

The Value of Training Technologists for Adverse Reactions to Contrast

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Purpose To design, implement, and measure outcomes of a technologist education program about anaphylactoid reactions to contrast media.

Methods Radiologic technologists viewed a 45-minute presentation and completed a pretest, posttest, and self-assessment. These steps were repeated 14 months later with different test questions. Statistical analysis included participants' *t* test to assess significant differences ($P < .05$) between pretests and posttests.

Results Seventeen computed tomography (CT) technologists participated in the first educational program, and 19 CT technologists participated in the second session. A statistically significant improvement ($P < .05$) was found between pretest and posttest mean test scores. However, the pretest scores were lower before the second session. Using a Likert scale (1 = completely agree vs 5 = completely disagree), technologists indicated the session improved their knowledge (mean score 1.1), made them more comfortable managing a reaction (mean score 1.1), and fostered confidence in recognizing symptoms of a reaction (mean score 1.4).

Discussion A didactic curriculum of managing anaphylactoid reactions to contrast media offers subjective benefits and short-term objective knowledge gain for CT technologists. After the training, technologists had increased knowledge of and comfort with managing an emergency situation and recognizing symptoms, which help to prevent morbidity and mortality. However, the results indicate that frequent repetition of the material is necessary for long-term gains.

Conclusion A dedicated educational program for technologists helps prevent and manage adverse reactions to contrast media through improved knowledge, increased comfort and confidence, and teamwork development. At a minimum, semiannual training sessions should occur for all technologists to retain knowledge.

Anaphylactoid reactions to iodinated and gadolinium contrast agents are rare but life-threatening events in radiology departments. Previous studies report an overall incidence of anaphylactoid reactions to nonionic iodinated contrast media of 0.2% to 3%, with severe reactions occurring in approximately 0.005% to 0.01% of all injections.¹⁻⁵ At least 4 deaths have been reported from reactions to iodinated contrast media.^{1,3,5} Thus, prevention and successful management of anaphylactoid reactions through continuing education and standard guidelines should be a critical component of a radiology department's quality and safety program.

The majority of education focuses on training the resident, fellow, and attending radiology physician.^{6,7}

However, the radiologic technologist often is the health care professional responsible for recognizing the symptoms of an anaphylactoid reaction. He or she is the first responder who initiates the management chain and notifies the supervising physician of an emergency situation. The technologist also must supervise the event until the physician arrives to assess and treat the patient.

The number of computed tomography (CT) examinations performed grew to more than 62 million in 2007 compared to only 3 million in 1980, and this number continues to increase each year.⁸ Although it is increasingly likely that a technologist will encounter an anaphylactoid reaction to iodinated contrast media during his or her career, many institutions offer no formalized training for technologists in this area.

Literature Review

A literature review was performed using various keywords, including *contrast media*, *adverse reaction*, *anaphylactoid*, *education*, *training*, *regulations*, *technologists*, *radiologic*, *radiology*, *residents*, *emergency*, *simulation*, and *teamwork*. The American Society of Radiologic Technologists (ASRT) and the American Registry of Radiologic Technologists (ARRT) Web sites also were searched for material related to contrast media training and requirements. A study released by the ASRT Education and Research Foundation in 2006 showed that 94.4% of 1550 radiologic technologist respondents were either involved in iodinated contrast administration or supervised others who administered contrast.⁹ Thus, contrast media training is crucial for nearly all technologists. Indeed, the ARRT clinical competency requirements state that in CT simulation training, technologists need to “manage patients as situation requires, including monitoring for possible contrast reactions.”¹⁰ In addition, the American College of Radiology (ACR) practice guidelines state that:

*[A]t a minimum, the technologist should understand the general benefits of contrast media administration, follow protocols that involve intravascular injection of contrast media, understand contraindications to intravascular injection of contrast media, and recognize adverse events following contrast media administration.*¹¹

Annual education and training programs support these ARRT and ACR guidelines. They also are part of an institution's compliance with reviews and continuing education mandated by regulatory agencies such as the Joint Commission.¹²

A study by Tofil et al showed increased subjective and objective scores of technologists involved with residents in one session of high-fidelity simulation training.¹³ However, no other documentation was found in the literature stating the benefits—or lack thereof—of providing technologists with routine, structured contrast media education. Other medical specialties have advocated the benefits of education in the form of a team approach to handling medical emergencies, such as code situations.^{14,15}

Thus, the purpose of this study was to design, implement, and determine the subjective and objective

outcomes of a training curriculum focused on anaphylactoid reactions to iodinated contrast media for radiologic technology personnel. It was hypothesized that the curriculum would provide increased knowledge, comfort, and a teamwork approach and would change the technologists' practice.

Methods

Because this was a quality safety program, institutional review board approval was not required. A diagnostic radiology resident and a board-certified radiologist with previous experience in contrast media lecture and simulation education created a 45-minute PowerPoint (Microsoft) presentation that reviewed:

- How to recognize symptoms of a contrast reaction, with pictures and sample cases.
- The different types of contrast reactions, including typical vital signs seen in moderate and severe reactions.
- Initial treatment steps, such as airway management and oxygen administration route.
- The contents of a contrast reaction box (ie, a box stocked with common medications administered in the event of a contrast reaction).

