

Association for Surgical Education

An early surgical training module for compartment pressure measurement



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KEYWORDS:

Surgical education;
Structured resident
education;
Compartment
syndrome;
Compartment pressure

Abstract

BACKGROUND: We test a novel simulated teaching module's ability to educate junior residents in the assessment of compartment syndrome (CS) and compartment pressure measurement (CPM).

METHODS: Twenty-two postgraduate year 1 and postgraduate year 2 surgical residents received a 2-hour didactic and practical teaching module on CS assessment and CPM using a simulated model. A structured teaching session by a postgraduate year 5 surgical resident was assessed by carefully constructed pretest, post-test, and delayed retention tests and a practical testing session by 2 board-certified general surgeons.

RESULTS: Analysis of variance demonstrated significant difference between pretest (6.1/10), post-test (7.9/10), and retention test (8.2/10) scores [F (2,49) = 9.24, $P < .01$], with no difference in post-test to retention test comparison ($P = .90$). Mean CPM scores were 8.5/10 for preparation, 9.0/10 for performance, and 8.5/10 for management components, which did not differ [F (2,57) = .46, $P = .63$].

CONCLUSIONS: We demonstrate an efficient simulated CS and CPM teaching module for the education of junior surgical residents using a synthetic model.

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The timely diagnosis and treatment of compartment syndrome (CS) are crucial to prevent the morbidity associated with its sequelae, such as renal failure and limb loss.¹⁻³ Despite the benefits of early identification, CS poses a challenge to clinicians as diagnosis relies largely on clinical judgment.^{1,4,5} We identified a need for increased early exposure to the diagnosis and management of CS in a surgical training curriculum. This report describes a didactic and practical, synthetic model-based, simulated

teaching module to improve junior surgical residents' ability to diagnose and manage CS.

Technical proficiency in compartment pressure measurement (CPM) is a vital aspect of care; however, the diagnostic utility of the intracompartmental pressure monitor relies on the clinician's technical proficiency. One study describes a 35% false positive rate for intracompartmental pressure monitors in the diagnosis of CS.⁶ The timely and accurate identification and treatment of CS are crucial to preserve limb function, quality of life, and reduce the morbidity associated with unnecessary fasciotomy.^{4,7-9} We postulate that an educational module targeted toward junior surgical residents may increase the knowledge base and technical proficiency of CS diagnosis.

Many studies encourage simulated teaching modules in surgical education¹⁰⁻¹⁴ and have documented the efficacy

The Brown University Summer Assistantship supported this study, but played no role in the formulation of this study or the publication of this manuscript.

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Manuscript received May 28, 2015; revised manuscript August 13, 2015

of CS evaluation^{15–17} and CS teaching modules¹⁸ through animal models. However, the value of a simulated CS teaching module for junior surgical residents using a synthetic model has not been directly investigated previously. We describe the impact of a novel synthetic model, simulated teaching module on junior surgical residents' knowledge base and technical proficiency in the diagnosis and management of CS. Quantitative measures include multiple-choice testing before, immediately after, and 1 month after administration of the teaching module, and practical testing by board-certified acute care surgeons. We offer this novel simulated teaching module for to aid in the training of junior surgical residents in CS management.

Methods

Participants

This project was conducted in accordance with institutional standards of ethics and was granted exemption from institutional review board review per federal regulation 45 Code of Federal Regulations 64.101(b)(2) for educational studies. This instructional module was administered during the course of an established training curriculum provided for incoming junior surgical residents at a level I trauma center. Twenty-two junior surgical residents gave informed consent and participated. All participants completed the pretest, 21 participants completed the post-test, and 12 participants completed the retention test.

Equipment

We used intracompartmental pressure monitors (295-000-000, Stryker Corporation; Kalamazoo, MI) and CS leg models (ERP #1519-6 and #1703-217, Sawbones; Pacific Research Laboratories Inc., Vashon Island, WA). The pretest and knowledge retention test were administered using Qualtrics Survey Software (Provo, UT).

Teaching module

Junior surgical residents received a 60-minute didactic and 90-minute practical session on the clinical assessment and performance of CPM for the diagnosis and management of CS. The sequence of module components is outlined in Fig. 1. Participant proficiency was measured

with a carefully constructed pretest and post-test multiple-choice examination after the didactic teaching session, as well as a knowledge retention test 1 month after module administration.

Written assessment

A panel of 40 written test questions were developed to address principles of CS diagnosis, management, and treatment based on existing literature.^{1–4,17,19–29} We administered these 40 questions to 14 senior residents. Based on the number of correct responses, the questions were categorized by difficulty level: easy ($n = 13$, $\geq 90\%$ correct), medium ($n = 4$, $\geq 80\%$ correct), hard ($n = 4$, $\geq 70\%$ correct), and very hard ($n = 19$, $\leq 70\%$ correct). Using this information, we created 3 unique 10-question tests of equal difficulty and comparable content based on senior resident performance (pretest score 6.9/10, post-test score 6.7/10, and retention test score 6.8/10, which did not differ significantly by 1-way within-subjects analysis of variance [ANOVA; $F(2,27) = .01$, $P = .99$]). Ten questions were discarded to maintain equivalent question categories and difficulty across tests.

Subjects were notified by an email containing a link to a confidential online survey containing the pretest, which was administered within 5 days before the administration of the teaching module. A PowerPoint presentation consisting of a case presentation and summary of fundamental concepts for the involved anatomy, physiology, diagnosis, and treatment of CS was presented with audience participation that was concluded with a question-and-answer session. This presentation included video examples of CPM technique and a demonstration of the Stryker intracompartmental monitor and Sawbones simulated lower extremity model. After the initial demonstration, the intracompartmental pressure monitor was distributed to each participant for the opportunity to establish familiarity with the device, and a member of the audience then demonstrated performance of the technique. Each resident had the same exposure to the intracompartmental pressure monitor beforehand and had no further practice before the practical examination. The post-test was administered after completion of the didactic portion. Participants were then directed immediately to the practical component. The knowledge retention test was administered 1 month after the teaching module via emailed link to a confidential online survey to evaluate the maintenance of learned information.

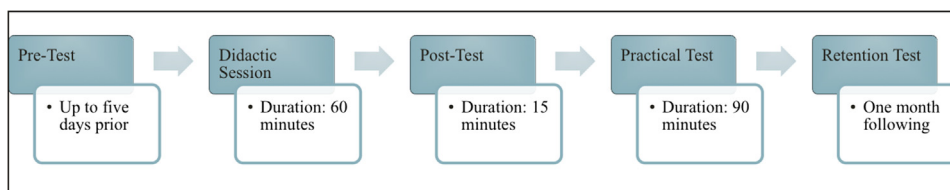


Figure 1 Sequence of module components.

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