Comparison of the Efficacy of A Bougie and Stylet in Patients With Endotracheal Intubation: A Meta-Analysis of Randomized Controlled Trials

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Abstract

Background: Endotracheal intubation (ETI) is a procedure widely performed for several clinical indications. In typical ETI, an endotracheal tube is placed into a patient’s trachea with the help of a malleable metal rod covered with a clear plastic sheath (called a “stylet”). However, another intubation aid, a bougie (also named a “gum elastic bougie” or “endotracheal tube introducer”), was also introduced in the clinical setting to improve the efficacy of conventional ETI.

Objective: To compare the efficacy of bougie and stylet approaches in ETI.

Design: A systematic review and meta-analysis of randomized controlled trials (RCTs).

Data sources: PubMed, Embase, and Cochrane Library databases were searched for studies published before November 2018.

Eligibility criteria: RCTs comparing the clinical outcomes of bougie and stylet approaches in patients who underwent orotracheal intubation were included. We conducted meta-analyses by using a random effects model. Treatment efficacy was measured by evaluating the first-attempt success rate and intubation duration.

Results: A total of 5 RCTs and 1038 patients were included. Although a bougie resulted in a better first-attempt success rate, no significant difference was observed between the approaches (risk ratios: 1.03, 95% confidence interval: 0.85-1.24). Moreover, no significant
differences were observed in the intubation duration and esophageal intubation rate between the bougie and stylet approaches.

**Conclusions:** ETI performed with a bougie was not superior over ETI performed with a stylet. Therefore, intubation approaches should be selected by considering personal preference and clinician expertise.

**Level of evidence:** Systematic review and meta-analysis, level I.

**Keywords:** endotracheal intubation; orotracheal intubation; bougie; endotracheal tube introducer; stylet
Introduction

Endotracheal intubation (ETI) is a major airway management performed during general anesthesia. Moreover, ETI can be a life-saving procedure for critically ill or injured patients in the emergency department (ED) or prior to their hospitalization. However, complications of ETI have been reported inside and outside hospitals.\textsuperscript{1,2} Major peri-intubation adverse events, including esophageal intubation and cardiac arrest, were reported in multicentered prospective surveillance.\textsuperscript{3} Achieving successful ETI in the initial attempt is crucial to reduce the possibility of adverse events,\textsuperscript{4} and similar benefits could be anticipated in prehospital ETI.\textsuperscript{5}

Stylet, a malleable metal rod with a distal end, is bent into a “hockey stick” shape.\textsuperscript{6} When placed in an endotracheal tube, a stylet adds stiffness to provide greater control for clinicians. After the endotracheal tube passes the vocal cord, the stylet is withdrawn.

Another inexpensive ETI aid, bougie (also known as endotracheal tube introducer), was first introduced into clinical practice by Macintosh in 1949.\textsuperscript{7} A bougie serves as a railroad for the entry of an endotracheal tube into the airway and may improve first-attempt success.\textsuperscript{8} Nevertheless, a bougie is usually reserved for patients with difficult airway anatomy.\textsuperscript{9}

Recently, a randomized controlled trial conducted at an ED reported that the use of a bougie rather than a stylet resulted in significantly higher first-attempt intubation success in
patients who underwent emergency orotracheal intubation.\textsuperscript{10} However, the outcomes of the 2 orotracheal intubation aids have not been systematically studied.

We performed a meta-analysis of available randomized controlled trials (RCTs) to compare the first-attempt orotracheal intubation success, duration, and safety of a bougie and stylet.

**Materials and Methods**

**Inclusion criteria**

RCTs that compared bougie and stylet approaches in patients who underwent orotracheal intubation were included. RCTs that clearly reported inclusion and exclusion criteria for patients, the orotracheal intubation technique, and evaluation methods for the first-attempt intubation success rate and intubation duration were included. We excluded manikin-, simulation-, and cadaver-based trials.

