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ORIGINAL ARTICLE

A comparison of Trachway intubating stylet and Airway Scope for tracheal intubation by novice operators: A manikin study

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Abstract The Trachway is a recently developed intubation device that resembles an illuminating stylet and incorporates a video-assisted system. This study evaluated the use of this system for tracheal intubation by novice operators. This randomized cross-over study compared the Trachway and the Airway Scope in simulated routine and difficult intubation scenarios. The difficult scenario was simulated by increasing the tongue volume of the manikin. The primary outcome measure in both airway scenarios was the time required for a successful tracheal intubation. For each scenario, the success rate, ease of intubation and operator preference were recorded for the two devices and compared. Average intubation time did not differ significantly between the Trachway and Airway Scope for the normal airway scenario (11.2 ± 6.5 vs. 9.8 ± 4.3 seconds, respectively; $p = 0.07$), but was significantly longer using the Trachway than with the Airway Scope on the difficult airway scenario (17.1 ± 11.1 vs. 9.5 ± 4.1 seconds, respectively; $p < 0.001$). The overall success rates of the Trachway and Airway Scope (96.3% and 98.6%, respectively) did not differ significantly ($p = 0.13$). Preference for the Airway Scope was greater in both scenarios, and particularly in the difficult airway scenario ($p < 0.001$). Although the devices are comparable in terms of ease of use and intubation time in normal scenarios, the ease of using the Airway Scope makes it more suitable for inexperienced operators in difficult intubation scenarios.

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Introduction

Tracheal intubation is a common and important medical procedure in maintenance of airway patency during anesthesia. Repeated attempts at performing tracheal intubation in patients with difficult airways are a leading cause of anesthesia-related adverse events such as dental and pharyngeal trauma, hypoxia, esophageal or bronchial intubation and unstable hemodynamic conditions [1,2]. Poor visualization of the glottis is a common cause of intubation failure [3]. The emergence of new technologies has aimed to address this problem by introducing devices that allow for fiber-optic video-assisted visualization of the airway. Various intubating stylets with fiber-optic imaging devices that are currently in clinical use have proven effective for managing difficult airways [4—8].

The Trachway intubating stylet (Biotronic Instrument Enterprise Ltd, Tai Chung, Taiwan) is a recently developed video-assisted system equipped with a rigid intubating stylet, a light source, camera and an adjustable screen attached to the handle [9]. To perform a tracheal intubation, a tracheal tube (internal diameter, 6.0—8.0 mm) is loaded over the device with the tip of the stylet slightly proximal to the tip of the tube (Fig. 1). Another transtracheal light source is mounted on the distal end of the stylet, which has an upward curvature. During intubation, the oral cavity, the epiglottis and the glottic opening are visualized on-screen. Successful intubation can be confirmed primarily by direct visualization of the glottic inlet and tracheal rings or alternatively with transtracheal illumination. The device is highly portable, because it is powered by rechargeable batteries contained in the handle.

The Airway Scope (AWS-S100; Pentax, Tokyo, Japan), is a new video-assisted laryngoscope, with a disposable polycarbonate blade called PBlade. This PBlade has a groove to hold and guide the insertion of the tracheal tube. The Airway Scope has proven effective for airway visualization in both simulated and actual scenarios [10—12]. Manikin studies have indicated that the Airway Scope provides faster and easier intubation compared to the direct laryngoscope and the GlideScope [10,12].

Although the Trachway intubating stylet is now widely used in Taiwan, there have not yet been reports evaluating its effectiveness. Therefore this study aimed to evaluate the use of the Trachway for tracheal intubation by novice operators in simulated normal and difficult intubation situations. The Trachway and Airway Scope were compared in terms of intubation time and success rate in simulated procedures performed by medical students with no clinical experience in tracheal intubation.

Methods

This study was approved by the institutional review board of the ethics committee of the Kaohsiung Medical University Hospital, and informed consent was obtained from all participants.

The participants were 36 medical students without previous experience in tracheal intubation. All students were briefly instructed in the use of the Trachway and the Airway Scope. Students then utilized both devices, which were preloaded with cuffed tracheal tubes (internal diameter, 7.5 mm), to perform three practice procedures using a human patient simulator, SimMan (Laerdal, Stavanger, Norway) with a normal airway.

