Research Article

Evaluation of the Satisfaction and Confidence of Medical Students, Residents, and Obstetricians in Teaching and Practicing Manual Placental Removal

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Received: October 17, 2024 **Revised:** December 2, 2024 **Accepted:** December 15, 2024

Abstract

The aim of this study is to assess the obstetrics and gynecology residents' and obstetricians' satisfaction with the use of manual placental removal manikins and their self-confidence in performing this procedure among medical students and residents. We have developed silicone rubber manikins consisting of the postpartum uterus, placenta, and cord to practice manual placenta removal. All medical students, obstetrics and gynecology residents, and obstetricians were invited to participate in October 2022 and in April 2023. A total of 112 participants were voluntarily admitted to participate, including 62 fifth-year medical students, 30 residents, and 20 obstetricians, with response rates of 100%, 85.7%, and 83.3%, respectively. The mean±S.D. scores for ease of use and overall satisfaction were 7.6±1.9 and 8.1±1.4, respectively, and did not differ significantly among medical students, residents, and obstetricians. The overall realism score was 7.2±1.6 and did not differ significantly among residents and obstetricians. The mean self-confidence scores in procedural skill performance after practicing with the manikins were significantly higher than before practicing (7.8±1.5 and 3.4±2.7, respectively). The reliability of Cronbach's alpha for the questionnaire values for all participants was 0.88. The manikins for practicing manual placental removal were satisfactory among residents and obstetricians and could enhance the self-confidence of medical students and residents in performing this procedure.

Keywords: Gynecology; Obstetrics; Manikins; Placenta Removal

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การประเมินความพึงพอใจและความเชื่อมั่นในการใช้หุ่นจำลองช่วยสอนและฝึกทักษะการล้วงรกของนักศึกษาแพทย์ แพทย์ประจำบ้าน และแพทย์เฉพาะทางสูติศาสตร์และนรีเวชวิทยา

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รับบทความ: 17 ตุลาคม 2567 **แก้ไขบทความ:** 2 ธันวาคม 2567 **รับตีพิมพ์:** 15 ธันวาคม 2567

บทคัดย่อ

วัตถุประสงค์ของงานวิจัย คือ ประเมินความพึงพอใจในการใช้หุ่นจำลองช่วยสอนและฝึกทักษะการล้วงรกในแพทย์ประจำบ้านและแพทย์เฉพาะทางสูติศาสตร์และนรีเวชวิทยา และประเมินความเชื่อมั่นในนักศึกษาแพทย์และแพทย์ประจำบ้านสาขาวิชาสูติศาสตร์และนรีเวชวิทยา ทีมผู้วิจัยสร้างหุ่นจำลองการล้วงรกใหม่ โดยใช้วัสดุจากซิลิโคนที่ให้ความนุ่มและขนาดใกล้เคียงกับมดลูกหลังคลอด รก และสายสะดือ โดยเชิญชวนนักศึกษาแพทย์ แพทย์ประจำบ้าน และแพทย์เฉพาะทางสูติศาสตร์และนรีเวชวิทยาให้เข้าร่วมงานวิจัยในช่วงเดือนตุลาคม พ.ศ. 2565 จนถึงเดือนเมษายน พ.ศ. 2566 มีผู้เข้าร่วมงานวิจัยโดยความสมัครใจ ทั้งหมด 112 คน เป็นนักศึกษาแพทย์ชั้นปีที่ 5 62 คน แพทย์ประจำบ้าน 30 คน และแพทย์เฉพาะทางสูติศาสตร์และนรีเวชวิทยา 20 คน ร้อยละการเข้าร่วมงานวิจัยแยกตามกลุ่มคือ 100 85.7 และ 83.3 ตามลำดับ คะแนนเฉลี่ยและค่าเบี่ยงเบนมาตรฐานของความยากง่ายและความพึงพอใจในการใช้หุ่นจำลอง คือ 7.6±1.9 และ 8.1±1.4 ตามลำดับ คะแนนความเสมือนจริงของหุ่นจำลองโดยรวม คือ 7.2±1.6 โดยไม่มีความแตกต่างในกลุ่มแพทย์ประจำบ้านและแพทย์เฉพาะทางสูติศาสตร์และนรีเวชวิทยา คะแนนความมั่นใจในการทำหัตถการล้วงรกหลังจากฝึกกับหุ่นจำลองเพิ่มขึ้นชัดเจนเมื่อเทียบกับคะแนนความมั่นใจก่อนฝึกกับหุ่นจำลอง (7.8±1.5 และ 3.4±2.7 ตามลำดับ) ความแม่นยำจากการใช้แบบสอบถามโดยใช้ค่า Cronbach's alpha มีค่าเท่ากับ 0.88 หุ่นจำลองการสอนและฝึกทักษะการล้วงรกได้รับความพึงพอใจจากแพทย์ประจำบ้านและแพทย์เฉพาะทางสูติศาสตร์และนรีเวชวิทยา และช่วยเพิ่มความมั่นใจการทำหัตถการในนักศึกษาแพทย์และแพทย์ประจำบ้าน

