Visualizing needle tips deep inside the body with an ultrasound probe with lower frequency apparently requires a relatively large amount of liquid. In this respect, the technique described by Liu and Mei appears to be superior to the original one.

The lumbar plexus, after the formation from the ventral rami with L1–L4 together with the additional branches from Th12 and L5, runs between the quadrates lumborum muscle and the psoas major muscle, which forms the psoas compartment. During the placement of a catheter into the psoas compartment, bacterial colonization of the catheter may occur, and its frequency is relatively high.[3] The catheter would provide microbial pathogens direct access to these nerve trunks from the skin surface. Once the infection is established, the microbial pathogens, mostly *Staphylococcus aureus* and *Staphylococcus epidermidis*,[4] being bridged by the nerve trunks of the lumbar plexus, spread into the intervertebral space. The intervertebral discs are avascular and are particularly vulnerable to the direct microbial invasion, providing further bacterial access to the adjacent vertebral body and epidural space. Thus, although rarely recognized, catheterization to the lumbar plexus is carried out at the risk of spinal infections. The early signs and symptoms of the infections are nonspecific, and low back pain is usually the first sign that the patient as well as the anesthesiologist would notice. In the case of continuous lumbar plexus block, however, these early signs are "blocked" by the local anesthetic(s), which makes the clinical diagnosis of the infection difficult.[5] The presence of a micro air bubble in the psoas muscle would be the first sign that anesthesiologists as well as radiologists would notice the presence of infection. Hence, the routine use of micro air bubble contrast in ultrasound-guided lumbar plexus block makes the clinical diagnosis of psoas muscle abscess and the subsequent development of pyogenic spondylodiscitis difficult.

Competing Interests

The author declares no competing interests.

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In Reply:

We appreciate Dr. Asakura for his interest in our recent article titled "Enhanced Needle Visibility by Micro Air Bubble in Ultrasound-guided Nerve Block"[1] published in Anesthesiology this year.

A variety of techniques, including use of an echogenic needle or needle guide apparatus, optical flow-based tracking, and image-based tracking of a needle, have been used for improving visualization, which is paramount in ultrasound-guided nerve block. In our clinical practice, we have found that needle visibility can be enhanced by introducing microbubbles into the needles. Our experiences may suggest the potential clinical application of this technique in improving ultrasound-guided nerve block.

Dr. Asakura raises the concern that introducing micro air bubbles into the psoas muscle may interfere with the diagnosis of psoas muscle abscess or pyogenic spondylodiscitis, given that micro air bubbles generated by

Staphylococcus aureus or *Staphylococcus epidermidis* are an early sign of pyogenic spondylodiscitis.[2]

We did consider this concern. In our unpublished data from an *in vitro* study, we have compared three different techniques, including negative pressure technique, mixing technique, and commercialized microbubbles, in generating ultrasound visible microbubbles in the needle. Among these three techniques, the negative pressure technique shows the highest success rate of introducing ultrasound visible microbubbles into the needle. In this technique, a 10-ml syringe is connected to a needle and then primed with 5 ml of normal saline. After introducing the needle into the subcutaneous tissue, 2 ml of saline is injected. The plunger is then pulled back 2 to 5 ml for about 10 s to generate a negative pressure (about −307 to −596 mmHg). Ultrasound visible micro vacuum bubbles will be generated in the needle by the negative pressure. These vacuum bubbles will disappear once negative pressure is released. Theoretically, no air will be introduced into the tissue. If the micro vacuum bubbles have been introduced into the tissue, it is important to clarify how long the microbubbles will be present in the tissue. Small bubbles have been found in hip-joint trauma[3] and strenuous physical exercise,[4] which is called "vacuum phenomenon" resulting from release of nitrogen due to the reduced pressure. These small bubbles can present for 180 min to 48 h.[3,4] We believe that the microbubbles, produced by our negative pressure technique, will be present for a very limited time. It is unlikely to interfere with the diagnosis of psoas muscle abscess and the subsequent pyogenic spondylodiscitis. Another possibility is to generate microbubbles with carbon dioxide, which can be absorbed quickly in soft tissues. Many practitioners still use the technique of loss of resistance to air during epidural anesthesia. To the best of our knowledge, there has been no report showing any significant adverse outcome with injection of small amounts of air into epidural space. Injection of large amounts of air, however, should be avoided.

Introduction of the microbubble-filled needle is a promising needle enhancement technique for ultrasound-guided nerve block in clinical practice. The advantages and limitations of this technique will need to be investigated further.

Competing Interests

The authors declare no competing interests.

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