

Impact of an Anesthesiology Rotation on Subsequent Endotracheal Intubation Success

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Abstract

Background Endotracheal intubation (ETI) is an essential skill that emergency medicine residents learn throughout their training.

Objective To evaluate the effect of implementing a postgraduate year (PGY)-1 anesthesiology rotation on ETI success in the emergency department during PGY-2.

Methods Residents in the study group completed a 4-week PGY-1 anesthesiology rotation. During the first 6 months of PGY-2, we compared ETI performance of the study group with a control group who did not experience a PGY-1 anesthesiology rotation. Data recorded included date, level of training, first- and second-attempt success, rescue devices used, major adverse events, and intubation scenario. A Pearson χ^2 test was used to compare first-attempt success, overall

success (≤ 2 attempts), and adverse events rates between the 2 groups.

Results Overall success rate for the study groups was 95.7% (111 of 116), compared with 94.5% (137 of 145) for the controls ($P = .66$). First-attempt success for the study group was 78.4% (91 of 116), compared with 83.4% (121 of 145) for the control group; this was not statistically significant ($P = .30$). Observed major and minor adverse events were similar: 19.0% for the study group (22 of 116) versus 24.8% (36 of 145) for the control group ($P = .26$).

Conclusions The addition of an anesthesiology rotation to the PGY-1 curriculum did not have a significant effect on ETI success or the rate of adverse events during the first 6 months of PGY-2. First-attempt overall success and adverse events of our PGY-2 study group were consistent with previously published studies.

Editor's Notes: The online version of this article contains the Airway Card assessment tool used in this study.

Introduction

Endotracheal intubation (ETI) is an essential skill for emergency department (ED) physicians. Emergency medicine (EM) residents gain experience with ETI throughout their training. A large multicenter study reported high levels of EM resident success with ETI.¹ As residents perform more ETIs, their success rate, commonly defined as first- or second-attempt successful passage of the

endotracheal tube, should improve. One study defined the "learning curve" for ETI success rate at 90% (95% confidence interval [CI], 0.80–0.99) after a median of 57 ETI attempts.² Another report suggested that postgraduate year (PGY)-1 residents completing a 1-month anesthesiology rotation required approximately 19 intubation attempts to complete the learning curve.³ The learning curve for paramedic students with a success rate of 96% was reported at a median of 30 ETI attempts.⁴ These studies show considerable variation in the learning curve among individual trainees and the different environments for intubations, including the emergency department, operating room, prehospital setting, and intensive care unit.

The EM residency programs must consider the number of intubation opportunities for their residents, residents' projected learning curve, and variations in the potential for learning among potential intubation environments. The Accreditation Council for Graduate Medical Education (ACGME) recommends a minimum of 35 ETI attempts during EM residency, but there is no way to determine the ideal number of ETI attempts for a given EM resident. The ED, the intensive care unit, and the operating room are common clinical venues for EM residents to gain ETI experience. To increase the number of intubation

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opportunities provided to residents, approximately 87% of US allopathic EM residencies have a required anesthesiology rotation. Most of these rotations are conducted in PGY-1, with 55% being 4-week rotations and 45% being less than 4 weeks or hybrid rotations.⁵ The purpose of this study was to evaluate the effect of implementing a PGY-1 anesthesiology rotation on residents' ETI success in the ED during PGY-2. We hypothesized that residents who had an anesthesiology rotation during PGY-1 would be more successful and have less adverse events with ETI during the first 6 months of PGY-2 than would residents who did not experience such a rotation.

Methods

Study Setting and Design

We conducted a prospective, observational study that compared ETI success rates and adverse events of 2 resident groups in the Indiana University EM residency program during the first 6 months of their PGY-2. Residents in the study group (N = 18) participated in a 4-week anesthesiology rotation (AR) in PGY-1, which replaced a radiology rotation. Control group residents (N = 17) did not have a PGY-1 anesthesiology rotation (NO-AR). Information about ETIs performed by the 2 groups during the study was recorded by faculty on Airway Cards. All ETIs performed during the study occurred in the ED at the residency's 2 urban, level-1 trauma centers.

