An Inexpensive and Easy Ultrasound Phantom

A Novel Use for SPAM

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Ultrasound models, commonly referred to as "phantoms," are simulation tools for ultrasound education. Commercially produced phantoms are available, but there are "homemade" alternatives such as raw poultry and gelatin molds. Precooked, processed meat, better known as SPAM (Hormel Foods Corporation, Austin, MN), can be used as an ultrasound phantom to teach several ultrasound applications. It is a versatile, hygienic, and easily manipulated medium that does not require refrigeration or preparatory work and can be easily discarded at the end of use.

Key Words—abscess; homemade ultrasound phantom; foreign bodies; medical education; simulation; ultrasound; vascular access

Ultrasound phantoms are used as simulation education tools for repeated practice of ultrasound-related skills, including the location of embedded foreign bodies, identifying abscesses, and practicing ultrasound-guided vascular access. Although durable, commercially available phantoms can cost hundreds to thousands of dollars.

Alternatives to commercial phantoms include a variety of materials, including poultry, pork, tofu, and gelatin. Raw poultry and pork may carry potential dangerous bacteria, including Salmonella and Campylobacter. Raw meat and tofu require refrigeration, which will limit the location and length of their use.

Gelatin phantoms entail labor-intense preparations involving multiple ingredients. Although the gel models do not generally carry the hygienic risks of raw poultry, they also require refrigeration. Gelatin phantoms can be reused but generally have a short shelf life that can be extended only with preservatives such as formalin. Repetitive use of gelatin models for ultrasound-guided procedures also creates artifacts when air is injected into the gel along the track of the needle.[1]

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SPAM (Hormel Foods Corporation, Austin, MN) is a well-known food product composed of precooked, processed meat that is available in most grocery stores in the United States. The average cost is less than $3.00, and it is a simple and inexpensive option as an ultrasound phantom. SPAM requires no additional time to prepare for use, does not need refrigeration, and theoretically has an indefinite shelf life. According to the Hormel website, "The product is always safe to consume as long as the seal has remained intact, unbroken, and securely attached." An obvious limitation of SPAM is that it cannot be reused at the end of a simulation exercise. It can, however, be easily discarded.

Materials and Methods

We describe 3 uses for the SPAM phantom to facilitate clinical ultrasound training for commonly performed studies in the emergency department and other clinical settings: detection of foreign bodies, diagnosis of abscesses, and ultrasound-guided vascular access.

Foreign Body Detection and Removal

The detection of foreign bodies can be extremely challenging. Ultrasound offers clinicians real-time localization of foreign bodies and yields diagnostic information regarding an associated abscess.[2] Ultrasound-guided foreign body removal reduces the procedural time and associated morbidity and improves the time to detection and procedural outcomes.[3]

With a scalpel, a small incision is made into a side of the SPAM block (Figure 1). Through this incision, a variety of objects, most of which are readily available in most clinical settings, can be inserted into the phantom. Needles, wood splinters from tongue depressors, sticks from cotton swabs, gravel, and pieces of plastic and glass are some examples. The general nature of SPAM allows the surface to "self-seal" at the incision site by smoothing the surface with your fingers. By using the sides of the SPAM block, the top remains an unblemished surface for the ultrasound examination. Figures 2–4 show the appearance of radiopaque objects on sonography. Because SPAM is a solid block, it holds up well in a water bath (Figure 5).

Both static and dynamic methods for the removal of the objects can be practiced (Figure 6). With the static method, the trainee uses a static image to estimate the depth of the foreign body, and then it is removed without direct visualization of the object by ultrasound. With the dynamic method, the trainee directly visualizes the removal of the foreign body with ultrasound during the procedure.

Figure 1. Make a small incision on the side of the SPAM block to insert foreign bodies.

Figure 2. Sonogram of a wood splinter in SPAM.

Figure 3. Sonogram of glass in SPAM.