คำสำคัญ: นรีเวช; สูติศาสตร์; หุ่นจำลอง; การล้วงรก

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Introduction

The incidence of retained placenta after vaginal delivery varies from 0.1% to 4.8% (Favilli et al., 2021; Greenbaum et.al., 2017; Weeks, 2008). There is a low incidence (0.1%) and high mortality (10%) value in less developed countries in contrast to more developed countries, where it is more common (3%) but with very low mortality (Weeks, 2008). This trend increases with associated risk factors, which include advanced maternal age, congenital uterine anomalies, previous uterine surgery, one or more previous abortions, two or more previous miscarriages, previously retained placenta, in vitro fertilization conceptions, preterm delivery, delivery of small-for-gestational-age infants, labor induction with oxytocin, and instrumental delivery, (Endler et al., 2012; Favilli et al., 2021; Fujita et al., 2021; Perlman & Carusi, 2019) whereas smoking at the start of pregnancy had protective effect (Endler et al., 2012) and high parity (two or more) was controversial (Endler et al., 2012; Perlman & Carusi, 2019). There are three principal mechanisms of retained placenta: (1) invasive placentation, (2) placental hypoperfusion, and (3) inadequate myometrial contractility. The invasive placentation results from previous uterine trauma. The placental hypoperfusion is related to incomplete spiral artery remodeling and shallow placentation. The inadequate myometrial contractility results in retention (Favilli et al., 2021; Weeks, 2008). Retained placenta is a potentially life-threatening event related to massive postpartum hemorrhage, massive blood transfusion, and medical and surgical treatment for stopping the bleeding, until hysterectomy (Endler et al., 2012; Perlman & Carusi, 2019). A risk factor of postpartum hemorrhage in patients with retained placenta was assisted reproductive technology pregnancy (Fujita et al., 2021). The mortality rate may be up to 10% if untreated or delayed in initiating manual removal of the placenta (Weeks, 2008). Manual removal of the placenta with adequate analgesia (Kongwattanakul et al., 2020) need be performed at the appropriate time by a person with the necessary skills. However, uterine inversion endometritis, retained pieces of the placenta and membranes, and postpartum hemorrhage may occur during and after the procedure (Cunningham et al., 2022; Endler et al., 2012; Perlman & Carusi, 2019).

Effective skills in manual placenta removal are important to decrease the maternal morbidity and mortality. According to the Thai Medical Competency Assessment Criteria for National License in 2020, training on this procedure must be included in the curriculum, and graduates can practice this procedure under supervision during their internship (Medical Council of Thailand, 2020). In 2022, the Royal Thai College of Obstetricians and Gynecologists stated that manual placenta removal was compulsory in the residency training program. Therefore, this procedure must be taught to medical students and obstetrics and gynecology residents according to competency in the Medical Council of

Thailand and the Royal Thai College of Obstetricians and Gynaecologists, respectively. The teaching in manual placenta removal consist of indication, contraindication, the necessary preparations and instruments, executing the procedure with proper technique, and recognizing and managing potential complications. The procedure consists of inserting the sterile gloved hand into the uterine cavity through the vagina and the cervix, identifying the placenta location, applying gentle traction and rotating the placenta to encourage detachment from the uterine wall, inspecting the placenta for completeness, and massaging the uterus to promote contraction and reduce bleeding after removing all lobes (Sumawong, 2002). In real practice, patients with retained placenta after vaginal delivery are rare and they need immediate effective management to decrease maternal morbidity and mortality. The manikin is useful for practice procedures without risking injury or pain to real patients. The procedures can be repeated multiple times, which helps to gain proficiency, boosting confidence, and can be used to replicate various situations with different challenges.

