

Evaluation of a sequential structured educational curriculum for emergency medical technicians in airway management

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Abstract

Background and Aims: Emergency medical technician (EMT) training programs for certification vary greatly from course to course, but it is necessary that each course at least meets local and national requirements. It is reasonable to expect that EMTs' performance should improve after a structured educational curriculum. We hypothesized that EMTs' performance in airway management would improve after a sequential structured educational curriculum involving airway, followed by cardiopulmonary resuscitation (CPR) modules, beyond what is achieved after only the airway module.

Materials and Methods: To evaluate this, 76 EMTs were assigned to a 2-week airway module with a structured curriculum. This was followed by the 2-week CPR module, and the EMTs were tested before (preCPR test) and after (postCPR test) the CPR modules for improvement in their airway skills. EMTs also completed a questionnaire to evaluate the curriculum.

Results: PostCPR test mean scores were higher than those of the preCPR test ($P < 0.05$) except for the bag valve mask domain. EMTs evaluated the curriculum and gave a score of 3.7/5 for perceived achievement of goals of the syllabus for improving their airway skills.

Conclusion: Thus, a sequential, structured curriculum in airway management followed by CPR, improves EMTs' performance levels above what they achieved after only the airway module, except for bag valve mask ventilation.

Key words: Airway management, emergency medical technician, structured educational curriculum

Introduction

Emergency medical technician (EMT) or ambulance technician are terms used in some countries to denote a healthcare provider of emergency medical services. Structured curricula in other disciplines, such as internal medicine, have been shown to improve resident knowledge base in that particular discipline.^[1,2] We wanted to evaluate whether structured educational curricula in airway management can improve EMTs performance. The purpose of the current study was to investigate whether a certain set of skills acquired recently from one-training module, if re-employed and reinforced during the course of the next

training module, could result in improvement of the competence of students in the former set of skills. We hypothesized that EMTs competence in airway management, gained after a 2-week airway training module, would improve further after immediate subsequent deployment of these airway skills in a 2-week cardiopulmonary resuscitation (CPR) training module in a sequential, structured educational curriculum. To test our hypothesis, 76 EMTs were assigned to a 2-week airway module with a structured curriculum followed by a 2-week CPR module and were tested for their airway management skills before and after the completion of the CPR module. The structured curriculum was developed following a review of the literature and common airway maneuvers and devices utilized by EMTs for basic level training were included. Since some patients receive cervical spinal immobilization, this was included in the curriculum. EMTs completed a postmodule questionnaire evaluating their perceptions of the degree to which goals for knowledge change were achieved and their preferences for the various teaching methods that were utilized.

Materials and Methods

The study protocol was reviewed and approved by the Institutional Review Board. Subjects included 76 EMTs of

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our Institution. Those EMTs eligible and those who agreed to participate in the study were enrolled after signing an informed consent. There were no EMTs who did not agree to participate in the study.

The EMTs underwent a 2-week basic airway training module, followed by preCPR module test and then went on to complete the CPR module where the skills learnt in the airway management module were employed. They were then subjected to the postCPR module test. Both the airway and CPR training modules consisted of a series of lectures given by the faculty and senior residents of the Department of Anesthesiology as well as individual skill demonstration on the mannequins, under supervision by the faculty. A total of 36 h of training was incorporated into 2 weeks for each of the two modules. Both the preCPR and postCPR tests involved checking the skill levels in airway management of the EMTs. The tests consisted of identical patterns of a viva on the theoretical aspects of each domain, followed by a practical demonstration of skills by each EMT on a mannequin. A flow-chart showing the sequence of the training program for the 76 EMTs is shown in Figure 1. Both the preCPR and the postCPR module tests consisted of five performance domains. The marks were entered onto a computer spreadsheet for data analysis. The five domains for airway assessment testing were: Positive pressure ventilation with a bag valve mask, oropharyngeal airway insertion, nasopharyngeal airway insertion, supplemental oxygen administration, and cervical spinal immobilization. The maximum score was 25 points, and a minimum score was 0. All domains were tested on the Laerdal Airway Management Trainer. The supplemental

oxygen administration test consisted of five different oxygen administration devices.

The residents were not given any feedback on test performance to protect the confidentiality of the examination content.

The airway module consisted of a structured curriculum incorporated in 2 weeks training in both the theoretical aspects and practical demonstration of use of airway devices on the Airway Management Trainer. The CPR module consisted of theoretical aspects of basic life support and advanced cardiac life support, use of defibrillation and use of the automated external defibrillator, as well as actual performance of CPR on the SimMan (Laerdal). During this training, the airway skills picked up during the airway module were reinforced. Each session of airway/CPR lasted around 1 h, and each EMT was asked individually to demonstrate prowess on the mannequin.

