

CHINESE MEDICAL SCIENCES JOURNAL

ORIGINAL ARTICLE

Shikani Optical Stylet-guided Intubation *via* the Intubating Laryngeal Airway in Patients With Scar Contracture of the Face and Neck

Dong Yang, Shi-yi Tong, Jin-hua Jin, Geng-zhi Tang,
Jing-hu Sui, Ling-xin Wei, and Xiao-ming Deng*

Department of Anesthesiology, Plastic Surgery Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing 100144, China

Key words: Shikani Optical Stylet; laryngeal mask airway; difficult airway; endotracheal intubation

Objective To evaluate the feasibility of the Shikani Optical Stylet (SOS)-guided intubation through a new Intubating Laryngeal Airway (ILA) in anticipated difficult airways caused by scar contracture of the face and neck.

Methods Thirty-three adult patients with anticipated difficult airways undergoing selective faciocervical scar plastic surgery under general anesthesia were enrolled in this study. After anesthesia induction, a size 2.5, 3.5 or 4.5 ILA was inserted. Following good lung ventilation being verified, the SOS preloaded with an endotracheal tube was inserted *via* the ILA. Once the clear vocal cords came into view under the SOS, the endotracheal tube was advanced through glottis into the trachea.

Results The ILA provided an effective airway in all patients. Intubation was successful at the first attempt on 22/33 (66.7%) occasions and at the second attempt on 6/33 (18.2%). Intubation failed in 5 (15.1%) patients who suffered from severe limitation of head extension due to scar contracture of the neck. These patients' tracheas were finally intubated using a fiberoptic bronchoscope *via* the ILA.

Conclusions The SOS-guided intubating method *via* the ILA is a feasible technique in patients with scar contracture of the face and neck. However, in patients with severe limitation of head extension, the use of SOS cannot be recommended. The SOS can be used as an alternative apparatus when the fiberoptic bronchoscope is not available.

Chin Med Sci J 2013; 28(4):195-200

THE Intubating Laryngeal Airway (ILA) is a new, reusable supraglottic airway device for airway management and endotracheal intubation. The ILA combines the features of the soft airway tube

of the classic Laryngeal Mask Airway (cLMA) and the ability for facilitating intubation of the Intubating Laryngeal Mask Airway (ILMA, FastrachTM).^{1, 2} Our experience using the ILA and other studies indicated that regular endotracheal tubes (ETTs) could be passed successfully into the tracheas, with or without fiberoptic guidance or with lighted stylet guidance in pediatric and adult patients with normal and anticipated difficult airways.³⁻⁵

In comparison of the ILMA, the ILA allows for straightforward passage of a rigid fiberscope when used as a conduit for tracheal intubation since it has a soft airway tube. However, there have been no other published studies to report whether a rigid fiberscope, for example the Shikani Optical Stylet (SOS) can facilitate tracheal intubation through the ILA in patients with difficult airways.

Our study evaluated the novel use of a SOS-guided intubation *via* an ILA in patients with scar contracture of the face and neck and anticipated difficult airways.

PATIENTS AND METHODS

Patients

After institutional review board of Plastic Surgery Hospital approval and obtaining written informed consent, we recruited 33 adult patients suffered from postburn scars of the neck and face, whose ASA physical status was I, age was 25 ± 9 (range 18-53) years and weight was 59 ± 15 (range 44-76) kg, who required general anesthesia with endotracheal intubation for elective plastic surgery in Plastic Surgery Hospital. The patients had anticipated difficult airways detected in the pre-operative assessment, according to a multivariate risk index used in our institution.^{6, 7} We excluded patients who were non-fasted, morbidly obese, and had gastroesophageal reflux or mouth opening (interincisor distance) < 1.5 cm. We also excluded patients with loose teeth or teeth in poor condition.

Airway management procedures

The intubations were performed by a single anesthesiologist (Xiao-ming Deng) who has more than 20 years' clinical experience in anesthesia and past experience of more than 100 intubations using the ILA (Cookgas LLC, Mercury Medical, Clearwater, FL, USA; Fig. 1) with or without fibreoptic bronchoscope (FOB)-guided technique.

We chose the ILA size according to the patient's body weight.⁸



Figure 1. The Intubating Laryngeal Airway.

We used a size 2.5 ILA for patients with body weight <50 kg, a size 3.5 ILA for patients 50-70 kg, and a size 4.5 for patients >70 kg. A standard disposable Murphy-type cuffed polyvinyl chloride endotracheal tube (Hudson Respiratory Care, Temecula, CA, USA) was used (internal diameter 7.0 mm in females and internal diameter 7.5 mm in males).

