A Validated Low-cost Training Model for Suprapubic Catheter Insertion

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OBJECTIVE To describe an anatomically correct simulator for use in suprapubic catheter (SPC) insertion training.

METHODS A scale reproduction of an adult male pelvis with bony landmarks and a subcutaneous fluid-filled reservoir was created using platinum cured silicone rubber. This model was evaluated by 6 expert urologists for content validity with a 16-item 5-point rating scale used to evaluate domains relevant to the simulator—physical attributes, realism of experience, realism of materials, and global rating. The simulator was used by 25 general surgeons from rural practices participating in a 2-day comprehensive specialized surgical skills course.

RESULTS The domains were scored between 1 and 5; 1 being "not at all realistic" and 5 being "highly realistic, no changes needed." The average expert ratings of the domains were 3.9 (physical attributes), 4.3 (realism of experience), and 3.9 (realism of materials). The simulator was rated more valuable as a training tool (4.5) compared with a testing tool (3.8) with an average global rating of 4.1.

CONCLUSION Experts and trainees reported high satisfaction with their experience using this simulator. Preliminary evidence suggests this simulator is a useful tool that can be integrated into training programs to facilitate learning this necessary urologic skill. UROLOGY 85: 23–26, 2015. © 2015 Elsevier Inc.

Insertion of a suprapubic catheter (SPC) is an important skill for urology trainees and rural surgeons. However, opportunities to learn and practice SPC insertion often happens in emergent settings where confidence in conducting this procedure may be low, and access to trained urologists is limited. Furthermore, lack of SPC insertion training can lead to inappropriate Foley catheterization and subsequent stricture development. A recent meta-analysis of noninfectious complications of indwelling catheters found the rate of stricture formation after short-term catheterization to be 3.4%.[1]

Although surgical simulators have been widely adopted in urologic training, there are few simulators available for SPC insertion. In an era of increased scrutiny of patient-centered outcomes, medical education needs to explore opportunities to provide authentic feedback. Simulators can improve both patient outcomes and the comfort level of trainees, as well as decrease the operative learning curve for this technical skill.[2-3]

We have developed a low-cost, anatomically correct simulator for use in SPC training allowing for an authentic experience. The purpose of this study was to evaluate our simulator through ratings from expert urology attendings.

Study Hypothesis

Expert users will deem an SPC insertion model as a realistic and effective simulator.

METHODS

Simulator Creation

The model was created in conjunction with the Center for Education in Medicine at Northwestern University Feinberg School of Medicine, which specializes in teaching students and residents' skills through simulation.[4] The Center provided expertise on optimal materials and methods to create the most realistic simulator.

The simulator has 4 parts: a bony pelvis, a bladder, a fat layer, and a skin layer (Fig. 1). The bony pelvis is made from urethane foam and stabilized with resin glue. Embedded within the foam are molded liquid plastic parts, which help to maintain the structure and provide palpable landmarks, such as the anterior superior iliac spine and pubic symphysis. The bladder is made from silicone rubber, intravenous tubing (to insert yellow-colored fluid), and a Leur lock, which functions to keep the

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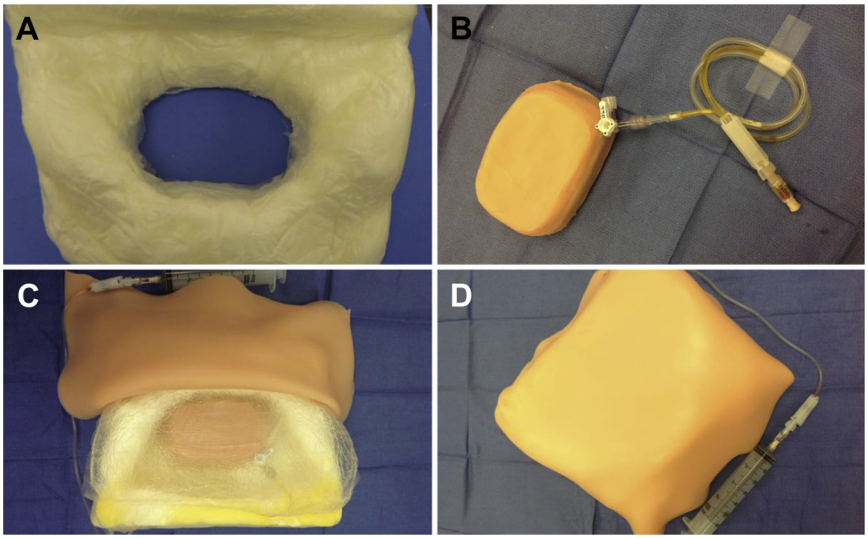

