Development of a Novel, Low-Cost, Low-Fidelity Simulation Model for Pudendal Nerve Block Application

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ABSTRACT

Background Pudendal nerve block is an important alternative to neuraxial anesthesia, yet studies demonstrate that 3% to 50% of pudendal nerve blocks are ineffective. Lack of clinician training is the most common cause, and there are no simulation models currently described.

Objective To develop and test a novel, low-cost, low-fidelity simulation model for training residents in the placement of a pudendal nerve block.

Methods A pudendal nerve block model was developed using commonly found supplies, with a cost of $20.57. First-year to fourth-year obstetrics and gynecology (OB/GYN) and family medicine (FM) residents were invited to 1 of 4 pudendal nerve block 1-hour simulation sessions from December 2019 to March 2021 during their required teaching sessions. Expert faculty led a discussion of pudendal nerve blocks, then participants practiced with the described model. A survey about the model was created by the authors and administrated prior to and immediately after the session. Pre- and post-surveys were analyzed by Wilcoxon signed rank tests, and Bonferroni correction was performed.

Results Thirty-four out of a total of 36 eligible residents participated (94%). Residents showed improvement in knowledge (median pre-simulation score 43.99 compared with 70.06 post-simulation, $P<.00625$) and self-assessed confidence (median pre-simulation score 1.7 compared with 3.2 post-simulation, $P<.00625$) of a pudendal block placement after simulation training.

Conclusions This new, low-cost, reusable, low-fidelity simulation model for pudendal nerve block placement improved knowledge and confidence in OB/GYN and FM residents after 1 hour of simulation training.

Introduction

Studies have demonstrated that 3% to 50% of pudendal nerve blocks are ineffective, with the most prevalent cause being lack of clinician education and training.[1] No simulation models for pudendal block application have been currently described in the literature.[2,3]

Vaginal birth (assisted and spontaneous), episiotomy, and perineal laceration repair are painful obstetric procedures. Many pregnant patients seek to avoid neuraxial analgesia for a variety of reasons.[4,5] For these patients, and those with additional pain management needs when regional blockade is insufficient, pudendal nerve block is an effective alternative.[6] The pudendal nerve provides sensory innervation to the clitoris, vulva, perineum, and anus, key areas affected in obstetric procedures.[4] Pudendal nerve block is a safe and simple local analgesia method for appropriate patients and is recommended by the American College of Obstetricians and Gynecologists.[5] As use of neuraxial analgesia and inhaled anesthetics has increased, opportunities for residents to learn and practice placement of pudendal block have decreased.

Application of a pudendal block on a laboring or immediately postpartum patient is particularly challenging due to the pain being experienced, presence of the fetal head in the vaginal canal, and emergent nature of obstetric situations. However, successful application can provide quick relief for patients during the second and third stages of labor and during perineal repair.

Discussions with our residents confirmed that, without simulation training, they are not comfortable offering pudendal block to patients. This report describes the development of a pudendal nerve block simulation model to improve resident knowledge of and confidence in performing this procedure.[7-12]

Methods

This study was conducted within obstetrics and gynecology (OB/GYN) and family medicine (FM) residency programs. Participation was voluntary and

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written informed consent was obtained from all participants.

The pudendal nerve block model was constructed using readily obtained items: Halloween candy basket ($2.00), a foam ball ($4.99), hot glue gun ($4.35), glue sticks ($0.26), wooden doll heads ($0.53), felt ($0.04), yarn ($0.02), Crayola Model Magic (soft, lightweight, air-dyeable modeling material; $4.47), polyester fabric ($0.70), scissors ($2.02), Velcro ($0.37), food coloring ($0.74), and fiber fill ($0.08). The cost of the model was $20.57 and calculated as a per unit cost with only materials directly utilized in the model included. All components of the model, except the Model Magic, fiber fill, and food coloring, were found to be reusable. The model was tested, modified, and maintained by the research team. The final model can be constructed in approximately 20 minutes (online supplementary data).

Pudendal block simulation training utilizing the model was conducted in 4 separate sessions from December 2019 to March 2021. The session was held in a conference room with the simulation model placed on a table. Each 1-hour simulation session was hosted by the research team faculty (C.W., A.R.) who are OB/GYN clinician educators. Subjects first took a 10-minute pre-simulation written survey and received a 15-minute lecture by the research team faculty on the indications of a pudendal nerve block, risks and benefits to the patients, and the procedure. Next, they practiced bilateral pudendal nerve blocks on the simulation model while receiving feedback and asking questions, and then finished the session with the 10-minute post-simulation written survey.