**Search strategy and study selection**

Relevant trials published before October 2018 were identified from the databases of PubMed, Embase, and the Cochrane Library. The following medical subject headings were used:  
*endotracheal intubation OR orotracheal intubation OR tracheal intubation*,  
* (bougie OR gum elastic bougie OR GEB OR Eschmann introducer OR endotracheal tube introducer),*
and (endotracheal tube OR stylet). No language restrictions were applied. The systematic review described herein has been accepted by PROSPERO (CRD42018107281).

Data extraction

Baseline and outcome data were independently retrieved by 2 reviewers (YJS and SWY). Furthermore, data regarding study designs, study population characteristics, inclusion and exclusion criteria, first-attempt intubation success rates, intubation durations, and complications were extracted. Decisions recorded individually by the reviewers were compared, and disagreements were resolved by a third reviewer (KWT).

Appraisal of methodological quality

Two reviewers (YJS and SWY) independently assessed the methodological quality of each study by using the Cochrane risk of bias tool (RoB 2.0). Studies were graded high, some, or low for an overall risk of bias. This grade was calculated by assessing 5 domains: bias arising from the randomization process, bias owing to deviations from intended interventions, bias owing to missing outcome data, bias in measurement of the outcome, and bias in selection of reported results.
Outcomes

The primary outcome was the first-attempt intubation success rate. Secondary outcomes were the intubation duration and esophageal intubation rate.

Statistical analyses

Data were entered and analyzed using Review Manager 5.3 (The Cochrane Collaboration, Oxford, England). A meta-analysis was performed following the Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines. The standard deviation (SD) was calculated using provided confidence interval (CI) limits, standard errors, or interquartile ranges (IQRs). Dichotomous outcomes were analyzed using risk ratios (RRs) as summary statistics. The effect sizes of continuous outcomes were reported as the weighted mean difference (WMD). The precision of effect sizes was reported at a CI of 95%. A pooled estimate of RRs and WMDs was computed using the DerSimonian and Laird random effects model. A statistically significant result was indicated by $P < .05$ or 95% CI not including one in RR and zero in WMD.

Statistical heterogeneity and inconsistency in treatment effects across studies were evaluated using Cochrane $Q$ test and $I^2$ statistics, respectively. Statistical significance was set at $P < .10$ for the Cochrane $Q$ test. Statistical heterogeneity across studies was assessed using the $I^2$ test, which quantifies the proportion of total outcome variability across studies.
Results

Trial characteristics

A flowchart of the screening and selection of studies is illustrated in Figure 1. The initial screen yielded 370 studies, of which 221 were found to be ineligible based on the criteria used for screening titles and abstracts, 94 were duplicated articles, and 12 were reviews. Thus, the full texts of 43 studies were retrieved. However, 21 were not human trials (manikin/cadaver), 11 had an inappropriate intervention in the control group, and 6 were not RCTs. Thus, 5 trials were finally eligible for inclusion in this meta-analysis.10,14-17

These 5 trials were published during 1996–2018 and included a total of 1038 patients; 3 trials were performed in a preoperative setting14-16, one trial at an ED10, and one trial in a prehospital medical setting.17 Among them, 633 (60.98%) were intubated because of medical issues (most of them were altered mental status) at ED, 230 patients (22.16%) were intubated for elective surgeries, 124 patients (11.95%) were intubated because of trauma at ED, while indications of 51 patients (4.91%) from the prehospital setting were unavailable. Regarding stylet approaches, 4 trials used a similar technique, except for the trial conducted by Tosh et al.16 (60° stylet). Regarding the gum elastic bougie approach, the technique used differed slightly among 5 trials due to the use of bougies from different manufacturers. To predict the ease of orotracheal intubation, Modified Mallampati score and 2 types of laryngeal view grading system (Cormack and Lehane classification and Cook’s modified laryngeal
classification) were adopted in the 5 trials. Modified Mallampati score was divided into 4 classes and evaluated when patients seated with maximal protrusion of base of tongue.\(^{18}\) By contrast, Cormack and Lehane classification and Cook’s modified laryngeal classification were evaluated with laryngoscopy. Cormack and Lehane classification was divided into 4 grades.\(^{19}\) However, Cook’s modified laryngeal classification subdivided grades 2 and 3 into 2a, 2b, 3a and 3b to differentiate “easy view” (grade 1 and 2a) from “restricted view” (2b and 3a), which was more sensitive and specific than Cormack and Lehane classification.\(^{20}\) The grading of baseline patient characteristics in 5 trials are shown in Table 1.

