Tongue Traction is as Effective as Jaw Lift Maneuver for Trachlight-guided Orotracheal Intubation

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Objective: The jaw lift maneuver has been traditionally used to facilitate Trachlight-guided orotracheal intubation. The aim of this study was to compare the jaw lift maneuver with another potentially useful maneuver, tongue traction, for facilitating Trachlight-guided orotracheal intubation.

Methods: This study was prospective and randomized in design. A single experienced investigator performed Trachlight-guided orotracheal intubations in 100 adult patients with clinically normal airways undergoing elective surgeries under general anesthesia with paralysis. Patients were divided into two groups: Group J (jaw lift); and Group T (tongue traction using a padded artery forceps). Three parameters were recorded: search time (device insertion to midline glow); time to intubate (device insertion to glow at suprasternal notch); and time to confirm (device insertion to confirmation of placement by capnography).

Results: All patients were intubated successfully using the Trachlight. Only one patient in Group J required more than two attempts for successful intubation. First and second attempt success rates were, respectively, 86% and 98% in Group J, and 92% and 100% in Group T. Mean search time, time to intubate and time to confirm were comparable: 6.36 ± 4.20 seconds, 11.23 ± 6.69 seconds and 21.59 ± 7.69 seconds, respectively, in Group J, and 6.81 ± 4.53 seconds, 10.79 ± 6.02 seconds and 22.80 ± 7.85 seconds, respectively, in Group T.

Conclusion: The tongue traction maneuver is as good as the jaw lift maneuver with regard to the success rate and time taken for Trachlight-guided orotracheal intubation.

1. Introduction

A lighted stylet uses the principle of transillumination of the soft tissues of the anterior part of the neck to guide the tip of the tracheal tube into the trachea. It takes advantage of the anterior location of the trachea in relation to the esophagus. Many variants of this device have been used since its introduction. Trachlight (Laerdal Medical Corporation, Wappingers Falls, NY, USA), the most recent among these, has overcome the disadvantages of previously used devices. Fiberoptic evaluation of Trachlight-guided orotracheal intubation attempted with the aid of the jaw lift maneuver has revealed that the device can occasionally get stuck in the vallecula above the epiglottis, or difficulty can be encountered in advancing it into the trachea due to the epiglottis coming in the way of the glottic opening.1 Review
of the literature reveals that the jaw lift maneuver has conventionally been used to facilitate unhindered passage of the device. However, one will occasionally encounter difficulty in advancing the wand after obtaining the midline glow despite the jaw lift maneuver. Two alternative maneuvers that have been suggested are lifting the tongue with the thumb of the nondominant hand or having an assistant pull the tongue while the intubator continues to give jaw thrust. The aim of this study was to compare the tongue traction maneuver with the conventional jaw lift maneuver with regard to ease and success of Trachlight-guided orotracheal intubation.

2. Methods

The study protocol strictly adhered to the principles of the Declaration of Helsinki. The study protocol was explained to the patients and written informed consent was obtained from all of them. The study was conducted in the operating rooms of Kasturba Hospital, a tertiary care teaching hospital in Manipal, South India.

A total of 100 adult patients aged above 18 years with American Society of Anesthesiologists’ physical status 1 or 2 and scheduled for elective surgery requiring orotracheal intubation were enrolled into this unblinded, prospective and randomized study. Patients with anticipated difficult airway, body mass index (BMI) >30 kg/m², patients who were not able to cooperate for a full airway assessment during preoperative evaluation, patients at risk for aspiration, patients who had a nasogastric tube in situ, and patients who were diagnosed with a communicable illness were excluded from the study.

The airway of all the patients was assessed in the sitting position by the same observer and the following measurements were recorded:

- interincisor distance—measured as the maximum distance between the upper and lower incisors with the patient holding the mouth widely open;
- thyromental distance—measured as the distance between the symphysis menti and the thyroid prominence with the head in full extension;
- sternomental distance—measured as the distance between the symphysis menti and sternal notch with the neck in full extension and the jaw clenched; and
- neck circumference—measured as the circumference of the neck at the thyroid prominence.

