AN EASILY MADE ULTRASOUND BIOPSY PHANTOM

To the Editor:—The performance of ultrasonically guided interventional procedures requires skill. It is not sufficient to be familiar with ultrasonic imaging. The different biopsy needles require different manipulations, which take some time to learn. To practice biopsies on corpses is not convenient, and there may be problems with gas development impairing image quality. Biopsy phantoms are commercially available, but expensive. This paper describes an easily made and cheap biopsy phantom.

PROCEDURE

The bulk substance is made of agar, which is boiled for half an hour. Concentrations from ½ to 3 per cent have been tried; 2.5 per cent was found optimal. It gives a reasonably rigid structure for the biopsy purpose. To regulate the sound velocity, a wide range of different substances may be used: ethanol, 1-N propanol, 1-3 butanediol, ethyleneglycol and glycerol were tried. The first two were dropped because of their low boiling point. Ethyleneglycol, purchased at an autoshop, where it is sold as antifreeze, has the advantage that it is toxic and thereby—to some extent, at least—prevents growth in the agar. Glycerol, however, is the most convenient to work with. An 8 per cent solution gives a sound velocity of 1537 m/sec, which is appropriate. A wide range of different inorganic particles were tried as scattering particles and for attenuation regulation: graphite, carbon, chalk, talc, and various grinding powders. The easiest way to attain a homogenous scattering was with a grinding powder—silicium carbide—with a well-defined particle size of 8–12 μ. A 5 per cent concentration of this powder was boiled with the agar. With this particle size and concentration, the attenuation is close to 0.4 db/MHz measured at 4 MHz—which is a little less than for the in vivo liver. By chosing a smaller particle size, i.e., 6–8 μ, a phantom can be made with similar attenuation, but almost no backscattering (fig. 1). The particle sizes can be mixed freely. If ethyleneglycol or other toxic substances are not used, benzoic acid may be added to prevent growth. After boiling the substance it was stirred continuously until a temperature of 37°C was reached. At this temperature it was poured into the container. When the gelatination was over, the substance was taken out of the container and holes were cut in it at various depths and sizes. These holes were filled with agar solution containing scattering particles of another color and another concentration (fig. 2). When the targets were gelatinized the substance was replaced in its container. A top layer was made using a gauze swab boiled in the agar solution. This mimics the abdominal wall by defocusing the ultra-

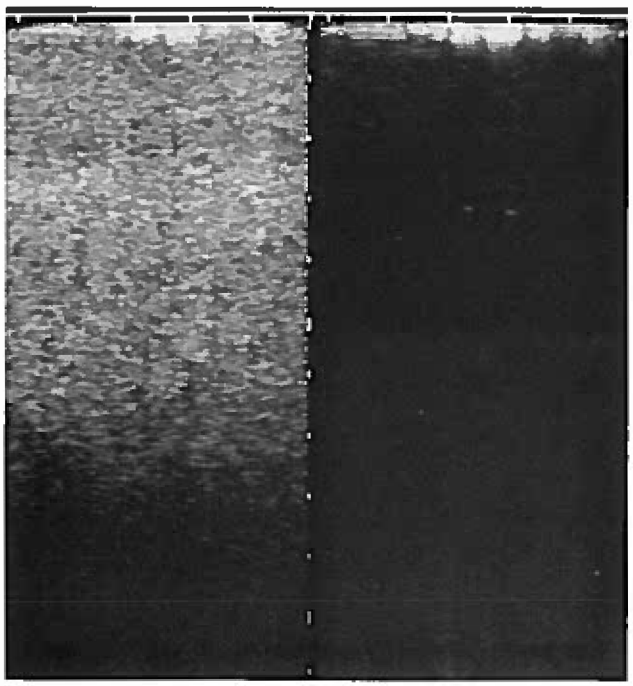


Figure 1 (*left*). A 5-MHz picture of two different bulk substances with the same gain settings. To the left 8- to 12-μ particles are used, to the right 6- to 8-μ particles are used. The attenuations of the two substances are equal.

