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The use of the GlideScope® for tracheal intubation in patients with ankylosing spondylitis

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Background. The GlideScope® Video Laryngoscope is a new intubating device. The aim of the study was to investigate the use of the GlideScope® for tracheal intubation in patients with ankylosing spondylitis (AS) undergoing general anaesthesia.

Methods. Twenty AS patients were chosen to undergo tracheal intubation by the GlideScope®. Preoperative airway assessments were carried out to predict the difficulty of tracheal intubation. Before intubation all patients were given a modified Cormack and Lehane (MCLS) grade and percentage of glottic opening (POGO) score by a separate anaesthetist using a Macintosh size 3 blade. The patients were then intubated, using the GlideScope®, by a different anaesthetist during which the larynx was inspected and given another MCLS grade and POGO score.

Results. Twelve of the AS patients were judged to have had difficult intubation by preoperative airway assessment. Eleven of the twelve patients had MCLS grades III or IV by direct laryngoscopy and were considered to have had a difficult laryngoscopy. Naso-tracheal intubations by the GlideScope® were successful on 17/20 occasions, including 8 of the 11 difficult laryngoscopy. The GlideScope® improved the MCLS grade and POGO score in the majority of AS patients compared with direct laryngoscopy ($P<0.01$).

Conclusions. The GlideScope® provides a better laryngoscopic view than that of direct laryngoscopy. Most of the AS patients presenting with MCLS grade III or IV by direct laryngoscopy can be intubated successfully by the GlideScope®. In elective patients with AS, awake fibreoptic intubation offers a higher level of security because it can be applied while maintaining spontaneous breathing. The use of GlideScope® for tracheal intubation may be an alternative option in these patients who prefer their airway management under anaesthesia.

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The GlideScope® (GS) (Saturn Biomedical System Inc., Burnaby, British Columbia, Canada) is a new video laryngoscope that was developed for management of difficult airways.[1] The device consists of a light source and video camera located in the blade of a rigid plastic laryngoscope which is connected to a separate liquid crystal display monitor. Previous studies have demonstrated that the GS may provide a better laryngoscopic view than direct laryngoscopy (DL)[2] and have potential advantage for tracheal intubation in patients with simulated difficult airway.[3] Published data on its use in the management of difficult airways has been promising but there is still no clinical report investigating its usage in recognized or suspected difficult airway management.

Patients with severe ankylosing spondylitis (AS) are frequently difficult or impossible to intubate because of limited

mouth opening and/or cervical spine rigidity.[4] Awake fibreoptic intubation is always the safest option, but some patients refuse awake intubation. The aim of the study was to investigate the use of GS for tracheal intubation in AS patients who preferred their airway management under general anaesthesia.

Methods

After Ethics Committee approval and written informed consent, we studied 20 patients with AS presenting for elective surgery over a 6-month (July–December 2004) period who preferred their airway management under general anaesthesia. All the patients possess histocompatibility antigen HLA-B27 and exhibited chronic and progressive inflammatory arthritis. Preoperative airway assessments include Mallampati classification,[5] thyromental distance, interincisor gap and atlanto-occipital extension. The Mallampati classification was recorded with the patient sitting with mouth open and tongue protruded. Thyromental distance was measured as the distance between the anterior chin and the thyroid notch with the head in full extension. The atlanto-occipital extension was evaluated by estimating the patient's ability to raise the chin above the occiput in full extension. All examinations were performed by a single and separate anaesthetist. The tests on airway examination that increase the likelihood of difficult intubation include: the Mallampati classification was $\geqslant$3, thyromental distance $\leqslant$6.5 cm, interincisor gap $\leqslant$4 cm or atlanto-occipital extension was limited. After the airway assessments, the anaesthetist was requested to complete an airway assessment sheet and predict the difficulty of tracheal intubation as difficult or non-difficult.