Pharyngeal structures were assessed with the mouth widely open according to modified Mallampati classification (with Ezri’s modification). Patient demographics such as age, sex, weight, height and BMI were also noted. Patients were kept nil per oral for solids for at least 6 hours (at least 3 hours for clear fluids) and given appropriate premedication.

Patients were randomly allocated by picking of lots to one of the two groups described below, and the Trachlight was used to facilitate orotracheal intubation in both groups. One hundred slips of paper with the letter “J” (50 slips) or “T” (50 slips) written on them were prepared, folded and placed in a container. Prior to starting a case, a third person who was not involved in the study was asked to pick one of the slips. The personnel allocated to the study could not be blinded to the group allocation.

- Group J: Trachlight-guided orotracheal intubation was performed with the person intubating giving a jaw lift maneuver using the non-dominant hand (Figure 1);
- Group T: Trachlight-guided orotracheal intubation was performed with tongue traction being provided by the person intubating using a padded artery forceps held in the non-dominant hand (Figure 2).

In the operating room, the patient was placed supine on the operating table without a pillow or a head ring under the occiput. Standard monitoring including electrocardiography (lead II), noninvasive blood pressure, pulse oximetry and peripheral nerve stimulation at the adductor pollicis were established. After induction of general anesthesia, the ability to ventilate with a mask was confirmed and neuromuscular blockade achieved with 0.1 mg/kg of vecuronium bromide. All patients were ventilated by bag and mask with 2% isoflurane oxygen till the train of four count was established to be zero. At this stage, intubation was performed by an anesthesiologist with experience of at least 20 successful Trachlight-guided intubations. In both groups, the
head was kept in a slightly extended position. Tracheal tubes of 7.0 mm or 8.0 mm internal diameter were used for women and men, respectively.

Each attempt to elicit the midline glow at the thyroid prominence was allowed no more than 30 seconds from the time of introducing the device into the oral cavity. Intubation was considered accomplished on appearance of the Trachlight glow at the suprasternal notch. The operator was allowed no longer than 45 seconds from the time of introducing the device into the oral cavity to establish the glow at the suprasternal notch. The following times were noted from the time of insertion of the Trachlight into the oral cavity. The time taken for appearance of a well circumscribed midline glow at the thyroid prominence was noted as the “search time”. Time taken for appearance of the glow at the suprasternal notch was taken as the “time to intubate”. Time till confirmation of intubation using capnography was taken as the “time to confirm” tracheal tube placement.

Esophageal intubation or inability to obtain a midline glow at the thyroid prominence or glow at the suprasternal notch within the stipulated time were considered as a failure. Two attempts at intubation were allowed with the allotted maneuver, failing which one attempt was permitted with the alternate maneuver. If unsuccessful, the study protocol permitted one attempt with the combined maneuver of jaw lift along with tongue traction. If this too proved unsuccessful, the patient would be intubated with conventional laryngoscopy. Between the attempts, patients were ventilated with 2% isoflurane in oxygen for 30 seconds. Correct tracheal tube placement was confirmed by capnography and by auscultation of the chest for bilateral equal air entry.

After tracheal intubation, a gentle direct laryngoscopy was performed to assess the pharynx and larynx for any trauma. All complications were recorded.

2.1. Statistical analysis

Data were analyzed using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA) for Windows. Statistical analyses of data in this study were performed using the following four statistical tests where appropriate: $\chi^2$ analysis, Fisher’s exact probability test, Student’s $t$ test, and Pearson’s correlation coefficient.

As our literature search did not reveal any study that had compared the conventional jaw lift maneuver with the tongue traction maneuver for Trachlight-guided orotracheal intubation, we estimated the sample size required based on the data of a pilot study that we had conducted. Of the 10 patients in the pilot study, only one needed a third attempt at intubation using the alternative technique. Excluding the data of that single patient, we calculated the mean time to intubate as 16.44 seconds with a standard deviation of 7.14 seconds. A sample size of 87 patients was required to achieve a level of significance of 0.05% with a power of 80% to detect a 5-second difference in the time to intubate between the two techniques. Hence, we decided to include a total of 100 patients in our study.