Figure 1. Model by parts. **(A)** Bony pelvis with pubic symphysis at the bottom, **(B)** Bladder with filling device, **(C)** fat layer, **(D)** Complete model with skin layer on top with pubic symphysis adjacent to syringe. (Color version available online.)

bladder full. Once full, the bladder is placed into the bony pelvis, and the unit is covered by skin and fat layers to simulate a complete pelvic cavity. The purpose of the multiple layers of skin, fat, and bladder wall is to represent authentic resistance during trocar insertion.

Next, water dyed with yellow food coloring is inserted into the bladder using a syringe to mimic a palpable bladder. This SPC model used a Bonanno 14-Fr suprapubic drainage catheter (BD Medical, Franklin Lakes, NJ).

The total cost of the model is $31.28 (Table 1) excluding the SPC kit. Each bladder can sustain between 10 and 15 SPC insertions before it is unable to remain distended. The bladder can be replaced for a cost of $7.97 per unit (Table 1). The skin and fat layers need to be replaced after approximately 50-75 insertions. Those layers can be rotated on the model, so non-punctured areas can cover the bladder. The bony pelvis does not need to be replaced. Over time, this makes the actual cost of the simulator lower given that part of the model can be recycled.

Study

Data were captured during a 2-day specialized surgical skills course sponsored by the American College of Surgeons and hosted by our institution. The course was attended by 25 rural practice general surgeons and facilitated by expert urologists. The urologic skills taught to the general surgeons were SPC insertion, management of testicular torsion, and ureteral implant. The latter 2 skills were taught on a cadaver model. None of the participants had experience with SPC insertion and were instructed by attending urologists. The general surgeons were given an opportunity to practice and were provided performance feedback as part of the course (Supplementary Figure 1). After this experience, the participants were asked to rate the model on 6 aspects of the simulator: (1) ability to perform procedure, (2) acquisition of surgical site, (3) lifelike feel of simulator, (4) relevance to practice, (5) value as a testing or training model, and (6) visualization of anatomy.

To further evaluate this model, 6 expert urologists at our institution tested and subsequently rated the simulator across 5 domains. They evaluated the model using a survey consisting of 16, 5-point rating scales and 1, 5-point global rating scale. The 16 items rated the simulator across 5 domains: physical attributes, realism of experience, realism of materials, value, and relevance to practice. These domains were scored as (1) "not at all realistic," (2) "lacks too many features to be useful," (3) "don't know," (4) "adequate realism but could be improved," and (5) "highly realistic, no changes needed." The last item was used to capture participants' global (overall) impression of the simulator and was scored with the same 5-point global rating scale.

Neither the general surgeons nor the expert urologists had knowledge of the others use of the model.

The rater agreement was estimated using intraclass correlation.

Table 1. Price of suprapubic catheter model by parts

Part	Cost ($)
Skin (silicone rubber)	15.04
Fat (gel wax)	1.66
Bladder	
Silicone rubber	5.47
Intravenous tubing	1.50
Luer lock	1.00
Base	
Urethane foam	5.97
Resin	0.64
Total cost	31.28

RESULTS

Twenty-two of the 25 general surgeons completed ratings on the model. The simulator was rated highest in the "ability to perform procedure" (mean = 4.1) and "value as a testing or training model" (mean = 4.1). The model rated lower for "lifelike feel of simulator" (mean = 3.4).

A summary of the rating results by the 6 expert urologists is found in Tables 2 and 3. The mean for each domain was 3.9 for physical attributes, 4.3 for realism of experience, and 3.9 for realism of materials (Table 2). The simulator was rated more valuable as a training tool (4.5) compared with that as a testing tool (3.8), with an