Curricula for Teaching MRI Safety, and MRI and CT Contrast Safety to Residents: How Effective Are Live Lectures and Online Modules?

Jordan Swensson, MD, Lane McMahan, MD, Ben Rase, MD, Bilal Tahir, MD

Abstract

Purpose: The advent of the diagnostic radiology core examination and the new ACGME "milestone" evaluation system for radiology residents places new emphasis on topics in MRI and CT safety, and MRI and CT contrast agents. We evaluated whether either lecture-based teaching or online modules would improve baseline resident knowledge in these areas, and assessed which intervention was more effective.

Methods: Before didactic intervention, 2 cohorts were created from 57 radiology residents, with equal numbers and a matched level of training. The residents were tested on their baseline knowledge of MRI, MRI contrast safety, and CT contrast safety, using a multiple-choice examination. One group attended a live, 1-hour lecture on the preceding topics. The other engaged in 3 short online educational modules. After 6 weeks, the residents were again tested with the same questions to assess for improvement in their understanding.

Results: Both the module and lecture cohorts demonstrated a statistically significant increase in questions answered correctly on CT contrast safety (13.1%, $P < .001$, and 19.1%, $P < .001$, respectively), and on MRI and MRI contrast safety (12.9%, $P < .001$, and 14.4%, $P < .001$). The preintervention and postintervention scores, and degree of improvement postintervention, were similar for the module versus lecture groups, without a statistically significant difference ($P = .70$). Resident confidence improved in both groups, for both modalities.

Conclusions: Focused didactic intervention improves resident knowledge of MRI and CT safety, and MRI and CT contrast agents. Live lectures and online modules can be equally effective, allowing residency programs flexibility.

Key Words: Education, MRI, CT, contrast, residents

J Am Coll Radiol 2015;12:1093-1096.

INTRODUCTION

The demands on today's radiology residency programs continue to evolve and expand. Each program faces the challenges and opportunities inherent in resident education in the nascent stages of the ABR Core Examination [1]. Residency programs affiliated with the ACGME have been provided with a new framework for evaluating residents: a joint project with the ABR known as the Diagnostic Radiology Milestone Project [2]. The goal of the project is to provide a framework to help program directors assess residents' progress in multiple areas of clinical and professional competency.

The new evaluation framework will require residency programs to re-evaluate the proportioning of resources, to facilitate the goals of the milestone project. One area that will likely present a challenge is the teaching and evaluation of noninterpretive skills, an area of professional development that traditionally has been assigned a lower priority. To address this new evaluation paradigm, residency programs have developed and will continue to develop new models and tools to aid their work. Our interest lies in the subarea of the Milestones of Practice-based Learning and Improvement, specifically, patient safety as it relates to contrast agents, radiation safety, MR safety, and sedation.

A variety of work has been done to explore the idea of educating residents in the areas of MRI physics and, to a lesser degree, MRI safety, as well as CT contrast and safety [3-5]. But to our knowledge, no targeted research with the milestones in mind has been done to evaluate effective ways to educate residents on these topics. Here, we present

Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, Indiana.

Corresponding author and reprints: Jordan Swensson, MD, Indiana University School of Medicine, Department of Radiology and Imaging Sciences, University Hospital, Room 0641, 550 N University Blvd, Indianapolis, IN 46202; e-mail: jswensso@iupui.edu.

The authors have no conflicts of interest related to the material discussed in this article.

1546-1440/15/$36.00 ■ http://dx.doi.org/10.1016/j.jacr.2015.04.012

data on our efforts to objectively measure the utility of online modules and traditional didactic lectures in teaching these important milestone concepts. More specifically, we measured overall improvement in knowledge and subjective comfort in using online modules versus didactic lectures to teach the same material.

METHODS

Our study was carried out at our single large academic radiology residency program. A total of 57 radiology residents participated, spanning all levels of resident radiology training (years 1 through 4). At the outset, the residents were split into 2 cohorts that were matched for year of training (Table 1). A set of 42 questions was designed by the investigators to cover the areas of MRI safety, MRI contrast and contrast use safety, and CT contrast and contrast use safety. Specific topics included types and doses of MRI and CT contrast, contrast reactions, contraindications, and MRI department zones (Fig. 1).

These questions were presented to the residents via online survey tools. These data were used to establish a knowledge baseline for the 2 cohorts. An additional question regarding the residents' subjective comfort in their knowledge about the areas described was included, using a 5-point Likert scale, with 5 representing the highest degree of comfort.

Before the education intervention, a set of 3 modules was created by the investigators, each focusing on 1 of the areas described. The material included in the modules was taken primarily from the ACR Guidance Document for MR Safe Practices [6], the ACR Manual on Contrast Media [7], and the ABR's study guide for the residency core examination. These modules were created using PowerPoint (Microsoft Corporation, Redmond, Washington) and transferred to Adobe Captivate (Adobe Systems, Inc, San Jose, California). One of the investigators hosted the modules on a website.

Following this, 1 cohort was given access to the online modules and instructed to complete them at their own pace over the course of approximately 1 week. The other cohort was instructed to attend a 1-hour live lecture during dedicated didactic time during the workday. This lecture was provided by the investigators and contained information identical to that compiled in the online modules.

Approximately 6 weeks after these educational interventions, the initial set of questions was administered to the lecture and module cohorts. The residents' subjective comfort level with the material was reassessed. The pre- and post-intervention data were collected and evaluated. A paired t test was used to evaluate whether statistically significant improvement occurred with intervention. An unpaired equal variance test was performed to evaluate performance and improvement, for comparison of the cohorts.

Table 1. Demographics of participants in study cohorts

PGY Year	Lecture Cohort	Module Cohort
2	8	7
3	6	6
4	7	7
5	8	8
Total	29	28

Note: Values are # of residents. PGY = postgraduate year.

RESULTS

A total of 50 of the 57 residents completed the entire CT study; 51 of the 57 residents completed the entire MRI study. Those who did not complete the entire study did not take 1 of the pre- or post-intervention tests, and their data were excluded. After data collection and statistical analysis, as described earlier, the results of questions pertaining to CT contrast and safety and MRI contrast and/or safety were separated; they are reproduced in Tables 2 and 3.

Cohort performance was not statistically significantly different before the lecture or modules. The performance of the residents in the lecture and module cohorts after the educational intervention was compared. In the area of CT contrast and safety, the lecture cohort demonstrated an absolute improvement of 19.2% in percentage of questions answered correctly after the educational intervention ($P < .001$). The module cohort demonstrated an absolute improvement of 23.1% in percentage of questions answered correctly ($P < .001$). The percentage correct did not differ significantly between the module and lecture cohorts in either the pre- or post-intervention raw scores.

In the area of MRI contrast and/or safety, the lecture cohort demonstrated an absolute improvement of 14.5% in percentage of questions answered correctly after the educational intervention ($P < .001$). The module cohort demonstrated an absolute improvement of 12.9% in percentage of questions answered correctly ($P < .001$). The percentage correct did not differ significantly between the module and lecture cohorts in either the pre- or post-intervention raw scores.

The degree of improvement in the lecture group was not significantly different, compared with the module group, in knowledge of either CT contrast and safety or