3. Results

Both groups were comparable in terms of age, sex, weight, height, BMI (Table 1), and all the airway parameters measured (Tables 2 and 3). All patients were successfully intubated with Trachlight guidance without resort to conventional laryngoscopy.

Of the 50 patients in Group J, 43 were successfully intubated at the first attempt (86%) and six at the second attempt (12%). One patient who needed a third attempt was successfully intubated with the crossover technique using the tongue traction maneuver. Of the 50 patients in Group T, 46 were intubated at the first attempt (92%) while the remaining four were intubated at the second attempt (8%). There was no statistically significant difference between the two groups in terms of number of attempts taken for intubation ($p > 0.05$, Fisher’s exact probability test) (Table 4). The mean ± standard deviation for search time, time to intubate and time to confirm were 6.36 ± 4.20 seconds, 11.23 ± 6.69 seconds and 21.59 ± 7.69 seconds, respectively, for Group J, and 6.81 ± 4.53 seconds, 10.79 ± 6.02 seconds and 22.80 ± 7.85 seconds, respectively, for Group T ($p > 0.05$, unpaired Student’s $t$ test) (Table 5). Using linear regression analysis,
we attempted to detect if there was any relationship among the measured airway parameters, modified Mallampati class and time to intubate. There was no correlation between the time to intubate and any of the parameters studied.

None of the patients had clinically significant oxygen desaturation ($\text{SpO}_2 < 93\%$) during the study period. Three patients in each group had minor trauma to the pharyngeal structures that consisted of minimal bruising of the faucial pillars or around the epiglottis. One patient in Group T had a small bruise over the tongue where it had been gripped to provide traction. No other significant complications attributable to the use of the Trachlight or

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### Table 1 Demographic data*

<table>
<thead>
<tr>
<th></th>
<th>Jaw lift ($n=50$)</th>
<th>Tongue traction ($n=50$)</th>
<th>$p^\dagger$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>$38.84\pm11.89$</td>
<td>$36.62\pm12.26$</td>
<td>$0.360$</td>
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<tr>
<td>Male/Female</td>
<td>$22/28$</td>
<td>$18/32$</td>
<td>$0.414$</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>$56.65\pm10.28$</td>
<td>$54.95\pm8.22$</td>
<td>$0.361$</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>$158.82\pm9.52$</td>
<td>$159.2\pm6.53$</td>
<td>$0.816$</td>
</tr>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>$22.42\pm3.29$</td>
<td>$21.78\pm3.18$</td>
<td>$0.325$</td>
</tr>
</tbody>
</table>

*Data are presented as mean±standard or $n$; †no statistically significant differences between groups ($p>0.05$, $\chi^2$ test for sex distribution and Student’s $t$ test for other data). BMI=body mass index.

### Table 2 Airway parameters*

<table>
<thead>
<tr>
<th></th>
<th>Jaw lift ($n=50$)</th>
<th>Tongue traction ($n=50$)</th>
<th>$p^\dagger$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interincisor distance (cm)</td>
<td>$4.66\pm0.53$</td>
<td>$4.55\pm0.55$</td>
<td>0.268</td>
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<tr>
<td>Thyromental distance (cm)</td>
<td>$7.88\pm1.32$</td>
<td>$8.05\pm1.26$</td>
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<tr>
<td>Sternomental distance (cm)</td>
<td>$17.30\pm1.67$</td>
<td>$17.27\pm1.48$</td>
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<tr>
<td>Neck circumference (cm)</td>
<td>$34.09\pm3.18$</td>
<td>$33.48\pm2.71$</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*Data are presented as mean±standard; †no statistically significant differences between groups ($p>0.05$, Student’s $t$ test).