Study Protocol

During the study period, information about ETI attempts by EM residents was immediately recorded by EM faculty on an Airway Card (provided as online supplemental material) for both groups. The Airway Card is a data-collection tool designed to track residents' success at intubation. We defined *success* as appropriate placement of the ET tube after ≤ 2 attempts. We defined *attempt* as each pass of the laryngoscope. We defined *major adverse events* as profound hypoxemia $< 70\%$, unrecognized esophageal intubation, observed aspiration, cardiac dysrhythmia, dental trauma, and cardiac arrest. We defined *minor adverse events* as mild hypoxemia $< 90\%$, esophageal intubation with immediate recognition, regurgitation, and bradycardia $< 60/\text{min}$.

Measurements

Data collected included resident name, date and type of encounter (medical, trauma, pediatric), preintubation information (airway assessment, preparation, patient position, medications administered), intubation information (number of attempts, success, adjunct airway maneuvers, rescue device usage, adverse events), and postintubation information (tube placement confirmation). The data were

What was known

Added opportunities to perform endotracheal intubation (ETI) during residency may result in improved emergency medicine (EM) resident success for this procedure.

What is new

An additional anesthesiology rotation for EM residents increases the number of opportunities to perform ETI.

Limitations

Single-site study and small sample size limit generalizability, as well as possible reporting bias from faculty raters.

Bottom line

The additional anesthesiology rotation did not have a significant effect on residents' ETI success or adverse event rates.

entered into a database for statistical analysis (Excel, Microsoft Corporation, Redmond, WA).

The Indiana University institutional review board approved this study.

Data Analysis

A Pearson χ^2 test was used to compare first-attempt success, overall success (≤ 2 attempts), and adverse events rates between the 2 groups. We performed a post hoc power analysis with a type I error of 0.05 and a type II error of 0.8 to find a difference of at least 10% between the 2 groups regarding first-attempt success rate. This analysis suggested a sample size of 200 per group would be required to detect a meaningful and statistically significant difference (StatMate 2.0 for Windows, GraphPad Software, Inc, La Jolla, CA).

Results

Analysis of self-maintained procedure logs suggested the AR group had a mean of 53 ETI attempts per resident in PGY-1, and the NO-AR group had a mean of 21 ETI attempts per resident during PGY-1 (TABLE 1).

During the PGY-2 study periods, the combined number of ETI attempts in the ED recorded in the resident procedure log for the AR group was 122 (116 Airway Cards), and for the NO-AR group, was 161 (145 Airway Cards; TABLE 2). The average time spent by each resident in the ED during the PGY-2 study periods was 3 months (range, 2–4 months); therefore, the average number of intubation attempts per resident per ED month during the study period was 2.15 for the AR group based on Airway Cards and 2.84 for the NO-AR group.

Based on the data included on the faculty-evaluated Airway Cards, the AR group performed 116 ETIs, and the NO-AR group performed 145. The AR group had a first attempt success rate of 78.4% and an overall success rate of

TABLE 1	RESIDENT DEMOGRAPHICS		
		NO-AR Group, n = 17, No.	AR Group, n = 18, No.
	Sex, % M	82	61
	Prior residency	0/17	0/18
	Prior EMT certification	0/17	1/18
	PGY-1 ETI attempts, mean ± SD (range)	20.8 ± 8.9 (7–46)	53.9 ± 13.1 (32–68)

Abbreviations: AR, anesthesiology rotation; EMT, emergency medical technician; NO-AR, no anesthesiology rotation; PGY, postgraduate year.

95.7%, whereas the NO-AR group had a first-attempt success rate of 83.4% and an overall success rate of 94.5%. First-attempt and overall success rates were compared between the 2 groups using a Pearson χ^2 test and showed no statistically significant difference ($P = .30$ and $P = .66$, respectively).

The AR group had a major adverse event rate of 10.3%, whereas the NO-AR group had a major adverse event rate of 10.3%. Overall adverse event rates for the AR group and NO-AR group were 24.8% and 19.0%, respectively ($P = .26$; TABLE 2).

Discussion

The study group residents’ additional ETI experience during a PGY-1, anesthesiology, 4-week rotation did not significantly improve their intubation success or the occurrence of ETI adverse events in the ED during their first 6 months of PGY-2 compared with the previous year’s cohort of PGY-2 who did not have the 4-week rotation.

