

Successful Intubation Using the Airtraq Double Lumen[®] with the Universal Adapter for Smartphones[®] in a Case of Intubation Difficulty

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Objective: The Universal Adapter for Smartphones[®] can record still images and movies during intubation using the monitor display and recording functions of a smartphone. Here, we describe the successful use of the Airtraq Double Lumen[®] with the Universal Adapter for Smartphones[®] for airway management during anesthesia in a patient with intubation difficulty.

Methods: A 78-year-old man required thoracoscopic upper lobectomy for a pulmonary tumor. Preoperative examination revealed micrognathia, mouth opening equivalent to a three-finger width, Mallampati Class II, mentum-hyoid bone distance equal to a 2.5-finger width, hyoid bone-thyroid cartilage distance equal to a two-finger width, and Class I findings in the Upper Lip Bite Test. After inducing anesthesia and confirming the feasibility of mask ventilation, we administered 70 mg of rocuronium and inserted the Airtraq Double Lumen[®]. The Universal Adapter for Smartphones[®] connected to a 4-inch iPod Touch[®] was attached to its eye cup, through which the iPod Touch displayed images for easy visualization of the glottal area.

Results: Prompt and smooth intubation with a 35-Fr double-lumen tube (DLT) was achieved. There were no adverse events associated with intubation.

Conclusion: Combination of the Universal Adapter for Smartphones[®] and the Airtraq Double Lumen[®] can facilitate smooth tracheal intubation with a DLT in cases of difficult intubation.

Key words: Universal Adapter for Smartphones[®], Airtraq Double Lumen[®], video laryngoscope, tracheal intubation, double-lumen tube

INTRODUCTION

The conventionally used Macintosh laryngoscope causes intubation difficulty at a certain frequency, because the visual axis deviates from the oral, pharyngeal, and laryngeal axes. In recent years, various indirect-view laryngoscopes (hereafter referred to as video laryngoscopes), which enable the visualization of the glottal area via a charge-coupled device camera attached to the blade tip or other devices, have been developed, and they have been compared and analyzed for determination of their usefulness for tracheal intubation.

The development of video laryngoscopes has improved the operability of single-lumen tubes (SLTs), which are standard endotracheal tubes, during tracheal intubation; in addition, it has contributed to a decrease in the number of cases of intubation difficulty. One-lung ventilation is required during surgery involving intrathoracic manipulations. While blockers can also be used, double lumen tubes (DLTs) are commonly used for one-lung ventilation as they can cause the lung to collapse rapidly and are rarely displaced during the operation, among other advantages (Fig. 1). However, because of their large diameter, increased length, and peculiar shape, their insertion is more

difficult than that of regular SLTs [1]. A few types of video laryngoscopes are suitable for tracheal intubation with DLT, and their wide adoption in clinical practice is currently warranted.

The Airtraq Double Lumen[®] (Prodol Meditec S. A., Vizcaya, Spain) has a basic structure similar to that of the Airtraq[®]. It includes a guide groove in which an endotracheal tube is placed and an optical channel for visualization of the glottis. The two devices differ with regard to the size of the guide groove. The smallest width of the opening of Airtraq[®] is 16 mm, whereas that of the Airtraq Double Lumen[®] is larger at 19 mm and can accommodate not only SLT but also a large-diameter endotracheal tube such as DLT. While a white light-emitting diode on the blade tip provides light, the glottic view is transferred from the plastic lens at the tip of the optical channel, via prisms and mirrors, to the eye cup at the proximal end. The Universal Adapter for Smartphones[®] (Prodol Meditec S. A., Vizcaya, Spain) is attached to the Airtraq Double Lumen[®] with the eye cup detached. A portable monitor such as a smartphone or an iPod is attached to the adapter. This facilitates improved glottic visualization and smooth performance of the procedure (Fig. 2).

In this report, we describe the successful use of the Airtraq Double Lumen[®] with the Universal Adapter