Figure 1. The Trachway intubating stylet preloaded with a tracheal tube. The stylet was incorporated with both a light source and transtracheal illumination.

The following day, students were asked to perform tracheal intubation on the simulator in both normal and difficult intubation scenarios. The difficult airway was simulated by using the simulator's "tongue edema" function. For each airway scenario, students performed three intubations using the Trachway and three intubations using the Airway Scope. The order of the devices was randomized. In the normal intubation scenario, an intubation attempt was considered successful if the intubation time did not exceed 30 seconds and the tracheal tube was in the trachea. This cut-off was determined based on the European Resuscitation Council guidelines for cardiopulmonary resuscitation [13], which state that a lack of ventilation for more than 30 seconds is unacceptable. According to a previous study, a time limit of 60 seconds should apply for the difficult airway scenario using Optical Stylet [2]. Therefore, the cut-off time was 60 seconds in the difficult intubation scenario.

The primary outcome measure in both scenarios was intubation time. This was measured from the time the

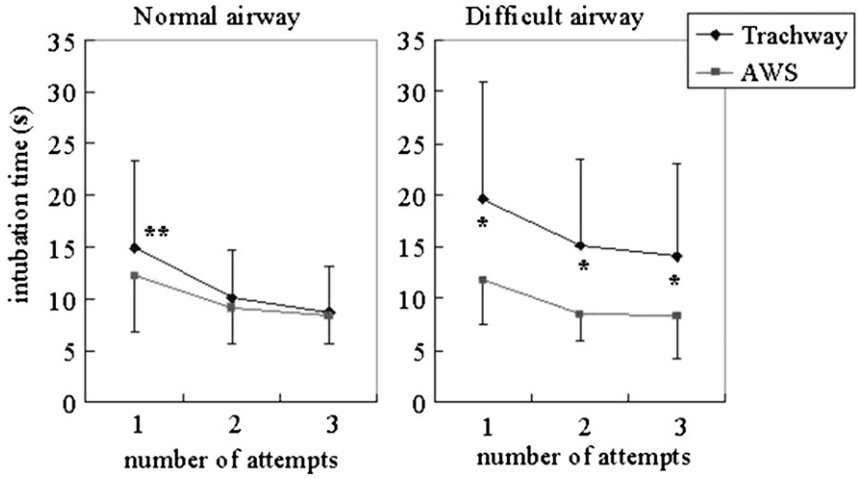

Figure 2. Comparison of the Trachway and Airway Scope (AWS) in terms of time required for tracheal intubation performed by medical students. The vertical axis shows the number of intubation attempts, and the horizontal axis shows the intubation time (seconds) ± standard deviation. * $p < 0.001$. ** $p < 0.05$).

operator picked up the device until the time the device was removed from the tracheal tube. Students were asked to rate the ease of intubation using each device using a Likert scale from 1 (extremely easy) to 5 (extremely difficult), as previously used in reported literature [2]. Finally, students were also asked which device they preferred.

Before performing the study, it was estimated that the average intubation time in a manikin was 17 seconds with the Airway Scope [12]. We regarded a difference of 5 seconds as a meaningful difference in a simulator study. Therefore, at least 30 subjects were needed for a study with power of 0.9 and a type 1 error of 0.05. Numerical data were expressed as mean ± standard deviation (SD), and ordinal data were expressed as median (range). The *t* test was used to compare intubation times for each attempt and McNemar tests were used to compare intubation success rate. The Wilcoxon's rank-sum test was used to analyze the Likert scale. One sample test of proportion was used to analyze student preference of airway device. The SPSS 12.0 (SPSS Inc., Chicago, IL, USA) software package was used for statistical analyses, and *p* values less than 0.05 were considered statistically significant.

Results

For each scenario, each of the 36 students completed three intubation attempts with both devices (six attempts in total). Fig. 2 compares the intubation times for the two devices in each scenario. In the normal airway scenario, average intubation time did not significantly differ between the Trachway and the Airway Scope (11.2 ± 6.5 s vs. 9.8 ± 4.3 seconds, respectively; $p = 0.07$). However, in the difficult scenario, intubation time was significantly longer when using the Trachway than that for the Airway Scope (17.1 ± 11.1 vs. 9.5 ± 4.1 seconds, respectively; $p < 0.001$).

