A Simple Phantom for Training in Ultrasound-guided Needle Biopsy Using the Freehand Technique

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Since 1982, we have been using conventional linear array transducers and a simple freehand technique not only for ultrasound-guided biopsy of abdominal masses, but also for superficial soft tissues including thyroid, breast, muscle, and subcutaneous tissues.[1-4] The major difficulty is that some expertise is necessary because the success of the procedure requires coordination of the operator's left hand that holds the transducer and his right hand that inserts the needle. A simple phantom that allows beginners to practice freehand, real-time, ultrasound-guided needle biopsy is presented.

MATERIAL AND METHOD

A container of approximately 20 × 15 × 10 cm is chosen with transparent or opaque walls, depending on whether or not the simulated lesions should be seen by the trainee. A jelly is then prepared with commercially available gel. A dark-colored jelly can also be used if the lesions are not to be seen. When the gel becomes viscid, a selection of objects destined to mimic soft tissue lesions are inserted into the jelly at various locations and depths. Any tissue-mimicking material can be used, such as the water-filled fingertips of surgical gloves, grapes, and glycerine suppositories. The jelly is placed overnight in the refrigerator and is then ready for use.

The probe is placed at the surface of the jelly; no acoustic couplant is needed. The beginner can select any target object and practice with the freehand technique.

Two techniques are available. In the first, the needle is inserted tangential to the transducer with an obliquity that is determined by the depth of the lesion; the more superficial the lesion, the more oblique the needle (Fig. 1A). When the needle has reached the scan plane, the tip appears as a bright echo (Fig. 1B). In the second technique, the needle is inserted obliquely from one end of the transducer in the direction of the scan plane (Fig. 2A). The distal portion of the needle is included in the field of view and is seen as an echogenic line (Fig. 2B).

DISCUSSION

Dedicated needle guides that fit sector-type transducers and linear array biopsy transducers are available from most manufacturers. These devices are costly and need to be sterilized between procedures. The major disadvantage is that such equipment does not allow reorientation of a fine needle that has deviated from its theoretic path. The freehand technique permits any alteration in the orientation of the biopsy needle as required under real-time monitoring.[5-7] In our experience, this has proved essential for accurate placement of the needle in minute targets and also to augment the sampling volume

Received January 20, 1989, from the Department of Diagnostic Radiology, University of Texas MD Anderson Cancer Center, Houston, Texas. Revised manuscript accepted for publication April 3, 1989.

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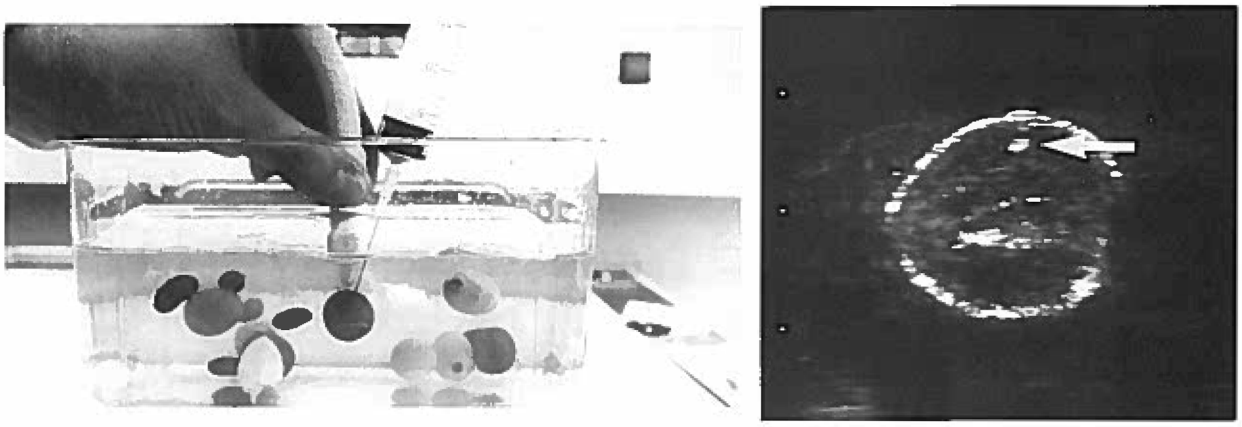