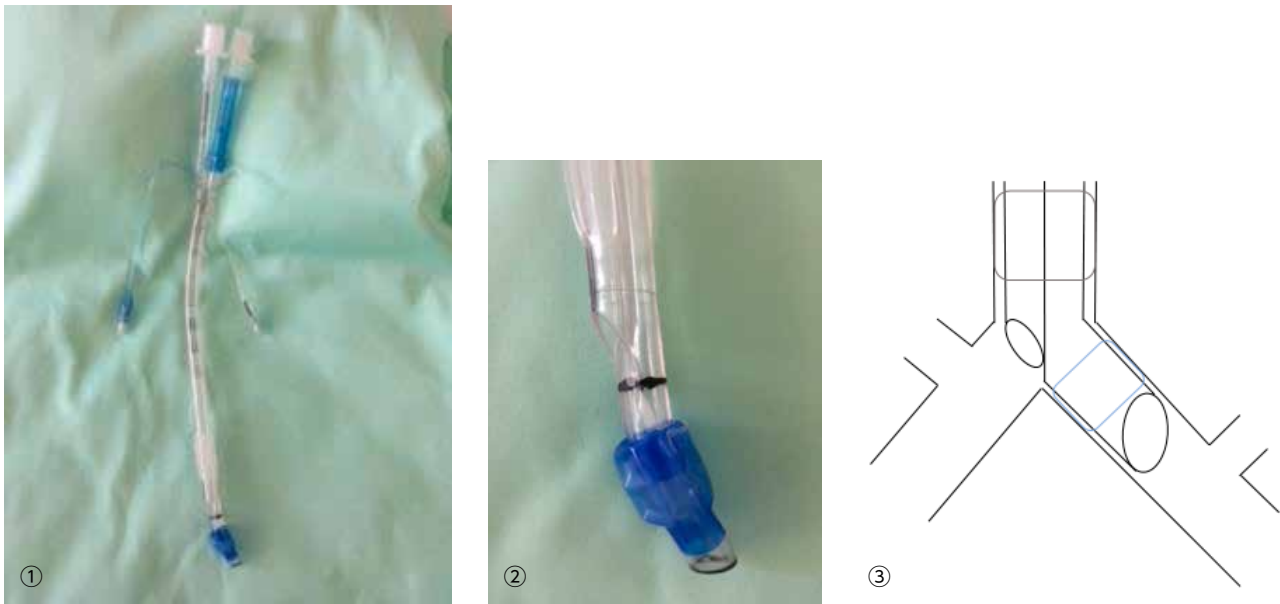


Fig. 1 Double lumen tube
 ① Double lumen tube, ② Tip of the double lumen tube, ③ Position of the double lumen tube in the trachea



Fig. 2 Airtraq Double Lumen[®] with the Universal Adapter for Smartphones[®]
 ① Airtraq Double Lumen[®], ② Universal Adapter for Smartphones[®], ③ Tracheal intubation while observing monitor screen

for Smartphones[®] for airway management during anesthesia in a 78-year-old man requiring one-lung ventilation for whom tracheal intubation was expected to be difficult.

MATERIALS AND METHODS

A 78-year-old man with a height of 166 cm, weight of 65 kg, and body mass index of 24 kg/m² was scheduled for upper lobectomy via video-assisted thoracoscopic surgery for a malignant tumor in the upper lobe of his right lung. The patient had a history of bronchial asthma and was taking inhaled and oral medications since the age of 65 years. The last attack had occurred 10 years back. In addition, he had undergone total nephroureterectomy for a left ureteral tumor at our hospital approximately 2 years back. According to his medical records from that time, the laryngeal view had been classified as grade 3 according to the Cormack and Lehane classification [2], and blind tracheal intubation had been performed with a tube introducer. At the current presentation, preoperative respiratory function testing revealed a

forced expiratory volume in 1 second (FEV₁) of 2.3 L. The ratio of FEV₁ to the forced vital capacity was 63%. Thoracic computed tomography (CT) revealed interstitial inflammatory changes in both lower lung fields. No other abnormal findings were observed. Other preoperative findings included micrognathia, mouth opening equal to a three-finger width, Mallampati Class II, mentum-hyoid bone distance equal to a 2.5-finger width, hyoid bone-thyroid cartilage distance equal to a two-finger width, and Class I findings in the Upper Lip Bite Test [3]. The range of motion of the cervical spine was normal, and craniocervical CT did not show stenosis or occlusion in the upper respiratory tract.

ANESTHETIC PLAN

Under general anesthesia combined with epidural anesthesia, one-lung ventilation using DLT was planned. Because intubation was expected to be difficult, we intended to perform tracheal intubation using the Airtraq Double Lumen[®] with the Universal Adapter for Smartphones[®]. In anticipation of unsuccessful intu-

