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COMMENTARY

Catheterized chicken for training on ultrasound-guided vascular access: A simple, cost-effective, and effective model

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ABSTRACT

Ultrasound-guided vascular access is a medical procedure that is becoming increasingly common in daily practice and is recommended to avoid iatrogenic complications. One of the procedures with a high-risk rate of complications is the vascular puncture. However, training on this technique can be challenging due to the limited availability of simulation models. We propose a simple, cost-effective, and effective ultrasound-guided vascular access simulation model that utilizes chicken breast and a urine catheter to address this need.

Introduction

Ultrasound-guided vascular access is a medical procedure that is becoming increasingly common in daily practice. It's recommended as an accurate technique to avoid complications [1–5]. It involves the use of ultrasound technology to locate and access veins. This procedure is safer than traditional methods. However, acquiring this skill may be challenging due to the limited availability of simulation models for training [4,6–8]. We propose a simple, cost-effective, and effective ultrasound-guided vascular access simulation model that utilizes chicken breast and a urine catheter to address this need.

Methods

The proposed model was built using the following materials (Fig. 1):

- An average-sized chicken breast with bones (500 g);
- Urine catheter 12F;
- Chest tube 14
- Suction tube
- Saline fluid bag;
- Scalpel blade 15;
- Betadine 20 ml

The model was built following these steps:

The chicken breast is placed on the table.
The suction tube is cut with the scalpel, its length has to be 1.5 times longer than the chicken breast
The chest tube, adapted to its introducer, is used to create a "tunnel" in the chicken breast; the depth of the tunnel was arbitrarily chosen between 3 and 5 cm.
Then, the chest tube is removed from the breast and the cut suction tube is adapted into the introducer (Fig. 2A).
The suction tube is at that moment used to guide the insertion of the urine catheter into the created "tunnel" by carefully pulling the suction tube out of the breast from one side and pushing at the same time the urine catheter (Fig. 2B).
After its insertion, the balloon of the urine catheter is inflated (Fig. 2C).
After this, the urine collector bag, filled with saline serum and 20 ml of betadine, is connected to the urine catheter.
The urine catheter is then purged and filled with the liquid (Fig. 2D).

After the chicken breast preparation, two blinded physicians performed the procedure following the steps described below:

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Fig. 1. Material needed for the proposed model.

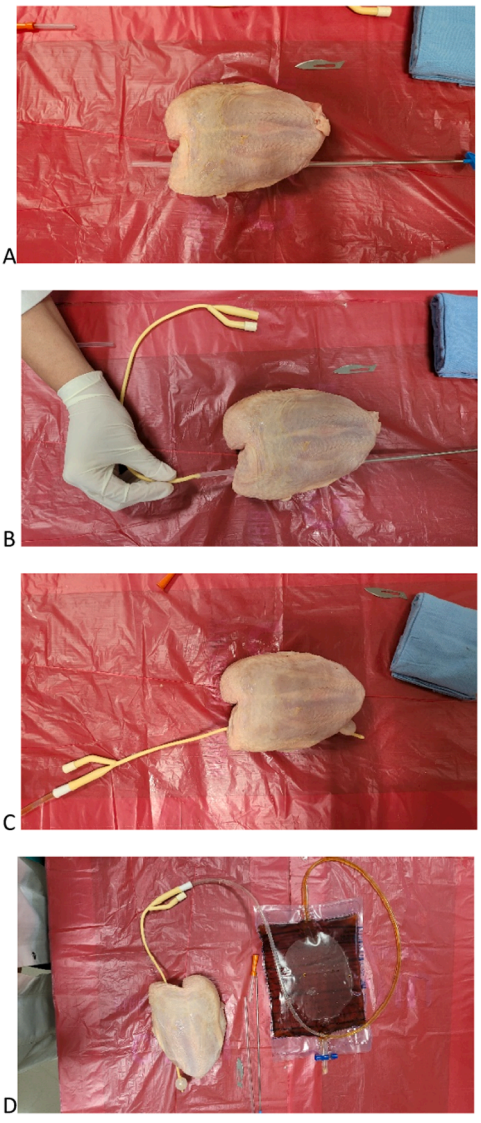

Fig. 2. The steps of the chicken breast preparation: creation of the tunnel in the breast muscles (A). The insertion of the urine catheter into the tunnel (B). The balloon of the urine catheter inflation (C). The urine catheter is filled with the liquid (D).

