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MEDICAL DOCTORS' PROCEDURAL SKILL PERFORMANCE AND ATTITUDE TOWARD ULTRASOUND-GUIDED PERICARDIOCENTESIS MODEL

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ABSTRACT

Background: Pericardiocentesis is regarded as a procedure that has the potential for saving lives. This procedure is indicated in patients with the diagnosis of cardiac tamponade and hemodynamic shock and should be done urgently to such cases. There would be severe complications if this procedure is not performed properly and skillfully. In this study, a newly developed ultrasound-guided pericardiocentesis model was used for training procedural skill with the aim to allow undergraduate medical students experience the procedure with the cheap and easily built model.
Aims: The objectives of the study were to develop ultrasound-guided pericardiocentesis model, to determine its usefulness for training the procedural skill, and to evaluate the medical doctors' attitude toward training with the model.
Methods: This pilot study was conducted to try out the model with medical doctors. The practical workshop plan for the trying out the model was developed. Video recording during the procedure, the questionnaire, and the semi-structured interview were conducted after the participants performed the procedure to assess their perception regarding with the efficacy and usefulness of the model.
Results: According to results, the participants could recognize the free fluid, pericardium, and heart of the model in ultrasound screen (4.2 ± 0.45, 4.6 ± 0.55, and 4.4 ± 0.55 respectively). The model was suitable for training ultrasound-guided pericardiocentesis (4.4 ± 0.55). The model was perceived to be good and useful for training ultrasound-guided pericardiocentesis. The participants also wanted to use the model for teaching the procedural skill to medical students before performing with the real patients.
Conclusions: The model was considered to be useful and appropriate for training the procedural skill. Therefore, the model could be used as the effective training tool for training ultrasound-guided pericardiocentesis.

Keywords: Procedural skill training, ultrasound-guided pericardiocentesis, undergraduate medical education

INTRODUCTION

Pericardiocentesis is regarded as a procedure that has potential for saving lives. This procedure is indicated in patients with diagnosis of cardiac tamponade and hemodynamic shock and should be done urgently to such cases [1]. There would be severe complications if this procedure is not performed properly and skillfully. Hence, in order to treat these patients effectively, physicians are needed to have enough practice for ultrasound-guided technique [2].

A newly graduated doctor is expected to have abilities to perform ranges of procedural skills. These skills would be either diagnosing the diseases or giving treatments on a patient [3]. Performing the

indicated clinical procedures with safe and skillful abilities is important in practice emergency medicine [4]. Ultrasound is still considered as a technology depending greatly upon the human interpretation even though it can be assessed easily and helpful for treatment. Consequently, physicians are needed to be competent enough in ultrasound imaging [5]. Recommendations from International Federation for Emergency Medicine (IFEM) and the Society of Radiologists in Ultrasound and the Alliance of Medical School Educators in Radiology also urged to use ultrasound phantoms for procedural training, for instance, in venous access training [6,7].

In this pilot study, a newly developed, ultrasound-guided pericardiocentesis model was used for training procedural skill. Five medical doctors participated to try-out the usefulness and feasibility of the model. Perception of the participants for using the model was also collected after the procedure with post-procedural questionnaire and semi-structured interview. The objectives of the research were to develop ultrasound-guided pericardiocentesis model, to determine its usefulness for training procedural skill, and to evaluate the medical doctors' attitude toward training with the model.

Research Question

- How will the developed ultrasound-guided pericardiocentesis model be effective for training procedural skill?
- What are the medical doctors' attitude toward training with the ultrasound-guided pericardiocentesis model?

METHODS

Study design

This research applied mixed method research approach [8]. Questionnaire with five-point Likert scale to study the efficacy and usefulness of the model was used as a quantitative component, and semi-structured interview to study the attitude of the participant including feedback and suggestion for the improvement was used as a qualitative component. The procedural workshop plan for trying out the model was developed for the study which include following steps:

- 15-minute brief orientation for the ultrasound-guided pericardiocentesis was introduced before the procedure.
- The participants performed procedure within 15 minutes (Figure 1).
- Evaluating of the model and the attitude of the participants were performed by administering anonymous questionnaire and semi-structured interview.

