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SUPPLEMENTARY DIGITAL FILE

Disaster and Emergency Medicine Journal
DOI: 10.5603/DEMJ.a2022.0001

ISSN 2451–4691, e-ISSN 2543–5957

VIDEO-ASSISTED VERSUS MACINTOSH DIRECT LARYNGOSCOPY FOR INTUBATION OF OBESE PATIENTS: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

CONTENT:

Table S1. Methodology characteristics of included trials.

Study	Inclusion criteria	Exclusion criteria	Primary outcome(s)	Finding(s)
Abdallah et al. 2011	Patients with a body mass index between 30 and 50 kg/m^2 who required orotracheal intubation for elective surgery	NS	Time to intubation defined as time from start of the first attempt of the insertion of the laryngoscope until a capnogram signal was obtained	The time required for tracheal intubation using the Pentax AWS was longer than for the Macintosh laryngoscope and #4 blade. The AWS should not routinely be substituted for a conventional Macintosh #4 blade in morbidly obese patients
Ander et al. 2017	ASA status I–III; surgery under general anesthesia requiring orotracheal intubation and mechanical ventilation; and body mass index (BMI) > 35 kg/m^2	Age < 18 years; previous difficult intubation; anticipated difficult intubation not related to obesity (Mallampati IV, small interincisal opening, reduced neck movement and short thyromental distance); and head-and-neck surgery	Time-to-intubation (s), was measured from the moment the anesthetist took the laryngoscope handle until end-tidal CO^2 was registered on the ventilator monitor, indicating successful intubation	In obese patients the airway may be secured equally fast using direct laryngoscopy (Macintosh®) and with video-laryngoscopy using the Stortz® C-MAC™. The risk for failed intubation, however, appears to be greater with direct laryngoscopy, especially in male obese patients
Andersen et al. 2011	Patients with BMI min. 35 kg/m^2 and age 18 and 60 year	The presence of severe mental illness, ongoing alcohol or substance abuse, previous difficult intubation, and patients considered by the anesthesiologist to require a different procedure of anesthesia or intubation (e.g. fiberoptic intubation) than prescribed by the study protocol	Time to intubate defined as the time from gripping the laryngoscope until registration of expired CO^2	Intubation of morbidly obese patients with GlideScope was slightly slower than with DL. The increased intubation time was of no clinical consequence as no patients became hypoxemic. Both devices generally performed well in the studied population, but the GlideScope provided better laryngoscopic views and decreased IDS scores
Barak et al. 2014	Obese patients who underwent laparoscopic sleeve gastrectomy	American Society of Anesthesiologists (ASA) class ≥ 4, pregnancy, patients who required rapid sequence induction and patients with known tracheal pathology	Intubation time; other features that were tested: direct laryngoscopic view, number of attempts to accomplish intubation and post-operative consequences, such as soft tissue injury	We found the VivaSight™ SL to be helpful in the endotracheal intubation and continuous surveillance of tube position in morbidly obese patients undergoing laparoscopic sleeve gastrectomy
Bathory et al. 2010	Patients with BMI > 35 kg/m^2, ASA 2 or 3, scheduled for bariatric surgery	Previous ENT surgery or radiotherapy, unstable cervical spine or urgent surgery	The duration of tracheal intubation	In morbid obese patients, the use of the Video Intubation Unit significantly improves the visualization of the larynx, thereby improving the intubation conditions.
Cakir et al. 2020	The patients who underwent elective bariatric surgery in the ASA II–III classification between the ages of 18 and 65 were included in the study	Patients with a history of a difficult airway, known airway pathology, or who underwent cervical spinal cord surgery	The heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure, peripheral oxygen saturation of patients before induction (T0), 5 (T1), and 15 (T2) min after intubation, and at the end of surgery (T3)	In patients undergoing bariatric surgery, intubation is expected to be difficult. Despite prolonging intubation time, better oropharyngeal and glottic images are obtained without causing hemodynamic changes with the McGrath. However, these advantages do not provide sufficient evidence for the McGrath to be used as the first choice

Table S1. Methodology characteristics of included trials.