1. Ultrasound machine preparation and anatomic structure identification, mainly the urine catheter simulating the vessel.
2. Puncture area preparation.
3. Ultrasound-guided puncture.

Results

The proposed model allowed the practice of ultrasound-guided venous puncture. The resulting ultrasound image has comparable density to human muscles, and the urine catheter is recognized in longitudinal and transversal modes (Fig. 3). It is also compressible with the ultrasound transducer as human vessels. Urine catheter identification, needle detection, and the moment of the puncture are shown in Fig. 4.

Discussion

A central catheter implant is an invasive procedure commonly realized in Emergency Medicine and intensive care departments. However, this procedure is highly associated with life-threatening complications [9–12].

Nowadays, scientific researchers recommend teaching medical students by simulation before performing invasive procedures in real life. Therefore, new simulation techniques and devices have been employed [13–15].

Several methods are used to simulate veins in ultrasound training. Mannequins (“Blue Phantom’’) are expensive devices; moreover, they have a different echogenicity from human tissue [16]. Gelatin and agar models are not very expensive and have acceptable and uniform echogenicity; however, they require sample preparation in advance [10, 17–19]. Silicone models have a good and homogenous echogenicity but are relatively expensive. Besides, they are commonly heavily marked by the puncture, which leaves a sort of “memory’’ trace after the procedure [9,16].

In low-income countries, it is usually difficult to have these simulators. We propose a low-cost and efficient simulator for vascular access and cyst puncture training. To create this model, a chicken breast is used to simulate the anatomical structure and feel of human tissues. This model provides the opportunity to train on needle insertion, and vein puncture on the same simulator. It provides a way for medical professionals to acquire and improve their technique without the risk of iatrogeny.

The model is simple to construct and economical, as chicken breast can be easily obtained, and urine catheters are available in healthcare settings. This model provides users with immediate feedback on their skills and the opportunity to practice until they feel confident. Furthermore, it can be adapted to replicate various scenarios, such as different skin types or vein depths, providing a hands-on learning experience for medical professionals.

The chicken model has certainly been used for ultrasound learning [9]. But we propose a new detail permitting ultrasound-guided vascular access, with reusable material, and without the limitations mentioned in prior studies. Multiple punctures are possible with our model, which saves time and reduces the need to frequently change the chicken breast even with large groups of trainees [9].

Despite the abovementioned strengths, our model has limitations: the chicken breast is perishable, and saline serum is not similar to the blood thickness.

In conclusion, our simple and cost-effective urine catheter simulation model provides medical professionals with an efficient means of training, which is not only practical but also cost-effective. It is a sustainable solution to medical training that can be used in medical schools and healthcare facilities worldwide, ensuring that patients receive the best possible care.

Dissemination of results

This simulator was tried in a workshop during the certificate “simulation of intensive care management” in the faculty of medicine, involving 24 participants

Fig. 3. The resulting ultrasound image obtained with the proposed model for ultrasound-guided venous puncture training, with long axis (A) and short axis (B) images.

Authors' contribution

Authors contributed to the conception or design of the work as follows; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content:

OCW contributed 30 %; RK 15 %; MJ 15 %; HA 10 %; MB 10 % and AN, IS, FI and NR contributed 5 % each.

All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Financial/Material support

None.

Disclosures

None.

Compliance with ethics guidelines

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation

Fig. 4. The puncture of the fluid (A) after ultrasound identification of the needle in the vessel (arrow-B).

(institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study. This article does not contain any studies with human or animal subjects performed by the any of the authors. The approval of the ethical committee is not required for this type of studies in our institution.

Declaration of competing interest

The authors declare no conflicts of interest.

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