

Usefulness of the Universal Adapter for Smartphones® in a Mannequin Study

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(Received August 7, 2018; Accepted September 1, 2018)

Objective: Because of the shape of a double-lumen tube (DLT), it is more difficult to use for intubation than an ordinary endotracheal tube. We prospectively investigated the usefulness of the Airtraq DL® attached to the Universal Adapter for Smartphones® for DLT intubation.

Method: At Tokai University Hachioji Hospital, anesthesiologists with ≥ 5 years' clinical experience intubated a tracheal intubation training mannequin with DLTs using the Airtraq DL® (Airtraq-alone phase) and the Airtraq DL® attached to the Universal Adapter for Smartphones® (adapter phase), and the time required was measured.

Result: The mean time required for intubation was shorter in the adapter phase than in the Airtraq-alone phase for all anesthesiologists (adapter phase, 9.05±2.48 seconds; Airtraq-alone phase, 10.67±2.19 seconds).

Conclusion: The use of Airtraq DL® attached to the Universal Adapter for Smartphones® significantly reduced the time required for DLT intubation. Furthermore, the combination of these devices was found to be useful and safe for DLT intubation because they provide a significant amount of information on the area from the oral cavity to the opening of the trachea and have high educational value because their combined use allows several physicians to share imaging information.

Key words: Universal Adapter for Smartphones®, video laryngoscope, tracheal intubation, double-lumen tube, mannequin study

INTRODUCTION

A double-lumen tube (DLT) has a large outer diameter and long overall length. Because of its peculiar shape, even if the opening of the trachea can be visually confirmed, tracheal intubation with a DLT may be difficult [1, 2]. The Airtraq DL® (Prodol Meditec SA, Vizcaya, Spain) is a video laryngoscope with a 19-mm side channel for a DLT, which allows intubation with a DLT of up to 41 Fr. Like Airtraq®, this device is designed for tracheal intubation while the opening of the trachea is observed from images obtained at the tip that are displaced on the eyecup through the prism structure. To use a monitor screen for continuous observation, the device needs to be used in combination with the Universal Adapter for Smartphones® (Prodol Meditec SA) or the Airtraq A-390® Wi-Fi camera (Prodol Meditec SA).

There is no consensus on the usefulness of Airtraq®. One study reported that it is superior to other video laryngoscopes for cases of intubation difficulty, particularly those with cervical spine immobilization [3]. In contrast, another study of tracheal intubation performed by anesthesiologists, residents in anesthesiology, and paramedics on an airway model showed that the

rate of successful tracheal intubation was lower for the Airtraq® than for other video laryngoscopes [4]. Hence, we aimed to determine whether the lack of a monitor screen contributes to the low success rate of tracheal intubation with Airtraq® alone.

In this randomized controlled study, we examined whether the Universal Adapter for Smartphones® is useful for DLT intubation with the Airtraq DL® by performing DLT intubation on a mannequin. The primary endpoint was the time required for intubation. We hypothesized that the use of the Universal Adapter for Smartphones® would reduce the time required for intubation because the video laryngoscope could be used without looking into the eyecup.

MATERIALS AND METHODS

The study protocol was approved by the Institutional Board of Tokai University, School of Medicine (ref. 17R-338) on 27 March 2018 (chair-person Dr. M Haida). The investigation conforms with the principles outlined in the Declaration of Helsinki. (Cardiovascular Research 1997; 35: 2-4). The study complies with the CONSORT 2010 statement for randomized studies.

The subjects were anesthesiologists with ≥ 5 years' clinical experience at Tokai University Hachioji

