ORIGINAL REPORT

Gelatin Thoracic Paravertebral Teaching Model for Placement of a Continuous Infusion Catheter in the Extrathoracic Paravertebral Space

Shruti Sevak, MD,[*] Ashley Woodfin, MD,[†,1] Zachary Hothem, DO,[*] Rose Callahan, MS,[*] James Robbins, MD,[*,†,‡] and Kathryn Ziegler, MD[*,†,§]

[*]Department of Surgery, Beaumont Health, Royal Oak, Michigan; [†]OUWB School of Medicine, Beaumont Health, Royal Oak, Michigan; [‡]Section of Trauma Surgery, Beaumont Health, Royal Oak, Michigan; and [§]Marcia and Eugene Applebaum Simulation Learning Institute, Beaumont Health, Royal Oak, Michigan

OBJECTIVE: Our aim was to develop an ultrasound-guided training curriculum for continuous infusion catheter placement in the paravertebral space and to create a gelatin thoracic spine-rib model for use in this training. We sought to create a model that was inexpensive and reusable such that multiple participants could use one model during training.

DESIGN: The model was prepared by embedding a firm foam thoracic spine replica with bilateral attached ribs into an opaque gelatin mixture. Once solidified, a preselected area was excised on each side, such that the model could be easily refilled with new gelatin blocks for use by each participant. This allowed for multiple participants to use the same model while eliminating confusion with prior tract marks.

SETTING: The Marcia and Eugene Applebaum Simulation Learning Institute, Beaumont Hospital, Royal Oak, MI; a private nonprofit tertiary care hospital associated with the OUWB School of Medicine, Rochester, MI.

PARTICIPANTS: Fifty-two medical students and general surgery residents underwent a 30-minute didactic session on ultrasound technique for catheter placement followed by practice on the gelatin model.

RESULTS: The texture and echogenicity of the model were subjectively comparable to those of tissue in vivo and the osseous elements of the spine in the model were clearly identified using ultrasound. The exchangeable catheter placement area provided an efficient and effective method to test accurate performance in catheter placement by multiple users. Participants increased their confidence in the use of ultrasound for this procedure.

CONCLUSIONS: To date, this is the first gelatin thoracic spine-rib model that has been used to teach ultrasound-guided catheter insertion into the paravertebral space, with removable testing areas that can be used by multiple users. This model can provide an inexpensive training tool that can be used in a surgical simulation setting. (J Surg Ed ■:■■■-■■■. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: ultrasonography, education: medical, gelatin, simulation, phantoms: imaging

COMPETENCIES: Practice-Based Learning and Improvement

INTRODUCTION

There has been an increasing effort within medical education to teach procedural skills using inanimate models to contain costs and improve patient safety. Simulation is now an important part of procedural training. In addition, duty hour limitations for residents may affect clinical opportunities to acquire basic procedural skills such as the use of ultrasound.

A recent innovation in the treatment of patients with rib fractures is the use of continuous infusion catheters in the extrathoracic paraspinous space for pain control. The published technique for catheter insertion described in 2010 uses anatomical landmarks.[1] However, the application of this technique and use by residents is limited by adequate palpation of the spinous processes and ribs, which can be especially challenging in

Correspondence: Inquires to Kathryn Ziegler, MD, Beaumont Hospital, Marcia and Eugene Applebaum Simulation Learning Institute, 3601 W 13 Mile Rd, Royal Oak, MI 48073; fax: (248) 992-2048; e-mail: Kathryn.Ziegler@beaumont.org

[1] Current address: Rush University Medical Center, 1653 W Congress Parkway Chicago, IL 60612.

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morbidly obese or muscular patients. Three potential complications of failing to recognize anatomic landmarks would include injury to the spine, pleura, or intercostal vessels and nerves. Consequently, we sought to develop a technique to insert these catheters using ultrasound guidance rather than with anatomic landmarks alone. Because this is a newly developed technique, no model currently exists to teach ultrasound-guided extrathoracic paravertebral continuous infusion catheter placement.

Several lumbosacral (as opposed to thoracic) gelatin spine models have been described to train participants in performing central neuroaxial blockade (as opposed to peripheral catheter placement) using ultrasound.[2-5] These models differ in the composition of the matrix and cost, and have limitations in their usefulness with multiple participants. Our aim was to develop an ultrasound-guided training curriculum for continuous infusion catheter placement, and create a gelatin-interfaced, thoracic spine-rib model to facilitate teaching the placement of the paraspinous catheter. In addition, we sought to create a model that was inexpensive and reusable so that multiple participants could use one model.