The methodological quality of the included trials is summarized in Table 2. Heegaard et al.\(^{17}\) reported some concerns regarding the risk in the randomization process due to its even or odd day regimen. Heegaard et al.\(^{17}\) evaluated deviations from the intended intervention and also reported some concerns; for example, some clinicians may have prematurely aborted using the bougie because of unfamiliarity. In terms of bias in the measurement of outcomes, Noguchi et al.\(^{15}\) and Tosh et al.\(^{16}\) reported some concerns due to lack of information regarding assessors. Additionally, an unreasonably large CI and an unreasonably large SD were noted in trials conducted by Heegaard et al.\(^{17}\) and Tosh et al.,\(^{16}\) respectively, for the intubation duration.
First-attempt intubation success rate

All trials compared the first-attempt intubation success rate between bougie and stylet approaches. The first-attempt success rate was defined as the presence of end-tidal capnography in all 5 included trials, and the intention-to-treat principle was applied to analyze the first-attempt intubation rate. The bougie approach had a better first-attempt success rate; however, no significant difference was observed between the approaches (RR: 1.03, 95% CI: 0.85-1.24; Fig. 2).

Intubation duration

All trials compared the intubation duration between bougie and stylet approaches. The definition of the intubation duration varied in the 5 trials and was listed as follows: Driver et al.\textsuperscript{10} evaluated time elapsed between the insertion and removal of a laryngoscope blade from a patient’s mouth, Gataure et al.\textsuperscript{14} evaluated time elapsed from an anesthetist taking a laryngoscope from the assistant to intubation confirmed through both auscultation and capnography, Heegaard et al.\textsuperscript{17} evaluated time elapsed from the insertion of an initial laryngoscope until intubation, Noguchi et al.\textsuperscript{15} evaluated time elapsed from the removal of the face mask to confirmation through capnography, and Tosh et al.\textsuperscript{16} evaluated time elapsed from the introduction of a videolaryngoscope into the oral cavity to appearance of end-tidal carbon dioxide waveform. Although the intubation duration of the stylet approach was
shorter, the intubation duration did not differ significantly between the patient groups (mean
difference: 6.01, 95% CI: −0.07-12.09; Fig. 3).

Complications

*Esophageal intubation rate*

Four trials\(^{10,14,16,17}\) compared the esophageal intubation rate between bougie and stylet
approaches. Although the esophageal intubation rate was lower in the bougie group, the
analysis showed no significant difference between the groups (RR: 0.59, 95% CI: 0.13-2.59;
Fig. 4).

*Others*

Other complications, including hypoxemia, pneumothorax with or without a clear cause
(chest trauma with a rib fracture during chest compression), lip laceration, witnessed
aspiration during intubation, iatrogenic bleeding from the oropharynx or perilaryngeal
structures, and dental trauma, were reported in the ED.\(^{10}\) No complication significantly
differed between the approaches (Supplemental Table 1, Supplemental Digital Content 1,
http://links.lww.com/TA/B296). Moreover, when patients were intubated with a bougie, the
overall complication rate was not significantly different between the groups (RR: 1.03, 95%
CI: 0.75-1.42).
Discussion

The main finding of this study is that no significant differences were observed in the first-attempt intubation success rate, intubation duration, or esophageal intubation rate between patients who underwent orotracheal intubation through bougie and stylet approaches. However, some limitations and concerns exist regarding data validity. First, some deviations existed during the conversion from IQRs to SDs in the study conducted by Driver et al.\textsuperscript{10} Moreover, CI and SD values in the studies of Heegaard et al.\textsuperscript{17} and Tosh et al.,\textsuperscript{16} respectively, were unusual, giving rise to a considerably larger range of CI in the mean difference (Figure 2).