Routine pre-operative preparations were performed as per our institution's protocol. A lubricated SOS (Clarus Medical Company, USA) was inserted into the ETT until its anterior end was closed to but not beyond the distal end of the ETT. The ETT-SOS unit was bent anteriorly to an angle of 40° to 60° at about 6 cm from the distal end according to the conditions of the individual patient's airway (Fig. 2). The cuff of the ILA and the outer wall of the ETT were lubricated with sterile water-soluble lubricant.

Anesthetic management was standardised. No pre-medication was given. After placement of standard monitors, an intravenous cannula was placed, and scopolamine 0.3 mg was administered for its antisialogogue effect. All patients were pre-oxygenated for 5 minutes. Anesthesia was induced with intravenous injection of midazolam 0.05 mg/kg, fentanyl 2 µg/kg and propofol 2 mg/kg. After confirmation of adequate facemask ventilation, vecuronium 0.1 mg/kg was intravenously administered for muscle relaxation. Manual 100% oxygen facemask ventilation was applied during 120 seconds before tracheal intubation technique was attempted.

The ILA was then inserted after application of jaw thrust, using the standard midline technique.⁹ The cuff was inflated when the ILA was in place following the manufacturer's recommendations. Successful placement was determined by observation of bilateral chest wall movement with the presence of normal end-tidal carbon dioxide waveforms upon delivery of a positive pressure breath. If the lung ventilation *via* the ILA was unsatisfactory, the ILA was then subsequently manipulated by the following predetermined manoeuvres to optimize the ventilation: we first tried pushing the ILA deeper in.



Figure 2. The endotracheal tube-Shikani Optical Stylet unit.

If this did not improve the ventilation, we then partially withdrew the ILA 4-6 cm and reinserted without deflating the cuff. We tried this measure, was similar to the "up-down manoeuvre",¹⁰ only one time. If we were still unable to achieve a satisfactory ventilation, we removed and reinserted the ILA, and tried this up to three times.

Upon optimization of lung ventilation, the lubricated ETT-SOS unit was inserted through the airway tube of the ILA with the 15-mm connector removed. In order to improve the laryngeal view, the following manipulations were allowed: readjustment of the ILA position, neck extension or flexion, removal of the SOS, and change of the anterior curved angle of the SOS. We limited the total time for all attempts to achieve and optimize the view of glottis to 3 minutes. The anesthesiologist monitoring the patient ensured that the patient's oxygen saturation did not decrease below 90% at any time. If oxygen desaturation (oxygen saturation < 90%) occurred during the intubation, the procedure was stopped and 100% oxygen was immediately supplied *via* the ILA. After optimizing the glottic view, we positioned the tip of the ETT-SOS unit at the laryngeal aperture, advanced the ETT through the vocal cords into the trachea along the SOS and then removed the SOS. The ETT cuff was inflated and the anesthesia circuit was connected to confirm correct ventilation through the ETT with bag ventilation and end tidal capnography.

After successful tracheal intubation, the ILA cuff was deflated, and the ILA was then removed over the ETT with the aid of the patented ILA Removal Stylet (Fig. 3) according to the manufacturer's instructions. End tidal capnography was verified to ensure that the ETT had not been dislodged during the ILA removal. We limited the number of intubating attempts to two, before carrying out intubation with a FOB (5.1-mm-outer diameter, Olympus LF-DP, Tokyo, Japan) through the ILA.

Recorded data

An independent observer recorded the following items: (1) Number of attempts needed for successful ILA placement and tracheal intubation (a failed attempt defined as removal of the ILA or the ETT from the oral cavity or the ILA); (2) Time taken for successful ILA placement, tracheal intubation and ILA removal: measured from the time that

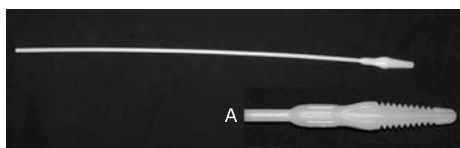


Figure 3. The Intubating Laryngeal Airway Removal Stylet.

A. The tapered tip of the Stylet allows it to accommodate standard endotracheal tube in multiple sizes.

the anesthesiologist's first picked up the ILA to the time that capnography confirmed the correct ILA placement, the successful tracheal intubation and adequate ventilation of the lungs *via* the ETT after removing the ILA; (3) Complications associated with the tracheal intubation, for example oxygen desaturation, inadvertent oesophageal intubation, laryngospasm, lips or dental injury, mucosal injury evidenced by blood staining of the ILA .