### Table 3 Modified Mallampati classification of the airway*

<table>
<thead>
<tr>
<th></th>
<th>Modified Mallampati Class</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Jaw lift</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Tongue traction</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>22</td>
</tr>
</tbody>
</table>

*Data are presented as $n$; †no statistically significant differences between groups ($p=0.089$, Fisher’s exact probability test; ‡Ezri et al’s modification of the Mallampati classification.

### Table 4 Number of attempts at intubation*

<table>
<thead>
<tr>
<th></th>
<th>Jaw lift ($n=49$)</th>
<th>Tongue traction ($n=50$)</th>
<th>Total ($n=99$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of attempts</td>
<td>43</td>
<td>46</td>
<td>89</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

*Data are presented as $n$; †$p=0.525$, Fisher’s exact probability test; ‡one patient in the jaw lift group was only successfully intubated using tongue traction.

### Table 5 Search time, time to intubate and time to confirm*

<table>
<thead>
<tr>
<th></th>
<th>Jaw lift ($n=49$)</th>
<th>Tongue traction ($n=50$)</th>
<th>$p^\dagger$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search time (s)</td>
<td>$6.36\pm4.20$</td>
<td>$6.81\pm4.53$</td>
<td>0.610</td>
</tr>
<tr>
<td>Time to intubate (s)</td>
<td>$11.23\pm6.69$</td>
<td>$10.79\pm6.02$</td>
<td>0.732</td>
</tr>
<tr>
<td>Time to confirm (s)</td>
<td>$21.59\pm7.69$</td>
<td>$22.80\pm7.85$</td>
<td>0.443</td>
</tr>
</tbody>
</table>

*Data are presented as mean±standard deviation; †Student’s $t$ test.
the maneuvers necessary to perform the technique were noted in any of the patients.

4. Discussion

Light-guided intubation is a semiblind technique that, despite its obvious disadvantage of not allowing the intubator direct visualization of the airway, is a proven and effective technique for intubation of patients with normal or difficult airways. Previous studies have shown that none of the well known predictors for difficult direct-vision laryngoscopic intubation are effective in predicting difficulty in lightwand-guided intubation.4,7

In a large study involving 950 patients, the presence of a large tongue or a large, floppy epiglottis were identified as common characteristics among patients in whom there was difficulty in intubation using the Trachlight.4 These structures probably impeded easy maneuverability of the Trachlight in the pharyngeal space above the glottic opening. Furthermore, these structures may act as a mechanical obstruction to advancement of the styleted tube into the glottic opening from the vallecula.

The tongue and epiglottis fall back in an anesthetized person, obstructing the natural passage of gases from the upper airway into the glottis. The “triple airway maneuver”, which involves head tilt, chin lift and jaw thrust, has been widely practiced as a means of overcoming this problem. In our study, we placed the head in a slightly extended position without a pillow under the occiput (which is equivalent to the “head tilt” component described above) and used the jaw lift maneuver to equate with the “chin lift” and “jaw thrust” components. This maneuver lifts the tongue and epiglottis away from the posterior pharyngeal wall, thereby creating some space for the passage of gases. However, it is difficult to clinically quantify this space between the epiglottis and posterior pharyngeal wall.

A narrow gap between the epiglottis and the posterior pharyngeal wall may allow gases to pass. However, for Trachlight-guided orotracheal intubation, the space created should be sufficiently large to allow easy passage of the tracheal tube–Trachlight assembly into the glottis. The jaw lift maneuver has become the primary maneuver employed when there is difficulty intubating while using the Trachlight, probably because of anesthesiologists’ familiarity with the maneuver. The anterior movement of the tongue is transmitted by the glossoepiglottic folds to the epiglottis, causing the epiglottis to be lifted off the posterior pharyngeal wall. Assuming this to be the mechanism for creation of posterior pharyngeal air space, direct lifting of the tongue may provide a better alternative to the conventional jaw lift maneuver.