Study	Inclusion criteria	Exclusion criteria	Primary outcome(s)	Finding(s)
Castillo-Monzón et al. 2017	Patients with BMI ≥ 40 kg/m^2, 18 years or older, and American Society of Anesthesiologists III physical status	Patients with a background of difficult intubation, except morbid obesity as the only factor, gastroesophageal symptomatic reflux, gastric bands, urgent surgery, rigid cervical spine, mouth opening less than 2.5 cm, and allergy to any of the drugs used during the procedure	Intubation time, laryngeal vision, the necessity of additional maneuvers to carry out the tracheal intubation, the success of the maneuvers, complications, and hemodynamic response	Both devices allow quick and safe management of the airway. The Airtraq laryngoscope improved the glottic view by the modified Cormack-Lehane classification, reduced the need for additional maneuvers for tracheal intubation, and also reduced the degree of sympathetic stimulus detected by a minor increase in heart rate after tracheal intubation
Dhonneur et al. 2008	ASA I–III morbidly obese adult patients (BMI > 35 kg/m^2) admitted for elective visceral surgery	Patients suffering from hiatus hernia with symptomatic untreated gastric reflux, with limited mouth aperture < 3.0 cm, and allergic to succinylcholine	Variations of hemodynamic parameters (heart rate and mean arterial pressure)	Because LMA CTrach promoted short apnea time and the Airtraq laryngoscope allowed early definitive airway, both video-assisted tracheal intubation devices prevented most serious arterial oxygenation desaturation evidenced during tracheal intubation of morbidly obese patients with the conventional Macintosh laryngoscope
Marrel et al. 2007	Morbidly obese patients, ASA II or III, aged 23–76 years, BMI > 35 kg/m^2 and scheduled for bariatric surgery	Previous ENT surgery or radiotherapy or unstable cervical spine requiring stabilization before intubation	Cormack and Lehane grade	For morbidly obese patients with a laryngoscopic grade of 2 or more, the video-laryngoscope nearly always allows a better visualization of the glottic anatomy, thereby improving the intubation conditions. It also probably facilitates faster endotracheal intubation. It is therefore a useful device to minimize the incidence of difficult intubation in morbidly obese patients. Therefore, in our institution, all morbidly obese patients are now intubated with this video-laryngoscope
Nandakumar et al. 2018	ASA grade I–III patients of age group 18–60 years, with a body mass index of ≥ 35 kg/m^2 scheduled for elective bariatric surgery	ASA IV–V patients, patients undergoing emergency surgery, patients with respiratory, oral and pharyngeal pathology, craniofacial abnormalities, restricted neck movement or known cervical spine disease, restricted mouth opening < 1.5 cm, bucked teeth, macroglossia, and patients scheduled for oral surgery	Time to intubate defined as the time taken from the time when the blade of the laryngoscope crosses the incisors to the first upstroke of the capnograph	GlideScope takes longer time to intubation with no added advantage in IDS and hemodynamic response to intubation in morbidly obese patients. McCoy is only as effective as Macintosh and hence Macintosh laryngoscope should be laryngoscope of choice due to its widespread availability and familiarity

Table S1. Methodology characteristics of included trials.

Study	Inclusion criteria	Exclusion criteria	Primary outcome(s)	Finding(s)
Ndoko et al. 2008	ASA I–III morbidly obese (BMI > 35 kg/m^2) consecutive adult patients. The patients underwent general, gynaecological, and bariatric surgery	Patients with the history of hiatus hernia, symptomatic gastric reflux, gastric banding, allergy to succinylcholine, and those with mouth opening of less than 30 mm (interincisor distance)	Tracheal intubation duration was defined as the time elapsing between the insertion of the laryngoscope into the oral cavity and the visualization (or the sensation in the case of blind tracheal intubation) of the tube crossing the glottis	The Airtraq laryngoscope shortened the duration of tracheal intubation and prevented reductions in arterial oxygen saturation in morbidly obese patients
Postaci et al. 2015	Female patients with ASA I–III, 18–65 age, BMI ≥ 30 kg/m2		Laryngoscopy time and complications of laryngoscopy	Video-laryngoscopy improves the glottic view of the obese cases when difficult intubation is estimated. However just the improved view of the glottis, could not provide superiority for intubation success
Ranieri et al. 2012	ASA physical status 1–3 and a BMI ≥ 35 kg/m2	History of untreated gastro-oesophageal reflux, suxamethonium intolerance, or previous difficult or failed intubation	Time in seconds from the moment the anesthetist picked up the device until cuff inflation	For obese patients in ramped position, Airtraq affords faster tracheal intubation than the Macintosh laryngoscope
Ruetzler et al. 2020	Patients aged 18–99 years, with BMI ≥ 40 kg/m2, and ASA physical status I–III	Patients for whom rapid sequence induction or fiberoptic awake intubation was anticipated	Best glottis visualization, was defined according to the Cormack and Lehane classification	McGrath video laryngoscope improves glottis visualization versus Macintosh direct laryngoscopy in morbidly obese patients. Large clinical trials are needed to determine whether improved airway visualization with video-laryngoscopy reduces intubation attempts and failures
Yousef et al. 2012	ASA I–III morbidly obese (BMI > 35 kg/m2) consecutive adult patients. The patients underwent general, gynecological, and bariatric surgery	Patients with the history of hiatus hernia, symptomatic gastric reflux, gastric banding, and those with mouth opening of less than 3.5 cm (interincisor distance)	The time to intubation was defined as the time taken from the end of the period of bag-mask ventilation and ended when end-tidal CO2 was detected on the monitor	The GlideScope video-laryngoscope and the LMA CTrach reduced the difficulty, improved laryngoscopic views and overall success rate of tracheal Intubation to a similar extent compared with the Macintosh laryngoscope in morbidly obese patients. The GlideScope improved intubation time for tracheal intubation compared with the LMA CTrach and Macintosh laryngoscope but no patient became hypoxic with LMA CTrach because of prolonged intubation time
Yumul et al. 2016	Participants scheduled for elective bariatric surgery and, 18–80 years of age with a BMI > 30 kg/m2	Patients with a history of facial abnormalities, previous oral-pharyngeal cancer or reconstructive surgery, cervical spine injury, patients who required an awake fiber optic intubation, emergency operations, severe mental disorder, pregnant patients, and those with a history of a difficult intubation	the three video-laryngoscopes would decrease the intubation time and improve the glottic view compared to standard direct-laryngoscope and with each other	Video-Mac and GlideScope required fewer intubation attempts than standard direct-laryngoscope and the McGrath device. The Video-Mac also significantly reduced the time needed to secure the airway and improved the glottic view compared to standard direct-laryngoscope