RESULTS

The mean risk score for difficult intubation in our patients was 24 (range 13-40), derived from different combinations of the assessed difficult airway items (Table 1).

All patients completed the study under the protocol detailed above. The numbers of ILA cuffs used for size 2.5, 3.5 and 4.5 were 3, 26 and 4, respectively. Anesthesia was uncomplicated in all patients.

Insertion of the ILA with subsequent ventilation was successful in all 33 patients. Ventilation quality was classified as adequate in 31 (94%) patients and possible in 2 (6%) cases. In 30 (91%) applications, ventilation was successful at the first attempt. Three (9%) patients required the second or the third attempt due to postburn scars of the face and neck with limited head extension and mouth opening. Mean time for insertion was 23 (15) seconds.

In 22 (66.7%) patients, the tracheas were intubated at the first attempt. In 6 (18.2%) cases, intubations were successful at the second attempt because inadvertent oesophageal intubation occurred during the first intubating attempt. Accidental oesophageal intubation was initially diagnosed

Table 1. Difficult airway risk factors assessed in patients

Difficult airway risk factor	Value	No. of patients
Previous difficult intubation	10	17
Interdental gap (cm)		
3.0-5.0	3	11
<3.0	13	22
Thyromental distance < 6.0 cm	4	24
Maximum range of head and neck movement (°)		
±90	2	6
<80	5	17
Mallampati class		
2	2	9
3	6	10
4	8	8

Value = points assigned by the multivariate risk index. Difficult airway risk is considered when value > 11.^{6, 7}

by absence of thoracic movement after the ETT was attached to the respiratory circuit and was confirmed by capnography. Between the first and the second intubation attempt, the patient was ventilated through the ILA. Successful intubation took an average of 89 (42) seconds across 28 patients.

Tracheal intubation was unsuccessful in 5 (15.1%) patients who suffered from severe limitation of head extension due to scar contracture of the neck. The laryngeal view could not be seen whatever applied any manoeuvre after two intubation attempts or inadvertent oesophageal intubation occurred twice even though the view of glottis could be seen. All 5 cases were eventually intubated successfully under fiberoptic guidance *via* the ILA in subsequent attempts.

The ILA was successfully removed using the manufacturer's Removal Stylet while keeping the ETT in place in all 33 patients. In 28 patients whose tracheal intubations were obtained using a SOS *via* the ILA, the mean time for the entire process was 121 (48) seconds.

In 2 patients, peripheral oxygen saturation briefly decreased to below 90%. Posterior pharyngeal mucous injuries occurred in only 1 patient. There were no significant complications and no clinically evident episodes of pulmonary aspiration, bronchospasm, laryngospasm or post-extubation stridor.

DISCUSSION

This study describes a novel application of a SOS-guided intubation *via* an ILA in patients with scar contracture of the face and neck.

The airway management of patients with scar contracture of the face and neck is usually stressful and toilsome to the anesthesiologists due to the abnormal anatomy of the upper airway. Awake fiberoptic intubation (AFOI) is often regarded as the safest option for patients with suspected or proven difficult airways. However, AFOI may not be performed in patients who are not cooperative or those who refuse it, especially for the patients who had uncomfortable experience in the past surgery.^{11, 12} In our practice, fiberoptic intubation through the cLMA or the ILMA after induction of general anesthesia is an ideal alternative to AFOI in adult and pediatric patients with postburn scars of the face and neck.

The ILA, a new supraglottic airway device has been introduced for clinical use since 2005 in our hospital. Recently, FOB-guided intubation *via* the ILA has become one of our favorite methods in the management of difficult airways.^{3, 4} The ILA is functionally identical to the ILMA but possesses

an improved design and structure that combines the advantages of the cLMA and the ILMA.^{1, 2}

In the present study, ventilation with the ILA was successful in all patients with three attempts by operator. Despite the existence of obvious anatomical abnormalities of the upper airway in patients with severe scar contracture of the neck and face, we found that as long as the patient's mouth opening was more than 1.5 cm, the ILA could be inserted successfully to provide a patent airway and maintain ventilation. This suggests that the ILA may be a useful tool for ventilation in patients with difficult airways.

The ILA provides a conduit for blind or FOB-guided tracheal intubation in patients, and insertion technique similar to an ILMA.¹³ However, this blind intubation might damage the larynx and surrounding tissues. Therefore, we recommend the use of a FOB whenever it is available. A FOB is useful in facilitating intubation *via* the ILA,^{3, 9} but its main disadvantage is the cost associated with its acquisition and maintenance. In this study, we observed that the SOS presents a useful alternative when the FOB is not available. The SOS is a semi-rigid fiberoptic stylet which combines the benefits of the lightwand and the FOB.¹⁴ Since the ILA is manufactured with medical grade silicone, the pliability of the device render the ILA can be as a conduit for SOS-guided tracheal intubation.