Fiberoptic evaluation of Trachlight-guided oral intubations attempted with the jaw lift maneuver revealed that in more than half the patients, laryngeal structures were encountered by the styleted tracheal tube during the elicitation of transillumination.1 In two patients, the tracheal tube pushed the epiglottis ahead of it into the laryngeal inlet, but the epiglottis returned to its normal position once the process of intubation was complete. The intubator did not notice any abnormal resistance to the passage of the styleted tracheal tube during these intubations. The same study also reported a case of displacement of the epiglottis into the larynx that required extubation to reduce the epiglottis to its original position. The implications of such an injury are not clear and the possibility of patient morbidity resulting from such undetected displacement of the epiglottis should be considered. This evidence favors the routine use of maneuvers such as the jaw lift or tongue traction to lift the epiglottis away from the posterior pharyngeal wall. Even though the jaw lift maneuver indirectly lifts the tongue and epiglottis away from the posterior pharyngeal wall, it is still possible for the tongue to fall back and reduce the space available for passage of the tracheal tube–Trachlight assembly. The tongue traction maneuver may overcome this problem by directly lifting the tongue away from the posterior pharyngeal wall.

Durga et al8 evaluated the efficacy of the jaw lift maneuver, tongue traction maneuver and simultaneous application of both maneuvers for facilitation of fiberoptic-guided intubation. Direct observation of the tongue and epiglottis via a fiberoptic scope placed in the oropharynx revealed that application of either maneuver alone did not consistently clear the airway obstruction, while simultaneous application of both maneuvers lifted both tongue and epiglottis away from the posterior pharyngeal wall in all of their patients.8

We observed in our study that all 50 patients were successfully intubated under Trachlight guidance using the tongue traction maneuver. One patient who could not be intubated after two attempts using the jaw lift maneuver was also successfully intubated using the tongue traction maneuver (which was, by design, our crossover technique).

To the best of our knowledge, there is no previous study comparing the tongue traction maneuver with the conventional jaw lift maneuver for facilitating Trachlight-guided orotracheal intubation. Our results suggest that the tongue traction maneuver is as good a maneuver as the conventional jaw lift maneuver for facilitating Trachlight-guided orotracheal intubation. In addition, the tongue traction
Tongue traction vs. jaw lift for Trachlight intubation was successful in the only patient in whom the conventional jaw lift maneuver failed. This, when viewed in the light of the 100% success rate when the tongue traction maneuver was used as the primary technique, seems to suggest that the technique might even be a clinically more useful and successful maneuver than the conventional jaw lift maneuver.

Several timings were noted in our study to identify the ease of Trachlight-guided intubation using either of the two maneuvers. All the timings were comparable between the two groups. When data from all the 99 patients was taken together, the time to intubate was 10.96 ± 6.32 seconds, which is shorter than the time taken to intubate in Hung et al’s study (16 ± 11 seconds). Hung et al defined time to intubate as the time from insertion of the device into the oral cavity to removal of the device from the tracheal tube, while we defined it as the time from insertion of the device into the oral cavity to the elicitation of suprasternal glow signifying correct tube position. This could explain the slightly shorter time in our study.

None of the measured airway parameters in our study, including the modified Mallampati classification, correlated with either the success rate or intubation times for Trachlight-guided orotracheal intubation. This is in partial agreement with earlier studies that had attempted to define predictors of difficulty during Trachlight-guided intubation. Longer intubation times were reported with Mallampati class 3 and BMI > 30 kg/m² by Wong et al. We could not assess the influence of a higher BMI in our study as we had excluded patients with BMI > 30 kg/m².

A limitation of our study is that all intubations were performed by a single experienced person and our results may not necessarily apply to less experienced personnel.

We conclude that the tongue traction maneuver is as effective as the jaw lift maneuver with regards to the success rate and time taken for orotracheal intubation using the Trachlight device in anesthetized and paralyzed adult patients with clinically normal airways.

Conflict of Interest Statement

The authors did not receive any funding for this study. None of the authors are affiliated with Laerdal Medical Corporation.

References