

Techniques and Procedures



A READILY AVAILABLE, INEXPENSIVE, AND REUSABLE SIMULATION MODEL FOR TEACHING ULTRASOUND-GUIDED ABSCESS IDENTIFICATION AND DRAINAGE

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Abstract—Background: The use of point-of-care ultrasonography as a noninvasive diagnostic tool for soft tissue infections has been shown to be superior to clinical judgment alone in determining the presence or absence of an occult abscess. As ultrasound-guided procedures become standard of care, there is an increasing demand to develop better and inexpensive simulation models to educate trainees. To date, there are no low-cost models for abscess simulation that can be constructed with minimal preparation time, be reused, and withstand multiple procedural attempts. **Objective:** To create an inexpensive, readily available, and reusable homemade ultrasound phantom that simulates a superficial soft tissue abscess and can be easily constructed. **Discussion:** We experimented with precooked polenta to create a model that would appear similar to human soft tissue under ultrasound examination. Paintballs were embedded in the polenta and evaluated at different depths until a sonographically satisfactory phantom abscess model was obtained. The use of a precooked commercial polenta phantom and commercial paintballs required minimal preparation and closely replicated a superficial soft tissue abscess on ultrasonographic examination. Various paintball brands and sizes were evaluated to confirm ease of reproducibility. The polenta can be reshaped easily and the model may be punctured or incised multiple times. **Conclusion:** A homemade high-fidelity simulation phantom that simulates an abscess in superficial soft tissue can be made inexpensively in <5 min and reused for numerous

trainees. This model allows for training for procedures such as ultrasound-guided abscess drainage. Published by Elsevier Inc.

Keywords—ultrasound; pediatrics/pediatric emergency medicine; soft tissue infection; education; simulation

INTRODUCTION

The use of ultrasound simulation models for the education of health care providers has been shown to improve diagnostic accuracy and patient safety during procedures (1–3). Utilizing point-of-care ultrasonography (POCUS) as a noninvasive diagnostic tool of soft tissue infections has been shown to be superior to clinical judgment alone in determining the presence or absence of an occult abscess (4). As ultrasound-guided procedures become standard of care, there is an increasing demand to develop authentic simulation models to educate trainees and improve provider competency during live-patient procedures.

Previous homemade ultrasound phantoms described in the literature require refrigeration and 12- to 24-h preparation prior to use (5–7). To date, there are no low-cost models for abscess simulation that can be constructed with minimal preparation time, be reused, and withstand multiple procedural attempts. Additionally, although various homemade

soft tissue phantoms have been described, previous models have cited limitations in simulating a realistic and reproducible abscess within the phantom (7).

Given the importance of POCUS simulation training and the paucity of readily available and reusable abscess models for educational instruction, we developed an ultrasound model that allows the physician to identify and measure a simulated abscess, insert a needle under ultrasound guidance, and drain the fluid collection. This model can be quickly constructed in < 5 min. Refrigeration is not required. Our model is reusable and can withstand multiple needle punctures.

Phantom Development

We experimented with precooked polenta and various materials as skin dressing to find a model that would appear similar to soft tissue under ultrasound and could withstand the pressure from the ultrasound probe. Polenta is a paste or dough made from cornmeal and typically used for cooking. Paintballs were embedded in the polenta and evaluated at different depths until a sonographically satisfactory phantom abscess model was obtained. Various paintball brands and sizes were evaluated to determine ease of reproducibility. A Sonosite M-Turbo (Bothell, Washington) bedside ultrasound machine with an L25x/13-6 MHz linear array transducer probe was used to scan the homemade phantom model. Images were electronically captured. The method for assembling this phantom model is described below.

The Materials Required for Creation of the Model Include

1. Gelatin-shelled paintballs (available in 0.5, 0.68, or 0.71 caliber)—we preferred JT SplatMaster (Neosho, MO) Paintball Ammo 100-Count Orange 0.5-caliber for \$8.99
2. Precooked and ready-to-serve polenta 18 oz—we used San Gennaro Foods Inc. (Kent, WA) polenta, 18 oz, \$2.79
3. 20 mL water
4. Kidney basin
5. Plastic wrap
6. 18-gauge 1.5-inch needle with 5-mL syringe (optional for needle-guided aspiration)
7. Large plastic basin or mixing bowl

Method for Creation of the Superficial Soft Tissue Model

Step 1: Remove the polenta from the packaging and place into a large plastic basin.

Step 2: Break up the polenta manually until a smooth uniform consistency is achieved.

Step 3: Add 20 mL of water to the polenta and incorporate it by hand. The ideal phantom is formed when the polenta has a dough-like pliable consistency and maintains its form when molded. This consistency is important for creating a model with limited acoustic shadowing. The volume of water needed to reach this consistency may vary, depending on the brand of polenta used.

Step 4: Transfer the polenta into the kidney basin and spread uniformly in the kidney basin.

Step 5: Insert the paintball into the polenta at a depth of 0.5 to 1.5 cm. Redistribute the polenta until the paintball is no longer visible from the surface.

Step 6: Cover the polenta phantom with plastic wrap, being careful to keep air pockets from forming between the surface of the polenta and the plastic wrap (Figure 1).

Step 7: Use a high-frequency linear probe to image the model.

*The model can be reused after drainage by repeating Steps 5–7 with a new paintball. Complete construction of the model should take approximately 5 min (<1 min per step).

DISCUSSION

The use of a precooked commercial polenta phantom required minimal preparation and visually simulated soft tissue on ultrasonography. Paintball pellets placed within the polenta phantom at a depth of 0.5 to 1.5 cm closely replicated a soft tissue abscess on ultrasound examination. The paintballs were visualized as a discrete round hypochoic fluid collection with distinct



Figure 1. Purchased materials (polenta and paintballs) and completed ultrasound model.

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