In our study, failures of intubation using the SOS *via* the ILA all occurred in patients with severe postburn scar contracture of the neck. In these patients, optimal ventilation and alignment of the ILA with the glottic aperture were extremely difficult to achieve because the efficacy of seal for the ILA similar to the ILMA depends on pharyngeal mucosal pressures, and consequently increased leaks occurred during ventilation as well as difficulties in alignment of the mask.^{15, 16} Additionally, the presence of the inflated mask in a narrowed hypopharynx may compress laryngeal structures in an inextensible neck, inducing a glottic collapse and more difficult to find the vocal cords, as previously reported with the ILMA and cLMA.^{6, 17} Ventilation through the ILA in these patients might be not optimal for performing the SOS-guided tracheal intubation, but it did prevent oxygen desaturation. On the other hand, although the stainless steel fiberoptic stylet of the SOS is malleable, the curved semi-rigid stylet cannot be adjusted immediately during intubation according to the anatomical abnormalities of the patient's airway. Therefore, in patients with the high anterior larynx caused by severe postburn scar contracture of the neck, the position of glottic aperture may exceed the visible scope of the SOS. However, compared with the SOS, the FOB is a flexible fiberoscope which has more flexibility. During a FOB-guided intubation, we can adjust the curved

angle of the tip of a FOB immediately according to the laryngeal abnormalities of the individual patient's airway. Therefore, the FOB is an easier device to find the glottic aperture than the SOS. That's why the five patients with failed intubations under the SOS all were intubated successfully using the FOB *via* the ILA.

Based on our experience, the successful rate of SOS-guided intubation *via* the ILA can be improved by paying attention to the following points: First, after insertion of the ILA, it is important that optimal ventilation is established, which is performed by partial withdrawal and reinsertion until the least resistance to bag ventilation is achieved, suggesting an optimum larynx alignment with the ILA. Under this circumstances, it is easy to find the glottic aperture using the SOS *via* the ILA. Second, what should be specially emphasized is that during advancing the ETT along the SOS, the ETT-SOS unit must remain aligned with the airway axis. Angled approaches to the glottic aperture frequently result in oesophageal intubation and intubating failure. Third, the curved angle of the SOS's stylet is an important factor to finish tracheal intubation successfully. The distal end of the ETT-SOS unit must be bent to an appropriate angle according to the anatomical abnormalities of patient's airway. Usually, in patients with normal airways, the curved angle of the SOS resembles to that of Macintosh laryngoscope (about 40°). However, in patients suffered from limitation of head extension due to scar contracture of the neck, the curved angle must be added (about 60°) since the main airway characteristic of these patients is an anterior larynx. Although the larger bent angle may help the SOS to negotiate acute oropharynx-tracheal angles and find the glottic aperture, the SOS cannot pass the airway tube of the ILA when the bent angle is more than 60°. This is one reason for the failure of intubations in our study. Fourth, the SOS can be used as a lightwand if blood or secretions obscure the fiberoptic view.¹⁸

But this method is not suitable in the patients with cervical scar contracture or cervical tissue expander, because the glow on the neck cannot be observed in these patients. The last one, we do suggest that one familiarize oneself with the use of the SOS *via* the ILA in patients with normal airways before attempting to apply this method in patients with anticipated difficult airways.

In assessing the relevance of our study, the following points should be considered. Although the present study was done by an experienced anesthesiologist who is familiar with the ILA and FOB technique, for the expert himself the SOS-guided intubating method *via* the ILA is still a new attempt on technique. In our study, four failed intubations occurred in initial ten patients. As more

experience had accumulated, the failure of intubation was decreased significantly. If the number of the patients enrolled in this study is increased, the success rate of intubation might be higher. Secondly, in order to prevent oxygen desaturation and minimize the injury to patients, we would give up the SOS when the glottic aperture cannot be visualized in 3 minutes. The intubating success rate would rise if adjusting the ILA position repeatedly and trying to more attempts of intubation using the SOS. Additionally, we chose vecuronium as muscle relaxant since succinylcholine has numerous side effects, especially for the postburn patients. According to our experience, it is really important that a successful facemask ventilation must be confirmed before intravenous administration of muscle relaxants during induction.¹¹ For the operators with limited experience in difficult airway management, they should be careful to apply muscle relaxants in patients with anticipated difficult airways.