A standard anaesthesia protocol was followed and routine monitoring applied. Patients were in the supine position with the head and neck supported on pillows so that they were as close to the neutral position as possible within their comfort range. After sufficient preoxygenation, patients received i.v. midazolam 0.01–0.04 mg kg^{-1} and fentanyl 1–2 μg kg^{-1} and underwent induction of anaesthesia by inhalation of sevoflurane in oxygen. When the eyelash reflex disappeared and mask ventilation was possible, succinylcholine 1.5 mg kg^{-1} was given i.v. A large pillow or pad was put under the patient's knees and the table was adjusted to moderate head-down position (Fig. 1). Once full neuromuscular block was achieved, all patients underwent an initial DL which was scored according to the modified Cormack and Lehane (MCLS) grading system[6] and percentage of glottic opening (POGO).[7] Because most of the previous studies investigating the laryngeal views of DL used the Macintosh (Heine, Germany) laryngoscope with a size 3 blade,[2 3] we also used this laryngoscope with the same size blade for DL in this study. These were performed by a separate anaesthetist who did not participate in any of the intubations or the patient's preoperative airway assessment.

Fig 1 A typical example of patient position for tracheal intubation by the GlideScope®.

After initial laryngoscopy, positive pressure ventilation was continued using a face mask and then the trachea was intubated using the GS. Our previous experience revealed that the tracheal intubation by the GS would be easier by nasal than the oral route. Naso-tracheal intubations were performed by another anaesthetist who was experienced in anaesthesia (>10 yr experience) and the use of the GS (>200 intubations) before the study. The person intubating with the GS was blinded to the laryngoscopy score given by the first anaesthetist. During intubation the larynx was inspected and given a second MCLS grade and POGO score. A difficult tracheal intubation is defined as a MCLS grade $\geqslant$III or a POGO score zero.

Data were analysed using the McNemar χ^2-test for matched pairs to examine MCLS grades between DL and GS.[2] A P-value <0.05 was considered statistically significant.

Results

Patient characteristics and the preoperative airway assessment data are shown in Table 1. The order of patients presented in Table 1 was according to the difficulties of tracheal intubation. After preoperative airway assessment, 8 patients (No.1–No.8) were judged to have normal airways and the remaining 12 patients (No.9–No.20) were judged to have difficult airways. Of the 12 difficult airways, 11 showed a MCLS grade III or IV during DL. Table 2 showed the comparison of MCLS grades between DL and GS. Of the 20 patients, 17 (85%) had improvement in the MCLS grade (P<0.01) obtained with the GS compared with DL. Of the eight patients who were MCLS grade III by DL, all had an improved laryngoscopic grade by GS. At the first attempt by the GS, 17 patients (No.1–No.17) could be nasally intubated, including 8 of the 11 patients with MCLS grade

Table 1 Patient characteristics and airway data in direct laryngoscopy (DL) and GlideScope® (GS). MP, Mallampatti classification; TMD, thyromental distance <6.5 cm; IG, interincisor gap <4 cm; AO, atlanto-occipital limitation; MCLS, modified Cormack–Lehane Score; POGO, percentage of glottic opening; Pre., predict difficulty intubation preoperative; DL, difficult intubation by DL; GS, difficult intubation by the GS

