Original Article

The Focused Cardiac Ultrasound Skill of Newly-Graduated Thai Doctors

Panupong Damgengkajornwong MD[1], Praew Kotruchin MD[2], Kamonwan Ianghong MD[2], Chatlert Pongchaiyakul MD[3]

[1] Out-patient Department, Police General Hospital, Bangkok, Thailand
[2] Department of Emergency Medicine, Khon Kaen University, Khon Kaen, Thailand
[3] Department of Medicine, Khon Kaen University, Khon Kaen, Thailand

Background: Focused cardiac ultrasound [FCU] is a bedside ultrasound protocol. It has emerged as a useful modality in various clinical scenarios, particularly in those that involve acute cardiac conditions. However, the FCU skill of newly-graduated doctors after a short training course has not yet been examined.

Objective: To determine the effectiveness of a short FCU training course for newly-graduated Thai doctors.

Materials and Methods: First-year intern doctors at Khon Kaen University's Faculty of Medicine were enrolled. The three-hour FCU training consisted of lectures and a hands-on echocardiography session. Examples of parasternal short axis [PSA], long axis [PLA], subcostal [SC], pleural scanning [PS] and apical four-chamber [A4C] views were provided. After one month, enrollees' practical skills with regard to image quality and image acquisition time on real patients were evaluated

Results: There was a total of 70 participants, 45.7% of whom were male. The mean age was 24.6 years old. Eighty-seven percent of participants passed the hands-on examination. The passage rates were 97.1% for SC, PSA, and PS views and 95.7% for the PLA view. The lowest passage rate was for the A4C view (92.8%).

Conclusion: The short FCU training course, which included lecture sessions and a hands-on session, was effective. Newly-graduated doctors in Thailand should be trained in FCU in order to improve patient treatment

Keywords: Echocardiogram, Cardiac ultrasound, Training, Skill

J Med Assoc Thai 2018; 101 [Suppl. 7]: S113-S118
Website: http://www.jmatonline.com

Cardiovascular disease [CVD] has been reported as the most common diagnosis in Thai outpatients (including the emergency patients)[1]. One out of 20 emergency patients presented with angina pectoris. Other patients presented with decompensated heart failure, cardiogenic shock, pulmonary embolism and pericardial effusion[2]. Prompt evaluation and diagnosis of CVD to reduce the morbidity and mortality is challenged. When used in conjunction with history taking and physical examination, the focused cardiac ultrasound [FCU] is a safe and rapid tool for timely diagnosis[3-5]. At the present, there are various FCU protocols in clinical practice, i.e., the Focused Assessment Transthoracic Echocardiogram Protocol [FATE][6], Focused Echocardiographic Evaluation in Resuscitation management [FEER][7], and Goal-directed transthoracic echocardiogram[8]. These protocols are useful to differentiate the obvious pathology and how it is related to the clinical presentations of the patient[6], allowing the pathology to be detected in a timely manner.

Focused Assessment Transthoracic Echocardiogram is a widely-used FCU protocol. There are five essential cardiac windows, including subcostal view [SC], apical four-chamber view [A4C], parasternal short axis view [PSA], parasternal long axis view [PLA], and pleural scanning view [PS][6]. One previous study demonstrated that the average time it took an experienced physician to perform FATE protocol was one minute[9]. In addition, non-experienced physicians were able to improve their skills in FATE protocol after a short training course[10,11].