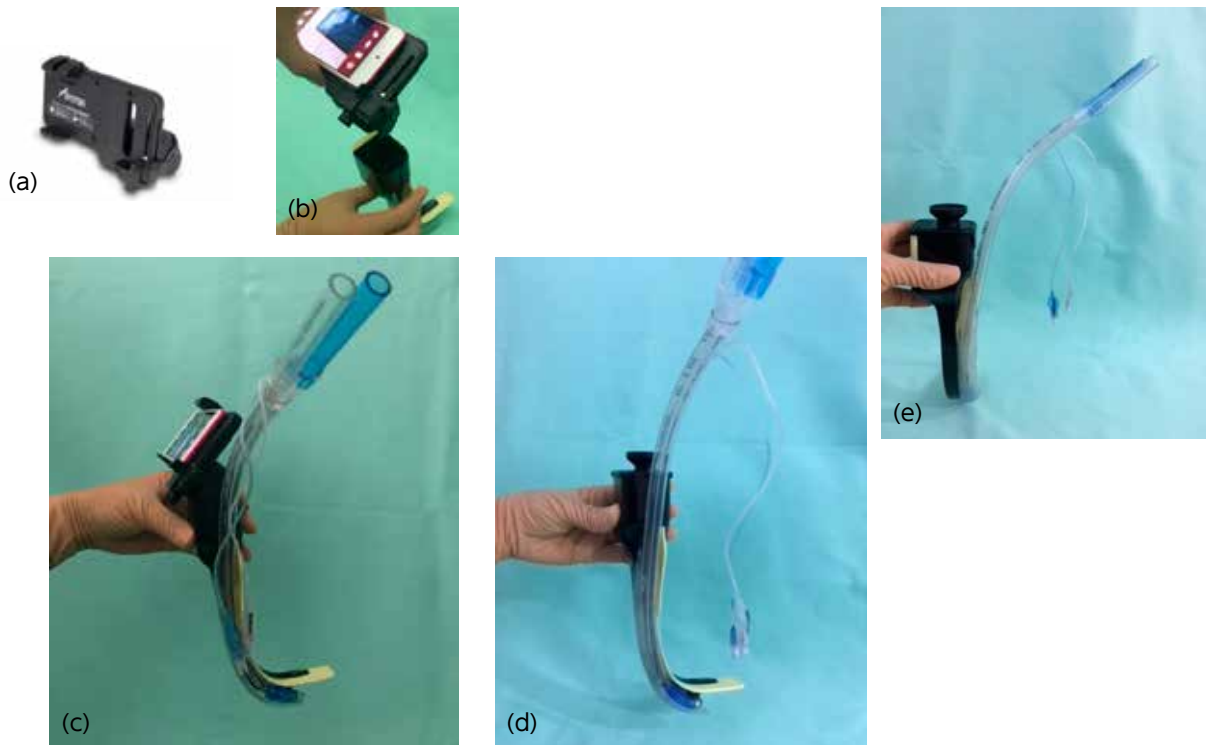


Fig. 1 (a) Universal Adapter for Smartphones®. (b) Phone adapter attached to an iPod. (c) Airtraq DL® attached to the phone adapter with a double-lumen tube (DLT) inserted in the adjacent channel. (d) Airtraq DL® with a DLT inserted in the adjacent channel. (e) Back view of the Airtraq DL® with a DLT on the adjacent channel.

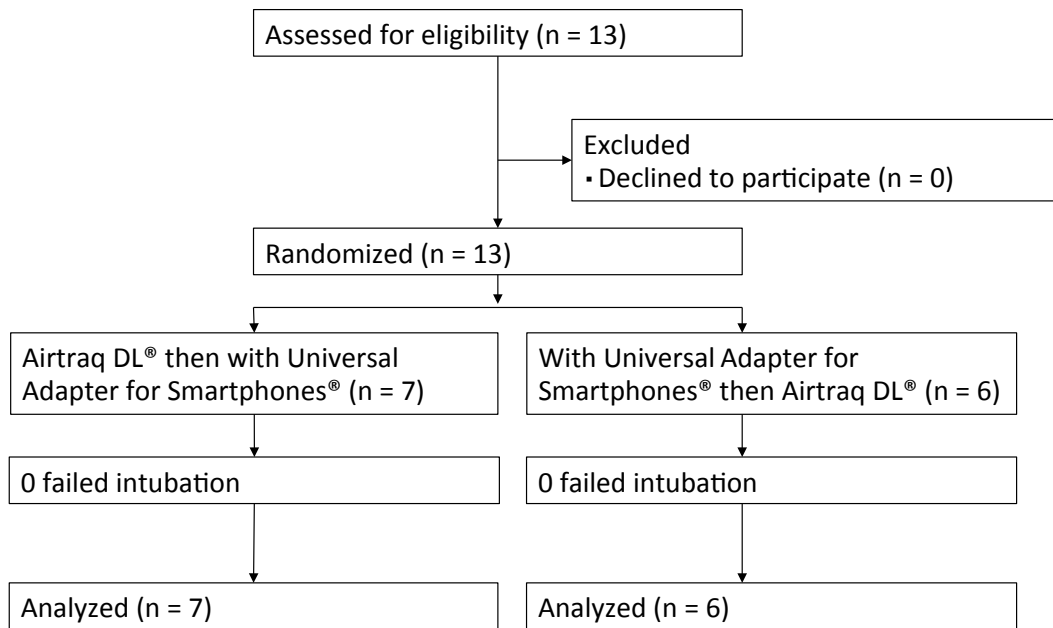


Fig. 2 CONSORT flow diagram of the study.

Hospital who fully understood the scope of this study and consented to participate in it between March and June 2018. Those who did not provide consent were excluded from the study.