Diagnosis of Abscesses

Soft tissue infections are very common in nearly every clinical setting. Using only physical examination, the ability to differentiate cellulitis versus an abscess is inaccurate. Sonography has been shown to be superior to clinical judgment alone in identifying occult abscesses and has changed management in approximately half of patients with cellulitis.[4]

Often preparation of the SPAM phantom as an abscess model is not required. Glutinous areas of approximately 1 cm in size are typically found throughout a block of SPAM and have the appearance of a fluid-filled abscess on sonography. For a larger simulated abscess, an incision can be made into the block, and a small area of the SPAM can be removed. The cavity can then be filled with a variety of liquid materials, but usually just ultrasound gel is suitable for the desired effect (Figure 7).

Ultrasound-Guided Vascular Access

Ultrasound-assisted vascular access has been extensively investigated and is listed as a "primary emergency ultrasound application" in the emergency medicine guidelines of the American College of Emergency Physicians.[5] To simulate vasculature in a block of SPAM, a large drinking straw is used to tunnel through the entire block (Figure 8). A finger from an examination glove is filled with water and tied off with a silk suture (Figure 9). Care should be taken to remove all air before it is sealed. The water-filled glove finger is than inserted into the tunnel created in the SPAM block. Pulling it through the tunnel by the tail of the suture will facilitate this process. The fluid-filled balloon is easily visualized in the body of the SPAM block and can be used to practice ultrasound-guided vascular access.

Figure 4. Sonogram of a nail in SPAM.

Figure 5. SPAM in a water bath.

Figure 6. Student using the dynamic approach to remove a foreign object with ultrasound guidance.

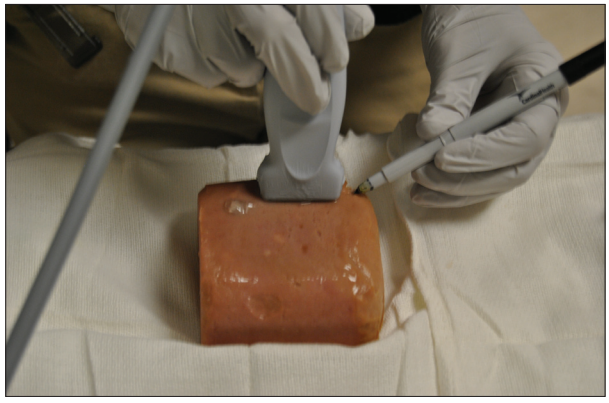
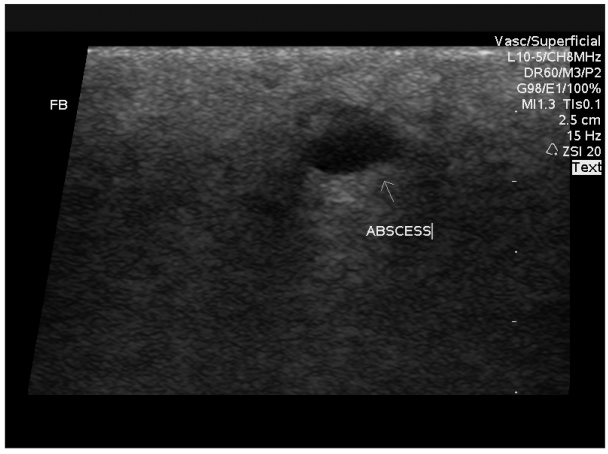


Figure 7. Abscess model made from SPAM.



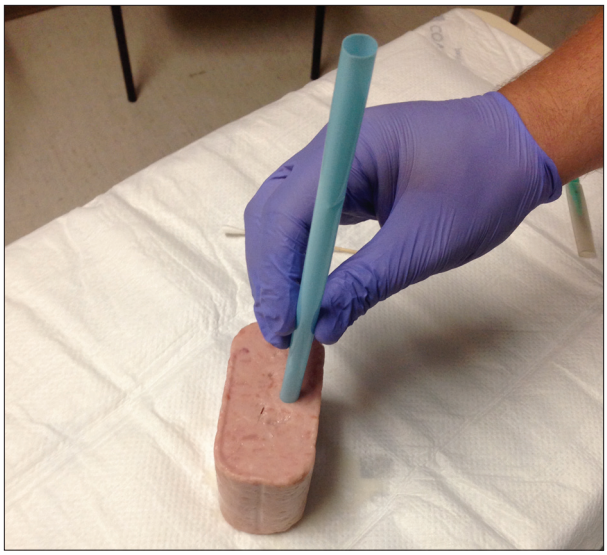


Figure 8. Use a drinking straw to core out a linear tract to simulate a blood vessel.