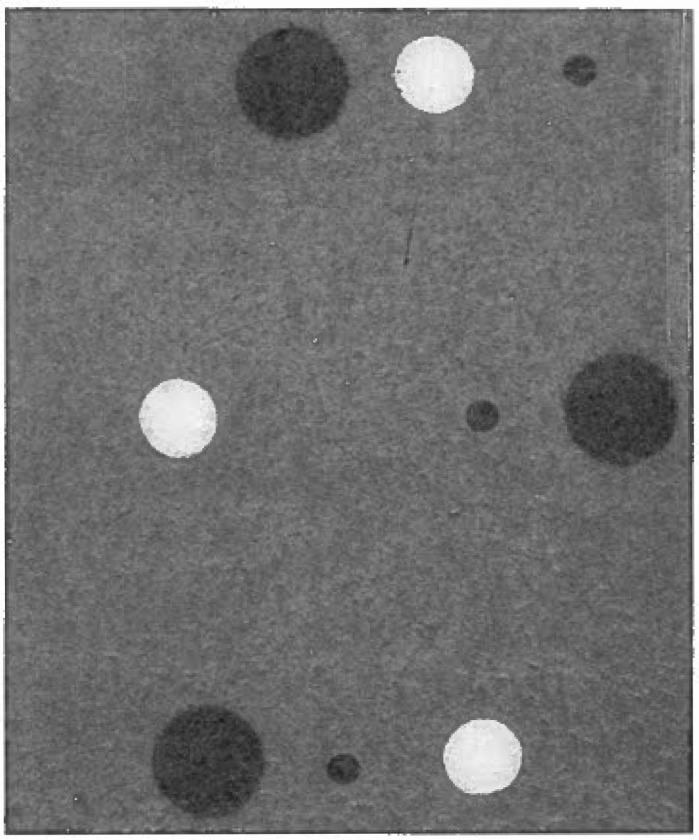
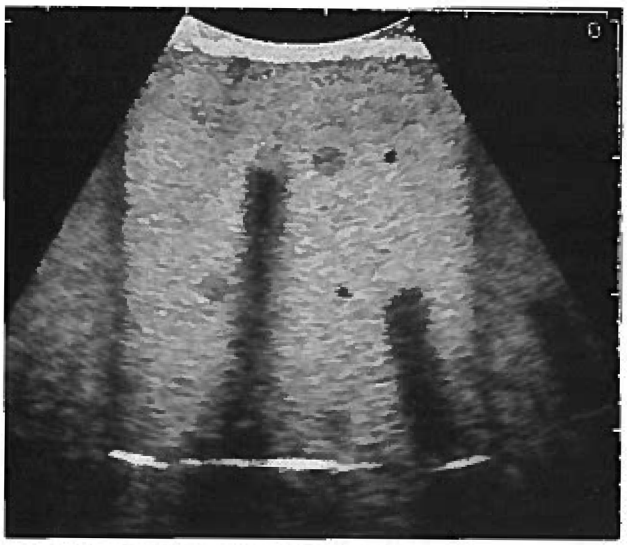
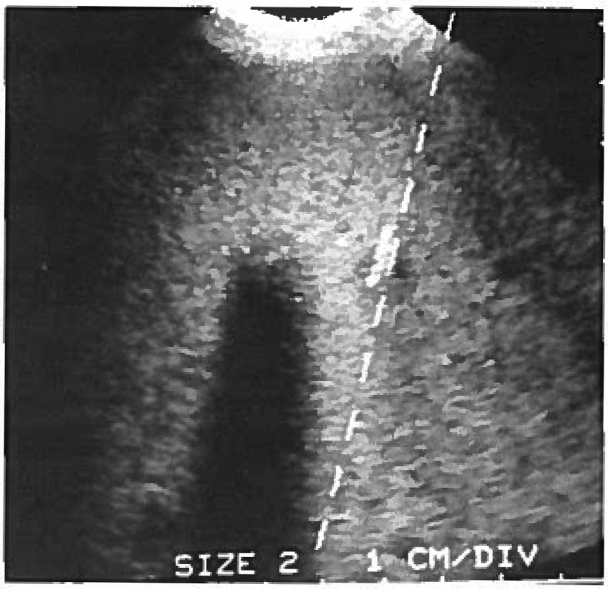


Figure 2 (*right*). A cut surface of the biopsy phantom.





