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The combination of a fiberoptic stylet and a McCoy laryngoscope facilitates tracheal intubation in difficult airway cases

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Abstract
Purpose. Fiberoptic stylets are considered useful for difficult airway management. In the present study, we assessed the usefulness of a fiberoptic stylet when the stylet was used with a Macintosh or a McCoy laryngoscope.
Methods. Twenty-four patients, whose airways were graded as Cormack grade III, were studied. We compared the times required for tracheal intubation when the fiberoptic stylet was used with a Macintosh direct laryngoscope and when it was used with a McCoy laryngoscope. Cormack grade III was subdivided into IIIa (with distance between the epiglottis and the posterior wall of the pharynx) and IIIb (with no distance between the epiglottis and the posterior wall of the pharynx), according to the view of the vocal cords by the laryngoscope.
Results. The intubation time in grade IIIb patients, who were intubated by the concurrent use of the fiberoptic stylet and the McCoy laryngoscope (28 ± 4 s), was not significantly different from that in grade IIIa patients (28 ± 10 s). The intubation time in grade IIIb patients, who were intubated by the concurrent use of the fiberoptic stylet and the Macintosh laryngoscope (52 ± 8 s), was significantly longer than that in grades IIIa (28 ± 10 s; $P < 0.01$) or IIIb with the McCoy laryngoscope (28 ± 4 s; $P < 0.01$).
Conclusion. The combination of a new handy fiberoptic stylet and a McCoy laryngoscope facilitated tracheal intubation of patients whose airway had no distance between the epiglottis and the posterior wall of the pharynx in laryngoscopic vocal cord view.

Key words Equipment · Fiberoptic stylet · Laryngoscope · Intubation (tracheal) · Technique

Introduction

Unexpected difficult airway is a serious concern for anesthesiologists, since an accurate prediction of a difficult airway is still difficult to make during a preoperative evaluation. According to Calder et al. [1], the available tests have a sensitivity of approximately 50%. Fiberoptic stylets are considered useful for tracheal intubation of patients with difficult airways, and several types of fiberoptic stylets are already commercially available. In our previous report, we introduced a fiberoptic stylet that has a compact light source and can be used by a physician acting alone [2]. With the use of this fiberoptic stylet, the physician who determines that the airway will be difficult to intubate can view the vocal cords through the eyepiece on the top of the stylet.

Until now, the number of studies describing efficiency of the fiberoptic stylet for difficult intubation has been limited. We reported 15 patients of Cormack grade III and one patient of grade IV who were safely intubated with the assistance of a fiberoptic stylet [2]. Recently, Kitamura et al. reported the efficiency of a fiberoptic stylet in their 32 cases of tracheal intubation, which included 3 cases with airway classified as Mallanpati grade III [3]. In both reports, direct laryngoscopy was concomitantly used to ensure a better view through the fiberoptic stylet. However, the best way to use the fiberoptic stylets has not yet been established. In the present study, we assessed the usefulness of our fiberoptic stylet in 24 patients of Cormack grade III and compared the intubation time when the fiberoptic stylet was used with the Macintosh direct laryngoscope and when used with the McCoy laryngoscope (laryngoscope with a flexible blade tip).

Methods

Fiberoptic stylet specifications

A fiberoptic stylet (PSS-6; Machida Instrument, Tokyo, Japan), 482 mm long and weighing 160 g, was used throughout the study. This stylet had a compact light

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source attached to the main body, and the shaft was composed of multicomponent glass optical fibers, which allowed a view of more than 10000 pixels [2].

Intubation method

Prior to the use of this system, approval of the local ethics committee and informed consent from all patients were obtained. No patient was an emergency case. In a preoperative examination, the upper airway view was classified according to Mallampati's criteria [4]. Data were obtained consecutively for 18 months, and the intubation time was measured in 24 patients graded Cormack III. These patients were encountered among a total of 1689 intubation cases. Five staff anesthesiologists, who had extensive anesthesia experience for more than 10 years and were centified by the local board, participated in the study as laryngoscopists.

Anesthesia was induced by 2 mg·kg^{-1} of propofol, and muscle relaxation was obtained by 0.15 mg·kg^{-1} of vecuronium. Before tracheal intubation was attempted, patients were ventilated manually with a face mask and 100% oxygen for 3 min. The height of the pillows was 6 to 10 cm. After muscles relaxation had been obtained, a Macintosh direct laryngoscope was inserted through the mouth, and visualization of the vocal cords was attempted according to standard procedures. Laryngeal pressure was not applied in any cases. The final view obtained by the direct laryngoscope was classified according to Cormack's criteria [5]. Cormack grade III was subdivided into IIIa and IIIb according to the vocal cord view by the laryngoscope (Fig. 1). In grade IIIb cases, no distance was observed between the epiglottis and the posterior wall of the pharynx. When direct visualization was possible by direct laryngoscope (Cormack grade I or II), tracheal intubation was completed according to standard procedures. When direct visualization was impossible by direct laryngoscope (Cormack grade III or IV), the intubation attempt was interrupted tentatively, and mask ventilation was repeated.