Although there have been large, multicenter observational studies of intubation success and adverse events, there have been no studies, to our knowledge, focusing on

the effect of specific rotations or training on ETI success.^{1,6} This study found ETI success and adverse event rates for PGY-2 residents that were similar to those found in other studies, which suggest the experiences at this site may be generalizable to other sites.^{1,7} The additional ETI attempts reported for the intervention group in PGY-1 were likely the result of the anesthesiology rotation and occurred in the operating room setting. Furthermore, although there was no difference in the average success rates between the 2 study groups, we cannot clearly say there was no difference among individuals. As prior studies have shown, there is variability of the learning curve among individuals and among different intubating environments.^{2–4}

In an average PGY-1 resident class, where each resident completes at least 20 PGY-1 ETI attempts, the completion of an anesthesiology rotation may not affect subsequent ETI success in the ED or complications during the first 6 months of PGY-2. Thus, the time spent in a dedicated anesthesiology rotation may be better focused on a difficult airway curriculum or another area altogether. However, if a residency class is not expected to have at least 20 ETI attempts in PGY-1 or an individual resident requires more ETI attempts to function at the average level, the PGY-1

TABLE 2	COMPARISON OF NUMBER OF ENDOTRACHEAL INTUBATIONS AND ADVERSE EVENTS BETWEEN THE NO-ANESTHESIOLOGY ROTATION (NO-AR) AND ANESTHESIOLOGY ROTATION (AR) GROUPS				
		NO-AR Group, n = 145, No. (%)	AR Group, n = 116, No. (%)	Change, % (95% CI)	P Value
	First-attempt success	121 (83.4)	91 (78.4)	−5 (−14.6, 4.6)	.30
	Second-attempt success	16/24 (66.7)	20/25 (80.0)	13.3 (121–11.2, 37.9)	.29
	Overall success (≤2 attempts)	137 (94.5)	111 (95.7)	1.2 (−4.0, 6.5)	.66
Adverse events					
	None	109 (75.2)	94 (81.0)		.34
	Minor	21 (14.5)	10 (8.6)		
	Major	15 (10.3)	12 (10.3)		
	Any adverse event	36 (24.8)	22 (19.0)	−5.9 (−15.9, 4.2)	.26

Abbreviations: EMT, emergency medical technician; ETI, endotracheal intubation; PGY-1, postgraduate year-1.

anesthesiology rotation may be beneficial for ETI success. Also, PGY-1 residents might receive benefits from an anesthesiology rotation that this study did not measure, such as additional practice with airway adjuncts (laryngeal mask airway, indirect laryngoscopy) and other procedures (central lines, arterial lines).

Another expected outcome from an anesthesiology rotation would be a reduction in adverse events. There is variability in how adverse events are defined in the literature. A large, multicenter study⁶ of ETI performed primarily by ED physicians and residents defined 19 common events that occur during ETI and found an overall incidence of 12%. Although this study did report variability in event occurrence among types of encounters (medical, trauma, and undefined) and method of intubation (rapid sequence intubation and intubation without paralysis), it did not report on variability in event occurrence for EM residents or among levels of training.⁶ A smaller study⁷ of EM residents performing ETI showed an adverse event rate of 15.8%, with a major adverse event rate (defined as immediate hypotension, hypoxemia, or dysrhythmia) of 1.4%. Although that study reported major adverse events by year of training, no differences were identified. Overall, conflicting data exist on the prevalence and trends of adverse events among EM residents performing ETI. Such events may be more a function of the patient rather than the individual completing the intubation.

Our study has several limitations. First, it is not known whether there were differences in ETI experience between the 2 groups before starting their EM residencies. Second, when comparing the faculty-completed Airway Cards versus the residents' procedure logs, we noted a small number of ETIs performed during the study period that

were not captured by EM faculty. Third, it is possible that our results could be affected by reporting bias among the faculty. Finally, our study involved a single residency program during the course of 2 classes of PGY-2s and has a relatively small sample size, limiting generalizability.

Conclusion

The addition of an anesthesiology rotation to the PGY-1 curriculum did not appear to have a significant effect on ETI success or adverse event rates in the ED during the first 6 months of PGY-2. Further study should be directed at the effect of a difficult-airway curriculum or the impact of other non-EM rotations in the EM curriculum on measureable EM resident functions.

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