In Thailand, there are 2,000 newly-graduated doctors (first-year interns) per year. They have been

Correspondence to:
Kotruchin P. Department of Emergency Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, 40002, Thailand.
Phone: +66-43-366869, **Fax:** +66-43-366870
E-mail: kpraew@kku.ac.th

How to cite this article: Damgengkajornwong P, Kotruchin P, Ianghong K, Pongchaiyakul C. The Focused Cardiac Ultrasound Skill of Newly-Graduated Thai Doctors. J Med Assoc Thai 2018;101;Suppl.7: S113-S118.

the backbone of the regional hospitals and act as primary care practitioners. Moreover, ultrasound machines are mandatory equipment in Thai primary hospitals. Therefore, implementation of FCU training may be a useful and affordable tool to help newly-graduated doctors evaluate CVD patients in clinical practice. However, there have been no studies evaluating the skills of newly-graduated doctors after undergoing such a training course. Therefore, the present study was designed to determine the effectiveness of a short FCU training course for newly-graduated Thai doctors.

Materials and Methods

A cross-sectional study was conducted at Srinagarind Hospital, a 1,000-bed tertiary care setting and a training hospital for medical students and specialized physicians at the Khon Kaen University Faculty of Medicine in Thailand. The present study was approved by the Khon Kaen University Ethics Committee. All participants, including patients acted as the FCU hands-on training models, signed informed consent forms prior to enrollment.

Population

Doctors in Thailand who had graduated from Thai medical universities and were in their first year of their internship at Srinagarind Hospital in the Khon Kaen University Faculty of Medicine from 2015 to 2016 were enrolled. The doctors who did not sign the consent form, did not fully participate in the FCU training, or did not take the pre-test or post-test were excluded.

FCU training

The participants were assigned to 10-person groups for each training session. Prior to beginning the training, the participants were asked to take a 13-question written examination as a pre-test. The examination consisted of static images and digital real-time cardiac video clips showing normal cardiac anatomy and essential pathological conditions, i.e., pericardial effusion, global ventricular function (normal, impaired), regional wall motion abnormality, and inferior vena cava diameter evaluation (Figure 1). Later, they attended a two-hour lecture about FCU process and interpretation of pathological conditions according to FATE protocol. The lecture was given by a cardiologist and included static slides and video clips with real-time explanation. In addition, there was a one-hour hands-on echocardiography session using a real-patient model. Examples of five FCU views, including parasternal short axis [PSA], long axis [PLA], subcostal [SC], pleural scanning [PS] and apical four-chamber view [A4C] were provided using a GE Healthcare LOGIQ P6 ultrasonography machine. Every participant was trained individually with the cardiologist.

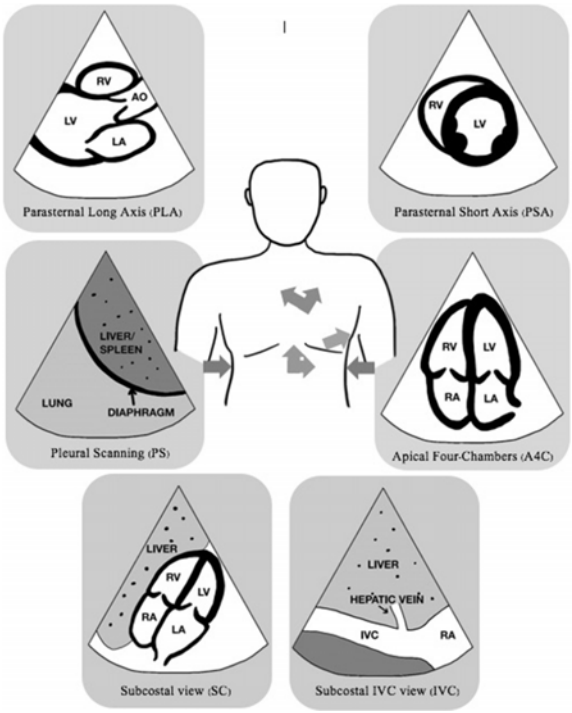

Figure 1. Echocardiographic views demonstrated in focus cardiac ultrasound training.

