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SHORT COMMUNICATION

Efficacy of Coopdech videolaryngoscope: comparisons with a Macintosh laryngoscope and the Airway Scope in a manikin with difficult airways

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Abstract We studied the efficacy of the Coopdech videolaryngoscope Portable VLP-100, by comparing it with a Macintosh laryngoscope, and another videolaryngoscope, the Airway Scope (AWS), in a manikin with four simulated difficult airways. In a randomized, crossover design, each of 50 residents inserted the three devices, in turn, and graded the view of the glottis at laryngoscopy. Time to see the glottis, time to intubate the trachea, and the success rate of tracheal intubation (within 120 s) were recorded. In all situations, the AWS provided a significantly shorter time to see the glottis. In a manikin with tongue edema, the AWS was associated with a significantly higher success rate of intubation than the VLP-100 and the Macintosh laryngoscope ($P < 0.05$). In a manikin with cervical spine rigidity or pharyngeal obstruction, the AWS and the VLP-100 provided significantly higher success rates of intubation than the Macintosh laryngoscope ($P < 0.05$). In a manikin with laryngospasm, no one could intubate the trachea using any device. Our results indicate that, in patients with difficult airways, the videolaryngoscopes (VLP-100 and AWS) would provide higher success rates of tracheal intubation than the Macintosh laryngoscope, but the VLP-100 may be inferior to the AWS.

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Videolaryngoscopes have been shown to be useful in patients with difficult airways [1–6]. Nevertheless, there may be differences in the efficacies between the videolaryngoscopes, in particular, among patients with different causes of difficult tracheal intubation (such as limited mouth opening, trauma to airway, or swelling of soft tissue).

We considered that an appropriate step to evaluate any new airway device is to assess its efficacy in a manikin before considering its use in patients with difficult airways [7]. The main aim of the study was to assess the efficacy of the Coopdech videolaryngoscope Portable VLP-100 (VLP-100) (Daiken Medical, Osaka, Japan), by comparing it with the Macintosh laryngoscope (Penlon; Smiths Medical Japan, Tokyo, Japan) and with an established videolaryngoscope, the Airway Scope (AWS) (Pentax-AWS®; Hoya, Tokyo, Japan), in a manikin with four different simulated difficult airways.

Fifty residents, who had been trained for more than 1 month at our department, participated in the study. Because of the nature of the study, the chairperson of the institutional research ethics committee judged that it would be unnecessary to obtain an approval from the committee. A written informed consent (describing the plans of the study and an estimated time taken for participation) was obtained from all participants.

Each participant was given a demonstration of the intubation technique and oral instructions regarding the correct use of these devices. We used an Intubation Trainer (Laerdal Airman; Laerdal Medical Japan, Tokyo, Japan) to simulate an easy airway situation and the following difficult airway situations: tongue edema, cervical spine

rigidity, pharyngeal obstruction, and laryngospasm. The sequence in the selection of the devices and situations used for each attempt was randomized, using random allocation numbers provided by a computer. All tracheal intubations were performed with a cuffed 7.5-mm ID tracheal tube (Portex; Smiths Medical, Tokyo, Japan).

Each participant inserted the VLP-100, the AWS, and the Macintosh laryngoscope, in turn, and the view of the glottis at laryngoscopy was graded using the classification reported by Cormack and Lehane [8]. No attempt was made to improve the view of the glottis by applying pressure on the neck. Laryngoscopy was defined as difficult when the view of the glottis was either grade 3 or grade 4. Time to see the glottis, time taken to intubate the trachea, and success rate of tracheal intubation were recorded. The time taken to see the glottis was defined as the time from insertion of the blade between the teeth until the glottis was seen. The time to tracheal intubation was defined as the time from insertion of the blade between the teeth to confirmation of the lung inflation. Tracheal intubation was judged to have failed when the tube was inserted into the esophagus or when the time to tracheal intubation was greater than 120 s.

