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Videolaryngoscopy versus direct laryngoscopy for nasotracheal intubation: A systematic review and meta-analysis of randomised controlled trials☆

Jia Jiang, MD Vice-Professor[a], Dan-Xu Ma, MD Attending Anesthesiology[a], Bo Li, MD Vice-Professor[b], An-Shi Wu, MD Professor[a], Fu-Shan Xue, MD Professor[c,*]

[a] Department of Anesthesiology, Beijing Chaoyang Hospital, Capital Medical University, Beijing, China
[b] Beijing Hospital of Traditional Chinese Medicine, affiliated with Capital Medical University, Beijing Institute of Traditional Chinese Medicine, Beijing, China
[c] Department of Anesthesiology, Beijing Friendship Hospital, Capital Medical University, Beijing, China

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ABSTRACT

Study objective: Nasotracheal intubation (NTI) is a common practice in the oral and maxillofacial surgeries. A systematic review and meta-analysis was performed to determine whether videolaryngoscopy (VL) compared with direct laryngoscopy (DL) can lead to better outcomes for NTI in adult surgical patients.

Measurements: Only randomised controlled trials comparing VL and DL for NTI were included. The primary outcome was overall success rate and the second outcomes were first-attempt success rate, intubation time, rate of Cormack and Lehane classification 1, rate of Magill Forceps used, rate of postoperative sore throat, and ease of intubation.

Main results: Fourteen studies with 20 comparisons ($n = 1052$) were included in quantitative synthesis. The overall success rate was similar between two groups (RR, 1.03; $p = 0.14$; moderate-quality evidence). VL was associated with a higher first-attempt success rate (RR 1.09; $p = 0.04$; low-quality evidence), a shorten intubation time (MD-6.72 s; $p = 0.0001$; low-quality evidence), a higher rate of Cormack and Lehane classification 1 (RR, 2.11; $p < 0.01$; high-quality evidence), a less use of the Magill forceps (RR, 0.11; $p < 0.01$; high-quality evidence) and a lower incidence of postoperative sore throat (RR, 0.50; $p = 0.03$; high-quality evidence). Subgroup analysis based on whether with a difficult airway showed higher overall success ($p < 0.01$) and first-attempt success rates with VL ($p = 0.04$) in patients with difficult airways; however, these benefits was not shown in patients with a normal airway ($p > 0.05$); Subgroup analysis based on operators' experience showed that success rate did not differ between groups ($p > 0.05$), but intubation time was shortened by more than 50s by non-experienced operators ($p < 0.05$). Subgroup analysis based on different devices used showed that only non-integrated VL led to a shorter intubation time ($p < 0.05$).

Conclusions: The use of VL does not increase the overall success rate of NTI in adult patients with general anesthesia, but it improves the first-attempt success rate and laryngeal visualization, and shortens the intubation time. VL is particularly beneficial for patients with difficult airways.

1. Introduction

Nasotracheal intubation (NTI) is a practice used commonly in the oral and maxillofacial surgeries to secure airway safety and provide a favorable operation field. It can also be employed in patients with suspicious cervical instability or severe spine degeneration with limited mouth opening and minimum spine mobility [1–7]. The NTI with direct laryngoscopy (DL) is most common in clinical practice, but it usually requires additional maneuvers such as the external laryngeal pressure or the assistant of the Magill forceps. Even a poor laryngeal visualization by DL can result in difficult or failed NTI [3].

Videolaryngoscopy (VL) has been used for orotracheal intubation (OTI) in the patients with normal and difficult airways. It has been reported that VL can provide an improved laryngeal visualization as well as an increased intubation success rate, especially for patients with difficult airways and novice operators [8–11]. For NTI, it has been

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* Corresponding author at: Department of Anesthesiology, Beijing Friendship Hospital, Capital Medical University, NO. 95 Yong-An Road, Xi-Cheng District, Beijing 100050, China.
E-mail address: xuefushan@aliyun.com (F.-S. Xue).

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demonstrated a higher success rate by using VL in observational studies [12,13]. Case series on extremely difficult airways recommended the use of VL for NTI [14–16]. A systematic review performed in 2013 showed that VL can provide a higher success rate and a shorter intubation time of NTI compared with the Macintosh DL [17]. However, two previous randomised controlled trials (RCTs) before 2013 [18,19] and two recent RCTs [20,21] comparing VL and DL for NTI are not included in this systematic review. Thus, this systematic review and meta-analysis of randomised RCTs was performed to determine whether the use of VL could improve the NTI outcomes such as overall and first-attempt success rates in adult surgical patients undergoing general anesthesia compared with DL. Our review has been registered at PROSPERO (http://www.crd.york.ac.uk/PROSPERO) and the registration number is: CRD42018086468.

2. Materials and methods

The PRISMA guidelines were followed [22]. The Cochrane Central Register of Controlled Trials (CENTRAL; 2017, Issue 9), PubMed (1946 to February 15th, 2018), EMBASE (1974 to February 15th, 2018), and ScienceDirect (1997 to February 15th, 2018) were searched. The search strategies of the four electronic databases were provided in the Supplemental data [23]. Study authors were mailed for literature without full-text or other useful information. Studies that have not been fully published (e.g. conference abstract) or studies without full-text were excluded. The reference lists of all eligible trials and reviews were screened for additional citations. No language restriction was imposed.

