TRACHEAL INTUBATION IN A MANNIKIN: COMPARISON OF THE BELSCOPE WITH THE MACINTOSH LARYNGOSCOPE

U. M. HODGES, D. O'FLAHERTY AND A. P. ADAMS

SUMMARY

Tracheal intubation carries a risk of accidental oesophageal intubation; this is increased with inexperienced trainees, and in patients with a difficult airway. The recent introduction of an angulated laryngoscope, the Belscope, may permit a better view of the vocal cords and increase the accuracy of orotracheal intubation. To determine how easy it is to learn to use the Belscope compared with the traditional Macintosh laryngoscope, a group of medical students attempted to intubate a mannikin which had been modified to simulate a difficult intubation. Time to intubation was fast with both laryngoscopes, although faster with the Macintosh, but the Belscope produced an unexpected greater incidence of failed intubation. (Br. J. Anaesth. 1993; 71: 905-907)

KEY WORDS

Intubation, tracheal: training. Equipment: laryngoscope

The Belscope laryngoscope (fig. 1) may be used for both routine and difficult tracheal intubation [1]. It has an angulated blade which provides a better view of the larynx than the Macintosh laryngoscope when optimal placement of the laryngoscope blade is restricted by limited atlanto-occipital extension, by a large tongue or a short mandible. It has been suggested that this laryngoscope should be readily available for practice and training purposes for anaesthetists [2]. In our department, we participate in the training of resuscitation skills and are therefore involved in providing practice and training for non-anaesthetists. We teach intubation skills to medical students on their anaesthetic attachment initially with mannikins and then in selected patients, and have noticed both oesophageal intubation and a failure to recognize this complication when it occurs [3]. Any technique which would decrease the incidence of failed intubation, particularly when laryngoscopy is not grade 1 according to the Cormack and Lehane classification [4], would be valuable.

The Belscope has been used regularly in clinical practice for more than 3500 tracheal intubations [1], but no formal assessment has been reported. The purpose of this study was to ascertain if the Belscope laryngoscope is easier for medical students to use than the "conventional" Macintosh laryngoscope.

METHODS

Twenty-five medical students who had not yet started their anaesthetic training were invited to pass a tracheal tube into a mannikin (Laerdal airway management trainer) which had been adjusted (by one of the authors) so that only the posterior extremity of the glottis was visible using a Macintosh blade—this corresponds to grade 2 of Cormack and Lehane's classification [4]. In this type of mannikin, mouth opening is greater than 2.5 cm and the "intubation" angle > 95°. An intubation angle of less than 95° reflects severe limitations of head extension on the neck [5] and both this and restricted mouth opening are possible causes of failure to intubate with the Belscope [1]. The medical students were asked to intubate the trachea using the Macintosh laryngoscope with the size 4 blade or the long-bladed Belscope laryngoscope.

A standard description and demonstration of both methods was given to each student. This was followed by a short practice at the grade 1 level of difficulty for up to 15 min until the student intubated successfully with both laryngoscopes. Each student then attempted tracheal intubation at the preset grade 2 level of difficulty—maximum 60 s allowed—20 times in succession, using the two types of laryngoscope alternately. The time from the blade...
passing the lips of the mannikin to the successful placement of the tube was recorded in each case. Tracheal intubation was confirmed by inflating the lungs of the mannikin after each attempt was completed; the student was not blinded to the result. For each successful intubation the student was asked to assess the level of difficulty, using a visual analogue scale (VAS) from 1 = extremely easy, to 100 = impossible. The number of failed intubations, defined as requiring more than 60 s or resulting in oesophageal intubation, was recorded.

Results were analysed using Wilcoxon’s rank sum test for non-parametric data (Minitab Statistical Package release 8 [6]).

<table>
<thead>
<tr>
<th></th>
<th>Macintosh</th>
<th>Belscope</th>
<th>P</th>
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<tbody>
<tr>
<td>No. intubations</td>
<td>230</td>
<td>230</td>
<td></td>
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<tr>
<td>Number failed</td>
<td>12</td>
<td>50</td>
<td></td>
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<tr>
<td>Failures per student†</td>
<td>0 (0–1)</td>
<td>2 (1–3)</td>
<td>0.002</td>
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<tr>
<td>Time to intubate (s)</td>
<td>13 (10–16)</td>
<td>17 (12–23)</td>
<td>0.003</td>
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<tr>
<td>Degree of difficulty (VAS 0–100 mm)</td>
<td>22 (14–36)</td>
<td>32 (20–52)</td>
<td>0.006</td>
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</table>

RESULTS

Two of 25 students failed, within the original 15 min allowed, to intubate successfully a grade 1 laryngoscopy and were excluded from the rest of the study.

