Successful Airtraq Use in an Air Medical Transport System

William Selde, MD,[1,2] Kyle English, MD,[1] Matthew Heffelfinger, CFRN,[3] Jan Eichel, CFRN,[3] and Glenn Ekblad, DO[1,3]

Abstract

Introduction: There is a large body of literature that shows that the AirTraq device achieves equal or superior rates of successful intubation in all classes of user. A recent prospective human trial of the device questioned the first pass success rate and whether effective training could occur outside the Operating Room (OR). The purpose of this study was to investigate the first pass success rate for intubation with the AirTraq (AT) device utilizing only mannequin training in an air ambulance setting from Aug. 1 2009 to Aug. 1 2012 and compare it to direct laryngoscopy (DL).

Hypothesis: We hypothesize that the AirTraq device will be as effective overall as direct laryngoscopy, and that this requires no OR training to achieve.

Methods: A retrospective chart review of 161 intubations by air ambulance flight nurses from Aug. 1, 2009 to Aug. 1, 2012 was conducted. Data regarding date of service, devices used, number of attempts, rescue device use, and complications was gathered and analyzed. The generalized estimating equation and the chi-squared test were used to evaluate the data.

Results: 161 intubations were reviewed. 135 met inclusion criteria. Overall first pass success rate for AT was 82% (68/83) and DL was 74% (35/47). Overall first use success rate for AT was 79% (71/90) and DL was 70% (43/61). The overall success rate of intubation for any patient in which either AT or DL was attempted is 96% (130/135).

Conclusion: AirTraq was shown to be as effective as direct laryngoscopy. All air crew training for the AirTraq device was performed on mannequins. The successof the device compared to DL shows that mannequin training is sufficient to implement the AirTraq device for pre-hospital intubation.

1. Western Michigan School of Medicine, Kalamazoo, MI

2. Wyoming Medical Center, Casper, WY

3. West Michigan Air Care, Kalamazoo, MI

Corresponding author:
William Selde, MD, 2510 E 15th St, Suite 12 PO Box 50770 Casper, WY 82605-0770,
wselde@wyomingmedicalcenter.org

1067-991X/$36.00

http://dx.doi.org/:10.1016/j.amj.2014.07.003

Introduction

Endotracheal intubation can be accomplished using a number of techniques. Many different devices have been used to help facilitate this procedure. One such device, Airtraq (AT; Prodol Meditec SA, Vizcaya, Spain), allows the user to indirectly view the glottic structures via a disposable, anatomically shaped, lighted, rigid plastic scope containing mirrors and prisms. The endotracheal tube is then passed along a track and directed exactly to where the view is pointing. The benefits of AT are that it is lightweight, disposable, and inexpensive, all of which are desirable in an air emergency medical service setting.

The advantages of AT are not purely convenience of carry. Many studies have been published displaying the benefits of the AT device. Multiple studies investigating the success rates of providers who are not experts at intubation have shown superior success rates with AT over direct laryngoscopy (DL).[1-4] It has also been shown that visualization of the glottic structures is superior with the AT device compared with DL.[1,2] Other studies have shown AT training requires less attempts to reach a 90% intubation success rate in medical and paramedic students compared with DL.[4,5] The use of the AT device has shown superior retention of intubation skills in medical students at a 6-month follow-up compared with DL.[6] Furthermore, a recent meta-analysis found that the time to intubation was shorter with AT when compared with DL for inexperienced providers. However, no significant difference existed for experienced intubators.[1] Many of the studies were performed using a mannequin model.[3-6]

A prospective human trial of the device questioned the first pass success rate of AT and whether effective training could occur outside the operating room. The authors performed a prospective randomized trial of AT compared with DL in a European prehospital setting involving 212 subjects and found a success rate of 47% for AT compared with 99% for DL, a 52% discrepancy. The authors concluded that not only was AT a poor device but speculated that it required extensive training on human subjects in the operating room.[7]

The purpose of our study was to investigate the first pass success rate for intubation with the AT device in a West Michigan Air Care (WMAC) setting from August 1, 2009, through August 1, 2012, and compare it with DL. Based on our experience with DL and AT at our WMAC service, we hypothesized that AT has a similar first pass success rate compared with DL. Additionally, all training at West Michigan Air

Table 1. Success Rate by Device and First Pass by Year

	Device (Success/Attempts)	
	AT	DL
First use	71/90	43/61
Second use	5/5	9/12
Third use	0/0	2/2
Overall	76/95	54/75
First pass	68/86	36/49
2009-2010	24/31	29/39
2010-2011	30/33	3/5
2011-2012	14/19	3/3

AT = Airtraq; DL = direct laryngoscopy.
The Z test from the generalized estimating equation indicates no significant difference between the success rates of the 2 devices overall ($P = .1$) or during the first attempt at intubation (first pass $P = .46$).

