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Original contribution

# A comparison between video laryngoscopy and direct laryngoscopy for endotracheal intubation in the emergency department: A meta-analysis of randomized controlled trials

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ABSTRACT

*Study objectives:* Direct laryngoscopy is the most commonly used modality for endotracheal intubation in the emergency department. Video laryngoscopy may improve glottic view during laryngoscopy and intubation success rate in such patients. This meta-analysis has been designed to compare clinical efficacy of video laryngoscopy with direct laryngoscopy for endotracheal intubation in the emergency department.
*Design:* Meta-analysis of randomized controlled trial.
*Setting:* Randomized controlled trials comparing video laryngoscopy and direct laryngoscopy for endotracheal intubation in adult patients in emergency department. PubMed (1946 to 20th October 2017) and The Cochrane Library databases (CENTRAL) were searched for potentially eligible trials on 20th October 2017.
*Patients:* Adult patients presenting in the emergency department.
*Interventions:* Video laryngoscopy & direct laryngoscopy for intubation in emergency department.
*Measurement:* Primary outcome was 'first intubation success rate' and secondary outcomes were overall intubation success rate, in-hospital mortality and oesophageal intubation rate.
*Main results:* Data of 1250 patients from 5 randomized controlled trials have been included in this study. Video laryngoscopy offers no advantage over direct laryngoscopy in terms of first intubation success rate (odds ratio 1.28, 95% CI 0.70, 2.36; $p = 0.42$), overall intubation success rate (OR 1.26, 95% CI 0.53, 3.01; $p = 0.6$) or in-hospital mortality (OR 1.25, 95% CI 0.8, 1.95; $p = 0.32$). However, oesophageal intubation rate is lower with the use of video laryngoscopy (OR 0.09, 95% CI 0.01, 0.7; $p = 0.02$).
*Conclusion:* Use of video laryngoscopy for emergency endotracheal intubation in adult patients is associated with reduced oesophageal intubation over direct laryngoscopy. However, no benefit was found in terms of overall intubation success.

## 1. Introduction

Endotracheal intubation is considered as the 'gold standard' of airway management in patients presenting in the Emergency department (ED) [1]. The Fourth National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society found that 31% of the airway related events in the ED lead to death of permanent neurological injury [2]. Failed or difficult and prolonged intubation may be associated with several complications such as oxyhemoglobin desaturation, sympathetic stimulation leading to hypertension and tachycardia and even hypoxemic cardiac arrest causing permanent neurological sequel or death [3].

Patients presenting in the ED are usually at higher risk of hypoxia and its consequences because of already deranged respiratory physiology resulting in decreased functional residual capacity or increased shunt fraction or both. Video laryngoscopy for endotracheal intubation may provide better laryngeal visualization [4] but how much this is translated into a clinical benefit such as less intubation time, higher intubation success rate or a less complications is debatable [3]. A Cochrane review found that video laryngoscopy is associated with significantly less failure rate and its effect size increases in patients with anticipated difficult airway. It is worth mentioning that amongst the 64 included trials in the Cochrane review, 61 of them were conducted during the routine anaesthesia practice. A large propensity score matched observational study [5] conducted in the ED reported that overall first attempt success rate is similar between GlideScope® and Macintosh

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direct laryngoscope. Interestingly this study also reported that first attempt intubation success rate is lower and a higher intubation failure in patients with slight difficult airway.

On the contrary a retrospective study [6] reported that C-MAC® video laryngoscope is associated with higher intubation success rate than Macintosh direct laryngoscope in the ED. However, no systematic review has specifically addressed this issue till date. So, we aimed to compare video laryngoscopy with direct laryngoscopy for endotracheal intubation in the ED.

## 2. Methods

This meta-analysis follows the recommendations of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for conducting and reporting its results [7]. A protocol of this meta-analysis has not been registered.

### 2.1. Eligibility criteria

Published prospective randomized controlled trials comparing any form of video laryngoscopy such as C-MAC® or glidescope® etc. with direct laryngoscopy in adult patients presenting in hospital emergency department requiring endotracheal intubation has been included in this meta-analysis. We have excluded trials conducted in cadavers, manikins or simulated models from this review.