Different situations or providers of ETI influence the intubation success rate. We observed that the overall success rate in the study of Driver et al.\textsuperscript{10} was higher than that in the study of Heegaard et al.\textsuperscript{17} (92.6\% vs 66.7\%), and a previous study showed that physician providers had a significantly higher success rate than did nonphysician providers.\textsuperscript{5} On the other hand, when compared to anesthesiologists, physicians at ED had significant higher first success (RR: 1.12, 95\% CI: 1.08-1.17) in the bougie group. However, according description from the author of Driver et al.,\textsuperscript{10} majority of physicians had utilized the bougie prior to the trial, therefore the results may be biased because of the familiarity of the bougie rather than the stylet. Another study also demonstrated a significantly higher incidence of difficult intubation among personnel who would be considered “proficient” intubators (who perform a median of
18 intubations annually) compared with “expert” intubators (who perform a median of 304 intubations annually; \( P < .05 \)). The number of intubations that should be performed prior to being considered competent to perform this procedure is unclear from the current data, but practitioners with a period of in-hospital physician training followed by an adequate number of intubations may achieve a higher level of competence.

Certain approaches regarding the bougie or stylet group differed among the included trials. For example, the bougie approach in our included trials varied, comprising different product specifications and manufacturers. A higher first-attempt success rate was observed in the 70-cm bougie group\(^{10}\) rather than in the other 60-cm bougie groups.\(^{16,17}\) Moreover, the name “bougie” is a collection term referring to intubation aids similar to endotracheal tube introducers. A previous study indicated that the 2 types of bougie had different holdup signs and related risks.\(^{22}\) Thus, because of the different characteristics of bougies, additional studies should be conducted to evaluate their performance and effectiveness.

Patients with higher grading Cormack–Lehane classification may have a higher risk of difficult intubation.\(^{19}\) In our studies, most of the patients were Grade 1 or 2, which means they were easier to intubate. However, a bougie is reserved for patients with poor laryngeal views or as a “rescue” method for failed intubation.\(^{9}\) Except for the study of Driver et al.,\(^{10}\) no data regarding the success rate and intubation duration at different grades were available. Additional studies are required to clarify whether the use of a bougie in patients with difficult intubation is beneficial.
intubation result in higher first-attempt intubation success rates and shorter intubation durations compared with the use of a stylet. Noguchi et al. used Cook’s modified laryngeal classification, another laryngeal view classification system. In the bougie group, no significant difference was observed between the easy group (Grade 1 and 2a) and the restricted group (Grade 2b and 3a). In the stylet group, significantly longer time ($P = .013$) was required for the restricted group than the easy group. Nonetheless, no significant difference in the intubation duration was observed between the bougie and stylet groups in the same classification, which was the same as our result for the overall intubation duration.

The trials included in our meta-analysis exhibited considerable heterogeneity because of various clinical factors. First, patients in the included trials exhibited various conditions. More than half of the trials included patients undergoing surgery in the anesthesiology department, but Driver et al. and Heegaard et al. included patients in the ED and prehospital medical setting, respectively. Second, the composition of patients according to Cormack–Lehane classification or Cook’s modified laryngeal classification varied among the trials. Third, the evaluation of the intubation duration differed among the included trials. Finally, product specifications and manufacturers regarding the same approach differed among the included trials. Such differences explain the observed heterogeneity among the trials.
Limitations

This study has several limitations. First, patients in our included trials were all adults or teenagers older than 12 years. Thus, we cannot deduce the outcomes of intubation in infants and neonates on the basis of our meta-analyses. Second, clinicians or paramedics have different degrees of acquaintance in the same ETI approach. Therefore, the first-attempt success rate and duration may be impacted by personal experience in both groups. Third, most of the sample size in our included trials was not more than 100 except for the study of Driver et al.\textsuperscript{10}, which may contribute to low representativeness. Fourth, a comparison of different complications in ETI was not adequately analyzed; most of our included trials had limited complication assessments other than complications in esophageal intubation. Finally, all bougie approach groups in our review adopted a railroaded bougie instead of a preloaded bougie, and a preloaded bougie provided better outcomes in the first-attempt success rate, shorter intubation duration, and preference according to recent research studies.\textsuperscript{23} Future trials should consider the preloaded bougie approach to investigate the comparative effectiveness of different bougie techniques.