The application Airtraq Mobile® (iOs: <https://itunes.apple.com/es/app/airtraq-mobile/id860540544>) was installed on the iPod Touch® (Apple Inc., Cupertino, CA, USA), connected to the adapter, before the portable display was used.

The anesthesiologists used two types of devices, Airtraq DL® alone (Airtraq-alone phase) and the

Airtraq DL® attached to the Universal Adapter for Smartphones® (adapter phase), to insert the 35-Fr Shiley® endobronchial tube with left polyurethane cuff (Medtronic, Minneapolis, MN, USA) (Fig. 1) into Airism® (Trucorp Ltd., Belfast, Northern Ireland), a tracheal intubation training mannequin. The time required for intubation was defined as the time from insertion of the Airtraq DL® into the oral cavity to its removal. From video images recorded during intubation, a third physician unrelated to this study measured the time (Fig. 2).

Table 1 Background data of the anesthesiologists

	Airraq DL then With Universal Phone Adapter	With Universal Phone Adapter then Airraq DL
Years of experience (years)	15 ± 9 (6-36)	17 ± 7 (6-30)
Qualification (Fellow/Board Certified/Qualified, n)	4/2/1	3/2/1
Age (years)	44 ± 9 (32-62)	47 ± 8 (32-56)
Sex (male/female, n)	4/3	4/2

Data are presented as means ± standard errors (range) or numbers of anesthesiologists. Fellow = fellow of the Japanese Society of Anesthesiologists; board-certified = Japanese Society of Anesthesiologists Board-certified anesthesiologist; qualified = Japanese Society of Anesthesiologists-qualified anesthesiologist.

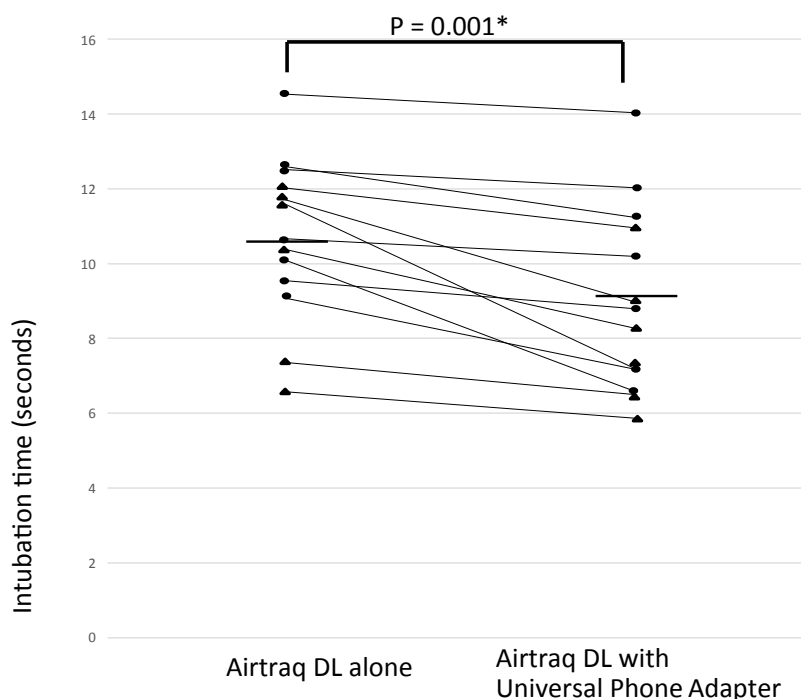


Fig. 3 Scattered plot of intubation time in the Airraq DL® alone and Airraq DL® with Universal Adapter for Smartphones® groups. Each intubation time was plotted and lines connecting two points of the same doctor were drawn (▲Airraq DL® alone first, ● with Universal Adapter for Smartphones® first). Median values were shown with horizontal lines. *P < 0.05 was considered significant.

Before the start of this study, the participating anesthesiologists performed intubation with both devices on the mannequin five times or more and became familiarized with the use of the devices [5]. The order of using the two types of the devices was randomly determined, using a random number chart.

After the experiment, a choice questionnaire survey was conducted to ask the anesthesiologists which device was more preferable for clinical use. In addition, they were asked to describe freely their impression of the use of the devices.

The analyses were conducted by Statistical Package for the Social Sciences (SPSS) Statistics software, version 25.0 (IBM Corporation, Armonk, NY, USA). A Wilcoxon's signed rank test was performed to detect significant differences in the time required for intubation between the devices. Kruskal-Wallis Test was used to compare Qualification and Fisher's exact test was used to compare sex. Mann-Whitney's U test was used to compare other data. Data are presented as

mean ± SE. The significance level was set at a P value < 5%.