Further study of the SOS-guided intubation *via* the ILA in patients with other types of difficult airways is needed. Future work could also study other rigid fibroscope, for example the Bonfils-assisted intubation *via* an ILA in patients with anticipated difficult airways, and compare the successful rate with the SOS and the Bonfils.

In conclusion, it is feasible and effective to use the SOS-guided tracheal intubation *via* the ILA in adult patients with scar contracture of the face and neck and anticipated difficult airways. This method provides a new option for solving difficult intubation. In patients suffered from severe limitation of head extension due to scar contracture of the neck, the use of SOS cannot be recommended. The SOS can be used as an alternative apparatus when the FOB is not available.

REFERENCES

1. Yang D, Deng XM, Tong SY, et al. Comparison of Cookgas and Fastrach intubating laryngeal mask airway with fiberoptic bronchoscope in anticipated difficult airway management. *Zhongguo Yi Xue Ke Xue Yuan Xue Bao* 2013, 35: 477-82.
2. Yang D, Deng XM, Tong SY, et al. Roles of Cookgas and Fastrach intubating laryngeal mask airway for anticipated difficult tracheal intubation. *Zhongguo Yi Xue Ke Xue Yuan Xue Bao* 2013, 35: 207-12.
3. Yang D, Deng XM, Tong SY, et al. Fibreoptic intubation through Cookgas intubating laryngeal airway in two children. *Anaesthesia* 2009; 64: 1148-9.
4. Deng XM, Yang D, Wei LX, et al. The feasibility of blind intubation *via* the Cookgas intubating laryngeal airway in adult patients under general anesthesia. *Chin J Anesth*

- 2006; 26: 224-6.
5. Wong DT, Woo JA, Arora G. Lighted stylet-guided intubation via the intubating laryngeal airway in a patient with Hallermann-streiff syndrome. *Can J Anaesth* 2009; 56: 147-50.
 6. Arne J, Descoins P, Fuscuardi J, et al. Preoperative assessment for difficult intubation in general and ENT surgery: Predictive value of a clinical multivariate risk index. *Br J Anaesth* 1998; 80: 140-6.
 7. Lopez AM, Valero R, Pons M, et al. Awake intubation using the LMA-CTrach™ in patients with difficult airways. *Anaesthesia* 2009; 64: 387-91.
 8. Mercury Medical. Intubating laryngeal airway (ILA) indications. Available from: <http://www.cookgas.com/assets/Documents/EnglishInsert.pdf>.
 9. Jagannathan N, Kozlowski RJ, Sohn LE, et al. A clinical evaluation of the intubating laryngeal airway as a conduit for tracheal intubation in children. *Anesth Analg* 2011; 112: 176-82.
 10. Liu EHC, Goy RWL, Chen FG. An evaluation of poor LMA CTrach views with a fibreoptic laryngoscope and the effectiveness of corrective measures. *Br J Anaesth* 2006; 97: 878-82.
 11. Xue FS, Liao X, Li CW, et al. Clinical experiences of airway management and tracheal intubation under general anesthesia in patients with scar contracture of the neck. *Chin Med J* 2008; 121: 989-97.
 12. Joo HS, Kapoor S, Rose DK, et al. The intubating laryngeal mask airway after induction of general anesthesia versus awake fiberoptic intubation in patients with difficult airways. *Anesth Analg* 2001; 92: 1342-6.
 13. Wong DT, Apichatibutra N, Arora G, et al. Repeated attempts improve tracheal tube insertion time using the intubating laryngeal airway in a mannequin. *J Clin Anesth* 2010; 22: 619-24.
 14. Pfitzner L, Cooper MG, Ho D. The Shikani Seeing Stylet for difficult intubation in children: Initial experience. *Anaesth Intensive Care* 2002; 30: 462-6.
 15. Langeron O, Semjen F, Bourgain JL, et al. Comparison of the intubating laryngeal mask airway with the fiberoptic intubation in anticipated difficult airway management. *Anesthesiology* 2001; 94: 968-72.
 16. Keller C, Brimacombe J. Pharyngeal mucosal pressures, airway sealing pressures, and fiberoptic position with the intubating versus the standard laryngeal mask airway. *Anesthesiology* 1999; 90: 1001-6.
 17. Gerstein NS, Braude DA, Hung O, et al. The Fastrach intubating laryngeal mask airway: An overview and update. *Can J Anaesth* 2010; 57: 588-601.
 18. Shukry M, Hanson RD, Koveleskie JR, et al. Management of the difficult pediatric airway with Shikani Optical Stylet™. *Paediatr Anaesth* 2005; 15: 342-5.