Conclusion

Bougie and stylet approaches in orotracheal intubation were comparable in the first-attempt intubation success rate, intubation duration, and esophageal intubation rate.
Therefore, we suggest that the choice of a bougie or stylet as an ETI aid should be determined by personal preferences and clinician expertise.
Contributions

Yen-Kuang Lin and Ka-Wai Tam devised and designed the study. Yu-Jia Sheu and Sung-Wei Yu extracted data; Yu-Jia Sheu, Sung-Wei Yu, Yen-Kuang Lin and Ka-Wai Tam analyzed and interpreted data; Yu-Jia Sheu and Sung-Wei Yu wrote the first draft; all authors contributed to subsequent versions and approved the final article; Yen-Kuang Lin and Ka-Wai Tam are the guarantors.
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16. Tosh P, Rajan S, Kumar L. Ease of Intubation with C-MAC Videolaryngoscope: Use 
of 60° Angled Styletted Endotracheal Tube versus Intubation over Bougie. *Anesth 

17. Heegaard WG, Black C, Pasquerella C, Miner J. Use of the endotracheal tube 
introducer as an adjunct for oral tracheal intubation in the prehospital setting. *Air Med 


Expertise in prehospital endotracheal intubation by emergency medicine


Figure and Table Legends

Figure 1. Schematic of the study selection process

Figure 2. Forest plot of comparison: bougie vs stylet; outcome: first-attempt intubation success rate

Figure 3. Forest plot of comparison: bougie vs stylet; outcome: intubation duration

Figure 4. Forest plot of comparison: bougie vs stylet; outcome: esophageal intubation rate

Table 1. Characteristics of included studies

Table 2. Methodological quality assessment of included trials
Figure 1. Schematic of the Study Selection Process

- Studies identified using the PubMed, Embase, and Cochrane Library databases (n = 370)

- Total records (n = 370)
  - Excluded based on review of the title and duplicates (n = 327)
    - Not relevant (n = 221)
    - Duplicate (n = 94)
    - Review (n = 12)

- Full-text articles assessed for eligibility (n = 43)
  - Studies excluded (n = 38)
    - Simulation/cadaver (n = 21)
    - Inappropriate intervention in control group (n = 11)
    - Non-RCT design (n = 6)

- Studies included in quantitative synthesis (meta-analysis) (n = 5)
Figure 2

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Bougie Events</th>
<th>Total Events</th>
<th>Weight M-H</th>
<th>Random 95% CI Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver 2010</td>
<td>373</td>
<td>367</td>
<td>29%</td>
<td>1.12 [1.08, 1.17]</td>
</tr>
<tr>
<td>Gaiaure 1996</td>
<td>41</td>
<td>50</td>
<td>16.4%</td>
<td>1.71 [1.25, 2.34]</td>
</tr>
<tr>
<td>Heegaard 2003</td>
<td>14</td>
<td>20</td>
<td>13.3%</td>
<td>1.08 [0.74, 1.60]</td>
</tr>
<tr>
<td>Noguchi 2003</td>
<td>29</td>
<td>30</td>
<td>27.8%</td>
<td>1.00 [0.91, 1.10]</td>
</tr>
<tr>
<td>Tsai 2010</td>
<td>15</td>
<td>36</td>
<td>13.2%</td>
<td>0.45 [0.31, 0.67]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>516</td>
<td>522</td>
<td>100.0%</td>
<td>1.03 [0.85, 1.24]</td>
</tr>
</tbody>
</table>

Total events 472 484

Heterogeneity: Tau² = 0.03, Ch² = 31.06, df = 4 (P = 0.00001); P = 87%
Test for overall effect Z = 0.29 (P = 0.77)
## Figure 3