No.	Sex	Age	Preoperative evaluation				DL		GS		Difficult intubation		
			MP	TMD	IG	AO	MCLS	POGO	MCLS	POGO	Pre.	DL	GS
1	F	25	I				I	100	I	100			
2	M	58	II				IIa	80	I	100			
3	M	62	II	ˇ			IIa	80	I	100			
4	F	28	II				IIa	60	I	100			
5	M	23	II				IIb	40	I	100			
6	F	43	II				IIb	40	I	100			
7	M	47	II	ˇ			IIb	20	I	100			
8	M	44	II				IIb	20	I	100			
9	M	78	III	ˇ			III	0	IIa	80	ˇ		
10	M	44	III	ˇ			III	0	IIa	80	ˇ	ˇ	
11	M	41	III	ˇ			III	0	IIa	80	ˇ	ˇ	
12	M	52	III	ˇ			III	0	IIa	80	ˇ	ˇ	
13	M	61	III	ˇ	ˇ		III	0	IIa	80	ˇ	ˇ	
14	M	37	III	ˇ			III	0	IIb	40	ˇ	ˇ	
15	M	55	III	ˇ			III	0	IIb	40	ˇ	ˇ	
16	M	61	III	ˇ	ˇ		III	0	IIb	20	ˇ	ˇ	
17	M	36	IV	ˇ			III	0	IIb	20	ˇ	ˇ	
18	M	49	IV	ˇ	ˇ		IV	0	III	0	ˇ	ˇ	ˇ
19	F	43	IV	ˇ	ˇ		IV	0	IV	0	ˇ	ˇ	ˇ
20	M	55	IV	ˇ	ˇ	ˇ	IV	0	IV	0	ˇ	ˇ	ˇ

Table 2 Comparison of MCLS grades between DL and GS (n=20), P<0.01 (McNemar χ^2-test). *Patients with improvement in MCLS grade

DL	GS					
	I	IIa	IIb	III	IV	Total
I	1	0	0	0	0	1
IIa	3*	0	0	0	0	3
IIb	4*	1*	0	0	0	5
III	0	4*	4*	0	0	8
IV	0	0	0	1*	2	3
Total	8	5	4	1	2	20

III by DL. There were three patients (No.18–No.20) presenting a MCLS grade IV by DL, and MCLS grade III or IV cannot be intubated successfully using the GS.

Discussions

Previous studies have demonstrated that the GS is an effective device for tracheal intubation. It provides an improved view of the larynx and allows for successful tracheal intubation. Some authors suggest that the GS has potential advantages over DL for difficult intubations.[2] To our knowledge, this study is the first clinical research evaluating the effectiveness of the GS in AS patients with difficult airways.

Airway management and intubation in AS patients can be challenging. Ankylosing produces a rigid 'bamboo spine' that restricts neck movement, and thus DL and tracheal intubation become difficult or impossible. Awake fibreoptic intubation is the safest choice at present, but some patients cannot tolerate the procedure and may refuse awake intubation. There are several alternatives that can be used in these patients, such as laryngeal mask airway or lightwand intubation. The laryngeal mask airway devices have been used successfully in AS patients after inhalational anaesthesia induction and are considered to be an alternative option for airway management.[4] Patients may also undergo fibreoptic intubation after anaesthesia induction by using an oral intubating airway such as the Berman or Ovassapian. Most of the operative procedures in supine position could be conducted successfully via LMA[†] (classical or intubating) because most AS patients had patent airways and LMA did resolve most of the airway problems in these patients. In this study, all patients received spine operation in the prone position. Thus, tracheal intubation may be necessary for these patients. The use of the GS may be an alternative for AS patients who prefer their airway management under general anaesthesia.

Patients with AS are also prone to spinal fractures even at minor movements, especially extension, resulting in neurological deficit and death. Careful manipulation of the neck during tracheal intubation is mandatory and was performed very carefully to avoid such fractures in this study.

We used four predictor tests to evaluate the airway condition before operation in AS patients and predicted the difficulties of tracheal intubation. In this study, the prediction of difficulties of tracheal intubation proved to be highly consistent with the MCLS grades by DL but not with the MCLS grade by GS. It meant that the conventional airway assessment tests may not be used to predict the difficulty in tracheally intubating AS patients using GS. The reason may be that the GS system does not need to align the three axes for tracheal intubation. Because of the limited numbers of patients, whether this finding can also be demonstrated in the general population was not known and further investigation should be considered to clarify this question.