Table 2. Intubation Location

	AT	DL	*P* Value
Ambulance	42	32	.2473
Helicopter	5	9	
In hospital	44	29	
Road scene	2	4	

AT = Airtraq; DL = direct laryngoscopy.
The chi-square test of location shows that there is no difference in where the devices were used.

Care is done exclusively with mannequins. As such, we hypothesized that AT proficiency can be achieved without operating room training.

Methods

Institutional review board approval was obtained, and the requirement for written patient consent was waived from the 2 hospitals that make up the governing cooperative of WMAC, Hospital A and Hospital B, City, State. A retrospective chart review was performed on all patients who were intubated when AT use began on August 1, 2009, through August 1, 2012. WMAC flight nurses were initially trained to competency on mannequin airway heads. Additionally, when deficiencies in training were identified, all nurses underwent remedial training. All nurses were credentialed annually during the study period. Data collected included the date of service, age, patient's chief complaint, reason for intubation, device used, number of attempts to achieve intubation, complications, performing provider, location where the procedure was performed, patient's body mass index (BMI), and Mallampati score. The data were collected and recorded by a single reviewer. Data were entered into an Excel spreadsheet (Microsoft, Redmond, WA), which was shared among investigators. No patient-identifying information was collected. No pediatric subjects were entered into the study group. Only nonpregnant, nonincarcerated adult patients who had intubation attempted by WMAC personnel using either DL or AT during this time period were included in the study data. The choice of the device and the number of attempts at intubation were at the discretion of the provider. All intubations performed by outside personnel and intubations not using DL or AT were excluded. Once collected, the data were analyzed for first attempt intubation rate (first pass), first attempt with device (first use), and overall success rate. Finally, intubation rates were compared along with BMI, Mallampati score, and location of intubation using a chi-square or *t* test to evaluate for statistical significance, which was set at 5% ($P < .05$). Overall, first pass and first attempt confidence intervals for the success rate were computed using a simple Z confidence interval. A generalized estimating equation with autoregressive correlation structure was used to analyze the data in order to take into account the sequential and conditional nature when a device is used for intubation in several attempts. The generalized estimating equation and chi-square test were computed using SAS 9.2 software with the confidence intervals in R software.

Results

One hundred sixty-one intubations were reviewed. One hundred thirty-five met the inclusion criteria. The overall first pass success rate for AT was 82% (68/83), and for DL, it was 74% (35/47). The 2009 to 2010 first attempt rate for AT was 77% (24/31), and for DL, it was 74% (29/39). The 2010 to 2011 first attempt rate for AT was 91% (30/33) and 60% for DL (3/5). The 2011 to 2012 first attempt rate for AT was 74% (14/19) and 100% for DL (3/3). The overall first use success rate for AT was 79% (71/90) and 70% for DL (43/61). The success rate for any attempt with the AT device was 80% (76/95) and 72% with DL (54/75). The overall success rate of intubation for any patient in which either AT or DL was attempted was 96% (130/135). Of the failures, Combitubes (Covidien, Mansfield, MA,) were used twice, video laryngoscopy was used for intubation twice, and 1 patient required bag valve mask ventilation (Table 1).

Intubations were recorded as occurring in 1 of 4 locations: ambulance, helicopter, the outside hospital, and roadway/scene. The success rates for AT were as follows: ambulance: 79% (33/42), helicopter: 80% (4/5), in hospital: 84% (37/44), and road/scene: 100% (2/2). The success rates for DL were as follows: ambulance: 75% (24/32), helicopter: 89% (8/9), in hospital: 66% (19/29), and road/scene: 50% (2/4). One DL intubation had no scene recorded. There were no differences in success rates among the 4 locations ($P = .25$) (Table 2).