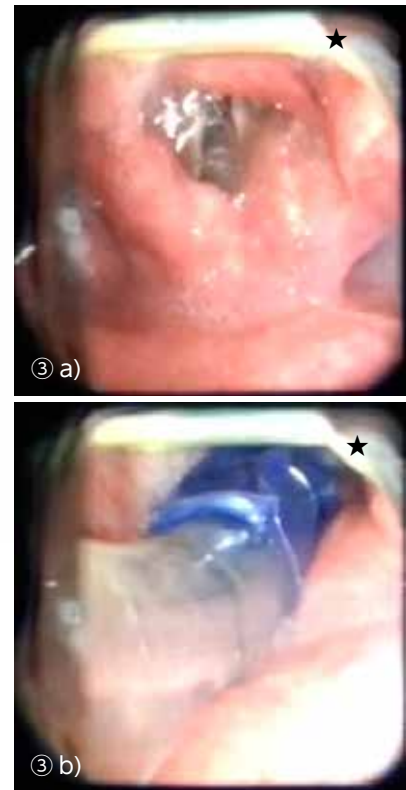
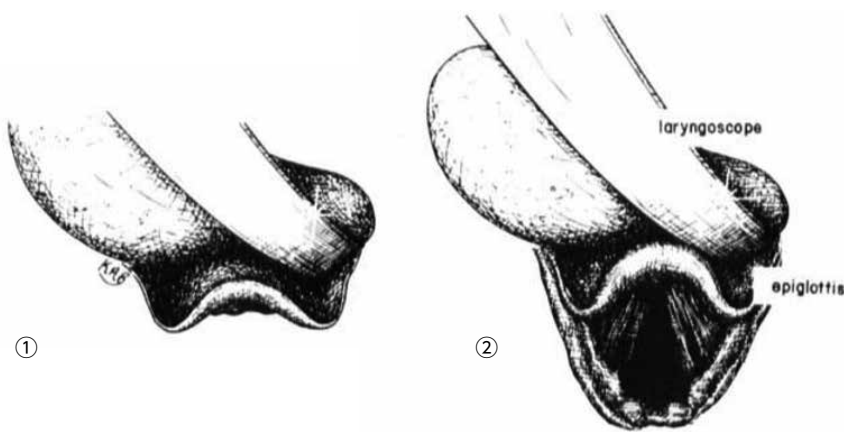


Fig. 3 Glottal view

① Cormack and Lehane classification grade 3, ② Cormack and Lehane classification grade 1, ③ Using Airtraq Double Lumen[®] a) Glottal view, b) Insertion of the DLT and advancement, ★ Blade of Airtraq Double Lumen[®]
 ①② Quoted from reference [2]

bation with DLT, we made arrangements for SLT, the Phycon TCB Bronchial Blocker[®] (Fuji Systems, Tokyo, Japan), the Airway Scope[®] (AWS, Nihon Kohden Corporation, Tokyo, Japan), the McGrath[®] MAC (Medtronic, Dublin, Scotland, The United Kingdom of Great Britain and Northern Ireland), and a bronchoscope. To protect the patient's personal information, a hospital-owned iPod was used instead of a smartphone as the image monitor attached to the adapter.

ANESTHETIC MANAGEMENT

Before surgery, 125 mg of methylprednisolone was intravenously injected for the prevention of asthmatic attacks. On arrival in the operating room, the blood pressure was 153/82 mmHg, heart rate 62 beats/min, and oxygen saturation (SpO₂) 98%. After an epidural catheter was placed from the Th5/6 intervertebral level, anesthesia was rapidly induced with oxygen at 6 L/min, propofol at 3.0 μg/mL via target-controlled infusion, and remifentanyl at 10 mg/h. Following confirmation of the feasibility of mask ventilation, 70 mg of rocuronium was administered and the Airtraq Double Lumen[®] was inserted. The Universal Adapter for Smartphones[®] connected to a 4-inch iPod Touch[®] (Apple Inc., Cupertino, CA, USA) was attached to its eye cup, through which the iPod Touch displayed images. The glottal area was easily visualized, and we promptly and smoothly intubated the patient with a 35-Fr DLT (Shiley[™] Endobronchial Tube with Left Polyurethane Cuff [Medtronic, Minneapolis, USA]) (Fig. 3).

RESULTS

Under the maintenance of anesthesia with propofol, remifentanyl, and ropivacaine (epidural injection), surgery was completed without any complications (surgical

duration, 3 h and 17 min; anesthesia duration, 4 h and 45 min). The patient favorably emerged from anesthesia and immediately resumed spontaneous breathing; consequently, he was extubated in the operating room and transferred to the intensive care unit. On postoperative day 1, no complications associated with tracheal intubation, such as pharyngolaryngeal discomfort and hoarseness, were observed.

DISCUSSION

We reported the successful intubation of a patient with anticipated difficult intubation by using the Airtraq Double Lumen[®] with the Universal Adapter for Smartphones[®].

In recent years, various types of video laryngoscopes have become available for clinical use. They are used more frequently than tracheal and laryngeal fiberscopes and supraglottic airway devices for cases of intubation difficulty, with a higher rate of successful tracheal intubation [4]. However, in general, visualization of the tracheal opening does not guarantee successful tracheal intubation. Even if the glottal area is visualized with a video laryngoscope, which can be expected to provide a better laryngeal view than do conventional Macintosh laryngoscopes [5], tracheal intubation is not necessarily easy in all patients.