During mask ventilation, an assistant prepared a tracheal tube 7.0 to 8.5 mm in diameter (Mallincklodt, Aethelone, Ireland) set on the fiberoptic stylet. For some grade IIIb cases, a McCoy laryngoscope was also prepared. In the second attempt, the tracheal tube set on the fiberoptic stylet was inserted beyond the tongue along the blade of the laryngoscope (Macintosh or McCoy). Next, viewing of the vocal cords was attempted again through the eyepiece of the fiberoptic stylet. The location of the vocal cords was determined by moving the top of the tracheal tube. For the grade IIIb cases, movement and rotation of the top of the stylet, and further lifting of jaw by the laryngoscope, were applied to visualize the vocal cords. When the McCoy laryngoscope was used, flexion of the blade tip was applied for better viewing. When the vocal cords were aligned with the center of the field of view, the tube was inserted through the vocal cords until the tracheal cartilage rings were observed through the eyepiece. The time required for tracheal intubation was defined as the time from the start of the second intubation attempt to the completion of tracheal intubation. The choice of laryngoscope for the patients with grade IIIb airway (Macintosh, group MA, or McCoy, group MC) was determined by a random number table. The patients with grade IIIa airway were intubated with Macintosh laryngoscopes (group C).

The data were expressed as means ± SD and were statistically analyzed by one-way analysis of variance with Scheffé's post-hoc test.

Results

The patient demographics were not different between the groups (Table 1). The intubation time with the use of the fiberoptic stylet in grade IIIa was 28 ± 10 s. The intubation time in grade IIIb patients, who were intubated by the concurrent use of the fiberoptic stylet and the McCoy laryngoscope, was 28 ± 4 s. This value was not significantly different from that for grade IIIa patients. The duration in grade IIIb patients, who were intubated by the concurrent use of the fiberoptic stylet and the Macintosh laryngoscope, was 52 ± 8 s (Fig. 2).

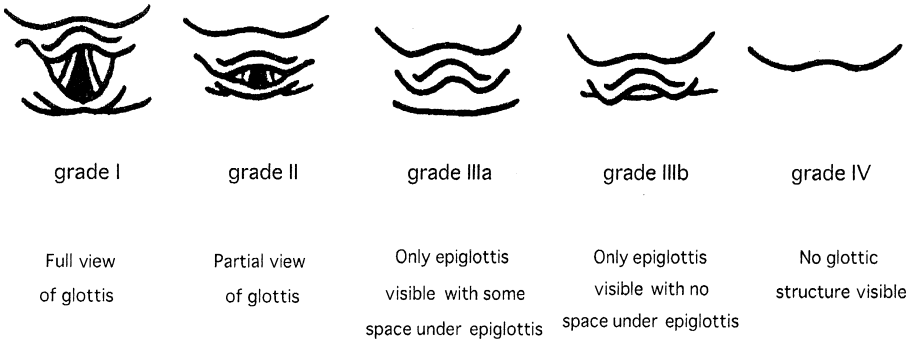

Fig. 1. Modified Cormack grading. Cormack grade III was subdivided into IIIa and IIIb according to the view of the vocal cords by the laryngoscope. In grade IIIb cases, no distance was observed between the epiglottis and the posterior wall of the pharynx

Table 1. Patient demographics

Group	C	MA	MC
No. of patients	12	5	7
Sex (male/female)	3/9	2/3	3/4
Age (yr)	61 ± 14	65 ± 11	61 ± 6
Height (cm)	163 ± 8	154 ± 12	159 ± 8
Weight (kg)	59 ± 10	54 ± 10	63 ± 4
Mallampati grade (1/2/3/4)	(3/9/0/0)	(0/5/0/0)	(0/5/1/1)
Modified Cormack grade	IIIa	IIIb	IIIb

Data are expressed as means ± SD. Group C, Macintosh laryngoscope was used; group MA, Macintosh laryngoscope was used; group MC, McCoy laryngoscope was used