The sessions also included an anonymous 10-question pretest and a 10-question immediate posttest that had been validated by 2 radiologists not participating in the study implementation. CT technologists on each shift (day and night) viewed the 45-minute presentation and completed an 8-question self-assessment of the training session using a Likert grading scale. The curriculum was repeated 14 months later, with different 10-question pretests and posttests administered.

Statistical analysis included participants' *t* test scores to track improvement of mean pretest and posttest scores and assess differences between night-shift and day-shift technologists with a predefined *P* value of < .05.

Results

For the first portion of the study, 17 CT technologists participated in the contrast media training sessions and completed the tests and evaluation forms. A statistically significant difference was seen in pretest and posttest scores ($P < .01$), with a pretest mean score of 61.3% and a posttest mean score of 100%. All self-assessments were between 1 and 2 on the Likert scale (see Table).

Table

Subjective Outcome Scores Following First Training Session

Postsession Evaluation Statements From Self-Assessment	Mean Score ^a
The session increased my knowledge regarding contrast reactions.	1.1
After this session, I am more comfortable if faced with a contrast reaction.	1.1
I think the session should be given to all new technologists and nurses.	1.1
The cases were useful in reinforcing didactic knowledge.	1.2
The length of the session was appropriate.	1.3
After this session, I am more confident in recognizing the signs of a contrast reaction.	1.4
After this session, I will know what the radiologists expect of me in dealing with a contrast reaction.	1.4

^a Likert scale: 1 = completely agree, 2 = mostly agree, 3 = neutral, 4 = mostly disagree, 5 = completely disagree.

In the reassessment 14 months later, 19 CT technologists (the initial 17 and 2 new technologists) participated and also returned statistically significantly different ($P < .01$) scores: pretest mean score of 52.6% and posttest mean score of 84.2%. No significant difference in test scores was found between day-shift and night-shift technologists ($P < .05$). Participants did not complete a postsession evaluation following the reassessment.

The curriculum is now an annual program at the institution where it initially was conducted and soon will be expanded to magnetic resonance (MR) imaging technologists and radiology nurses at that facility.

Discussion

The study demonstrates that a didactic curriculum of managing anaphylactoid reactions to contrast media offers subjective benefits and short-term objective knowledge gain for CT technologists. After the training, the technologists were more comfortable with the basics of managing an emergency situation and more confident in recognizing symptoms. This increased knowledge and comfort is important to ensuring that timely, proper treatment occurs to prevent morbidity and mortality.

These short-term outcomes are similar to prior research studies that showed immediate improvement of resident knowledge with didactic, simulation, or computer-based curricula about contrast media.^{7,16-18}

However, the lower mean pretest scores 14 months later indicate that without frequent repetition of a curriculum, long-term gains do not occur. A recent study by Trout et al similarly demonstrated that residents' scores were no longer significantly improved relative to pretest scores at 9 months.¹⁹ Scores in the immediate postintervention period and at 3 and 6 months were improved but returned to preintervention scores at 9 months. In addition, residents who had undergone the training for 3 consecutive years did not have statistically significantly higher pretest scores than those new to the curriculum. Predictors of knowledge scores also were time relative to the course, experience with a contrast reaction between examinations, and studying between assessments.¹⁹ Because exposure to a reaction cannot be predicted and studying is an individual decision, it is important to provide, at minimum, semiannual training sessions for all technologists to retain knowledge.

One means of increasing the frequency of training is by including the technologists in the simulation lab training sessions with radiologists and residents. This tactic also prevents monotony of a purely didactic curriculum. Tofil et al have shown improved posttest scores for both residents and technologists after a single simulation lab experience.¹³ Thus, combining didactic material and simulation experience throughout the year might be the best solution and would address different learning styles. Random case-based drills throughout the year also would reinforce knowledge.

After the quality improvement project and additional training, CT technologists were added as instructors in the simulation lab training for intravenous catheter insertion and oxygen administration. These skills are part of basic management during a contrast reaction and continue to foster teamwork within a department.

Potential hindrances to the success of a curriculum for radiologic technologists include access to and funding for simulation training, availability of physicians and managers to create and routinely run didactic sessions, and coordination of technologists' schedules.

Limitations of the study include small sample size, no delayed posttesting, and no inclusion of simulation or

hands-on training in the curriculum. Including MR and fluoroscopy technologists and nurses would increase the sample size for future research.

Conclusion

A contrast curriculum for residents and technologists offers subjective and objective benefits, and CT and MR technologists should receive regular education about anaphylactoid reactions to contrast media. For optimal success, the curriculum should be repeated at least every 6 months to sustain knowledge and skills. The program easily could be replicated at other institutions with minimal expense. Future work should involve obtaining continuing education credits for the technologists who participate in the program, testing long-term retention, and expanding the program to nursing staff, all radiologic technologists, and managers.

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