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 [6]. 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 [7].

The Universal Adapter for Smartphones[®] was released in November 2015 in Japan. This product,



Fig. 4 Position of the main lumen tip when the bronchial lumen tip passes through the glottis

- ① Airtraq Double Lumen[®] and 39-Fr DLT (Shiley[™] Endobronchial Tube with Left Polyurethane Cuff)
 ② Lateral view, ③ Bottom view ★Main lumen tip

which is compatible with all types of Airtraq[®] devices, is a device that connects the Airtraq[®] with a portable display such as a smartphone or an iPod and transfers images from the eye cup of the Airtraq[®] to the display. By use of the adapter, the glottic view that is transferred from the plastic lens at the tip of the optical channel, via prisms and mirrors, to the eye cup at the proximal end can be imaged by the camera on smartphones, so that the glottal area can be visualized on the monitor. Because the Airtraq[®] is designed such that the operator can perform tracheal intubation while peering into the eye cup, continuous observation of the airway condition during the procedure is considered difficult [8]. However, the adapter has resolved these difficulties.

Before a portable display is used, the dedicated application known as Airtraq Mobile[®] (iOs: <https://itunes.apple.com/es/app/airtraq-mobile/id860540544>, Android: <https://play.google.com/store/apps/details?id=com.geoactio.airview>) should be installed on the smartphone connected to the adapter. This application enables the display of images, recording of still and video images, and focusing of images. Because the built-in battery of the Airtraq[®] provides power to the lighting, driving, and heating units of the lens for approximately 40 min, a dying battery or loss of transparency of the lens under normal use is not a concern. Meanwhile, because activation of the application does not automatically block smartphones from receiving incoming calls or messages, communication settings regarding phone calls, text messages, and social media applications should be changed when personal devices are used. For the present case, we used the hospital-owned iPod Touch[®] in the airplane mode to prevent interference with the other medical devices.

DLTs used for one-lung ventilation have a unique shape because of the large external diameter and increased overall length. Therefore, their insertion is occasionally more difficult than that of ordinary endotracheal tubes [1], and tracheal intubation with DLT often becomes even more difficult in cases of intubation difficulty. Very few video laryngoscopes with the guide groove are suitable for DLT insertion. Before the AWS Intlock (M-ITL-LL)[®] (Nihon Kohden Corporation, Tokyo, Japan), which can be used with

DLTs, was released in September 2016, the Airtraq Double Lumen[®] was the only video laryngoscope with the guide groove that could be used for DLT insertion.

We used the Airtraq Double Lumen[®] as the first-choice device in the present case not only because its monitor can be shared by multiple people, but also because focusing and recording can be performed simply by touching the screen. In addition, it weighs less than 200g even when assembled with the Universal Adapter for Smartphones[®], and is thereby easy to handle. Moreover, the Airtraq Double Lumen[®] is intended for single use and costs only about ¥12,000 (the Universal Adapter for Smartphones[®], which does not come into contact with a patient and can be used repeatedly, also costs as low as ¥12,500), and this feature renders it superior to the competitive products, such as Airwayscope[®] and McGRATH[®], which cost more than ¥200,000.

The Airtraq Double Lumen[®] is compatible with tube sizes of up to 41 Fr, and the inner surface of the guide groove is minimized to reduce tube friction. However, when the bronchial lumen of a large-diameter DLT is advanced toward the glottis, the opening of the main lumen contacts the curved section of the guide groove to cause friction (Fig. 4). Because the increased time required for intubation due to friction is a concern, a small-diameter (35 Fr) DLT was selected for our patient. Although the use of a tube that is as large as possible is recommended for one-lung ventilation [11], a study reported that tubes with smaller diameters can also be safely used [1]. In our patient, there was no problem such as an increased airway pressure during one-lung ventilation.

The use of the Airtraq Double Lumen[®] and Universal Adapter for Smartphones[®] allows the continuous monitoring of displayed images without continuous peering into the eye piece during the period from insertion of the blade section in the oral cavity to visualization of the glottis. This seems to reduce the time required for intubation. Furthermore, the adapter allows the operator to share images with assistants and record still and video images.

In conclusion, the findings from this case suggest that combined use of the Universal Adapter for Smartphones[®] and Airtraq Double Lumen[®] facilitates

the safe and smooth insertion of DLT in cases of intubation difficulty.

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We have obtained consent from the patient for publication of this case report. This investigation conformed to the principles outlined in the Declaration of Helsinki (Cardiovascular Research 1997; 35: 2-4). The authors have no conflict of interest to declare.

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