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Research Article

**BENEFIT OF A VISUAL AID IN THE MANAGEMENT OF
MODERATE-SEVERITY CONTRAST MEDIA REACTIONS**¹Dr Zain ul Hassan,²Dr Anum Amjad,³Dr Abdul Hadi¹MO, THQ Hospital Mankera, Bhakkar., ²WMO, Allama Iqbal Memorial Hospital, Sialkot.,³MO, BHU 59 MB, Khushab.**Article Received:** October 2020**Accepted:** November 2020**Published:** December 2020

Life-threatening anaphylaxis could happen in consequences of administration of IV contrast agents due to adverse reactions. But the ranges of these adverse reaction is low starting from 0.2% to 0.7% for nonionic iodinated contrast media and 0.06% for gadolinium-based contrast media. Many radiologists have minimum experience in managing the contrast reactions because they are rare and 50% radiologist have no idea regarding administration of the correct dose of epinephrine during a severe reaction. A survey conducted in 2009 stated that 91% of radiologists have accurately identified epinephrine as the initial drug of choice for a contrast medium related action. Result demonstrated in such way that 41% have given correct administration route and dose; 11% have knowledge about the concentration were available to them and what concentrations were needed; and 17% would have administered potentially fatal overdoses of epinephrine.

The study concludes that visual aid has significantly associated with more confidence of participants in contrast medium reaction management. But there was reduction in observed error rate which is not statistically significant.

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INTRODUCTION:

Life-threatening anaphylaxis could happen in consequences of administration of IV contrast agents due to adverse reactions. But the ranges of these adverse reaction is low starting from 0.2% to 0.7% for nonionic iodinated contrast media and 0.06% for gadolinium-based contrast media. Many radiologists have minimum experience in managing the contrast reactions because they are rare and 50% radiologist have no idea regarding administration of the correct dose of epinephrine during a severe reaction. A survey conducted in 2009 stated that 91% of radiologists have accurately identified epinephrine as the initial drug of choice for a contrast medium related action. Result demonstrated in such way that 41% have given correct administration route and dose; 11% have knowledge about the concentration were available to them and what concentrations were needed; and 17% would have administered potentially fatal overdoses of epinephrine. This lack of knowledge is a significant concern given that radiologists are often the sole provider responsible for managing a potentially life-threatening contrast medium reaction. In educating the radiologists the high-fidelity simulation courses have been shown to be a most valuable and cost-effective tool. Moreover these simulation courses act as an opportunity to practice medication administration and basic life support management. These skills are essential in the management of adverse reactions to IV contrast media. In emergent clinical situations, Clinical decision algorithms are commonly used in health care. The algorithms briefly explain and instruct about how to give best treatment to a patient for a given clinical problem. In the setting of a reaction to contrast media these algorithms in visual aids can expedite clinical decisions when time is critical. In the management of these situation errors are common and these errors in epinephrine administration can result in life-threatening events. Automated epinephrine intra muscular (IM) devices have been shown to reduce time to epinephrine administration and errors in management. However, errors still occur, including self-administration, which is commonly reported in the general public and health care worker.

The aim of the study is to evaluate a visual aid would decrease time to administer IM epinephrine and lower management error rates.

SUBJECTS AND METHODS:

It was a prospective study approved by institutional review board. In annual high-fidelity contrast medium reaction simulation program all radiology fellows, radiology students and radiology mid-level providers, and radiology nurses were required to

participate. The program consisted of 60 minutes session. Participants in each session were divided into smaller groups of two to four active responders to a simulation while the other participants observed in the room. This division was done to mimic our clinical practice, in which a small group of individuals usually respond to potential contrast medium reactions, including members of radiology nursing. One of the three scenarios provided to participants was a contrast medium reaction of moderate severity in a pediatric patient for which administration of 0.15 mg of IM epinephrine was the most appropriate management. A visual aid was provided to a group on an alternating basis in chronologic calendar order. The visual aid included clinical decision algorithms for response to the following scenarios: unresponsive, hypotensive, wheezing/bronchospasm, facial/laryngeal edema, and urticaria. The moderate-severity contrast medium reaction simulation involved a high-fidelity child mannequin presenting with urticaria and shortness of breath after receiving IV contrast medium. The symptoms did not respond to nebulized albuterol and diphenhydramine. Oxygen saturation subsequently declined with rise in heart rate and respiratory rates, new wheezing, and patient-reported worsening shortness of breath with chest tightness. This scenario was designed to mimic an actual event that occurred in our department. The mannequin had an IV line as well as a thigh pad in place to allow administration of IV or IM medication. The other two simulation scenarios were not examined in this study. One involved a severe anaphylactic contrast medium reaction requiring the use of IV epinephrine, and the other involved a simulated discussion on the appropriate management and workup of a pregnant patient with suspected pulmonary embolism.