We created a pre- and post-simulation training assessment containing 10 questions (6 multiple-choice and 4 open-ended) with a maximum score of 100, 7 questions to evaluate confidence on a 5-point Likert scale, and 4 open-ended questions regarding the model (online supplementary data).[13-18] The assessment instrument was not tested prior to administration. Wilcoxon signed rank tests were used to compare pre- and post-simulation median scoring. Bonferroni correction was applied for k=8 and P value $<.05$ noting a P value $<.00625$ to be statistically significant. Independent samples t test analysis was completed between the OB/GYN and FM data to evaluate for any differences. Separately, the model was reviewed by 6 simulation experts who are OB/GYN faculty at various institutions, have performed numerous pudendal nerve blocks, and have developed multiple other simulation models. Through using the model or watching the model being used via video call, the experts provided verbal, open-ended feedback.

The University of Illinois at Chicago Institutional Review Board approved this study.

TABLE 1
Demographics of Participants

Demographics	N (%)
Total participants	36 (100)
Participants who completed the post-assessment	34 (94)
Gender	
Female	30 (88)
Male	4 (12)
Type of residency	
Obstetrics and gynecology	19 (56)
Family medicine	15 (44)
Year of residency	
PGY-1	12 (35)
PGY-2	5 (15)
PGY-3	12 (35)
PGY-4	5 (15)
Prior experience with a pudendal nerve block simulation	
Yes	5 (15)
No	29 (85)
Prior experience with a pudendal nerve block	
Yes	7 (21)
No	27 (79)

Abbreviation: PGY, postgraduate year.

Results

A total of 34 OB/GYN (19) and FM (15) residents (of 36 eligible, 94%) participated in the simulation training. Two OB/GYN residents left the study because of clinical responsibilities. Their pre-simulation assessment was not included. Demographics of the residents are shown in TABLE 1.

Overall, there was an improvement in knowledge with pudendal block placement after simulation training, with median pre-simulation score 43.99 compared with 70.06 post-simulation ($P<.00625$). Confidence and comfort also improved (TABLE 2). There were no differences found for knowledge, confidence, or comfort between OB/GYN and FM residents.

Strengths noted by residents in the open-ended written survey was the realistic feel of the ischial spines, fetal head simulating the second stage of labor, applying the block by palpation, and colored fluid allowing easy assessment. The main weakness noted by the residents was that the Model Magic did not replicate the feel of the vaginal wall due to its rigidity. After 4 needle applications through the Model Magic, the material would break and need replacing.

Experts provided verbal open-ended positive feedback emphasizing the need for this model, accessibility of the materials used, swift reproducibility of the model, and the need to allow for participant

TABLE 2
Resident Pre-Simulation and Post-Simulation Performance Medians

	Pre-Simulation Median (Scale 0–100)	Post-Simulation Median (Scale 0–100)	*P* Value
Knowledge test	43.99	70.06	<.00625
	Pre-Simulation Median (Scale 1–5)	**Post-Simulation Median (Scale 1–5)**	
Level of experience with procedure	1.4	2.3	<.00625
Level of knowledge with procedure	1.8	3.3	<.00625
Confidence in ability to perform procedure	1.7	3.2	<.00625
Confidence in identifying good patient candidate for procedure	2.0	3.9	<.00625
Confidence in discussing risks and benefits of procedure	2.0	4.0	<.00625
Confidence in identifying anatomic landmarks for procedure	2.1	3.7	<.00625
Comfort with offering procedure to patients	1.7	3.7	<.00625

assessment of placement. Expert feedback for improvement included durability and haptics of the structures, ability to verify proper needle placement, and ability to change the feel of ischial spines and incorporate a simulated ligament.

Discussion

Residents who underwent simulation training with our model showed improvement in knowledge as well as confidence and comfort. All participants agreed that this simulation model is a helpful tool and desired future simulations.

A meta-analysis of obstetrics simulation found that simulation can increase physicians' knowledge, skills, and satisfaction.[19] Our findings for a pudendal nerve block simulation model are in alignment with this meta-analysis.

This model was made from readily available materials, including online, at a cost of $20.57 and assembled in 30 minutes. Thus, the simulation is accessible to those without well-funded simulation centers and can incorporated into existing conferences, with faculty competent in performing pudendal nerve blocks. There may be cost for faculty to run the sessions.

Limitations of this study include the small sample size at one institution, which limits generalizing to other programs. The assessment instrument had not been evaluated for validity evidence; thus, participants may have interpreted questions differently than intended. The post-assessment was conducted immediately which does not allow conclusions about retention of knowledge or confidence.

Our future work includes improving the vaginal wall and haptics of the sacrospinous ligament, testing the model at other institutions, and observing the number of successful pudendal nerve blocks performed by OB/GYN and FM physicians after simulation sessions.

Conclusions

This novel, low-cost, reusable, low-fidelity model for pudendal nerve block application improved OB/GYN and FM resident knowledge and confidence in the procedure, in a 1-hour session with experienced faculty.

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