The main aim of the study was to compare the success rates of tracheal intubation among the three laryngoscopes. The Stuart–Maxwell test was used to compare the success rates between the three devices, and if this showed a significant difference, the McNemar test was used to compare the rates between two groups. The second aim was to compare the easiness of viewing the glottis between the laryngoscopes. We considered that the difference would be clinically meaningful if the viewing of the glottis using one device was difficult (grade 3 or 4) and viewing using the other device was easy (grade 1 or 2). A 2×3 table (grade 1 or 2 vs. grade 3 or 4, for the three devices) was constructed, and the Stuart–Maxwell test (followed by the McNemar test) was used to compare the rates among the three devices. The Friedman test was used to compare the time to see the glottis and the time to tracheal intubation, between the three devices, and if these showed a significant difference, the Wilcoxon signed-rank sum test was used to compare the times between two devices. $P < 0.05$ was considered significant.

In a manikin with a normal airway, all participants successfully intubated the trachea using the VLP-100 and the AWS, whereas 48 of 50 participants (96 %) succeeded in intubating the trachea using the Macintosh laryngoscope (Table 1). There was no significant difference between the groups in the success rate of tracheal intubation. The time to see the glottis and the time to tracheal intubation using the VLP-100 or the AWS were significantly shorter than the times when using the Macintosh laryngoscope ($P < 0.05$). There was no significant difference in the ease of viewing the glottis at laryngoscopy between the groups (Table 2).

Table 1 Number of successful intubations, time to tracheal intubation, and time to see the glottis for the Macintosh laryngoscope, VLP-100, and the AWS

	Macintosh laryngoscope ($n = 50$)	VLP-100 ($n = 50$)	AWS ($n = 50$)
Normal airway			
No. of successful intubations (%)	48 (96 %)	50 (100 %)	50 (100 %)
Time to intubation (s)	38.3 (23.8)	27.1 (7.8)*	22.4 (15.1)*
Time to see the glottis (s)	12.4 (14.7)	8.0 (3.3)*	8.0 (9.2)*
Tongue edema			
No. of successful intubations (%)	0 (0 %)	11 (22 %)*	47 (94 %)* #
Time to intubation (s)	120 (0)	108.7 (22.9)*	36.0 (24.6)* #
Time to see the glottis (s)	34.7 (13.7)	23.9 (13.7)*	13.6 (6.6)* #
Cervical spine rigidity			
No. of successful intubations (%)	46 (92 %)	50 (100 %)*	50 (100 %)*
Time to intubation (s)	47.0 (28.1)	29.8 (12.1)*	24.7 (11.3)*
Time to see the glottis (s)	12.5 (6.1)	10.4 (4.4)*	9.6 (4.4)*
Pharyngeal obstruction			
No. of successful intubations (%)	9 (18 %)	43 (86 %)*	43 (86 %)*
Time to intubation (s)	105.6 (32.3)	49.4 (32.7)*	38.9 (34.7)*
Time to see the glottis (s)	34.7 (13.7)	23.9 (13.7)*	13.6 (6.6)* #
Laryngospasm			
No. of successful intubations (%)	0 (0 %)	0 (0 %)	0 (0 %)
Time to intubation (s)	120 (0)	120 (0)	120 (0)
Time to see the glottis (s)	10.4 (7.8)	8.4 (4.2)	7.6 (4.8)*

Values are mean (SD) or number (percentage)

* $P < 0.05$ compared with Macintosh laryngoscope

# $P < 0.05$ compared with VLP-100

In a manikin with tongue edema, the success rate of tracheal intubation was significantly higher for the AWS than for the VLP-100 ($P < 0.05$) or the Macintosh laryngoscope ($P < 0.05$). For the Macintosh laryngoscope, the view of the glottis was always not clear (grade 3 or grade 4), and for the VLP-100, the view was not clear in 41 of 50 participants. In contrast, for the AWS, it was always possible to obtain a clear view of the glottis (grade 1 or grade 2) (Table 2). The time to see the glottis and the time to tracheal intubation using the AWS were significantly shorter than the times using the VLP-100 or the Macintosh laryngoscope ($P < 0.05$) (Table 1).

In a manikin with cervical spine rigidity, all participants successfully intubated the trachea using the VLP-100 and the AWS, whereas 45 of 50 participants (92 %) succeeded using the Macintosh laryngoscope ($P < 0.05$) (Table 1). The time to see the glottis or the time to tracheal intubation using the AWS or the VLP-100 was significantly shorter than those times using the Macintosh laryngoscope ($P < 0.05$) (Table 1).