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Bougie Mean</th>
<th>Bougie SD</th>
<th>Bougie Total</th>
<th>Stylet Mean</th>
<th>Stylet SD</th>
<th>Stylet Total</th>
<th>Mean Difference IV, Random, 95% CI</th>
<th>Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver 2018</td>
<td>36.0</td>
<td>16.3</td>
<td>37.3</td>
<td>36.0</td>
<td>21.48</td>
<td>32.8</td>
<td>2.00 [0.95, 4.05]</td>
<td></td>
</tr>
<tr>
<td>Gatare 1996</td>
<td>14.4</td>
<td>1.92</td>
<td>41.0</td>
<td>16.1</td>
<td>2.94</td>
<td>24.9</td>
<td>-0.70 [-2.01, 0.61]</td>
<td></td>
</tr>
<tr>
<td>Heegaard 2003</td>
<td>62.0</td>
<td>22.5</td>
<td>10.0</td>
<td>62.0</td>
<td>63.08</td>
<td>29.6</td>
<td>0.00 [48.51, 49.51]</td>
<td></td>
</tr>
<tr>
<td>Noguchi 2003</td>
<td>31.9</td>
<td>5.66</td>
<td>26.0</td>
<td>29.7</td>
<td>5.78</td>
<td>29.0</td>
<td>2.20 [0.92, 5.22]</td>
<td></td>
</tr>
<tr>
<td>Tosh 2018</td>
<td>77.43</td>
<td>36.55</td>
<td>15.0</td>
<td>16.97</td>
<td>7.31</td>
<td>33.8</td>
<td>6.01 [-0.07, 12.09]</td>
<td></td>
</tr>
</tbody>
</table>

| Total (95% CI)    | 476         | 443       | 100.0%       | 6.01        | [-0.07, 12.09] |

Heterogeneity: Tau² = 30.33; Chi² = 47.11, df = 4 (P < 0.00001); I² = 92%
Test for overall effect: Z = 1.94 (P = 0.05)
Figure 4

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Bougie Events</th>
<th>Total</th>
<th>Stylet Events</th>
<th>Total</th>
<th>Weight</th>
<th>M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver 2018</td>
<td>3</td>
<td>376</td>
<td>2</td>
<td>376</td>
<td>22.4%</td>
<td>0.14 [0.01, 2.72]</td>
<td></td>
</tr>
<tr>
<td>Cesta 1996</td>
<td>2</td>
<td>50</td>
<td>0</td>
<td>50</td>
<td>21.7%</td>
<td>5.00 [0.25, 101.59]</td>
<td></td>
</tr>
<tr>
<td>Heegaard 2003</td>
<td>1</td>
<td>20</td>
<td>2</td>
<td>31</td>
<td>33.9%</td>
<td>0.78 [0.03, 8.00]</td>
<td></td>
</tr>
<tr>
<td>Tosh 2018</td>
<td>0</td>
<td>35</td>
<td>2</td>
<td>35</td>
<td>21.9%</td>
<td>0.20 [0.01, 4.02]</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI): 486 / 492 = 100.0% 0.59 [0.13, 2.59]

Total events 3 / 7

Heterogeneity: Tau² = 0.26; Chi² = 3.39, df = 3 (P = 0.34); I² = 11%

Test for overall effect: Z = 0.70 (P = 0.48)
<table>
<thead>
<tr>
<th>Author</th>
<th>(Year)</th>
<th>Inclusion criteria</th>
<th>No. of patients (% male)</th>
<th>Inclusion criteria</th>
<th>BMI, kg/m²</th>
<th>Age, year, mean ± SD</th>
<th>Grading of laryngeal view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver (2018)</td>
<td></td>
<td>10 patients in emergency department; age &gt; 18 years</td>
<td>B: 381 (71)</td>
<td>B: Bougie (15 Fr, 70 cm, bent into an appropriate curve)</td>
<td>S: 376 (68)</td>
<td>S: 46 ± 18</td>
<td>S: CL1 (72/75)</td>
</tr>
<tr>
<td>Gature (1996)</td>
<td></td>
<td>14 patients for elective surgery; ASA Grades I–II; patients with obesity and asthma excluded</td>
<td>B: 50 (22)</td>
<td>B: Bougie (15 Fr)</td>
<td>S: 50 (32)</td>
<td>S: 46</td>
<td>S: CL1 (94/92)</td>
</tr>
</tbody>
</table>