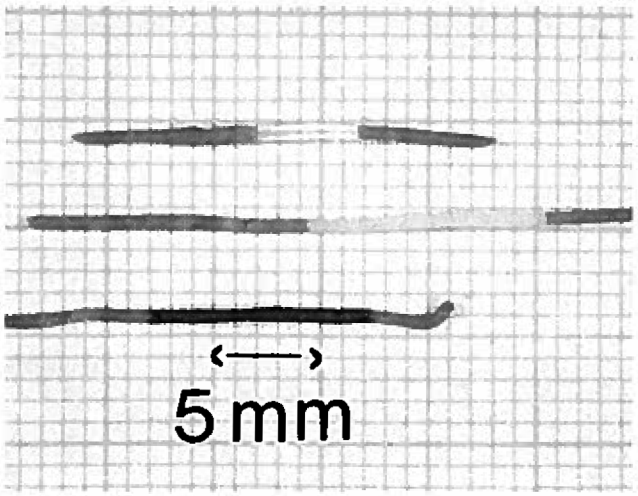


Figure 3 (*top left*). An ultrasound image of the biopsy phantom. Three different lesions are placed at three different distances from the "abdominal wall."

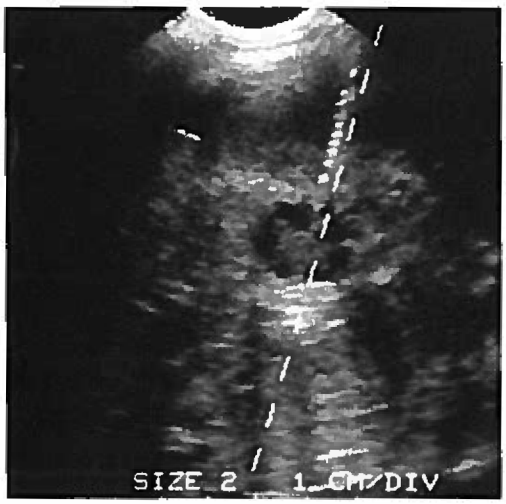
Figure 4 (*top right*). A biopsy needle is seen traversing one of the lesions.

Figure 5 (*left*). The results of three biopsies. Notice that the lesions have a different color from the surroundings.

sound beam. Furthermore, the biopsy needle will be steered by the gauze, thereby preventing the phantom from being cut by the needle like cheese is cut by a string, thereby increasing the lifetime of the phantom.

USE

When biopsies are taken from this phantom it is possible to see by the color of the biopsy whether the lesion



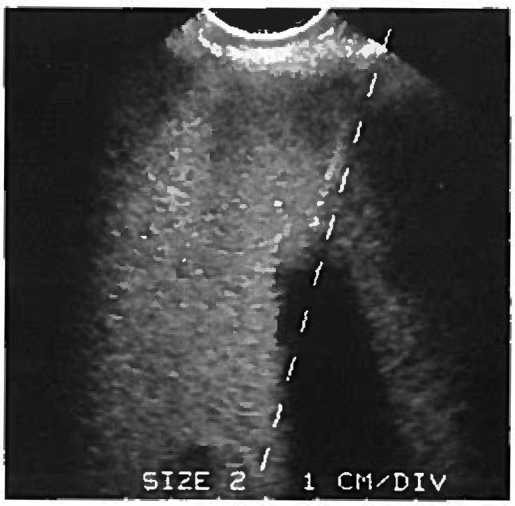


Figure 6. A biopsy needle in the liver (*left*) and a biopsy needle in the phantom (*right*). The gain of the scanner has been reduced 10 db on the right.

is hit (figs. 3–5). When not in use the lid must be replaced on the container so as to prevent evaporation. Storage in the refrigerator will reduce fungal growth. Even when antifreeze is used the phantom does not tolerate freezing.

DISCUSSION

When 8- to 12-μ particles are used, and the concentration of these scattering particles is regulated to give an attenuation similar to the liver, the echogenicity of the phantom is found to be much higher than the echogenicity of the liver. The implication of this is that it is much more difficult to see the needle in the phantom than in a liver (fig. 6). For the training situation, this is an advantage.—KNUD-ERIK FREDFELDT, MD, *Department of Ultrasound, Herlev Hospital, University of Copenhagen, Herlev, Denmark.*

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