Both the MCLS grade and POGO score were significantly improved by GS in AS patients. This finding was in keeping with previous studies comparing the MCLS grades of DL and GS in the general population. It demonstrated that the GS may improve the laryngeal view not only in normal airways but also in difficult airway situation. The reason why we used modified but not conventional Cormack and Lehane system is that the MCLS may confer increased sensitivity when studying difficult intubation. Though some might argue that some extra manoeuvre or equipment may be still required in a proportion of the MCLS grade I and II laryngoscopies. In this study, only MCLS III or IV was defined as difficult intubation. As the evaluations of laryngoscopic views by DL and GS were performed by two separate anaesthetists, there might be a constant bias in the assessment of the laryngoscopic view grading.

Twelve of the AS patients were judged as difficult intubation before operation. Eleven of the twelve patients had a

[†]LMA® is the property of Intavent Ltd.

MCLS grade III or IV by DL and were defined as difficult intubation. Usually, the airway management of these patients was suggested as awake fibreoptic intubation. But in this study, by the usage of the GS, 9 of the 12 patients presenting with difficult intubation by DL can be tracheally intubated successfully and smoothly under general anaesthesia. By adjusting the patient's position, the approach of the GS into the patient's mouth could be made easier. At first, the patients were always in a semi-sitting position because of neck rigidity during inhalational induction. After induction, we put a large pillow under the patient's knees and adjusted the table to moderate head-down position. This procedure would increase the degree between oral axis and horizontal level and make the following approach of the blade of the GS into the patient's mouth easier (Fig. 1).

The main limitation of the GS as compared with standard laryngoscopes is the resistance to the advancement of the tracheal tube.[8–10] All the intubations in this study were nasal intubation with an intubating stylet in the tracheal tube. Our experience was that the principal limitation in using the GS for successful tracheal intubation was not in getting a good view of the glottis, but rather in manipulating the tracheal tube through the vocal cords. Some authors have suggested to use a stylet formed in the shape of a 'hockey stick' (with a 90° bend)[8] or curve the stylet to follow the 60° angulation of the GS blade.[9] The above procedures can help ensure that the tube is directed sufficiently anteriorly to enter the glottis. However, nasal intubation can make the manipulation of tracheal tube along the posterior pharyngeal wall easier and improve the successful rate of intubation with the tube directed anteriorly sufficiently. This finding was also observed during our routine practice of the GS in the general population. Some patients with a good laryngeal view but cannot be intubated orally by the GS always can be intubated successfully via the nasal route. But nasal intubation carries significant morbidity in terms of epistaxis and subsequent sinusitis, and this should be taken into consideration while using this device. Further studies may clarify the difference between nasal and oral intubation by the GS in this clinical scenario.

There were three patients with severe AS who could not be intubated successfully using the GS. Though these three patients could be tracheally intubated by fibreoptic intubation under general anaesthesia using an oral or nasal intubating airway, we decided to wake these patients and perform awake fibreoptic intubation. These patients all presented with Mallampati classification grade IV and thyromental distance <6.5 cm, though the interincisor gap was >4 cm, and the atlanto-occipital extension was severely limited. The MCLS grades were IV for these patients by DL. Though the MCLS grades were improved from IV to III in two of three occasions by GS, tracheal intubation still failed. It meant that the GS device still has its limitation though it can be of great help in difficult airway management, and awake fibreoptic intubation technique should not be replaced at extreme difficult airways.

The use of the GS potentially challenges the prevailing wisdom that such patients must be managed by awake fibreoptic intubation and may prove helpful when the patient refuses. But all non-awake techniques bear the risk of failure which in combination with apnoea may be hazardous. The use of the GS in anaesthetized patients may be advocated if the airway difficulty occurs unexpectedly by conventional laryngoscopy.

In conclusion, our study in AS patients for tracheal intubation showed that the GS provides a better laryngoscopic view than that of DL. Most of the AS patients presenting with difficult airways by DL can be nasally intubated successfully by the GS under general anaesthesia. It demonstrated the growing wealth of information regarding the applicability of the GS in patients with difficult airways by DL. The common teaching that patients with a known difficult airway must be managed by awake fibreoptic intubation may be challenged.

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