RESULTS

Thirteen anesthesiologists met the inclusion criteria and consented to participate in this study. Their background characteristics were as follows: duration of experience, 6 to 36 years (mean, 16 years); age range, 32 to 62 years (mean, 45 years). There were 8 men and 5 women, including 7 fellow, 4 board-certified, and 2 qualified anesthesiologists accredited by the Japanese Society of Anesthesiologists. There were no significant differences between two groups in terms of background data of anesthesiologists (P values were not shown.) (Table 1).

The mean time required for intubation was significantly shorter in the adapter phase than in the Airraq-alone phase (9.05 ± 2.48 seconds vs. 10.67 ± 2.19 seconds; P < 0.01). In all anesthesiologists, the time required for intubation was shorter in the adapter phase

than in the Airtraq-alone phase (Fig. 3).

In the questionnaire survey on a device of their choice for clinical use, 12 (92.3%) of the 13 anesthesiologists chose the video laryngoscope attached to the adapter. In the questionnaire survey on their impression on the use of the Universal Adapter for Smartphones[®], the anesthesiologists described the adapter as displaying a better view of the larynx on the monitor screen (12 anesthesiologists, 92.3%) and because information displayed on the monitor screen can be shared with others, the adapter has educational value (9 anesthesiologists, 69.2%). One anesthesiologist (7.7%) who looked into the eyecup with the left eye reported that the adapter made intubation easier because the endotracheal tube did not interfere with the face.

DISCUSSION

In general, when the Airtraq DL[®] is used alone, the operator inserts it into the oral cavity without looking into the eyecup. After the Airtraq[®] is advanced to the presumed site of the epiglottic vallecula, the operator observes the state of the glottis through the eyecup and inserts a DLT. Meanwhile, the Universal Adapter for Smartphones[®], which was used in this study, allows visualization on a monitor screen from the stage of inserting a DLT into the oral cavity; hence, DLT can be guided to the trachea without changing the direction of eyes. Thus, most (92.3%) of the anesthesiologists thought that the adapter provided a better view. It seems that the better view contributed to improved performance, which in turn reduced the time required for intubation.

In addition, blind insertion of the Airtraq[®], as described above, has been associated with concern about safety regarding the conditions in the oral cavity, such as foreign bodies and blockages. By monitoring images displayed by the Universal Adapter for Smartphones[®], which was used in this study, on a monitor screen, tracheal intubation can presumably be performed more safely. Because images displayed on a monitor screen can be shared with others, 9 (69.2%) of the 13 anesthesiologists believed that the adapter has educational value. The Universal Adapter for Smartphones[®] uses the camera functionality on a smartphone to take images displayed on the eyecup and displays them on a monitor screen via the installed application. Even when the camera needs to be focused during intubation, the functionality of the application allows focusing only by touching the screen. This feature of the adapter appeared to be more advantageous than the features of endoscopes and other devices. Moreover, the recording function of the application also appeared to be useful for educational purposes.

In 1 (7.7%) of the 13 anesthesiologists, when the DLT was inserted while the anesthesiologist was looking into the eyecup with the left eye, the tube hit the

face (Fig. 1e). Because ordinary tubes are shorter than DLTs, the use of the former may have little effect on intubation. However, when a longer tube is inserted, the use of the adapter appeared to be more effective.

The Universal Adapter for Smartphones[®] has other useful features. It can be used with all types of the Airtraq[®]. Furthermore, because the adapter is not in direct contact with the patient during use, it can be reused more than once.

Compared with the usefulness of other video laryngoscopes, that of Airtraq[®] is rated inconsistently [3, 4]. However, this study revealed that the use of the Universal Adapter for Smartphones[®] improves the operability of the Airtraq[®] and may reduce the time required for intubation. When the Universal Adapter for Smartphones[®] is used, it should be noted that even during activation of the application, neither incoming calls nor messages are automatically blocked. Thus, when using a personal smartphone, the communication settings for phone calls, text messages, social networking system, etc. should be changed individually.

Although we have determined the usefulness of the Universal Adapter for Smartphones[®], as this was a mannequin study, the results cannot be generalized to actual clinical setting.

The use of Airtraq DL[®] in combination with the Universal Adapter for Smartphones[®] allowed continuous observation on a monitor screen, which improved the impression of their use. Consequently, the time required for intubation with a DLT was significantly reduced. Furthermore, the use of the Universal Adapter for Smartphones[®] provided much information on the area from the oral cavity to the opening of the trachea; therefore, the combined use of these devices was found to be useful and safe for intubation with a DLT. Because their combined use allowed several physicians to share imaging information, it was also considered to have a high educational value.

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