Of 135 patients, Mallampati scores were recorded for 32 patients (24%). Eighty-nine (66%) were unable to be accessed because of unstable patient conditions. Fourteen (10%) charts had no score recorded and no explanation. The median Mallampati score for successful AT intubation was 2.61 (18 patients). For successful DL intubation, the median Mallampati score was 2.75 (12 patients). There was no difference in Mallampati scores between AT and DL ($P = .69$) (Table 3).

BMI was calculated for each patient based on the charted height and weight. The average BMI for successful AT intubation was 31.82 (76 patients), and for DL, it was 31.73 (53 patients).

Table 3. Mallampati Score

Score	AT	DL	GV	*P* Value .6897
1	1	1		
2	8	4		
3	6	4		
4	3	3	2	
Mean	2.61111	2.75		
SD	0.84984	0.96531		

AT = Airtraq; DL = direct laryngoscopy; GV = video laryngoscopy; SD = standard deviation.
The *t*-test shows that the Mallampati score differences were not statistically significant between the 2 devices.

Table 4. BMI

Summary of BMI	Mean	SD	95% CI		*P* Value
DL	31.7349	6.61708	29.9288	33.541	.9494
AT	31.8189	8.42077	29.8946	33.7431	

AT = Airtraq; CI = confidence interval; DL = direct laryngoscopy; SD = standard deviation.
BMI analysis between the 2 devices shows no differences.

Table 5. Success Rate and Z CI

	Device, Estimate (CI)	
	AT	DL
Overall CI	0.80 (0.72-0.88)	0.72 (0.61-0.83)
First use CI	0.79 (0.70-0.87)	0.70 (0.59-0.82)
First pass CI	0.79 (0.70-0.87)	0.73 (0.61-0.86)

AT = Airtraq; CI = confidence intervals; DL = direct laryngoscopy.
The success rates of Airtraq and direct laryngoscopy show no statistical difference.

Height was not recorded for 1 DL patient. There was no difference in the average BMIs of patients in the DL and video laryngoscopy groups ($P = .95$) (Table 4).

The following complications were recorded: soiled airway (blood, emesis, and secretions) in 19 (14%), unable to pass the tube in 1 (< 1%), esophageal intubation in 2 (1%), AT too large to use in 3 (2%), cuff tear in 1 (< 1%), difficulty separating the tube from AT in 3 (2%), swelling in the mouth or airway in 3 (2%), a large tongue in 3 (2%), DL lightbulb failure in 1 (< 1%), a small mouth in 1 (< 1%), and difficulty passing the tube in 2 (1%).

Three separate analyses were conducted: 1) the overall success rate with respect to each device, 2) the success rate with respect to each device in its first use, and 3) the success rate of each device during the first attempt at intubation (first pass). The chi-square test was used to test analysis 3. The post hoc power analysis showed the study has at least 80% power to show a 5% difference based on the chi-square test and logistic regression with a medium effect size (Table 5).

Discussion

These data show that there was no significant difference between AT and DL as used by flight nurses during the study period. Even though the choice of device was left to the discretion of the flight nurse at bedside, the similar location, BMI, and Mallampati scores show that the patients were comparable with each other.

These results are widely divergent from the study by Trimmel et al,[7] which found not only a high number of AT failures but also numerous complications with the AT. The authors of this study would speculate that the difference in results is explained by the differences in training. Before placing the AT into service, all WMAC flight nurses trained to initial competency. Instruction on the technique was covered in a clinical education setting for approximately 30 minutes. Proper advancement and successful placement were emphasized. Each nurse was required to complete 5 successful intubations on adult standard airway heads. Credentialing of all flight nurses followed standardized evaluation of the technique and successful placement. Initially, remedial mannequin training was used for individual crewmembers who had 2 AT failures. The focus of training was on dealing with large tongues and soiled airways. Because remedial training increased success rates, all flight nurses were required to complete it. Additionally, yearly credentialing with the device is required of all nurses. These interventions increased the first pass success rate to 91% (30/33) in the second year of use and an overall first pass rate of 82% (68/83).