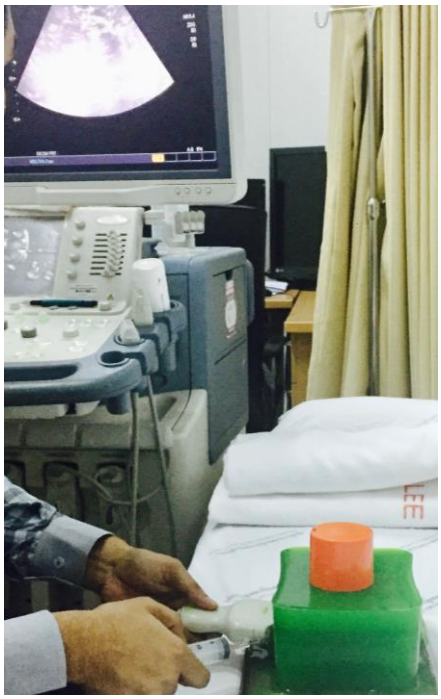

Figure 1. One of the participants performing the ultrasound-guided pericardiocentesis with the model

Study setting
The study was conducted at the Department of Radiology, Golden Jubilee Hospital located in Bangkok, Thailand.

Participants
Participants were five Myanmar medical doctors studying Master or PhD degrees at Mahidol University. Four participants were male and one participant was female. Three participants were specialists in Medical Physiology, Pathology and Anatomy. The remaining two participants were General Practitioners with experience of more than five years in medical field.

Ethical consideration
The participants were informed about the procedure of the study and asked their verbal consent for video recording for the procedure and audio recording for semi-structured interview. The participants were also informed that they were free to decline participation or withdraw from the study anytime if they did not want to participate anymore.

Data collection
Video recording during the procedure
Video recording to participant's hand, model and ultrasound-screen was done during the procedure to observe the performance of the participants performing the procedure with the model.
Participant's perception questionnaire
The participants were administered with 13-item participant's perception questionnaire anonymously after performing the procedure. Questionnaire used five-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree).
Semi-structured interview

After answering the questionnaire, semi-structured interview was evaluated to study the attitude towards performing the procedure, and to seek the participants' feedback and suggestion for further improvement of the model. The interview duration for each participant was 10 minutes.

Data analysis

Video recording during the procedure was analyzed by investigator and following quantitative measurements were made: Proper handling of ultrasound probe and needle, identifying the position of the pericardial fluid clearly and accurately on the ultrasound monitor, number of attempts for needle insertion, number of verbal assists and physical assists needed to complete the task, and time for completing the procedure. Analysis of questionnaire was conducted with statistical analysis and presented with mean score and standard deviation. Analysis of semi-structured interview was performed by transcribing the audio recordings. After that, transcription was read again and sentences from the data would be grouped and coded. Emerging themes and ideas were categorized to explain to attitude toward performing the procedure.

RESULTS

The results of evaluating the efficacy and usefulness of the model for training procedural skill with medical doctors are presented as follows:

Video recording during the procedure

Proper handling of ultrasound probe was done by all participants. All five participants could identify the position of the pericardial fluid clearly and accurately on the ultrasound monitor. All the participants could finish ultrasound-guided pericardiocentesis within one attempt of inserting needle. One participant needed two times verbal assists, two participants needed one verbal assist each and two participants did not require any assists from the investigator. Time for completing the procedure was ranging from one minute and thirteen seconds to three minutes and thirty-one seconds. The detail is presented in Table 1.

Participant's perception questionnaire

After finishing the procedure, all the participants answered the questionnaire. The detail of the participants' answers is presented in Table 2. Medical doctors felt that they could recognize the free fluid, pericardium and heart of the model in ultrasound screen (4.2 ± 0.45, 4.6 ± 0.55, and 4.4 ± 0.55 respectively). The participants could see the needle movement in the ultrasound screen (4.4 ± 0.55) and learned procedural skill for ultrasound-guided pericardiocentesis (4.4 ± 0.55). The participants *could not* decide that the consistency of the model during insertion feels realistic (3.8 ± 1.09). Structures inside the model had a similar appearance as real anatomical structures in the ultrasound screen (4.0 ± 0.71). Training on this model was helpful for manipulating and interpreting the position of probe and needle during ultrasound scanning (4.2 ± 0.45). The low-cost and ease of developing of these models made them more accessible (4.4 ± 0.89).

