DEVELOPING "DO IT YOURSELF" PHANTOM FOR TEACHING SELDINGER TECHNIQUE IN VASCULAR ACCESS PLACEMENT TO GENERAL PRACTITIONERS

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Abstract

Establishing a vascular access is a crucial aspect in managing critically ill patients in the Intensive Care Unit (ICU). The skill in placing vascular access varies among healthcare professionals. Clinical experience and level of training among nurses, general practitioners, and intensivists are the determinants of skill in placing vascular access. Training to establish vascular access using the Seldinger technique needs practice using a vascular phantom or a cadaver. Commercially sold phantoms are difficult to get, and an alternative training phantom is needed. We built a simple "do-it-yourself" model of a vascular phantom using "easy-to-find" material that can be used to practice the Seldinger technique. We used a synthetic polyurethane sponge 16x16 cm in size as a base and a polyvinyl alcohol sheet of the same size. We used 22 F urinary catheters trimmed to 12 to represent blood vessels. The final product is a piece of the urinary catheter embedded in the sponge and then covered by polyvinyl alcohol to simulate the epidermis. The phantom can be used in training programs to improve the skill of general practitioners in placing advanced vascular access. 13 general practitioners were involved in this training, and 100% said that this phantom could simulate the experience. "Do-it-yourself" phantom for vascular access training can be used ro practice the Seldinger technique and can simulate the real experience.

Keywords

Vascular access, phantom, "Do It Yourself", Seldinger Technique

Introduction

Vascular access is an important aspect in managing critically ill patients in the Intensive Care Unit (ICU). Vascular access provides a means to administer fluid resuscitation, parenteral nutrition, vasopressors, or inotropes and a way to measure intravascular pressure as one of the parameters in hemodynamic monitoring. Over 5 million vascular access is placed in the United States annually, growing yearly.[1]

The skill in placing vascular access is somewhat varied among healthcare practitioners. Clinical experience and training among nurses, general practitioners, and intensivists determine the skill in establishing vascular access. General practitioners (GP) in Indonesia are the backbone of intensive care services, as they are the medical personnel who work full-time in the ICU alongside nurses. Developing skills as an intensivist working in the ICU is difficult for GPs. Vascular access placement for GPs is a crucial skill, and a way to improve vascular access placement is by using the Seldinger technique.

The Seldinger method is a technique used in placing vascular access percutaneously. This technique, also known as the wire technique, involves using a guide wire to facilitate catheter insertion. This technique was first documented by Sven Ivar Seldinger in 1953.[2] This is a common technique when learning to place vascular access. However, complications can arise from this technique, such as loss or retention of guide wire.[3] Surgical or endovascular rescue for loss or retention of guidewire should be performed to prevent further damage.

GPs can practice placing a vascular access using the Seldinger technique on a phantom or a cadaver. A commercial phantom is hard to attain, and an alternative way to create a training phantom is needed. We built a simple "do it yourself" vascular phantom model that can be used to practice the Seldinger technique using easy-to-find material.

Methods

We used everyday objects and materials found in hospitals to build a training phantom to practice the Seldinger technique. The general idea is to place a tube to host the wire, while the trainee can switch between the dilator and catheter inside the tube. Based on this concept, we built a rectangular phantom model with a tube embedded inside the model. As a practice device, we used Certofix V720 triple lumen central venous catheter (Braun) with a 16 gauge guiding needle in a Y piece; 1 guide wire, 50 cm, J tip; a 9 cm dilator; and 7 F central lines catheter.

For the base, we used a synthetic polyurethane sponge 12x12 cm in size and a polyvinyl alcohol sheet 16x16 cm in size. We used 22 F urinary catheters trimmed to 12 cm to represent blood vessels. The polyurethane sponge was sliced open in order to place the trimmed urinary catheter. We used synthetic rubber adhesive (Aica Aibon,

PT Aica Indonesia) to build this model. The preparation of the model can be seen in Figure 1.

