Advanced Low-Cost Ultrasound-Guided Vascular Access Simulation

The Chicken Breast Model

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Abstract: There is a growing body of literature that supports the use of ultrasound for vascular access. Advanced simulation has become a widely applied technique for training medical staff in vascular access. Nevertheless, advanced simulators are expensive and of limited usage. We describe both a step-wise systematic approach and an experimental cadaveric model of vascular access using a simple piece of chicken that can be easily used for trainees.

Key Words: ultrasound, teaching, animal model, simulation, vascular access

There is a growing body of scientific evidence that supports the use of ultrasound (US) for vascular access.1-3 However, the success of the technique requires additional training, and there is still lack of consensus on the number of procedures required to achieve this efficiency into the clinical practice.

Training in the use of US for vascular access is challenging. Emergency departments and intensive care units must satisfy very specific needs.4 The use of advanced medical simulation is becoming a key component of training in vascular access. Nevertheless, advanced simulators for vascular access are expensive and of limited usage. There are limited data about the use of “homemade” simulation models as an alternative to the expensive existing models.5,6

The objective of this study was to describe an experimental cadaveric model of vascular access on the basis of using a simple piece of chicken breast and to describe a systematic approach for US-guided vascular access.

METHODS

Animal Cadaveric Model

A good-sized boneless and skinless piece of chicken breast bought at a local supermarket was used. The breast was kept in a standard freezer until 15 minutes before use. The chicken breast was then decontaminated for 5 seconds in a container with 10 mL of bleach diluted in 1 L of tap water. A 10-cm Penrose drain was used. A 3-way stop-cock was inserted in the Penrose and secured with a 2-0 silk suture in one of the ends of the drain and the other end was directly tied with a 2-0 silk suture. A tunnel was made with tweezers in the chicken breast and the Penrose is inserted.

FIGURE 1. Model preparation. A Penrose drain is used. A 3-way stop-cock is inserted and secured with a 2-0 silk suture in one of the ends of the drain and the other end is directly tied with a 2-0 silk suture. A tunnel is made with tweezers in the chicken breast and the Penrose is inserted.

Procedure

A point-of-care US machine with a 12L-R linear probe was used for image acquisition. A 10-step systematic approach was designed to access the fake vessel on the basis of previous existing guidelines1,2 (Table 1). A sterile cover kit was used. The probe was directly tied with a 2-0 silk suture. A tunnel was made with tweezers in the chicken breast and the 10-cm Penrose was inserted (Fig. 1). Tap water was used to fill the drain.


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<tr>
<th>Step</th>
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<td>1.</td>
<td>Ensure the use of sterile measures: plastic cover kit and sterile gel.</td>
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<td>3.</td>
<td>Ensure model/screen concordance: structures right sided to the examinee should be identified on the right side of the screen.</td>
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<td>4.</td>
<td>Appropriate depth adjustment.</td>
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<td>Appropriate gain adjustment.</td>
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was positioned with the dot to the left and concordance between
the chicken position, operator and screen was ensured. A cross-
sectional axis view was then obtained for structure visualization
and vessel recognition. Vessel internal diameter was then mea-
sured. With the vessel in the center of the screen, the depth be-
tween the skin margin and the center of the fake vessel (x) was
calculated. The same distance apply to the surface of the skin
away from the US probe was used to locate the insertion point.
The distance between the insertion point and the center of the ves-

of the equilateral sides). The hypotenuse of this triangle will be the
distance that the needle would need to be advanced with an angle
of 45° to end up with the tip at the center of the vessel (Fig. 2).

Cross-sectional and longitudinal axis views were obtained
(Figs. 3, 4). A 21-G needle was used. A US-guided vascular ac-
cess cannulation was performed. With the probe in transverse po-
sition, a cross-sectional axis view was obtained for structure
visualization. With the tip of the needle close to the superior wall
of the vessel, a clockwise probe turn to longitudinal sectional plane
was performed to identify the needle entering into the vessel. Once
fluid return was obtained, a wire was introduced through the needle
into the vessel and a confirmatory image was obtained (Fig. 5).

DISCUSSION

Our chicken breast model allows visualization of the US
signs/images of vascular structures and made it possible to prac-
tice the systematic approach, wire introduction, and cannulation

FIGURE 2. Pythagorean Theorem and US-guided vascular access.
On a cross-sectional view, locate the vessel at the center of the
screen. Measure the depth between the skin margin and the
center of the fake vessel (x). Apply the same measured distance
(X to the surface of the skin away from the US probe). The distance
between the insertion point and the center of the vessel would
then be calculated on the basis of the Pythagorean Theorem
(1.4 × X). The hypotenuse of this triangle will be the distance that
the needle would need to be advanced with an angle of 45° to
end up with the tip at the center of the vessel.

FIGURE 3. Cross-sectional view.

FIGURE 4. Longitudinal view.

FIGURE 5. Wire confirmation.
The relatively low incidence of medical emergencies in pediatrics, together with other factors such as the increase in the number of medical residents in the emergency department and/or intensive care unit and timetable restrictions, makes the training on vascular access a challenge. A step-wise systematic approach along with the use of advance simulation is an essential component of the current training process in several institutions. In the last 10 years, advanced simulation has become a widely applied technique. Several models exist for US-vascular access but those are expensive and of limited use. Some groups have built simple homemade simulators using different materials such as silicone or meat with positive results.5–7 In our case, the combination of a chicken breast model and a stepwise systematic approach helped us establish a model to train our staff in US-guided vascular access.

CONCLUSIONS

The use of cadaveric animal models can be integrated in the armamentarium of advance simulators in US-guided vascular access, resulting in a low economic cost of personnel training.

REFERENCES