The manikin is an essential instrument for teaching and practice to achieve procedural skill competency and confidence before performing the procedure under supervision with real patients. The texture of manikins used for practicing manual placenta removal should be as similar as possible to that of a real placenta, cord, gravid cervix, and postpartum uterus. However, high-quality manikins are expensive and unaffordable for those in low-income countries. Cheaper manikins are of low quality, flimsy, and lack the realism of real organs. Therefore, we created manikins comprising the postpartum uterus, placenta, and cord, using materials with similar textures to the real elements. These manikins were found to be durable and affordable for teaching medical students and enabling obstetrics and gynecology residents to practice their procedural skills. So far, we could not identify a study using the manikin for teaching manual placental removal, but we found a study of the Surabaya hysterectomy mannequin, which was used in simulation-based training for teaching abdominal hysterectomy skills for residents (Syamsuri et al., 2022). A silicone-latex simulation anal sphincter injury model was used in the simulation-based training to improve the self-confidence of residents in identifying the external sphincter ani, suturing the anal mucosa, suturing the internal sphincter ani, suturing the external sphincter ani, and evaluating sphincter ani tone (Wahyuningtyas et al., 2022).

Research Objectives

1. To evaluate the satisfaction among obstetrics and gynecology residents and obstetricians while using the developed manikins to practice manual placenta removal.

2. To assess the self-confidence among medical students and obstetrics and gynecology residents before and after practicing on the manikins.

Research Hypothesis

Manual placenta removal is a procedure that must be taught to medical students and residents. They have to learn about indication, contraindication, instrument, and procedure ("know") and patient management before, during, and after the procedure ("know-how"). The manikin is an essential instrument for teaching and practice that helps achieving procedural skill competency ("show how") and the necessary confidence before performing the procedure under supervision with real patients ("do"). Currently, the study primarily measures satisfaction and self-confidence, which are indirect indicators of "do".

Literature Review

According to Miller's pyramid of clinical competence, "knows" is associated with knowledge, "know-how" is associated with applied knowledge to solve a medical problems, "show how" is associated with skill demonstration, and "do" is associated with doing it in real-life situations (Miller, 1990). Simulation-based teaching is relevant to Miller's pyramid as it builds clinical knowledge ("know" and "knows how") and transitions to a phase of knowledge consolidation and action through supervised demonstration ("shows") followed by routine, competent and confident performance of the skills ("do"), and offers the opportunity to apply knowledge and skills to situations that mimic real-life situations, which occur in a standardized and safe environment without distractions (Le, 2023).

According to Bloom's taxonomy of the cognitive domain in classifying education goals and objectives; knowledge, comprehension, application, analysis, synthesis and evaluation (Huitt, 2011), can be effectively applied to simulated-based teaching. Students recall information in anatomy and physiology, explaining concepts and processes, demonstrating understanding and performing the procedure, analyzing the outcomes and identifying factors to failure, creating new strategies or combining multiple techniques, and critically assessing the performance, providing feedback and identifying areas for improvement. Simulated-based teaching promotes higher-order thinking skills and allows students to gain practical experience in a safe and controlled settings (Huitt, 2011; Le, 2023).

Simulation-based teaching underpins the other two theories, adult learning theory (intrinsically motivated, independent, self-directed, and self-regulated) and experiential learning theory (gain education by directly engaging with scenarios of life by four stages

of Kolb's experiential learning cycle: reflective observation, abstract conceptualization, active experimentation, and concrete experience). The key features and best-practice principles of simulation-based education are feedback in both formative and summative, deliberate practice, curriculum integration, quantitative and qualitative outcome measurements, matching the real-life task with technologies, repetitive practice of technical skills, mastery learning, transfer to practice, team training, high-stakes testing, and instructor training (Le, 2023).

There were three theory foundations that are associated with simulation-based teaching: behavioral learning theory, constructivist learning theory, and social-cognitive learning theory. The behavioral learning theory focuses on behavior change and improvement; deliberate practice and feedback. The constructivist learning theory focuses on the perceptions, interpretations, mental processes, conceptual constructs, understandings, and practical knowledge that influence their decision-making and action. The social-cognitive learning theory focuses on learning and feedback in real clinical education and work in authentic workplace settings (McGaghie & Harris, 2018).