MATERIALS AND METHODS

Gelatin Base Model Preparation

The model was prepared by embedding a firm foam thoracic spine replica with bilateral attached ribs (Sawbones, Vashon, WA, model 1325-7) into a gelatin mixture in a translucent plastic container.

The gelatin substrate was prepared by filling a plastic container with 1,500 mL of cold water; 150 g of unflavored porcine gelatin powder (225 g bloom, Great Lakes Gelatin, Grayslake, IL) was gently sprinkled on top of the water and allowed to bloom for 3 minutes without any stirring (final concentration 10% w/v). The bloomed mixture was microwaved for 4 minutes, without stirring, to melt the gelatin; the resultant mixture had a temperature of approximately 45°C. The liquefied gelatin was rapidly stirred on a laboratory stir plate and 7.5 g of sodium benzoate was added as a preservative (0.5% final concentration). In order to opacify the gelatin, 20 g of psyllium fiber (Kroger Sugar-Free Orange Flavor Natural Fiber, The Kroger Co, Cincinnati, OH) along with 400 μL of 1.0% basic fuchsin dye (EM Diagnostic Systems, Gibbstown, NJ) and 80 μL of 1.0% methylene blue dye (Fisher Scientific, Fair Lawn, NJ) were added. The gelatin was then poured into a 24 cm × 16.8 cm × 10.2 cm translucent plastic food storage container with a capacity of 2,920 ml (Surefresh, Greenbrier International, Inc), to a depth of 2 cm. Any surface bubbles were removed with a spoon or paper towel. The container was refrigerated at 4°C for approximately 10 minutes until the gelatin was solidified. The foam thoracic spine replica with bilateral attached ribs was placed on top of the solid gelatin with the spinous processes touching the solidified gelatin surface. The remaining liquid gelatin mixture was

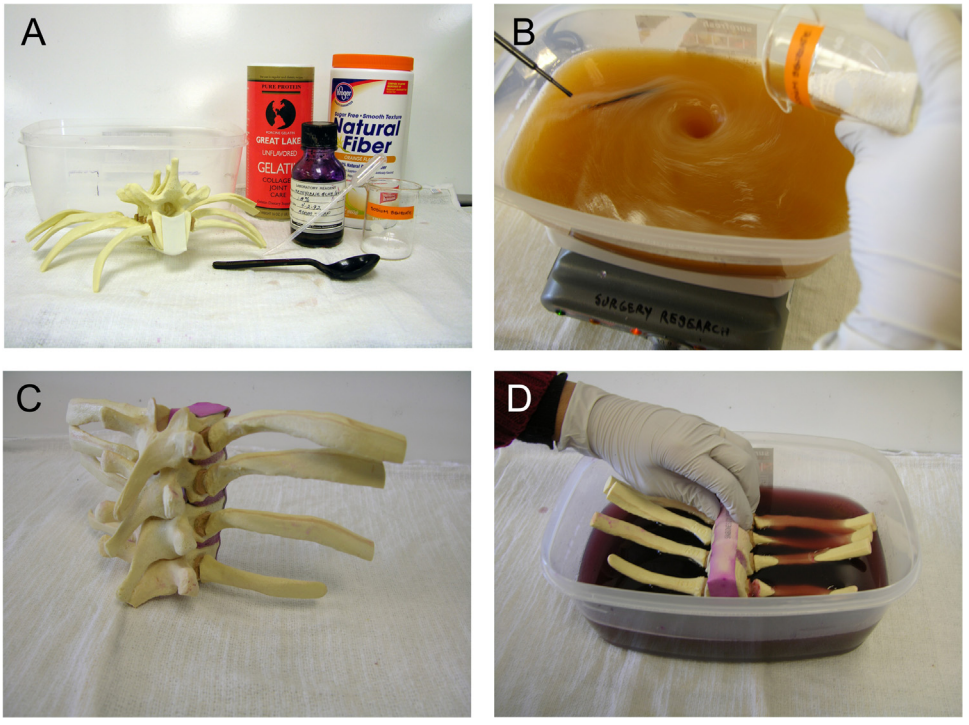

FIGURE 1. (A) Materials needed for gelatin paravertebral model. (B) Gelatin is softened in water, microwaved, and sodium benzoate added as preservative. Dye and psyllium fiber increase opacity. (C) Rigid foam thoracic spine model with attached bilateral ribs. (D) The spine/ribs are placed into the warm gelatin. Once solidified, the entire model including the embedded spine/ribs is removed from the plastic container.