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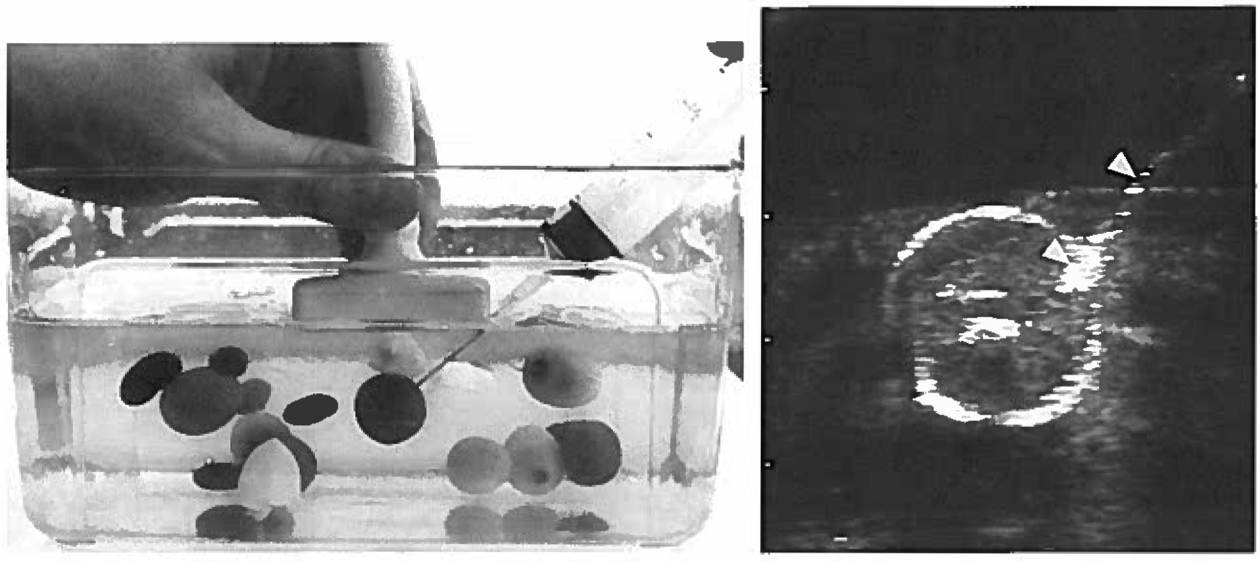
Figure 1 Ultrasound-guided puncture of a grape: First technique. **A,** On-edge view of the 7.5-MHz linear array probe placed at the surface of the phantom. The needle has been inserted tangential to the transducer and oblique to the scan plane in direction of the grape. **B,** Sonogram obtained during the procedure shows the needle tip *(arrow)* within the grape.

through fan-like needle passes within the mass. Many high-frequency transducers do not have a needle guiding system and in such a case the freehand technique is the only available technique for ultrasound-guided fine-needle biopsy of superficial soft tissues.[1,3–5]

The phantom described herein is simple and quickly made at virtually no cost. Pitfalls in visualizing the needle tip can be simulated and explained. With the technique using the tangential insertion of the needle oblique to the scan plane, a certain degree of experience is needed to determine the obliquity of the needle required for its tip to reach the scan plane and therefore become apparent on the screen precisely at the level of the lesion. This is best obtained using this phantom.

Figure 2 Ultrasound-guided puncture of a grape: Second technique. **A,** Frontal view of the 7.5-MHz probe shows the needle inserted obliquely from the end of the transducer within the scan plane. **B,** Sonogram obtained during the procedure shows the distal echogenic portion of the needle *(arrowheads)* penetrating the grape.



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Obviously, parameters such as the variable resistance of human tissues to the progression of the needle cannot be reproduced with this device.

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