The manikins is an essential instrument in simulation-based teaching such as Surabaya hysterectomy mannequin can be used to learn abdominal hysterectomy skills for residents (Syamsuri et al, 2022). The a silicone-latex simulation anal sphincter injury model can improve the self-confidence of residents in identifying the external sphincter ani, suturing the anal mucosa, suturing the internal sphincter ani, suturing the external sphincter ani, and evaluating sphincter ani tone (Wahyuningtyas et al., 2022).

Research Methods

Study Design

This cross-sectional observational study used questionnaires to evaluate satisfaction with manikins and compare self-confidence before and after practicing on the manikins. All fifth-year medical students rotating in the Department of Obstetrics and Gynecology between October 2022 and April 2023, obstetrics and gynecology residents, and obstetricians were invited to participate. The main outcome measures in this study were satisfaction with the manikins and self-confidence in performing manual placenta removal. Three medical student rotations took place during the study period. Obstetrics and gynecology residents and obstetricians performed the procedure with the manikins and rated their satisfaction and self-confidence using the same questionnaire at their convenience.

Setting

On the first day of each eight-week rotation, fifth-year medical students from the Department of Obstetrics and Gynecology were routinely oriented toward learning in the

Department. After implementing the Faculty of Medicine curriculum and the Thai Medical Competency Assessment Criteria for National License announcement, manual placental removal was one of the essential skills for medical students and was included in the curriculum. This procedure was usually assigned to teach at the end of the first week. The manikin which is used to teach this skill, is composed only of the pelvic cavity, placenta and cord, the uterus could not be included (Figure 1).

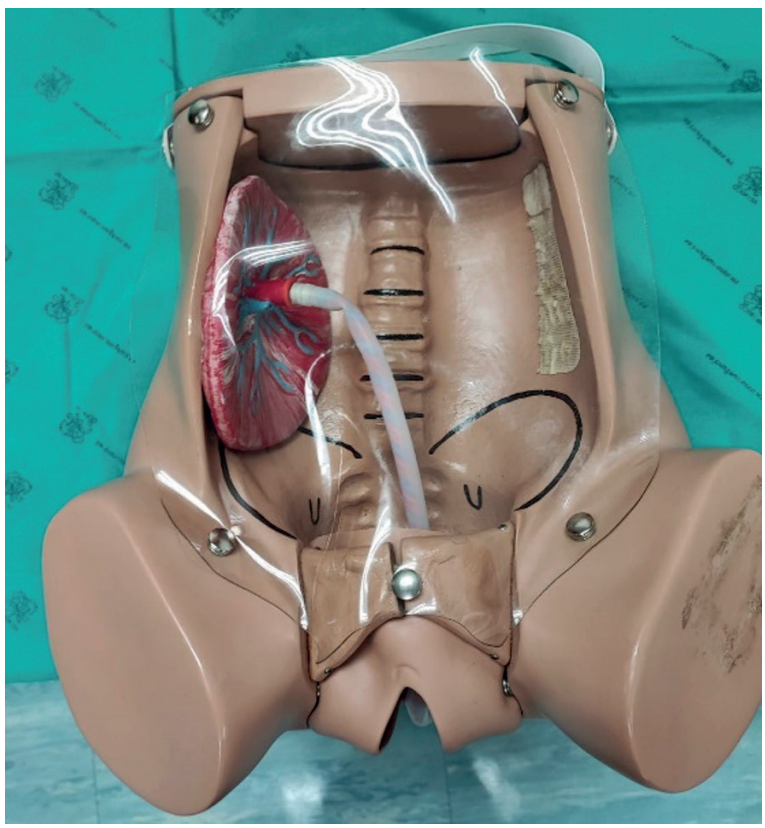

Figure 1. Obstetric Susie® S500; original childbirth simulator (Gaumard, U.S. and Canada)

Manikin Development

From November 2021 to May 2022 the authors developed and created the manikins, which was funded by the Medical Innovation Center (INN-02-64-016). The petty patent registration certificate was approved by the Thai Department of Intellectual Property (No. 22757, November 7, 2023). The manikins comprised the postpartum uterus and bisections of the uterus, placenta, and cord. They were made from silicone rubber (Shore Hardness Scale = Shore A (20–30)), resulting in softness, elasticity, and durability. The manikins were similar to a real postpartum uterus, placenta, and cord in terms of size, shape, surface, and consistency (Figure 2).