Although 91% is not as high as the success rate of 99% with intensive operating room training reported in the study by Trimmel et al,[7] it is better than some other published flight service DL rates for both first pass and overall success rate. Brown et al[8] retrospectively reviewed intubation success rates from an 89 rotorcraft air medical system from January 1, 2007, through December 31, 2009. They used mannequin-only training and found a DL first pass success rate of 78.9% (3,710/4,871) and an overall intubation rate of 91.7% (4,313/4,871). Based on the cumulative first pass rate of 82% (68/83) and the overall success rate of 96% (130/135), the authors feel confident that the AT device achieves success rates better than or at least comparable with other air medical DL success rates when using mannequin-only training.

In contrast to the study by Trimmel et al,[7] our study displays a much higher AT success rate along with a lower complication rate. Although it is impossible to explain these differences in full, there are obvious discrepancies that could explain some of the differences. Most importantly, the operators in the Trimmel et al study performed only 5 intubations with the AT in the operating room to complete their training. This is in stark contrast to the number of DL intubations performed yearly by these same physicians (> 80 per year per physician). These differences may explain the differences in AT success rates (80% vs. 47%) and cuff tears (< 1% vs. 18%).[7]

There are certain limitations present within our study. Only 1 reviewer collected all the data. This does not allow for interrater reliability to be measured. The total number of patients included was 135, which limits the power of the study. It is powered to show a 20% difference between the devices. Given the fact that the study calling AT use into question showed a 52% difference in the success rate between the devices and given that the our data trend toward AT being significantly more successful, the authors feel confident that AT is not inferior to DL. In addition, the nurses who performed the intubation also charted the intubation information, which affects the objectivity of the study and could introduce bias. This was unavoidable because neither the investigators nor the device operators knew at the time of charting the data would be used for investigational purposes. We also did not measure individual operator skill by investigating differences in the success rate by device and operator. When the first pass success rate is broken down by year, there is an increase in the success rate during the second year compared with the first. There is also evidence that the nurses elected to use AT far more often than DL in years 2 and 3 of the study. Furthermore, because of the retrospective nature of the study, device selection was left to operator discretion, and no randomization could be implemented. However, despite the lack of randomization, our analysis displays no difference between the study groups with regarding location, BMI, or Mallampati score.

Conclusion

There was no statistical difference between the success rates of AT compared with DL for WMAC flight nurses when training was performed with mannequins. This held true despite the varied locations of intubations and across all patient populations. We have shown that the AT device is capable of achieving success rates comparable with DL with mannequin training alone. Based on our data, the authors recommend AT as a first-line intubation device that does not require operating room training.

References

1. Lu Y, Jiang H, Zhu YS. Airtraq laryngoscope versus conventional Macintosh laryngoscope: a systematic review and meta-analysis. *Anaesthesia*. 2011;66:1160-1167.
2. White MC, Marsh CJ, Beringer RM, et al. A randomized, controlled trial comparing the Airtraq™ optical laryngoscope with conventional laryngoscopy in infants and children. *Anaesthesia*. 2012;67:226-231.
3. Maharaj CH, Ni Chonghaile M, Higgins BD, Harte BH, Laffey JG. Tracheal intubation by inexperienced medical residents using the Airtraq and Macintosh laryngoscopes—a manikin study. *Am J Emerg Med*. 2006;24:769-774.
4. Maharaj CH, Costello JF, Higgins BD, Harte BH, Laffey JG. Learning and performance of tracheal intubation by novice personnel: a comparison of the Airtraq and Macintosh laryngoscope. *Anaesthesia*. 2006;61:671-677.
5. Woollard M, Lighton D, Mannion W, et al. Airtraq vs standard laryngoscopy by student paramedics and experienced prehospital laryngoscopists managing a model of difficult intubation. *Anaesthesia*. 2008;63:26-31.
6. Maharaj CH, Costello J, Higgins BD, Harte BH, Laffey JG. Retention of tracheal intubation skills by novice personnel: a comparison of the Airtraq and Macintosh laryngoscopes. *Anaesthesia*. 2007;62:272-278.
7. Trimmel H, Kreutziger J, Fertsak G, Fitzka R, Dittrich M, Voelckel WG. Use of the Airtraq laryngoscope for emergency intubation in the prehospital setting: a randomized control trial. *Crit Care Med*. 2011;39:489-493.
8. Brown CA, Cox K, Hurwitz S, Walls RM. 4,871 emergency airway encounters by air medical providers: a report of the Air Transport Emergency Airway Management (NEAR VI: "A-TEAM") Project. *West J Emerg Med*. 2014;15:188-193.