In a manikin with pharyngeal obstruction, the success rate of tracheal intubation was significantly higher for the VLP-100 (86 %) and the AWS (86 %) than for the Macintosh laryngoscope (18 %) (Table 1). The time to see the glottis using the AWS was significantly shorter than the times for the VLP-100 and the Macintosh laryngoscope ($P < 0.05$) (Table 1).

In a manikin with laryngospasm, no participant could intubate the trachea using any device (Table 1). There were no significant differences in the view of the glottis at laryngoscopy and the time to see the glottis among the three devices (Tables 1, 2).

For the Macintosh laryngoscope, it is required to place the head and neck in the sniffing position to align the oral, pharyngeal, and laryngeal axes, whereas for the videolaryngoscopes, this alignment may not be required to see the glottis. In fact, in this study, both the VLP-100 and AWS provided a better view of the glottis in these several difficult airway situations. However, in all simulated difficult airways, the time to see the glottis using the VLP-100 was significantly longer than with the AWS. In addition, the VLP-100 was less effective than the AWS in patients with tongue edema. A likely reason for the difference in the efficacy between these videolaryngoscopes in patients with tongue edema is the difference in blade shape. The shape of the blade of the AWS is based on the oropharyngeal wall, and because a clear view of the glottis can be obtained by sliding the blade on the oropharyngeal wall toward the glottis, insertion of the blade will not be affected by the size of the tongue. In contrast, because the shape of the blade of the VLP-100 is similar to the shape of the Macintosh blade, there would not be much difference in the ease of insertion of the blade between the VLP-100 and the Macintosh laryngoscopes.

In a manikin with laryngospasm, tracheal intubation could not be achieved with any device used, because even when the view of the glottis was obtained, it was impossible to insert a tube beyond the closed glottis. Although the videolaryngoscope may be useful in patients with difficult airways, these results indicate that they may be less effective in some situations. To establish the role of videolaryngoscopes in patient with difficult airways, it would be necessary to elucidate possible cases of difficult tracheal intubation using a videolaryngoscope. Reported difficulties include limited mouth opening, a tumor in the oropharynx, and bleeding or vomiting in the oropharynx [7]. Our manikin study suggests that laryngospasm would also be a cause of difficulty in tracheal intubation using a videolaryngoscope. Nevertheless, the failure rate of tracheal intubation in the manikin used may not be same as the failure rate in patients, because the degree of laryngospasm may differ between this manikin and patients.

We recruited residents who had been trained for more than 1 month. It is known that the expertise of the anesthesiologist will affect the success rate of tracheal intubation. We considered that experienced anesthesiologists would be able to intubate the trachea using either videolaryngoscope or the Macintosh laryngoscope or a fiberoptic

Table 2 View of the glottis at laryngoscopy for the Macintosh laryngoscope, VLP-100, and the AWS ($n = 50$)

	Cormack and Lehane classification			
	1	2	3	4
Normal airway				
Macintosh laryngoscope	42	7	1	0
VLP-100	49	1	0	0
AWS	49	1	0	0
Tongue edema				
Macintosh laryngoscope	0	0	22	28
VLP-100	0	9	38	3
AWS	30	20	0	0
Cervical spine rigidity				
Macintosh laryngoscope	25	19	6	0
VLP-100	42	8	0	0
AWS	48	2	0	0
Pharyngeal obstruction				
Macintosh laryngoscope	0	10	26	14
VLP-100	22	24	3	1
AWS	40	5	5	0
Laryngospasm				
Macintosh laryngoscope	42	6	2	0
VLP-100	47	3	0	0
AWS	49	1	0	0

bronchoscope, whereas for less experienced anesthesiologists (but with minimum skills) videolaryngoscopes may be regarded as the first choice when tracheal intubation using a Macintosh laryngoscope has failed. The participants had minimum skills with the Macintosh laryngoscopes because, in a manikin with normal airway, these were no significant differences in the success rate of tracheal intubation between the VLP-100, the AWS, and the Macintosh laryngoscope.

In conclusion, our manikin study indicates that the VLP-100 may be better than the Macintosh laryngoscope in several difficult airway situations, but it may not be as effective as another videolaryngoscope, the AWS.

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