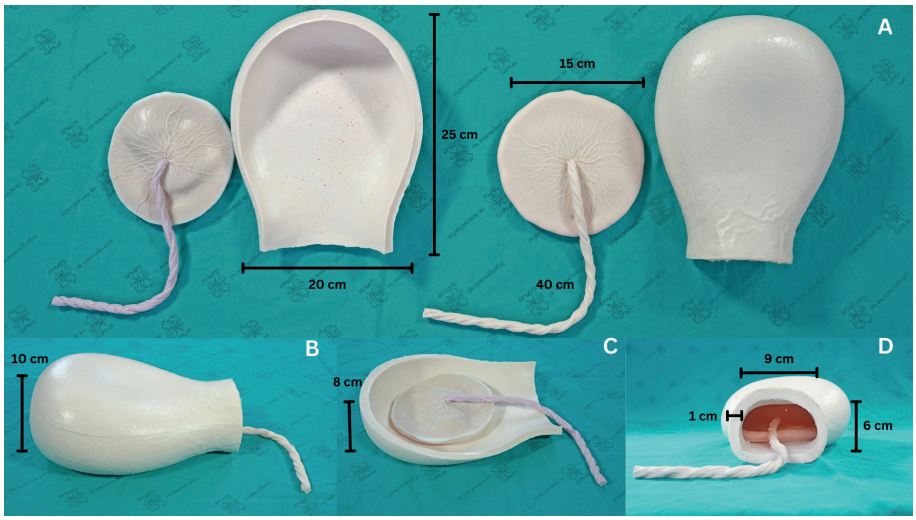

Figure 2. Manikins of the postpartum uterus and bisection of the uterus, placenta, and cord. A. Placenta, cord, and uterus; front view. B. Uterus; side view. C. Bisection of the uterus; side view. D. Uterus; bottom view.

The new manikins were assembled according to the pelvis manikin Obstetric Susie® S500, the original childbirth simulator (Gaumard, U.S. and Canada) used for teaching or practicing (Figure 3). The global shape of the uterus can provide realism of sensation during the removal of the placenta from the inner surface of the uterus and digital curettage for removal of the residual piece of membrane.

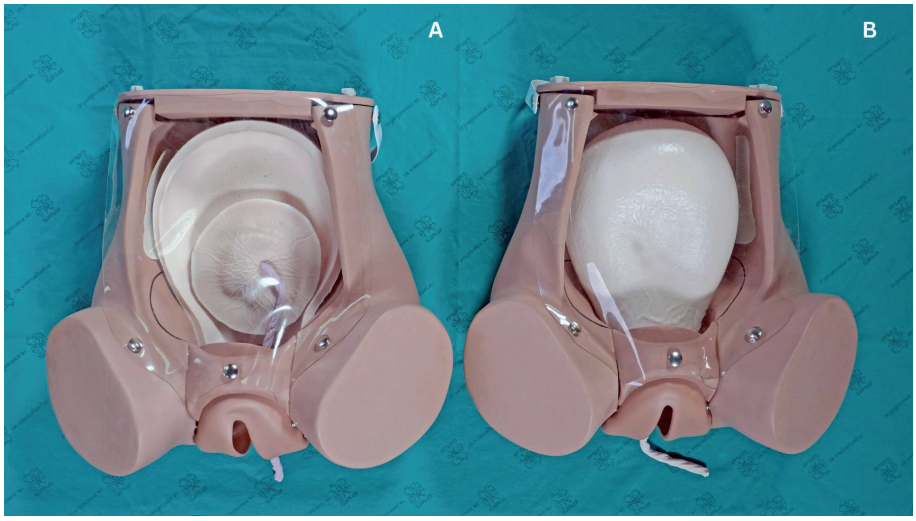

Figure 3. Assembled manikins with Obstetric Susie® S500 (Gaumard, U.S. and Canada) for teaching and practicing. A. Bisection of the uterus. B. Uterus.