Table 1 Results from analysis of video recording during the procedure

Participants	**Number of attempts for inserting the needle**	**Number of assists needed verbally or physically to complete the task**	**Time for completing the procedure (minutes)**
Participant 1	1 time	2 times	2:39
Participant 2	1 time	-	2:25
Participant 3	1 time	1 time	3:21
Participant 4	1 time	1 time	3:31
Participant 5	1 time	-	1:13

The participants thought that the model was suitable for training ultrasound-guided pericardiocentesis (4.4 ± 0.55). The participants could not decide that the time schedule for performing the procedure was adequate (3.6 ± 1.67). The participants also thought that this training was adequate to obtain the sufficient procedural skill for performing ultrasound-guided pericardiocentesis (4.0 ± 0.71). The participants felt that overall usefulness of the model for training pericardiocentesis was good (3.8 ± 0.84).

Table 2 Participant's perception questionnaire

No.	Question	Mean	SD*
1.	How well can you recognize the free fluid of the model in ultrasound screen?	4.2	0.45
2.	How well can you recognize the pericardium of the model in ultrasound screen?	4.6	0.55
3.	How well can you recognize the heart of the model in ultrasound screen?	4.4	0.55
4.	How well can you see the needle movement in the ultrasound screen?	4.4	0.55
5.	Do you think you learn procedural skill for ultrasound-guided pericardiocentesis?	4.4	0.55
6.	The consistency of the model during insertion feels realistic.	3.8	1.09
7.	Structures inside the model have a similar appearance as real anatomical structures in the ultrasound screen.	4.0	0.71
8.	Training on this model is helpful for manipulating and interpreting of the position of probe and needle during ultrasound scanning.	4.2	0.45
9.	The low cost and ease of developing of these models makes them more accessible.	4.4	0.89
10.	Do you think that the model is suitable for training ultrasound-guided pericardiocentesis?	4.4	0.55
11.	Was the time schedule for performing the procedure adequate?	3.6	1.67
12.	Do you think that this training is adequate to obtain the sufficient procedural skill for performing ultrasound-guided pericardiocentesis?	4.0	0.71
13.	The overall usefulness of the model for training pericardiocentesis.	3.8	0.84

*Standard deviation

Semi-structured interview

Six categories of attitude toward the model emerged from interview.

1. Usefulness and efficacy

The participants felt that the model was good and useful for the medical students for practicing ultrasound-guided pericardiocentesis: '… we can see the needle, the heart and the pericardium and the pericardial fluid clearly in the ultrasound' (Participant 2). One participant stated that the model is useful for medical students for practicing procedural skill: '… This it is the useful for the medical students for practicing in our timing for medical school' (Participant 3).

2. Experience of the participants

The participants stated that performing procedural skill training with the model was first time and the feeling of penetrating the pericardium was very good: '…this is the first time for ultrasound guided and the model', '… this is the first time pericardial penetrating feeling "doch!", this is the good feeling' (participant 4).

3. Appropriateness for teaching undergraduate medical students

All the participants thought that the model should be use in teaching procedural skill to undergraduate medical students: '… It will be useful and should be applied for the training the medical students to practice the pericardiocentesis' (Participant 3), '… I think starting with third MB (third year students) is good because they start to learn the pathology in third MB, and then they have finished learning anatomy' (Participant 4).

4. Attractiveness of the model

The participants felt that performing the procedure with the model was interesting and exciting: '… I feel the excitation and interesting in this model, and after using this model, and I feel like the satisfied for me to doing the practice for the pericardiocentesis' (participant 3), '… I am very surprise and I feel the very good feeling…' (Participant 4).

5. Features to be changed

The participants wanted to change the outer gelatine coat and syringe to make the model better for training procedural skill: '… I would like to change the gelatine coat, it is very soft…' (Participant 1), '… The syringe was too tight to absorb during this procedure. If the syringe is too tight, the position of the needle can be changed' (Participant 2).

6. Suggestion for improvement

The participants suggested to make the model more realistic such as position of the heart like real anatomy: '… this model should be modified to realistic condition, including the position, and the real heart contraction' (Participant 5), '…you should make the heart of the model to be similar with the actual structure of the heart' (Participant 3).

DISCUSSION

The participants' performance for the procedure was evaluated using video recording. All the participants performed the proper handling of the probe and needle and identified of the position of the pericardial fluid clearly and accurately. They could perform the procedure within one attempt. All the participants finished the procedure within 10-minute duration.