Evaluation

After one month, the participants were asked to take the same 13-question written examination as a post-test, as well as perform an individual hands-on examination on real patient. The board-qualified cardiologists and emergency physicians evaluated the hands-on examination. A checklist was used to evaluate performance on each of the five FCU views, consisting of main elements: 1) proper orientation of hand and probe, 2) correct explanation of cardiac anatomy (chambers, valves, pericardium, great vessels) and correct pathology identification (pericardial effusion, global ventricular function and inferior vena cava evaluation), and 3) obtaining adequate windows and quality of image. The scores were given according to the checklists. The time spent on acquisition of each image (from the time that the ultrasound probe touched

the patient's skin until the best image was obtained) was measured using a digital timer.

Operating definitions

Participants who achieved a score of more than 80% were considered to have passed the written examination. For the hands-on examination, a possible total of 100 points was given for each of the FCU views. Participants who achieved a score of more than 50 on all FCU views were considered to have passed. Participants who passed both the written and hands-on examinations were considered to have passed the FCU training.

Statistical analysis

The Shaphiro-Wilk test was used to test the distribution of continuous variables. Data was presented as median and interquartile range [IQR] if it was not normally distributed and was presented as mean $\pm$ standard deviation [SD] if it was normally distributed. The categorical variables were presented as percentages. A comparison of pre- and post-test scores was presented as the difference of the median confidence ranges. The Wilcoxon signed-rank test was used to test the difference, which determined the significance level to be 0.05. The factors that related to participants passing the FCU training were tested using binary logistic regression and presented in odds ratio [OR] and a 95% confident Interval (95% CI). The significance level was 0.05. Data were processed and analyzed using STATA version 10 (copyright Khon Kaen University).

Results

A total of 74 first-year intern doctors at Srinagarind Hospital in the Khon Kaen University Faculty of Medicine were recruited from 2015 to 2016. Three doctors did not sign the consent form and one doctor did not fully participate in FCU training. Data of the 70 remaining participants were analyzed (Figure 2). There were 32 males (45.7%) in the present study. Mean age was 24.6$\pm$1.4 years old and mean grade point average [GPA] at graduation was 3.5$\pm$0.3 (Table 1).

The total score on the written examination was 35. The median scores on the pre-test and post-test were 16 (IQR 10.5 to 22) and 32 (IQR 31 to 34), respectively. The difference in the median confidence ranges of the pre-test and post-test scores was 16.5 (95% CI 13, 18, p<0.01).

Eighty-seven percent of participants passed the overall hands-on examination. The passage rates

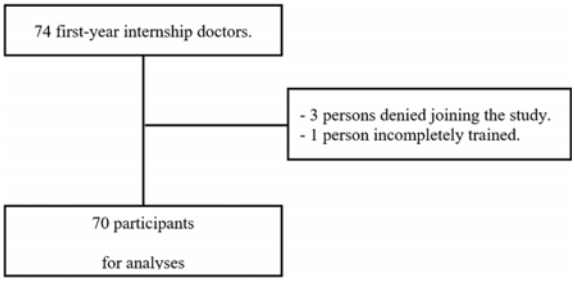

Figure 2. Study population.

Table 1. Baseline characteristics

Characters	n (%)
Gender	
Female	38 (54.29)
Male	32 (45.71)
Age (year)	24.66$\pm$1.43
Grade point average	3.50$\pm$0.27
Pre-test score, median (IQR)	16 (10.5 to 22)
Post-test score, median (IQR)	32 (31 to 34)

IQR = interquartile range

were 97.1% for the SC, PSA, and PS views, and 95.7% for the PLA view. The lowest passage rate was for the A4C view (92.8%). The median time of image acquisition was shortest for the PSA view at 15 seconds (IQR 9,35), and was longest for the A4C view at 35 seconds (IQR 24,60). The median overall image acquisition time was 368 seconds (IQR 316,470; Table 2).

One factor the authors found to be associated with passage of the FCU training was male gender (with a 6.9 times higher passage rate than the women; 95% CI 1.42, 33.83, p<0.01). In addition, male participants had a 9.6-times higher passage rate in the hands-on examination than did the female participants (95% CI 1.15, 80.72, p<0.01). No other factors were significantly associated with passing the FCU training in the present study (Table 3).