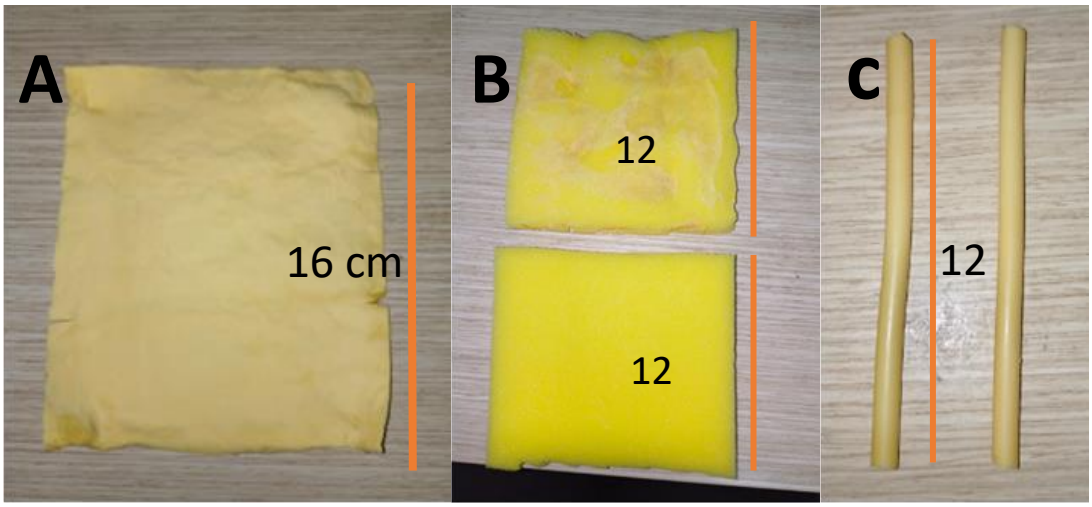

Figure 1. Preparation of the phantom. A: polyvinyl alcohol sheet 16x16 cm in size. B: polyurethane sponge 12x12 cm in size. C: Urinary catheter trimmed to 12 cm.

After material preparation, the pieces were put together to create a single phantom model, as can be seen in figure 2.

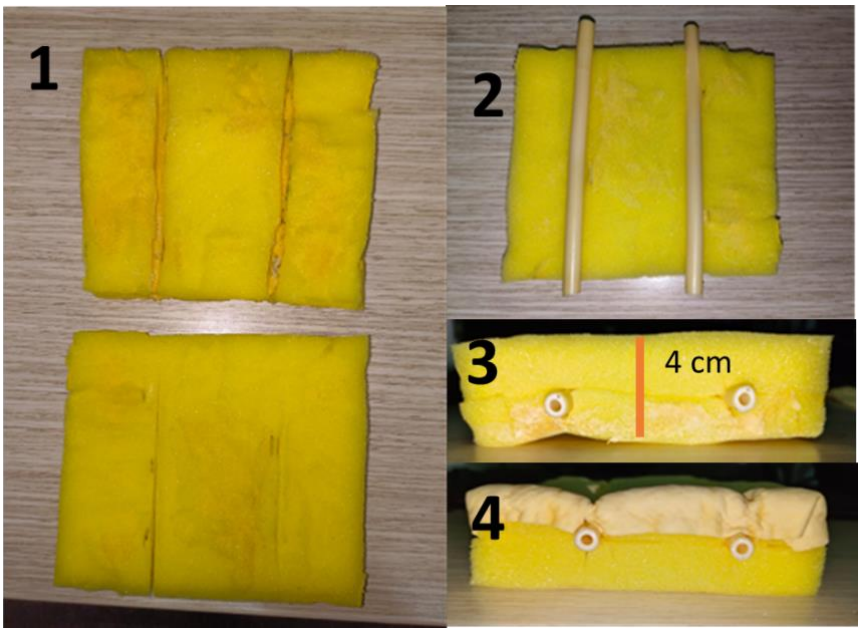

Figure 2. Assembling the phantom. 1. Both sponges were cut deep to facilitate the urinary catheter tube; 2. Both urinary catheters placed; 3. The catheter is sandwiched between 2 sponges. 4. The thickness of the phantom model is 4 cm.

The final product is a piece of urinary catheter embedded in the sponge and then covered by polyvinyl alcohol to simulate the epidermis.

Result

The vascular phantom model was used to train GPs in the ICU at the University of Indonesia Hospital. The training included 13 GPs who have worked in the ICU for 3-12 months. These GPs have similar work experiences and only graduated from medical school just over two years ago. These GPs have yet to perform vascular access placement using the Seldinger technique. One instructor is involved in the training process.