The participants' perception for performing the procedure was evaluated with anonymous questionnaire with 5-point Likert scale. According to the results, the free fluid, pericardium and heart of the model could be recognized very well in ultrasound screen. These findings were consistent with the previous study for assessment of low-cost ultrasound pericardiocentesis model [9]. Movement of the needle could be seen in the ultrasound screen. The structures inside the model were similar to real anatomical structures in the ultrasound screen. Training the procedure with the model was helpful for manipulating and interpreting the position of the probe and needle during ultrasound scanning (4.2 ± 0.45). The model was also suitable for training the procedure (4.4 ± 0.55). These findings are also coherent with Campo Dell'orto et al. [9]. The participants could not decide that the consistency of the model felt realistic (3.8 ± 1.09). This result was inconsistent with the previous study done by Makeeva et al. [5] in which the consistency of the phantom felt realistic. The reason might be due to the softness of the model because the model was built with agar gelatine. Time schedule was undecided to be adequate (3.6 ± 1.67) probably because of their willingness to be trained more frequently. Participant could not decide for overall usefulness of the model for training pericardiocentesis probably because they want to change the material used in model to be more firm and realistic.

According the results from semi-structured interview, the model was perceived to be good and useful for training the procedure. Performing the procedure was new experience for the participants. Therefore, the model and the procedure were found to be interesting and exciting. The model was appropriate for teaching undergraduate medical students. The participants from the study wanted the model to be used for teaching procedural skill before the students' experience with the real patients. The consistency of the model was perceived to be very soft for the procedure and suggested to change with more firm and

more tolerant material for needle insertion. Some participants even suggested to make the model available for contraction of heart.

LIMITATIONS

This study had limitation for not including the cardiologists because their experiences and feedback were thought to be more appropriate for this study. Another limitation was that the participants were actively recruited to voluntary participation in the study. This could lead to potential selection bias that could influence the study. The last limitation is that the data collection tools such as questionnaire in this study was not reviewed by experts in medical education because of the inadequate time available during the study.

IMPLICATIONS FOR FUTURE RESEARCH

According to limitations from this study, future studies should be emphasized on including the cardiologists to elicit more valid and reliable experiences and suggestions. Future research should also give attention in recruiting participants randomly and should increase number of participants for more conclusive results.

CONCLUSIONS

Medical doctors from this study could perform the ultrasound-guided pericardiocentesis procedure with the model very well. The model was considered to be good and useful for training ultrasound-guided pericardiocentesis and appropriate for teaching undergraduate medical students. Therefore, ultrasound-guided pericardiocentesis model could be used as an effective training tool for practicing procedural skill.

REFERENCES

1. Ristic AD, Imazio M, Adler Y, Anastasakis A, Badano LP, Brucato A, et al. Triage strategy for urgent management of cardiac tamponade: A position statement of the European Society of Cardiology Working Group on Myocardial and Pericardial Diseases. Eur Heart J. 2014;35(34):2279–84.
2. Zerth H, Harwood R, Tommaso L, Girzadas D V. An inexpensive, easily constructed, reusable task trainer for simulating ultrasound-guided pericardiocentesis. J Emerg Med [Internet]. 2012;43(6):1066–9. Available from: http://dx.doi.org/10.1016/j.jemermed.2011.05.066
3. Ringsted C, Schroeder T V., Henriksen J, Ramsing B, Lyngdorf P, Jønsson V, et al. Medical students' experience in practical skills is far from stakeholders' expectations. Med Teach [Internet]. 2001;23(4):412–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12098390
4. Van Der Vlugt TM, Harter PM. Teaching procedural skills to medical students: One institution's experience with an emergency procedures course. Ann Emerg Med. 2002;40(1):41–9.
5. Makeeva V, Gullett JP, Dowla S, Olson K, Resuehr D. Evaluation of Homemade Ballistic Gelatin Phantoms as a Low-Cost Alternative to Commercial-Grade Phantoms in Medical Education. Med Sci Educ [Internet]. 2016; Available from:
6. http://link.springer.com/10.1007/s40670-016-0258-3
7. Atkinson P, Bowra J, Lambert M, Lamprecht H, Noble V, Jarman B. International Federation for Emergency Medicine point of care ultrasound curriculum. CJEM [Internet]. 2015;17(2):161–70. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26052968
8. Baltarowich OH, Di Salvo DN, Scoutt LM, Brown DL, Cox CW, DiPietro MA, et al. National ultrasound curriculum for medical students. Ultrasound Q. 2014;30(1):13–9.
9. Cresswell JW, Plano Clark VL. Designing and conducting mixed method research. 2nd ed. Thousand Oaks, CA: Sage; 2011.
10. Campo Dell'orto M, Hempel D, Starzetz A, Seibel A, Hannemann U, Walcher F, et al. Assessment of a low-cost ultrasound pericardiocentesis model. Emerg Med Int [Internet]. 2013;2013. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24288616