The overall success rate for the Trachway (96.3%) was slightly lower than that for the Airway Scope (98.6%) ($p = 0.13$) (Table 1). When success rate was analyzed separately for normal and difficult airway scenarios the devices were found to be comparable in both scenarios. Most participants reported the Airway Scope to be easier to use in both scenarios. Most participants also indicated that they preferred using the Airway Scope (Table 2).

Discussion

The results of this study demonstrated that most novice operators could successfully use both airway devices in normal and difficult simulated intubation scenarios. Both the Trachway and Airway Scope performed similarly on the normal airway. However, intubation times were faster using the Airway Scope in difficult airways. Intubation success rates were similar between the two devices in all scenarios. Most students reported the Trachway to be more difficult to use compared to the Airway Scope, and most indicated that they preferred using the Airway Scope. These results suggest that, although the Trachway is effective for tracheal intubation, the Airway Scope is more suitable for beginners when faced with difficult airway scenarios.

One explanation for these results is that in the SimMAN, the PBlade of the Airway Scope provided a greater visual

Table 1 Comparison of intubation success rates for the trachway and airway scope.

	Trachway	Airway Scope	*p*
Overall success (*n*)	208/216 (96.3%)	213/216 (98.6%)	0.13
Success in normal airway (*n*)	105/108 (97.2%)	107/108 (99.1%)	0.31
Success in difficult airway (*n*)	103/108 (95.4%)	106/108 (98.7%)	0.24

The total number of intubation attempts for each airway device was 216 (three attempts per student per scenario; $3 \times 2 \times 36 = 216$).

Table 2 Ease of intubation reported by operator and preferred device for each airway scenario.

	Trachway $n = 36$	Airway scope $n = 36$	p
Ease of intubation			
Normal airway	2 (1–3)	1 (1–3)	<0.001
Difficult airway	2 (1–4)	1 (1–3)	<0.001
Preferred device			
Normal airway (n)	13/36 (36.1%)	23 (63.9%)	0.034
Difficult airway (n)	5/36 (13.9%)	31 (86.1%)	<0.001

Data are expressed as mean (standard deviation) or number (%). Ease of intubation was rated on a Likert scale.

field than the Trachway in the reduced oropharyngeal space of the difficult airway. Furthermore, advancing the Trachway to the glottic opening in this limited space was very difficult for the novice operators. The Airway Scope's guidance and targeting system facilitated the insertion of the preloaded tracheal tube through the groove of the PBlade after centering the target symbol on the glottis [10,14].

The advanced patient simulator in this study provided extremely realistic simulations of normal and difficult airway conditions [15]. The simulator enabled comparison of the devices under varying conditions such as tongue volume and pharyngeal obstructions, head and neck mobility, and mouth and glottic opening. The SimMan also provided highly consistent simulated conditions for the participants. Finally, the SimMan avoided the ethical issues of evaluating procedures performed on human patients by inexperienced operators.

One limitation of this study is that the device could not simulate other clinical factors such as the presence of secretions, bleeding, or the fogging of the lens of the device. Moreover, difficult airways in clinical patients may result from many more conditions than those considered here, including limited mouth opening, poor dentition, limited neck motion, and oral or neck tumors. This study only controlled for one factor, which was reduced pharyngeal space. Double-blinding was also impractical, because the airway device could not be hidden from the operator.

Although intubating fiber-optic stylets have been available for many years, they are not widely used for several reasons [4,16,17]. Firstly, as rigid stylets do not allow for nasal intubation, the Trachway may be unsuitable for patients with limited jaw movement. Secondly, it lacks a working channel for suction or oxygen delivery. Therefore, the recommended clinical practice is oropharyngeal suction before tracheal intubation. Finally, the length and curve of the distal stylet of the Trachway limits visualization to as far as the proximal part of the trachea.

In conclusion, most novice operators can efficiently use both airway devices in normal and difficult intubation scenarios. Although the Trachway intubating stylet and the Airway Scope are comparably effective in a normal airway, the Airway Scope provides faster and easier intubation compared to the Trachway in difficult airway scenarios. As such, the Airway Scope would be more suitable for inexperienced operators in managing difficult airways.

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