A postrotation questionnaire was completed by the EMTs for curriculum evaluation. The questionnaire was a feedback of the entire training experience that the EMTs underwent. This survey was identified by examination number, not name. The residents were asked to rank on a scale of 1-5 (1 = did not address the purpose, 2 = achieved the purpose 30%, 3 = clearly achieved the purpose, 4 = exceeded the achievement of the purpose >50%, 5 = significantly achieved the purpose consistently) the following topics and purposes of the curriculum:

1. Syllabus purpose: To add to your knowledge base in the evaluation and optimization of patients with airway compromise
2. Positive pressure ventilation with a bag valve mask: To improve skills of bag valve mask ventilation
3. Oropharyngeal airway: To improve skills in inserting it
4. Nasopharyngeal airway: To consider the possibility of insertion and improve skills in its use
5. Supplemental oxygen administration: To improve methods of oxygen administration with a variety of devices
6. Immobilizing the cervical spine: To make you consider the possibility of cervical spine injury in trauma patients.

The data was consolidated in a computerized table by an independent party and analyzed. The EMTs also made qualitative comments on each of the above points.

Statistical analysis

For purposes of the study, a convenient sample of 76 EMTs who belonged to three successive batches of the EMT training program, coming for airway and CPR training modules were enrolled. Subsequent *posthoc* power analysis was done based on the assumption that a 30% increase in the mean scores of the postCPR module over the preCPR module, represents a

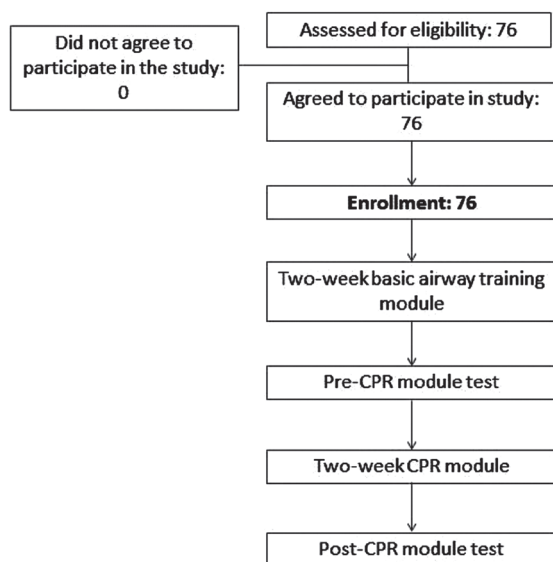


Figure 1: Flow-chart of the training program for the 76 emergency medical technicians

significant improvement in skills. Assuming $\alpha = 0.05$, such calculation indicated the power of the study to be 86.4%.

Statistical analysis was performed using SPSS Statistical Software Version 19 (IBM corp., Armonk, New York, USA). Results were considered significant at $P < 0.05$. Repeated measures ANOVA analysis was used to test the difference between preCPR module and postCPR module mean test scores. Normality assumption was checked for the total scores and the scores in each domain.

For the postrotation questionnaire, a two-sided Wilcoxon rank sum test was used.

Results

Performance

Emergency medical technicians' performance level in basic airway management increased after a sequential, structured curriculum in which the airway module of 2 weeks was followed by 2-week CPR module, except for bag valve mask ventilation. We compared the preCPR module test mean scores for the entire test and in each domain with the postCPR module test mean

scores. The postCPR test mean total score and the postCPR test mean scores of oropharyngeal airway insertion, nasopharyngeal airway insertion, supplemental oxygen administration and cervical spinal immobilization were significantly more than those of the preCPR (but postairway module) test mean scores [Table 1, $P < 0.05$]. The bag valve mask ventilation postCPR test mean scores, however, were not significantly higher than the preCPR test mean scores [Table 1, $P > 0.05$].

Curriculum evaluation

Nasopharyngeal airway insertion was the intervention with the highest mean score of 4.3, that is, exceeded the achievement of the purpose $>50\%$ [Table 2]. Nearly 60% of the responses were proportioned as the highest score of 5 for nasopharyngeal airway insertion [Table 2]. Furthermore, this component of the evaluation received the highest percentages of the residents' responses as a score of 5 [Table 2]. Supplemental oxygen administration received lower scores on the EMTs' evaluations. The residents' evaluation of a structured curriculum indicated that the syllabus was a good reference, but it contained too much material in the airway section to cover in just 2 weeks. Per the EMTs' comments, doing the CPR curriculum following the airway module, enhanced their confidence in the airway management of patients ("I feel more confident about the types of airway management decisions after doing both the airway and CPR modules than after doing only the airway module").

Discussion

This study shows that a sequential, structured educational curriculum in CPR training, immediately following an airway module, increased EMTs' performance in airway management except for the bag valve mask ventilation domain. Furthermore, the EMTs' evaluation of this curriculum indicated that it was useful to have the CPR module immediately following the airway module to improve their performance, and that enhanced their confidence in their airway management skills. The EMTs' performed best on the nasopharyngeal airway insertion domain.