Data Sources and Measurement

The questionnaire was developed, tested, and assessed for validity and reliability. It consisted of three sections. The first one collected the participants' general data, including their status (student/resident/obstetrician), sex, the number of times and the last time that manual placenta removal was performed in patients (for residents and obstetricians), and the self-confidence score before using the manikins for practice (for medical students and residents). The second section evaluated satisfaction with the manikins regarding realism in seven items; size and shape in the cervix, uterus, placenta and cord, addition of surface and consistency in uterus, placenta and cord, placental adherence in placenta and the overall impression. A 10-point rating scale was used to assess how close the manikins are to real world, with score of 1 and 10 indicating strongly not realism and strongly realism (for residents and obstetricians). The last section evaluated satisfaction with the manikins regarding ease of use and overall satisfaction, and self-confidence scores were obtained after using the manikins. A 10-point rating scale was used to assess satisfaction with the manikins and self-confidence, with scores of 1 and 10 indicating strongly dissatisfied/not confident and strongly satisfied/confident, respectively. Before conducting the research, the questionnaires were assessed for validity and reliability by 38 medical students in their first and second rotations. The internal validity and reliability using Cronbach's alpha values were 0.90 and 0.84, respectively.

We have used the new manikins to teach the related skills to medical students since the 2022 academic year. We asked for approval from the ethics committee to conduct this study. The medical students were informed about this study and invited to participate voluntarily on the first day of the rotation. In class on manual placenta removal, usually at the end of the first week, manikins were used to teach and practice manual placenta removal to all medical students. At the end of the class, the medical students read and voluntarily signed the informed consent form before participating in the study and rated their self-confidence in performing these procedural skills before and after practicing with the manikins via a questionnaire. All residents and obstetricians in the Department of Obstetrics and Gynecology were invited to participate in this study to evaluate their satisfaction with the manikins, and the residents rated their self-confidence before and after practicing the procedure using the same questionnaire. The study was conducted from October 2022 to April 2023. Some residents and obstetricians had experience in manual placenta removal varied from the year of training and the sub-specially in obstetrics and gynecology, respectively.

Statistical Methods

The data were analyzed using the R Statistical Software (v4.1.0; R Core Team 2021, R Foundation for Statistical Computing, Vienna, Austria). Demographic characteristics

were presented as numbers and percentages, and the differences between the two or three groups were compared using the chi-square or Fisher's exact test. The scores were presented as means and standard deviations, and the differences between the groups were compared using ANOVA. A paired-sample t-test was used to compare the differences in self-confidence scores before and after manual placenta removal using manikins. Statistical significance was set at $p<0.05$.

Ethical Considerations

This study was approved by the Ethics Committee of the Office of the Human Research Ethics Unit (grant number REC 65-344-12-1). The authors developed the survey questionnaire. Before participating in the study, all participants were given written informed consent, and they responded anonymously to the questionnaire.

Research Results

Participants and Descriptive Data

A total of 112 participants were recruited for the study, including 62 fifth-year medical students, 30 residents, and 20 obstetricians, with response rates of 100%, 85.7%, and 83.3%, respectively. Two-thirds of the participants were women. Most residents had clinical practice of this skill in fewer than five cases, whereas the obstetrics had more experience, and both had performed this procedure for more than 12 months. Experience using this skill differed significantly among residents and obstetricians ($p<0.001$). The mean±S.D. scores for ease of use and overall satisfaction were 7.6±1.9 and 8.1±1.4, respectively, and did not differ significantly among medical students, residents, and obstetricians (Table 1).

Table 1. Demographic characteristics of all participants, scores for ease of use and overall satisfaction

Demographic Characteristics	Medical Students N=62 n (%)	Residents N=30 n (%)	Obstetricians N=20 n (%)	Total N=112 n (%)	P-value
Sex					0.85[a]
Female	39 (62.9)	17 (56.7)	12 (60.0)	68 (60.7)	
Male	23 (37.1)	13 (43.3)	8 (40.0)	44 (39.3)	
Experience in manual placenta removal					<0.001[b*]
≤ 5	-	26 (86.7)	7 (35.0)	33 (66.0)	
> 5	-	4 (13.3)	13 (65.0)	17 (34.0)	