Discussion

The present study of a short FCU training course for newly-graduated doctors or the first-year interns showed that three-hours of FCU training (including a two-hour lecture and a one-hour hands-on session) was effective. Eighty-seven percent of participants passed the training course. Scores were highest on the SC view and lowest on the A4C view.

Table 2. Passing rate of hands-on examination and time of image acquisition in each echocardiographic view

Echocardiographic view	n (%)	Time of image acquisition (second)			
		median	IQR	min	max
Subcostal view	68 (97.1)	20	15 to 40	7	80
Apical 4-chamber view	65 (92.8)	35	24 to 60	7	184
Parasternal long axis view	67 (95.7)	20	12 to 32	5	240
Parasternal short axis view	68 (97.1)	15	9 to 35	4	87
Pleural scanning view left side	68 (97.1)	35	20 to 48	10	130
Pleural scanning view right side	68 (97.1)	19	8 to 30	5	171
Total	61 (87.1)	368	316 to 470	163	780

IQR = interquartile range; min = minimum; max = maximum

Table 3. Factors associated with passing of the FCU training

Factors	Odd ratio	95% confidence interval	*p*-value
Male	6.92	1.43, 33.83	<0.01
Prior ultrasound training	0.64	0.07, 5.80	0.68
Prior emergency ultrasound experience ≥3 times	1.15	0.22, 6.03	0.87
Prior any ultrasound experience ≥3 times	1.15	0.36, 3.71	0.81
High self-grading confidence after training FCU	1.63	0.43, 6.21	0.48

The shortest image acquisition time was on the PSA view and longest on the A4C view.

The findings of the present study were consistent with those of a prior study by Jones et al[11] which found that a short FCU training course for emergency medicine residents was effective. In their study, 80% of participants passed the written and hand-on examinations. However, the population in their study had varying experience in emergency ultrasound, while in our study, none of the participants had experience in emergency ultrasound. Our results suggest that a short FCU training course can be useful for educating non-experienced doctors.

Focused cardiac ultrasound is used in emergency settings to answer specific clinically-relevant questions by identifying the presence or absence of one or more findings using a pre-specified protocol[12]. In the present study, we used FATE protocol, which focuses on specific pathologies including pericardial effusion or cardiac tamponade, global ventricular function, pleural effusion, and intravascular volume as estimated by evaluating the inferior vena cava[6]. A study by Frederiksen et al reported that the total time necessary for experienced doctors to perform overall FCU was 69.3 seconds[9]. However, in the present study, this took five times longer, with an average time of 368 seconds. In addition to the lack of experience of the participants in our study, this could also be explained by various other factors. There are five echocardiographic views in the FATE protocol, which have varying levels of difficulty. We found that participants had the lowest scores on the A4C view, and that image acquisition using this view required the longest amount of time. Image acquisition using SC and PSA views did not take as long. This suggests that less-experienced newly-graduated doctors should be encouraged to use SC and PSA views, as they had the highest yields in the present study. These views can be used to evaluate pericardial effusion and global ventricular function regardless of the A4C view.

Male gender was found to be associated with passing the FCU training in this study. This is not consistent with previous research in this area. Beaulieu et al. found that gender was not associated with the success rate of bedside ultrasound training using web-based e-learning and simulation[13]. Further research should be conducted to determine the factors

that predict successful FCU training.

To our knowledge, this was the first study to determine the effectiveness of a short FCU training course for first-year intern doctors in Thailand. The strength of the present study was that the training included both lectures and a hands-on session in real patient models. The participants had one month after training to gain real-world experience before coming to test how much knowledge they retained from the course. One limitation of the present study was that the examination has not been formally validated, and, thus, might not accurately represent a real-world setting. Moreover, there was only a single training session. Repeat sessions may be more effective for improving performance in using the difficult FCU views.