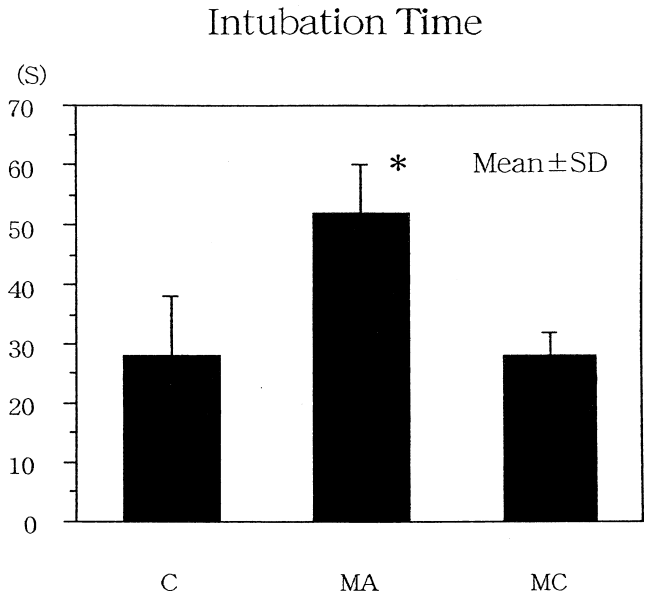

Fig. 2. Intubation time in Cormack grade III cases. The intubation time using fiberoptic stylet in grade IIIb cases, which were intubated by the concurrent use of the fiberoptic stylet and the McCoy laryngoscope (*MC*), was not significantly different from that in grades IIIa (*C*). The intubation time in grade IIIb cases, which were intubated by the concurrent use of the fiberoptic stylet and the Macintosh laryngoscope (*MA*), was significantly longer than that in grades IIIa (*C*) or IIIb with the McCoy laryngoscope (*MC*) ($P < 0.01$)

This intubation time was significantly longer than in grade IIIa and IIIb patients with the McCoy laryngoscope. No grade IV case was encountered in the present study. Throughout the period of this study, there was no case in which intubation was impossible when the fiberoptic stylet was used. No complications related to tracheal intubation were observed.

Discussion

The present study demonstrated that the intubation time when a fiberoptic stylet and a McCoy laryngoscope were concurrently used for patients with Cormack grade IIIb airway was approximately 30 s. This period was almost same as that required for patients with grade IIIa or routine direct laryngoscopic intubation. The delay observed in grade IIIb cases, when a fiberoptic stylet and a Macintosh laryngoscope were used, may be due to the length of time required to insert the tube with the stylet beyond the epiglottis, given that there is no distance between the epiglottis and the posterior wall of the pharynx in these cases. Since the use of the McCoy laryngoscope shortened the duration significantly, the flexion of the tip of the McCoy laryngoscope was effective to make a space between the epiglottis and posterior wall of the pharynx, and to improve the view through the fiberoptic stylet. This observation implied that even when the fiberoptic stylet is used for intubation, the space around the vocal cords is critical for visualization of the vocal cords and safe tracheal intubation. The idea of the concurrent use of the fiberoptic stylet and the McCoy laryngoscope in extremely difficult airway cases has already been mentioned in our previous report [2]. In the present study, we demonstrated the effectiveness of this combination. Throughout the period of this study, there was no case in which intubation was impossible when the fiberoptic stylet was used. In addition, the intubation time for difficult airway cases was not longer than that for uncomplicated cases, when the combination of the fiberoptic stylet and the McCoy laryngoscope was used. Considering that most patients in groups III and IV were extremely difficult or impossible to intubate with a routine direct laryngoscopic approach, the new airway management demonstrated in this report appears to offer a useful means of reducing the risk of fatal airway trouble.

Vacanti and Roberts [6] first reported that the simultaneous use of a stylet and a flexible fiberscope was effective for difficult airway intubation. In their report, they noted that a certain stiffness of the stylet was necessary for proper airway management. However, in their method, anesthetists need to insert both the stylet and the fiberscope into the narrow internal space of a tracheal tube. As a result of technological advances, fiberoptic stylets have been devised, and several different types have already become commercially available. All of them have a dual function as both a stylet and a fiberscope. The fiberoptic stylet reported by Gravenstein et al. (Nanoscope; Nanoptics, Gainesvill, FL, USA) requires an outer light source and display, and it has a resolution of approximately 3000 pixels. The other fiberoptic stylet reported by Kitamura et al. (StyletScope; NihonKoden, Tokyo, Japan) requires an outer battery box and has a resolution of 3500 pixels.

This type has a maneuverable tip. The fiberoptic stylet used in this study does not require an outer light source or display, and it has a resolution of more than 10000 pixels. Although there are some differences among the specifications of these fiberoptic stylets, they all may be effective for tracheal intubation of difficult airways. According to the study by Gravenstein et al., this device is useful not only in cases of difficult airway management, but also for untrained laryngoscopists to reduce the complication of sore throat [7]. Further technological advance will improve the device and may introduce more sophisticated use of the fiberoptic stylet in airway management.

The results of the present study may not be conclusive, because the study could not be conducted in a double-blind manner. The incidence of difficult airway is not extremely high, and the situation of difficult airway management is disturbing, needs urgent solution, and easily results in panic [8]. For these reasons, unbiased and reliable data collection regarding difficult airway management is not easy. To establish the most effective use of the fiberoptic stylet in airway management, widespread use of the stylet and more extended clinical experience may be indispensable.

In conclusion, new airway management with the fiberoptic stylet and the McCoy laryngoscope facilitated tracheal intubation of patients whose airways had no distance between the epiglottis and the posterior wall of the pharynx. This technique was considered a useful approach to reduce the risk of fatal airway problems.

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