### 2.2. Information sources & search strategy

PubMed (1946 to 20th October 2017) and The Cochrane **Central** Register of Controlled Trials (CENTRAL) were searched for potentially eligible trials on 20th October 2017. We have not imposed any language restriction or date restriction in initial search strategy; however trials were excluded when there was no English language abstract available. References of the previously published meta-analyses were also searched for eligible trials. Following keywords were used to search database: 'video laryngoscopy', 'video laryngoscope', 'direct laryngoscopy', 'direct laryngoscope', 'C-MAC', 'glidescope', 'emergency', 'emergency department', 'emergency room'. Details of PubMed search strategy have been provided in Appendix 1.

### 2.3. Study selection

Two authors (SM and SB) independently searched title and abstract of the potentially eligible articles. Finally, full text of the possible articles was retrieved and assessed for eligibility. Any disputes between the two authors were solved by discussion and consultation with a third author (DKB).

### 2.4. Data collection process

Two authors (SM & SB) independently retrieved required data from the eligible RCTs and all data were initially tabulated in a Microsoft Excel™ (Microsoft Corp., Redmond, WA) data sheet. Another author crosschecked these data before analysis (AS).

### 2.5. Data items

Following data were retrieved from the full text for all studies: First author, year of publication, sample size, characteristics of included patients, first intubation success rate, total intubation success rate, oesophageal intubation rate, mortality at longest follow-up and any other reported complications.

### 2.6. Risk of bias in individual studies

Two authors (DKB & SB) independently assessed the methodological quality of the included studies. Following methodological questions were searched from the studies as per the Cochrane methodology: method of randomization, allocation concealment, blinding of the participants and personnel, blinding of outcome assessment, incomplete data reporting, selective reporting and any other bias. For each area of bias, we will designate the trials as low risk of bias, unclear risk of bias or high risk of bias. Risk of bias at individual study level will be graphically presented in the review.

### 2.7. Summary measures and synthesis of results

Primary outcome of this meta-analysis is 'first intubation success rate' in the included patients. Secondary outcomes are overall intubation success rate, oesophageal intubation rate, mortality at longest available follow-up and any other reported complications related to the device use.

For continuous variables, mean and standard deviation (SD) values were extracted for both groups, a mean difference was computed at the study level, and a weighted mean difference was computed in order to pool the results across all studies. If the values were reported as median and an inter-quartile range or total range of values, the mean value was estimated using the median and the low and high end of the range for samples smaller than 25; for samples $> 25$, the median itself was used. The standard deviation (SD) was estimated from the median and the low and high end of the range for samples smaller than 15, as range/4 for samples from 15 to 70, and as range/6 for samples $> 70$. If only an inter-quartile range was available, SD was estimated as inter-quartile range/1.35 [8].

For binary outcomes, we calculated the following: (1) the odds ratio (OR) for each trial; (2) the pooled OR using the inverse variance method; (3) the number needed to treat (NNT) where a statistical significance was found, i.e. the number of patients who must be treated for one patient to benefit from the intervention. NNT was calculated from OR in Visual Rx online software (Visual Rx version 3.0, Dr Chris Cates, http://www.nntonline.net/visualrx/). All statistical variables were calculated with 95% confidence interval (95% CI). The Q-test was used to analyse heterogeneity of trials. Considering possible clinical heterogeneity due to study design and patients' population, we used a random effect model for all pooled analysis. Pooled analysis was done in RevMan software (Review Manager (RevMan) [Computer program]. Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). Publication bias was assessed by funnel plot. A meta-regression was also planned to assess the effects of sample size, baseline risk of events in control group patients and year of publication on postoperative outcome. A meta-regression was planned by metareg command in STATA version 13.0 (STATA SE 13.0, Stata Corp, College Station, TX, USA) in case of $> 10$ trials is found for any outcome.

## 3. Results

Initial database searching revealed 623831 articles. After duplicate removal, and screening 278 articles were evaluated from title and abstract for possible inclusion. We found 8 controlled trials comparing video laryngoscopy with direct laryngoscopy for endotracheal intubation in the emergency department [9–16]. However, one of the trial [14] was excluded as it was quasi-randomized in design, one trial [15] was excluded as full text was not available in English language and another trial was excluded as it was conducted in pre-hospital setting [16]. Finally, data from 1250 patients have been included in this meta-analysis and systematic review. A flow diagram showing stages of database searching and study selection has been provided in Fig. 1. Characteristics of the individual studies have been provided in Table 1. Amongst these trials, C-MAC® video laryngoscope with Macintosh blade was used in three RCTs and Glidescope® was used in rest of the two trials. Risk of bias summary showing review authors' judgements about each risk of bias item for each included study has been provided in

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