Table 1. Characteristics of Included Studies
<table>
<thead>
<tr>
<th>Study</th>
<th>Age</th>
<th>ASA</th>
<th>Patients Undergoing Surgery</th>
<th>Bougie Type</th>
<th>Standard Intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heegaard (2003)</td>
<td>≥ 18 years; ASA I-III</td>
<td>31</td>
<td>35</td>
<td>Bougie (15 Fr, 60 cm)</td>
<td>Endotracheal Intubation</td>
</tr>
<tr>
<td>Noguchi (2003)</td>
<td>&lt; 20 years; ASA I-III</td>
<td>30</td>
<td>30</td>
<td>Bougie (Eschmann tracheal tube introducer)</td>
<td>Endotracheal Intubation</td>
</tr>
<tr>
<td>Tosh (2018)</td>
<td>18-70 years; ASA I-II</td>
<td>N/P</td>
<td>N/P</td>
<td>Bougie (15 Fr, 60 cm)</td>
<td>Stylet (60°)</td>
</tr>
</tbody>
</table>

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SD was estimated using a statistics method.
soft palate is not visible at all
Table 2. Methodological Quality Assessment of the Included Trials

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias arising from the randomization process</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Some concerns(^1)</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Bias due to deviations from intended interventions</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Some concerns(^2)</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Bias due to missing outcome data</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Bias in measurement of the outcome</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Some concerns(^3)</td>
<td>Some concerns(^3)</td>
</tr>
<tr>
<td>Bias in selection of the reported result</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Overall risk of bias</td>
<td>Low risk</td>
<td>Low risk</td>
<td>High risk(^4)</td>
<td>Some concerns</td>
<td>Some concerns(^5)</td>
</tr>
</tbody>
</table>

Methodological quality assessment was based on the Cochrane risk of bias tool (RoB 2.0).

1. Patients were randomized on an even or odd day regimen

2. Some clinicians prematurely aborted using the ETI because of unfamiliarity

3. Lack of any information about assessors
4. Unreasonably large confidence interval in intubation duration is also noted

5. Unreasonably large standard deviation in intubation duration between the 2 groups is also noted
**Supplemental Table 1.** Complications

<table>
<thead>
<tr>
<th>Complications</th>
<th>Bougie group</th>
<th>Stylet group</th>
<th>Risk ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoxemia†</td>
<td>47/371</td>
<td>50/364</td>
<td>0.92 (0.64–1.34)</td>
</tr>
<tr>
<td>Pneumothorax with clear cause</td>
<td>9/381</td>
<td>9/376</td>
<td>0.99 (0.40–2.46)</td>
</tr>
<tr>
<td>Pneumothorax without clear cause</td>
<td>1/381</td>
<td>3/376</td>
<td>0.32 (0.03–3.17)</td>
</tr>
<tr>
<td>Lip laceration</td>
<td>7/381</td>
<td>3/376</td>
<td>2.31 (0.60–8.84)</td>
</tr>
<tr>
<td>Witnessed aspiration during intubation</td>
<td>3/381</td>
<td>1/376</td>
<td>2.96 (0.31–28.33)</td>
</tr>
<tr>
<td>Iatrogenic bleeding from the oropharynx or perilaryngeal structures</td>
<td>2/381</td>
<td>2/376</td>
<td>0.99 (0.14–6.97)</td>
</tr>
<tr>
<td>Dental trauma</td>
<td>1/381</td>
<td>1/376</td>
<td>0.99 (0.06–15.76)</td>
</tr>
</tbody>
</table>

†Oximetry was not available for all patients