The results from the remaining 23 students are shown in table 1. A total of 460 intubations were attempted. The Belscope laryngoscope produced significantly more failed intubations (50/230) (table 1); 54% of these were unrecognized oesophageal intubation, and in 46% the student exceeded the time permitted. With the Macintosh laryngoscope there were 12/230 failures: 67% were unrecognized oesophageal intubation. The median difference in overall failure per student is 2 (fig. 2) (95% confidence interval (CI) 1–3) (P = 0.002). The time to successful intubation was longer with the Belscope laryngoscope (fig. 3A). The median difference was 4 s (95% CI 2–7 s) (P = 0.003). The degree of difficulty (VAS) with the Belscope was also significantly greater (fig. 3B): the median difference was 8 mm (95% CI 2–16 mm) (P = 0.006). Improvement with practice was observed (fig. 4), with the difference in the number of failed intubations between the first five and the second five attempts being significant for both methods (P < 0.01).

DISCUSSION

The Macintosh laryngoscope elevates the epiglottis indirectly by stretching the hyo-epiglottic ligament [7]. Sometimes the hyoid bone cannot be adequately displaced forward and the epiglottis continues to obstruct the view of the larynx. The Belscope lifts the epiglottis directly [1] and the back of the tongue is flattened. It facilitates direct laryngoscopy when optimal placement of the laryngoscope blade is restricted by limited atlanto-occipital extension, a large tongue or a short mandible, so it has been used in grade 3 or more difficult laryngoscopies. The “learning curve” is said to be easy [2] and it is recommended for routine laryngoscopies [1].

It is important that all doctors (and medical students) should achieve competence in cardiopulmonary resuscitation, and therefore intubation [3, 8]. In a previous study [9] of the cardiopulmonary resuscitation skills of pre-registration house officers,
45% of the doctors tested failed to intubate a mannikin and those that were successful took longer than 35 s (upper limit of time allowed for pass grade in advanced Cardiac Life Support examination in the United States) [10]. The Macintosh laryngoscope is widely recommended at present to non-anaesthetists [8, 11, 12]. As we have found previously that failed intubation by students is related to the degree of difficulty at laryngoscopy [3], the Belscope blade (which is designed to facilitate otherwise difficult intubation) might reduce the observed incidence of failed intubations. As grade 3 laryngoscopy is found only in about 1.7–3% of patients [13, 14], it seemed appropriate to use the grade 2 difficulty of laryngoscopy as the test. The students received our standard training in intubation as described previously [3]. The two who failed to intubate a grade 1 laryngoscopy within the 15 min allowed were excluded. The remaining 23 students, after demonstrating that they could intubate a grade 1 laryngoscopy, entered the study and with both types of laryngoscope learned to intubate a grade 2 laryngoscopy.

The designer of the Belscope has suggested that it should be contraindicated for use in rapid sequence induction because “the Macintosh blade has been found marginally quicker to use” [1]. In our study, although the time to intubation was faster with the Macintosh laryngoscope, both laryngoscopes met the criteria for time to intubation laid down by the American Advanced Cardiac Life Support examination. The times to intubation compared well with the results reported by experienced anaesthetists using other instruments [15]. The visual analogue scores were not high with either blade, although the Macintosh had better scores.

The major unexpected difference between the two blades was in the number of failed intubations, although the students did better with both laryngoscopes than the house officers reported previously [9]. Of the 230 intubation attempts made with each laryngoscope, there was a 5% failure rate overall with the Macintosh laryngoscope and a 21% failure rate with the Belscope. For both laryngoscopes, the majority of the failures occurred within the first five attempts (75% for the Macintosh and 62% for the Belscope) and the majority of failures were oesophageal intubation. The students considered two factors to be important with the Belscope. First, they found that when the Belscope blade had been placed correctly it tended to slip out of position more readily than the Macintosh blade. This may be related to the nature of the plastic “tissues” of the mannikin rather than to the blade itself, but it is difficult to see why a similar effect was not seen with the Macintosh. Second, they found it difficult to see the larynx clearly when the tracheal tube was inserted into the mouth. This might be overcome by the use of an introducer in the tube [2].

In conclusion, we were impressed by the students’ speed of intubation and low failure rate with the Macintosh laryngoscope. Failed intubation was more likely using the Belscope and we cannot recommend it as a replacement for the Macintosh laryngoscope for routine laryngoscopy by non-anaesthetists.

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REFERENCES