Only RCTs comparing the VL and DL for NTI in adult (age > 18 years old) surgical patients requiring general anesthesia were included. Manikin study, cadaver study, simulated study, and observational study were excluded. Patients with chronic suppurative sinusitis, midface instability, suspected basilar skull fracture, coagulopathy, or limited mouth opening (< 3 cm) were excluded. Patients in the intervention group used a VL and patients in the control group used a DL. Optimizing maneuvers such as rotation of the nasal tube, cuff inflation to elevate the tip of the tube, external laryngeal pressure, or use of stylet and the Magill forceps, could be initiated at the discretion of the operators.

The Primary outcome was overall success rate. The secondary outcomes were first-attempt success rate, intubation time (from advancement of nasal tube into nostril until the appearance of a capnography curve or from the blade passing the incisors until passage of the nasal tube was completed, according to the original authors' definitions), rate of Cormack and Lehane classification 1, rate of the Magill forceps used, rate of postoperative sore throat (moderate and severe, assessed during hospitalization), and ease of intubation.

The titles and abstracts were independently screened by two study authors (J.J.; D.X.M.). After retrieving the full-texts of any potentially relevant studies, their eligibility was determined. Any disagreements between the two review authors were resolved by discussion with other authors until a consensus was obtained. A PRISMA flow diagram was completed to record the selection process in sufficient detail [24].

Data was extracted by two review authors (J.J. and D.X.M.). For continuous data, mean, standard deviation (SD), and sample size were extracted. Data like median and interquartile range that could not be used directly were converted to mean and SD by using formula provided in the Cochrane handbook [23]. For the dichotomous variables, the number of events occurred, and sample size were extracted. For the studies with more than two comparisons under same grouping method according to different situations, each situation was considered as a single comparison and thus two or more comparisons with equational sample size were created. Although a unit-of-analysis error would occur accordingly, this could facilitate the investigation of heterogeneity and subgroup analyses [23]. Any disagreement on data extraction was resolved by discussion with a third author (F.S.X.) until a consensus was reached.

The study author of the original report was contacted for important missing statistics. For the participants missing due to dropout, if "missing at random", analysis was performed based on the available data, if not, an available case analysis was performed, and the potential bias was discussed in discussion section. If a study did not mention withdrawals, no drop-out was assumed [23].

The risk of bias for each eligible study was independently assessed by two review authors (J.J. and D.X.M.) by using the "Risk of bias" assessment tool of the Cochrane Handbook [23], and a "Risk of bias" summary figure was generated by using Review Manager (RevMan 5.3; Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). If all seven domains were assigned to "low risk" of bias, the study was classified as "low risk"; if one or more domains were assigned to "unclear risk" of bias, the study was classified as "unclear risk"; if one or more domains were assigned to "high risk" of bias, the study was classified as "high risk" [23]. The criteria of the GRADE system (study limitations, consistency of effect, imprecision, indirectness, and publication bias) were used to assess the quality of evidence associated with all outcomes [25,26]. Then a "Grade evidence profile" table was developed by using the GRADE software (www.guidelinedevelopment.org) to rate these outcomes as high, moderate, low, or very low quality. The quality of evidence was downgraded by one or two level when serious or very serious deficiencies were considered in these criteria.

Both weighted mean difference (WMD) and 95% confidence interval (CI) were used for continuous data. Both relative risk (RR) and 95% CI were used for dichotomous data. $P < 0.05$ was considered statistically significant. Review Manager was used to perform the pooled analysis for the outcomes from more than one study. A Chi-squared test with the I^2 statistic (with statistical significance set at the level of two-tailed 0.10) was used to describe the percentage of the total variance across studies from heterogeneity rather than from chance. If I^2 is < 40%, namely there is no statistical heterogeneity among studies, and a fixed-effect model is used; otherwise, a random-effects model is used. For the results that could not be analyzed via meta-analysis, only a qualitative systematic review was planned.

Before pooled analysis, clinical and methodological heterogeneity was considered. In the presence of statistical heterogeneity ($I^2 > 40\%$) or an indication of clinical heterogeneity, subgroup analysis was planned for primary outcome and two secondary outcomes (first-attempt success rate and intubation time) according to following possible heterogeneous factors: whether with a difficult airway; operator' s experience: experienced or inexperienced (according to the judgments of study authors); different devices: VL with an integrated channel like Airtraq, VL with a standard blade like C-MAC, or VL with an angled blade like Glidescope [27]. Sensitivity analysis was planned to explore other potential sources of heterogeneity if necessary. Reporting bias was also assessed by using funnel plot if the result of primary outcome was from at least 10 trials [28].

3. Results

Using search strategy, a total of 103 papers were identified. Of them, 82 were excluded during title and abstract screening due to duplicates and being irrelevant to our research question. Twenty-one studies were selected for full text assessment using inclusion and exclusion criteria. Seven studies were further removed because of awake intubation [29], different grouping methods [30], no external video [31], no full-text [32], and non-RCTs [12,14,33]. Among the remaining 14 studies [6,18–21,34–42], 6 had 2 comparisons [6,20,35,39,41,42], thus, 14 studies with 20 comparisons ($n = 1052$) were eventually included in the review for data extraction. Authors from 7 studies were contacted for unpublished data and detailed information on study design [19–21,36,38,39,42], only 2 of them replied [19,39]. The process of selection of studies is shown in Fig. 1.

The characteristics of included studies are listed in Table 1. Of the 14 included studies, 12 were carried out in the dental, maxillofacial, or

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