In conclusion, FCU has been proposed as a useful tool in a variety of clinical scenarios. The short FCU training course is effective for newly-graduated Thai doctor who are crucial to primary and emergency care in most regional hospitals throughout the country.

What is already known on this topic?

Focused cardiac ultrasound performed by emergency physicians has been proven to be a useful method for timely diagnosis of acute cardiac conditions such as pericardial effusion, cardiac tamponade, and the presence or absence of poor left ventricular contraction.

What this study adds?

The authors found that newly-graduated doctors who had no experience using ultrasounds or echocardiograms could be effectively trained in FCU.

Acknowledgements

The authors wish to thank the residents and staff at the Khon Kaen University Department of Emergency Medicine for their support. We would also like to thank all of the patients who participated in this study.

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Office of Permanent Secretary for Public Health, Ministry of Public Health. Number of out-patients by 21 cause groups according from health service units, Ministry of Public Health, Whole Kingdom 2005-2014 [Internet]. 2014 [cited 2016 Nov 19]. Available from: http://service.nso.go.th/nso/web/statseries/tables/00000_Whole_Kingdom/out-48-57.xls.
2. National Hospital Ambulatory Medical Care Survey, Center for Disease Control and Prevention (CDC). National Center for Health Statistics [Internet]. 2011 [cited 2016 Nov 19]. Available from: http://www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2011_ed_web_tables.pdf.
3. Tayal VS, Kline JA. Emergency echocardiography to detect pericardial effusion in patients in PEA and near-PEA states. Resuscitation 2003;59:315-8.
4. Hauser AM. The emerging role of echocardiography in the emergency department. Ann Emerg Med 1989;18:1298-303.
5. Bocka JJ, Overton DT, Hauser A. Electromechanical dissociation in human beings: an echocardiographic evaluation. Ann Emerg Med 1988;17:450-2.
6. Jensen MB, Sloth E, Larsen KM, Schmidt MB. Transthoracic echocardiography for cardiopulmonary monitoring in intensive care. Eur J Anaesthesiol 2004;21:700-7.
7. Breitkreutz R, Walcher F, Seeger FH. Focused echocardiographic evaluation in resuscitation management: concept of an advanced life support-conformed algorithm. Crit Care Med 2007;35(5 Suppl):S150-61.
8. Manasia AR, Nagaraj HM, Kodali RB, Croft LB, Oropello JM, Kohli-Seth R, et al. Feasibility and potential clinical utility of goal-directed transthoracic echocardiography performed by noncardiologist intensivists using a small hand-carried device (SonoHeart) in critically ill patients. J Cardiothorac Vasc Anesth 2005;19:155-9.
9. Frederiksen CA, Juhl-Olsen P, Larsen UT, Nielsen DG, Eika B, Sloth E. New pocket echocardiography device is interchangeable with high-end portable system when performed by experienced examiners. Acta Anaesthesiol Scand 2010;54:1217-23.
10. Frederiksen CA, Juhl-Olsen P, Nielsen DG, Eika B, Sloth E. Limited intervention improves technical skill in focus assessed transthoracic echocardiography among novice examiners. BMC Med Educ 2012;12:65.
11. Jones AE, Tayal VS, Kline JA. Focused training of emergency medicine residents in goal-directed echocardiography: a prospective study. Acad Emerg Med 2003;10:1054-8.
12. Spencer KT, Kimura BJ, Korcarz CE, Pellikka PA, Rahko PS, Siegel RJ. Focused cardiac ultrasound: recommendations from the American Society of

Echocardiography. J Am Soc Echocardiogr 2013;26:567-81.
13. Beaulieu Y, Laprise R, Drolet P, Thivierge RL, Serri K, Albert M, et al. Bedside ultrasound training using web-based e-learning and simulation early in the curriculum of residents. Crit Ultrasound J 2015;7:1.