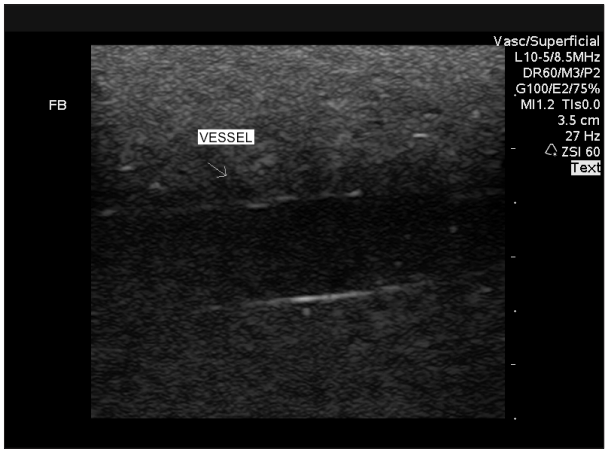


Figure 9. Sonogram of a simulated vessel in SPAM.

Another method is to core out a tunnel and plug one end with the removed remnants. The plugged end of the SPAM is then directed downward, and the tunnel is filled with ultrasound gel. We use a syringe with an intravenous catheter to inject the gel into the block to minimize air pockets (Figure 10). This procedure is a very fast technique that still produces an adequate "fluid-filled" vessel on sonography.

Discussion

Although SPAM is an excellent ultrasound model, it does not have the same consistency as human tissue. It does not cut or possess the same tactile sensation when performing incision and drainage or retrieving foreign bodies as human tissue. SPAM comes in many different varieties, such as Bacon SPAM and Jalapeno SPAM. However, it is unclear whether these SPAM products can be used for the applications discussed in this article or for other examination simulations.

In summary, we believe that SPAM provides a reliable, safe, cost-effective, sanitary, and easy-to-prepare alternative to previously used simulation models.

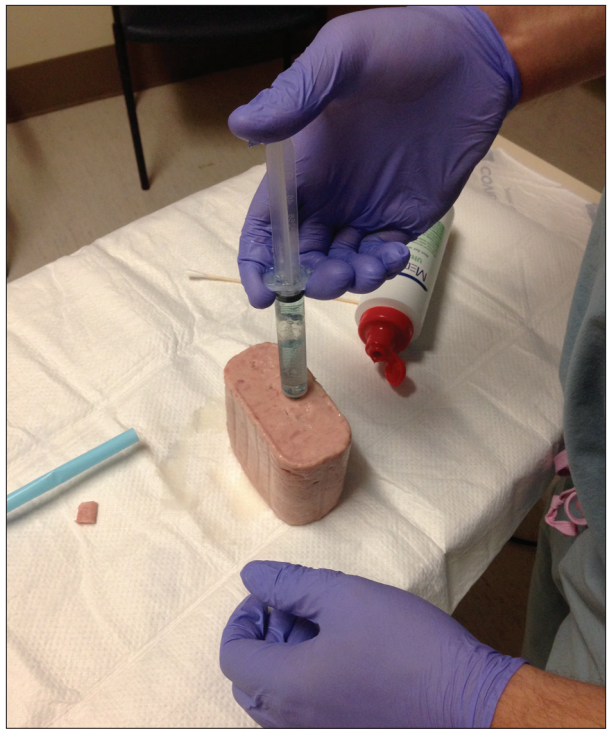


Figure 10. Use a syringe filled with ultrasound gel to fill the tract to simulate vasculature.

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