Ultrasound guiding was used in the vascular access placement. The GPs practiced identifying the vascular structure and needle pointing using ultrasound, and then practiced the Seldinger technique of inserting the Certofix Trio V720 vascular catheter using the already built phantom. The steps of practice can be seen in Figure 3.

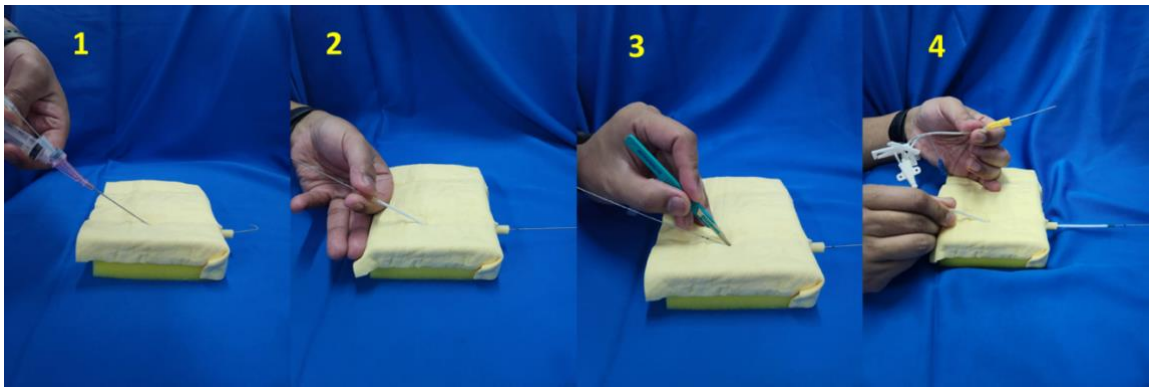

Figure 3. Using the phantom to practice Seldinger technique. 1. Puncturing the phantom using guide needle and threading of wire through the Y piece; 2. Inserting the dilator; 3. Incision using a scalpel to ease catheter insertion; 4. inserting the catheter using the Seldinger technique.

All the GPs succeeded using the phantom to practice the Seldinger technique. A demonstration was performed by the instructor before the actual practice. The instructor also oversaw the training program. 13 GPs said this could help them with everyday duties or medical emergencies. The GPs also practiced fixation sutures using the phantom to keep the catheter in place. The GPs said that this could simulate the real experience in placing vascular access.

Discussion

Nowadays, the "do-it-yourself" practice phantom is gaining popularity. Practice phantoms for vascular access that allow a person to practice a specific skill can be prepared quickly. Unlike the many ultrasound phantoms mentioned in various scientific articles, for example, such as the phantom model mentioned in the Di Domenico et al.'s article in 20074. A phantom that specifically facilitates the Seldinger

technique for vascular access does not exist to date. The reason why no literature exists until now to simulate the real-life situation is that commercial phantoms are likely more suitable however, it is also more expensive.

Alternatively, we were able to create a simple phantom that simulates an over-the-wire technique, emphasizing in how the trainee can handle the wire and not lose it during the procedure. This is a very important maneuver for beginners to prevent complications like loss or retention of the guidewire. This phantom can help GPs train in placing vascular access.

In the future, a phantom that can simulate ultrasound guiding and facilitate the Seldinger technique can be developed using simple, every day medical supplies to simulate the real-life experience of placing vascular access.

Conclusion

"Do-it-yourself" phantom for vascular access training can be used to practice the Seldinger technique for GPs, and can simulate real experience.

Competing Interests

Authors declare no conflict of interest.

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References

1. Kornbau C, Lee KC, Hughes GD, Firstenberg MS. Central Line Complication. Int J Crit Illn Inj Sci. 2015 Jul-Sep; 5(3): 170–178.
2. Seldinger SI. (1953) Catheter Replacement of the Needle in Percutaneous Arteriography: A new technique, Acta Radiologica, 39:5, 368-376
3. Schummer W, Schummer C, Gaser E, Bartunek R. Loss of the guide wire: Mishap or blunder? Br J Anaesth 2002;88:144-6.
4. Di Domenico S, Santori G, Porcile E, et al. Inexpensive homemade models for ultrasound-guided vein cannulation training. Journal of Clinical Anesthesia (2007) 19, 491–496