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Rapid decay of transthoracic echocardiography skills at 1 month: A prospective observational study

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OBJECTIVE: Focused transthoracic echocardiography (FTTE) is an emerging tool in the management of critically ill patients, but the lack of adequate training models has limited the expansion of this technology. Although basic FTTE training courses have been shown to be sufficient in developing echocardiography skills, limited data exist regarding skill retention. In an effort to develop an adequate FTTE training model, we sought to determine the degree of skill retention after FTTE training.

DESIGN: A prospective, observational study.

SETTING: An academic center.

PARTICIPANTS: Surgical residents and medical students: 31 subjects were enrolled from February to June 2016.

RESULTS: Participants underwent a 2-hour FTTE course including didactics and a hands-on session measuring ejection fraction of left ventricle (LV) and inferior vena cava (IVC) diameter. Written knowledge and performance examinations applying FTTE were conducted before the course, immediately after, and at 1- and 3-month intervals, which were evaluated on a 0 to 9 scale and analyzed with paired *t*-tests. Performance examination scores obtaining the LV and IVC views preinitial and postinitial training increased from 1.7 to 6.5 (LV) and from 2.0 to 6.8 (IVC) ($p < 0.01$), decreased to 5.0 and 4.8, respectively, at 1 month (posttraining vs 1 month, $p < 0.01$), and did not significantly change at 3 months (5.4 and 5.0, respectively). Written examination scores increased from 42% to 62% (pretraining vs posttraining, $p < 0.01$), decreased to 48% in 1 month (posttraining vs 1 month, $p < 0.01$), and further decreased to 34% at 3 months (1 month vs 3 month, $p < 0.01$).

CONCLUSIONS: Although a short training course appears sufficient to impart basic FTTE skills and knowledge, skills are significantly decayed at 1 month and knowledge continually decreases at 1 and 3 months. Future FTTE training models should consider the rapid degradation of knowledge and skills in determining frequency of refresher training and ongoing evaluation. (J Surg Ed ▮:▮▮▮-▮▮▮. © 2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: echocardiography, ultrasound training, critical care ultrasound, bedside ultrasound

COMPETENCIES: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement

INTRODUCTION

Transthoracic echocardiography (TTE) is typically performed by cardiologists, but less than comprehensive bedside focused TTE (FTTE) by noncardiologists has developed to broad applications in the diagnosis, monitoring, and management of critically ill patients.[1] Multiple groups including anesthesiologists, intensivists, surgeons, and emergency physicians have expressed interest in using FTTE to provide real-time information related to the immediate care of critically ill patients.[2-4] Various FTTE protocols have been developed with different sets of echocardiographic views and assessments, including focused assessment with TTE, bedside echocardiographic assessment in trauma/critical care, focused echocardiographic examination in life support, focused echocardiographic evaluation in

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resuscitation management, and bedside limited echocardiography by emergency physicians.[5-9] A recent consensus statement recommends the application of FTTE in the setting of hemodynamic instability of uncertain or suspected cardiac etiology, and there is also strong agreement among international critical care experts regarding recommendations for appropriate use of FTTE in critically ill patients, based on systematic evidence review.[10,11]

Despite its increasing popularity, studies demonstrating improved clinical outcomes for critically ill patients managed by FTTE are generally lacking, and it has been emphasized that adequate training and external certification of operators who perform FTTE are required to perform randomized studies.[1,11-13] It is also recognized that similarly trained practitioners are needed for implementation of FTTE as well as quality assurance of echocardiographic images.[1,13] Although the vast majority of adult and pediatric intensivists are trained in performing ultrasound in a wide variety of clinical settings, there is no standard process of credentialing, and the optimal training model of FTTE remains controversial.[14-16] A 1-day training course has been shown to be sufficient for a noncardiologist to attain basic FTTE skills,[17] while experience from cardiology and cardiac anesthesiology indicates that at least 50 supervised studies are required to perform and interpret FTTE independently.[18]

Furthermore, there is considerable debate regarding the type and frequency of posttraining continuing education requirements and how this may influence skill retention. As acquisition and interpretation of FTTE images are clinical skills, it is suggested that accreditation and privileging should include continuing education that will form the basis for quality assurance.[19,20] Unfortunately, there are limited data regarding the degree of skill retention posttraining, despite this information being a critical and necessary component for establishing adequate training models and thereafter evaluating FTTE protocols.

In an effort to eventually develop an appropriate FTTE training model, we sought to determine the degree of skill retention after initial FTTE training. We hypothesized that skills of FTTE gained in a 2-hour training session would be decayed in 3 months without continuous or repeat training, and longitudinally examined FTTE knowledge and skills on acquisition of ultrasound images.

METHODS

Study Design

We conducted a prospective observational study with surgical residents and medical students (MS) to test the hypothesis that FTTE skills gained in a 2-hour training composed of hands-on practices, and lectures would be decayed in 3 months without continuous or repeat training. This study was reviewed and approved by the institutional review board for the conduct of human research before enrollment of subjects.

Study Setting and Population

The study was performed at a large academic medical center from February 2016 to June 2016. Study subjects were second- and third-year MS (MS-2 and MS-3) at the University of Texas Health Science Center at San Antonio Medical School and postgraduate year 1 (PGY-1) residents in University of Texas Health Science Center at San Antonio General Surgery Program. After providing general information about the study to all MS-2s, MS-3s, and PGY-1s, interested students and residents volunteered to participate. We obtained informed consent from each subject and ensured the subject's voluntary agreement to participate.

Study Protocol

FTTE Training

All subjects underwent a 2-hour FTTE training that was developed by the authors based on existing 1-day training courses that had been reported. The training curriculum consisted of 1 hour of didactics and 1 hour of hands-on practice. Lecture-based didactics included basic physics of echocardiography, familiarization with the echocardiography machine, image orientation on basic views, anatomical identification and evaluations, and left ventricular ejection fraction (LVEF) and inferior vena cava (IVC) diameter measurements. During hands-on practice sessions, each subject performed FTTE on live models who were healthy volunteers, obtained parasternal long-axis view and subcostal views, and learned to measure LVEF and IVC diameter. FTTE was performed using the Sonosite M-turbo Ultrasound System (FUJIFILM Sonosite, Bothell, WA) equipped with a 5 to 1 MHz broadband sector, phased array transducer. Didactics and hands-on training were jointly provided by a board-certified anesthesiologist and a trauma and critical care fellow previously trained in FTTE, and the teacher to subject ratio was either 1:2 or 1:3 during the hands-on practice session. Healthy volunteers were prescreened to be adequate echocardiography FTTE models by a certified echosonographer.

Examinations and Evaluation of Skills

Written knowledge examinations as well as performance examinations applying FTTE on live models who were healthy volunteers were conducted before the course, immediately after the course, and at 1- and 3-month intervals. Information about the study subject's previous or interval experience of ultrasound was also obtained simultaneously.

Performance examinations consisted of subjects obtaining 2 specific ultrasound images: a (LV) image on parasternal long-axis view and an IVC image on subcostal view. They