

Improving Education for the Management of Contrast Reactions: An Online Didactic Model

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Purpose: Radiologists could improve their knowledge of contrast reaction management. The aim of this study was to evaluate to what degree the implementation of a didactic module resulted in improved technologist, nurse, and physician knowledge and comfort levels regarding the appropriate management of adverse reactions to contrast media.

Methods: After institutional review board approval was obtained, nurses, technologists, and physicians involved in contrast administration were required to complete the educational module. Premodule and postmodule assessments were designed online. Each assessment included knowledge-based questions regarding the appropriate management of different types of contrast reactions, as well as questions regarding each respondent's comfort level with the treatment of various types of adverse contrast reactions. Comfort level was measured using a 6-point, Likert-type scale. Premodule and postmodule assessment scores were compared using McNemar's test.

Results: After module completion, physicians demonstrated a statistically significant improvement in knowledge regarding the proper administration route, concentration, and dose of intramuscular epinephrine. Physicians demonstrated significantly increased comfort with the administration of intramuscular epinephrine to adult and pediatric patients after module completion ($P < .05$). Module completion resulted in statistically significant improvements in respondents' comfort levels with the treatment of an adverse reaction to contrast media, although 19% of personnel still reported feeling uncomfortable after completing the module.

Conclusions: Didactic instruction in contrast reaction management results in improved knowledge and comfort levels for physicians, nurses, and technologists. However, a significant percentage of personnel still reported feeling uncomfortable treating an adverse contrast reaction after module completion, suggesting that didactic instruction alone may be inadequate.

Key Words: Education, adult learning, contrast media/adverse effects, questionnaires, anaphylaxis/prevention and control

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INTRODUCTION

Adverse events from low-osmolality ionic and nonionic contrast media are rare, with overall incidence ranging from 0.2% to 0.7% [1-3]. The frequency of adverse events after the intravenous injection of gadolinium ranges from 0.02% to 2.4% [3,4]. Although rare, these reactions are potentially life-threatening events.

Because of the low incidence of adverse reactions to contrast media, it is expected that only a minority of personnel, even in a high-volume department of radiology, would have been recently involved with the treatment of a patient's adverse contrast reaction. Infrequent involvement in the treatment of adverse contrast reactions likely explains why radiologists lack sufficient knowledge in contrast reaction management. A survey of Canadian and US board-certified radiologists regarding the treatment of contrast reactions demonstrated that 9% were unable to identify epinephrine as the treatment of choice for moderate to severe contrast reactions, and 89% were unable to describe what potencies and delivery systems for epinephrine are available in their facilities' treatment boxes [5]. The majority of radiologists do not know an appropriate epinephrine dose, and incorrectly administered doses are more likely to be overdoses [2,6].

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Incorrect treatment can lead to adverse outcomes, including cardiac sequelae and death [2].

Within our large medical school-affiliated radiology department, an online educational module was developed to educate departmental personnel regarding contrast and emergency management. In this study, we evaluated to what degree the implementation of a didactic module resulted in improved technologist, nurse, and physician knowledge and comfort levels regarding the appropriate treatment of an adverse reaction to contrast media. We also sought to understand if didactic instruction differentially improved knowledge and comfort levels in various role groups (eg, physicians, nurses, and technologists).

METHODS

This HIPAA-compliant study was undertaken after institutional review board review.

Online Module Development

Within a large medical school-affiliated radiology department, a departmental committee developed an online educational module regarding contrast and emergency management. From April to September 2010, a 1-hour-long module was created with 4 components: general concepts of emergency management and team dynamics, overview of the various types of reactions to intravenous contrast media and the treatment algorithms for the most common types of adverse reactions in adults and children, treatment of contrast media extravasations, and an overview of the contents and use of the department's contrast reaction kits. The 4 components could be completed in 1 sitting or up to 4 sittings, at the discretion of the individual completing the module. The module consisted of slides with audio overlay and "how-to" video vignettes. For example, a short video demonstrated the correct use of an epinephrine autoinjector.

Online Module Assessments

In addition to the module, the departmental committee developed multiple-choice premodule and postmodule assessment questions using Zoomerang Online Surveys and Polls (Zoomerang, Palo Alto, California). The postmodule assessment was composed of identical multiple-choice questions as the premodule assessment, as well as one additional question regarding the utility of the online module itself (Appendix). Premodule and postmodule assessments included questions relevant to the content in each of the 4 module components. Multiple-choice questions interrogating a respondent's comfort level were scored on a 6-point Likert-type scale (eg, question 7 in the Appendix). A pilot group of 5 departmental personnel vetted the assessments' questions for accuracy, applicability, and ease of use. Completion of the premodule assessment was required before proceeding with the online module content. Completion of the postmodule assessment was required after each respondent had viewed

all 4 components of the online module. Premodule and postmodule assessments were linked to each individual by a unique identifier entered by each respondent. If a respondent incorrectly entered this unique identifier, the premodule and postmodule assessments could not be linked to a single individual, limiting inclusion in data analyses. Each respondent was required to self-identify with a role group (ie, resident physician, clinical fellow, attending radiologist, technologist, nurse, physician assistant or nurse practitioner, or other, such as clinical research coordinator, technologist assistant, or manager). A subset of questions required completion only by physicians (questions 10, 11, 16, and 17 in the Appendix), so respondents who self-identified in a nonphysician role group were not shown these questions. Each respondent was also required to self-identify the percentage of clinical time spent performing interventional procedures.

Study Participants

All physicians and nurses in the radiology department were required to complete the online module and premodule and postmodule assessments. Subsets of technologists, physician assistants or nurse practitioners, and other personnel involved in contrast administration or interventional procedures were also required to complete the module and assessments. Eligible personnel were invited to complete the module through a hyperlink embedded in a departmental e-mail, with e-mail reminders to confirm completion by the assigned due date. Completion was required for all departmental personnel during the summer of 2011. Of 725 departmental personnel required to complete the module and premodule and postmodule assessments, 522 completed both assessments, for an overall response rate of 72%.

Statistical Analyses

Data from individuals who completed only the premodule or postmodule assessment were excluded from analyses, unless specifically cited in the results section. Tabular data were compiled from respondents who completed both assessments. Premodule and postmodule assessment data were linked for each individual. For these paired data, proportions on premodule and postmodule assessments were compared using McNemar's test, with P values $< .05$ considered statistically significant.

RESULTS

The premodule assessment was completed by 571 individuals within the department, including 73 resident physicians (12.8%), 68 clinical fellows (12%), 125 attending radiologists (21.9%), 199 technologists (34.9%), 76 nurses (13.3%), 14 physician assistants or nurse practitioners (2.5%), and 16 others (2.8%). Of the 571 departmental personnel who completed the premodule assessment, the postmodule assessment was completed by 522 individuals (91.4%), including 65 of 73 resident physicians (89%), 63 of 68 clinical fellows (92.6%), 116 of 125

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