The time to epinephrine administration was started as soon as the contrast medium reaction kit was opened by a participant. Errors were not addressed during the simulation but were reviewed and discussed in the debriefing sessions immediately afterward. The Wilcoxon signed rank test was used for comparing survey responses. Times for epinephrine administration were compared using a t test. The proportions of errors were compared with a Fisher exact test. Testing was considered statistically significant with a p value of less than 0.05.

RESULTS:

A total of 128 participants were recruited into the program, out of them 70 participated in the moderate-severity scenario. Of the 128 participants, 70 were male and 58 were female and the mean age was 41 years old. Eighty-five percent completed the annual

simulation-based contrast media reaction. Survey results after the training revealed that 55.8% of all participants felt very comfortable or comfortable and 44.2% felt uncomfortable or very uncomfortable in managing a reaction to contrast media. When asked about their comfort level when a visual aid was available, 93.5% of participants felt they would be very comfortable or comfortable managing a contrast medium reaction, whereas 6.5% said they would be uncomfortable or very uncomfortable ($p < 0.001$). Additionally, 97.8% of participants strongly agreed or agreed that the flowchart would aid in correct route and dose administration of epinephrine to adult and pediatric patients, and 86.9% strongly agreed or agreed that the flowchart would help decrease time to proper administration of medication during a contrast medium reaction. Excluding the groups with errors, the mean time to appropriate administration of IM epinephrine was 97 seconds with versus 152 seconds without the visual aid.

Overall management error rate for all groups was 28.6%. Two groups (18.2%) with access to the visual aid made an error in IM epinephrine drug administration versus four groups (40%) without access. Epinephrine self-administration accounted for five of six errors (83.3%) and was seen in 23.8% of all groups. One (9.1%) occurred in groups with the visual aid versus four (40%) in groups without the visual aid ($p = 0.36$). The remaining error was improper administration of the adult 0.3-mg dose of epinephrine (rather than the appropriate 0.15-mg pediatric dose), which occurred in one group with access to the visual aid.

DISCUSSION:

The few clinical emergencies encountered and managed by radiologists are anaphylactic contrast media reactions. Contrast media reactions are infrequent, and, as a result, radiologists' comfort level with managing these reactions is low. Previous studies have shown that high-fidelity simulation programs, such as the one used in this study, are beneficial in training for infrequent events like contrast media reactions. For example, one study used cognitive aids in a simulation setting of intraoperative anaphylaxis. Results indicated that groups with a linear cognitive aid (flowchart) performed significantly better than groups with no cognitive aid or a branched (more complex) cognitive aid. In addition, pictures on how to actually use the epinephrine autoinjector were included on our aid to help mitigate risk of mistakes in administration. With these results in mind, our study sought to augment the results of prior contrast medium reaction simulation training programs and assess the utility of

visual aids in relation to physician confidence, time to epinephrine administration, and effect on medication dose and administration errors. Of the participants, 87% ($n = 120$) agreed or strongly agreed that the poster would help decrease the time needed to administer the correct medication to manage the contrast medium reaction. Additionally, results of our survey show that the flowchart increased physicians' confidence in their ability to appropriately respond to a moderate-severity contrast medium reaction, with 97.8% of our participants agreeing it would help them to select the correct dose and route of medication administration. Medication errors are common in medicine and likely even more common within emergency situations like anaphylaxis. Prior work has shown anaphylaxis-related medication error rates in a pediatric emergency department up to 35%, and another study found that only 14.4% ($n = 41$) of doctors surveyed would administer epinephrine correctly. Epinephrine is used in both anaphylaxis and cardiac arrest but requires different doses and routes, which may lead to confusion in proper administration. In particular, medication error rates in contrast media reaction simulations as high as 58% have been reported. Furthermore, healthcare providers prefer autoinjectors because of their ease of use, convenience, and speed of administration, among other reasons.

This result highlights the potential of our visual aid to improve management of contrast media reactions by decreasing time needed to administer the proper dose of IM epinephrine. Our study had several limitations. Our small sample size of observed groups made comparison of small differences in error rates and time to epinephrine administration difficult. Future studies looking at single individuals during a simulated contrast medium reaction event are needed. Because of limitations of availability for both our instructors and the simulation laboratory, we were unable to correlate participant responses on the survey regarding comfort with management errors. Moreover the effectiveness of the visual aid was time to epinephrine administration and overall error rate identified during observation.

The study concludes that visual aid has significantly associated with more confidence of participants in contrast medium reaction management. But there was reduction in observed error rate which is not statistically significant.

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