Table 1: Comparison of preCPR module test and postCPR module test mean scores*

Variable	PreCPR module score (mean \pm SD)	PostCPR module score (mean \pm SD)	P value
Total	9.8 \pm 2.8	14.3 \pm 3.1	<0.0001
Bag valve mask ventilation	1.2 \pm 0.7	1.4 \pm 0.8	0.1621
Oropharyngeal airway insertion	2.6 \pm 1.2	4.3 \pm 1.5	<0.0001
Nasopharyngeal airway insertion	2.5 \pm 0.7	4.4 \pm 0.9	<0.0001
Oxygen administration	2.1 \pm 1.4	4.5 \pm 1.7	<0.0001
Cervical spine immobilization	2.1 \pm 1.8	4.7 \pm 1.5	<0.0001

*Repeated measure ANOVA analysis. CPR = Cardiopulmonary resuscitation, SD = Standard deviation

Table 2: Postmodule questionnaire scoring response summaries of syllabus, bag valve mask ventilation, oropharyngeal airway, nasopharyngeal airway, oxygen administration, and cervical spine immobilization*

	Minimum	Median	Maximum	Score proportion (%)				
				1	2	3	4	5
Syllabus	2	4	5	0	14.6	33.3	22.9	29.2
Bag valve mask ventilation	1	3	5	12.2	19.5	34.2	26.8	7.3
Oropharyngeal airway	1	3	5	23.1	18.0	18.0	20.5	20.5
Nasopharyngeal airway	2	5	5	0	4.3	17.4	19.6	58.7
Oxygen administration	1	3	5	25.8	19.4	19.4	22.6	12.9
Cervical spine immobilization	2	4	5	0	6.3	22.9	43.8	27.1

Scoring responses: 1 = Did not address the purpose, 2 = Achieved the purpose 30%, 3 = Clearly achieved the purpose, 4 = Exceeded the achievement of the purpose $>50\%$, 5 = Significantly achieved the purpose consistently. *Two-sided Wilcoxon rank sum test

The EMTs' performance in the bag valve mask domain did not improve even after the CPR module. Factors that can explain this result include the more difficult nature of this domain as compared to others, learning style, the content of the educational experience, the frequency of the instruction and the EMTs' effort.

The EMTs' evaluation of the curriculum indicated that the syllabus was a good reference, but it contained too much material to cover in the airway module within just 2 weeks. Potentially, the syllabus could be given to the resident several weeks prior to the airway training module, or the content of the syllabus could be stream-lined, an approach we need to take.

We believe that the beneficial effects of a structured educational curriculum are found not only in the specific content of the curriculum but also in the way the curriculum is structured to adapt to the diverse learning styles of the residents. It has been shown that individuals have different learning styles. Some prefer to learn by hearing the information and some prefer to visualize the information. Using different teaching methods helps overcome individual preferences for learning, helps maintain the students' interest, and helps reinforce the information.^[3] This reinforcement of learning can enhance the depth of learning, promote the retention of information, and enhance the ability to apply what has been learned.^[3] Our sequential, structured curriculum included a hands-on airway management module, which was followed by a CPR module, where the skills learnt during the airway module were well-utilized leading to better performances in four out of the five domains that we tested for.

The training on the use of the nasopharyngeal airway was well received by the EMTs; however, the domain related to administration of supplemental oxygen received lower scores on the EMTs' evaluations secondary to the problems of adequately explaining the intricacies of oxygen delivery methods within a very limited time frame. Further thought should go into streamlining the curriculum in the future.

The EMTs expressed that doing the CPR module immediately after going through the airway module contributed significantly to improving their airway management skills. The postCPR module test, mean scores of only 14.3 can be significantly improved upon. Furthermore, the interest of available clinical anesthesiologists and staff in EMT training modules may not be present, unless full-time personnel are spared for

these training programs. In the United States, to maintain the National Registry of EMTs certification, basic level EMTs must obtain at least 48 h of additional education and either complete a 24 h refresher course or complete an additional 24 h of Continuing Education that would cover, on an hour by hour basis, the same topics as the refresher course would. At our Institute, EMT training for airway and CPR is provided by clinical Anesthesiologists, who take time off from their clinical duties to run the module.

Conclusions

In summary, this study shows that a sequential, structured educational curriculum in airway management followed immediately by a CPR training module, enhanced EMTs' airway skills, except in bag valve mask ventilation. This improvement in airway management skills can contribute to the optimization of a sick patient's medical status prior to hospital arrival and ultimately lead to achieving all of the benefits that derive from a robust trauma care system, such as prompt response to emergency calls, performance of certain out-of-hospital medical procedures and safe transport of patients to hospital in accordance with protocols and guidelines established by physician medical directors.

We feel that this kind of structured educational curriculum in EMT training is useful and should be adaptable for other programs. One of the limitations of our study is that there will be a need to use validated outcome and assessment measures in the future. Another limitation is the small number of participants, which limits the ability to generalize results. However, because of the great impact of airway management on the optimization of a patient's medical status and the subsequent impact on patient care, we feel that EMT training programs can benefit from such structured educational curriculum in the Emergency Medical Department.

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