Table 1. Continued

Demographic Characteristics	Medical Students N=62 n (%)	Residents N=30 n (%)	Obstetricians N=20 n (%)	Total N=112 n (%)	P-value
Last time performing manual placenta removal					0.26[b]
< 3 months	-	1 (4.5)	2 (10.0)	3 (7.1)	
3–12 months	-	7 (31.8)	2 (10.0)	9 (21.4)	
> 12 months	-	14 (63.6)	16 (80.0)	30 (71.4)	
Ease of use (mean±S.D.)	7.6±1.9	7.8±1.6	7.6±12.1	7.6±1.9	0.85[c]
Overall satisfactory score (mean±S.D.)	8.1±1.5	8.2±1.2	7.8±1.2	8.1±1.4	0.66[c]

[a] Chi-square test, [b] Fisher's exact test, [c] ANOVA test, [*] Statistically significant

The overall realism score of the manikins

The overall realism score was 7.2±1.6 and did not differ significantly among residents and obstetricians. The mean realism score was highest in the size and shape of the uterus and lowest in the adherence between the surface of the placenta and uterus (8.2±1.0 and 7.0±1.8, respectively) (Table 2).

Table 2. Realism score of the manikin among residents and obstetricians

Variable	Mean Score ± S.D. (maximum 10 points)			
	Residents N=30	Obstetrician N=20	Total N=50	P-value
Realism in size and shape of the uterus	8.1±0.9	8.3±1.2	8.2±1.0	0.35
Realism in surface and consistency of the uterus	7.5±1.8	7.6±1.6	7.5±1.7	0.79
Realism in size and shape of the cervix	7.5±1.3	7.2±1.4	7.4±1.4	0.5
Realism in and shape of the placenta and cord	7.9±1.5	7.7±1.7	7.8±1.5	0.66
Realism of surface and consistency of the placenta and cord	8.0±1.3	7.3±2.0	7.7±1.6	0.17
Realism in adherence between the placenta and uterus	7.2±1.8	6.6±1.9	7.0±1.8	0.20
Overall realism score	7.4±1.5	6.9±1.7	7.2±1.6	0.25

The self-confidence scores before and after practicing

The mean self-confidence scores in procedural skill performance after practicing with the manikins were significantly higher before practicing (7.8±1.5 and 3.4±2.7, respectively). The mean difference in self-confidence scores before and after practicing significantly differed among medical students and residents. ($p<0.001$) (Table 3). The reliability using Cronbach's alpha of the questionnaire values for all participants was 0.88.

Table 3. Self-confidence before and after practice with the manikin among medical students and residents

Variable	Mean Score ± S.D. (maximum 10 points)			
	Before	After	Mean difference	P-value
Medical students (N=62)	2.2±1.7	7.6±1.6	5.4±2.1	<0.001
Residents (N=30)	5.8±2.7	8.2±1.2	2.4±2.4	0.05
Total (N=92)	3.4±2.7	7.8±1.5	4.4±2.6	<0.001

Discussion and Conclusions

For the manikins devised for manual placenta removal, the overall ease of use and satisfaction in practicing skills were high for all participants. Residents and obstetricians were highly satisfied with the manikins; among medical students and residents, the manikins could enhance self-confidence in performing this procedure. The reliability of using the manikins was high. This was the first interventional study on the construction of models of the postpartum uterus, placenta, and cord for manual placenta removal in Thailand. The medical students represented beginners, the residents represented practitioners, and the obstetricians represented experts in this skill. These manikins are well-accepted by practitioners and experts for use. The manikins we developed could enhance self-confidence in performing this procedure for both the beginner and the practitioner. These manikins can be manufactured at our institute at a lower costs, and the faculty can provide sufficient manikins for teaching and practice for undergraduate and postgraduate students. However, the assessment of self-confidence and satisfaction was highly subjective, and the competence of medical students and residents was not evaluated. In addition, the manikin should be modified in realism to adhere to the placenta and uterus and include more of the cervix in the gravid uterus. If it possible the next project, adding a checklist for before and after skill assessments could offer a concrete measure of "show how," aligning more closely with Miller's pyramid.

Recommendations

Medical students and residents can improve self-confidence when performing manual placenta removal on manikins. These manikins can be assembled with other manikins, which other institutes have used and the manikins designed for manual placenta removal could indeed be adapted for training on related obstetric emergencies like umbilical cord prolapse and uterine inversion. Both procedures require specific maneuvers that can be practiced on a model to build skill and confidence. The results of this study may be generalized to both undergraduate and postgraduate training in Thailand.

Acknowledgments

This work was supported by the Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand (Grant Number: REC 65-344-12-1.)

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