ASA: American Society of Anesthesiologists grade; BMI: body mass index; IDS: intubation difficulty scale score; LMA: laryngeal mask airway

Table S2. Polled analysis of airway parameters using American Society of Methodology grade and Mallampati class among included trials

Parameter	No. of studies	Events/participants		Events		Heterogeneity between trials		P-value for differences across groups
		VL	DL	OR	95% CI	P-value	I^2 statistic	
American Society of Anesthesiologists grade								
I grade	8	78/594 (13.1%)	68/413 (16.5%)	1.14	0.73 to 1.76	0.69	0%	0.56
II grade	8	222/594 (37.4%)	142/413 (34.4%)	1.13	0.83 to 1.52	0.51	0%	0.44
III grade	8	291/594 (49.0%)	201/413 (48.7%)	0.78	0.55 to 1.10	0.49	0%	0.16
IV grade	8	3/594 (0.5%)	2/413 (0.4%)	1.50	0.24 to 9.39	NA	NA	0.66
Mallampati class								
1 class	14	206/833 (24.7%)	165/624 (26.4%)	0.92	0.68 to 1.26	0.24	19%	0.62
2 class	14	345/833 (41.4%)	263/624 (42.1%)	0.97	0.78 to 1.22	0.93	0%	0.82
3 class	14	233/833 (28.0%)	165/624 (26.4%)	1.03	0.80 to 1.32	0.63	0%	0.83
4 class	14	46/833 (5.9%)	27/624 (5.1%)	1.13	0.66 to 1.92	0.76	0%	0.66

CI: confidence interval; DL: direct-laryngoscope; NA: not applicable; OR: odds ratio; VL: video-assisted intubation

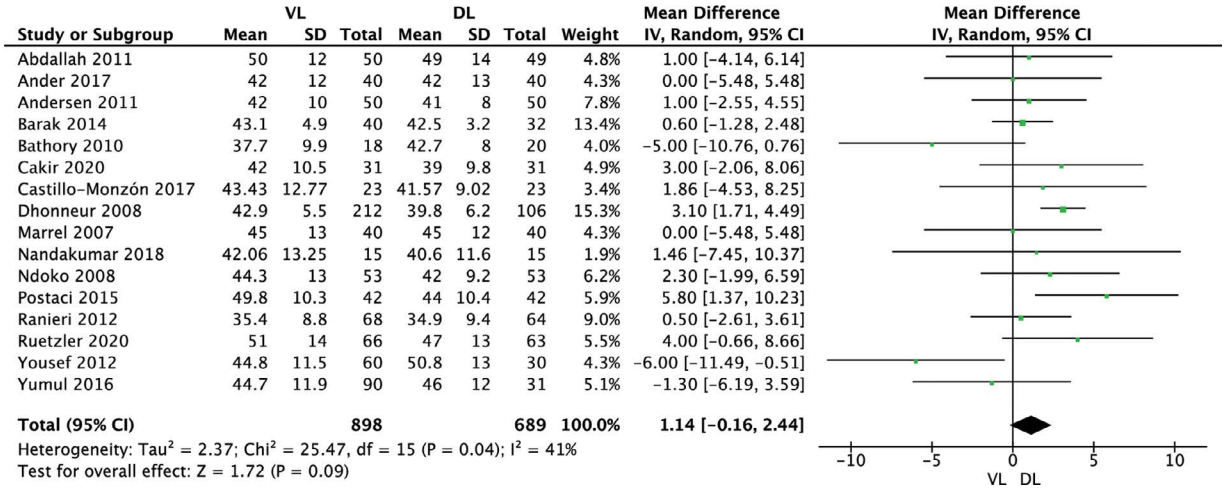

FIGURE S1. Forest plot of patients age in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

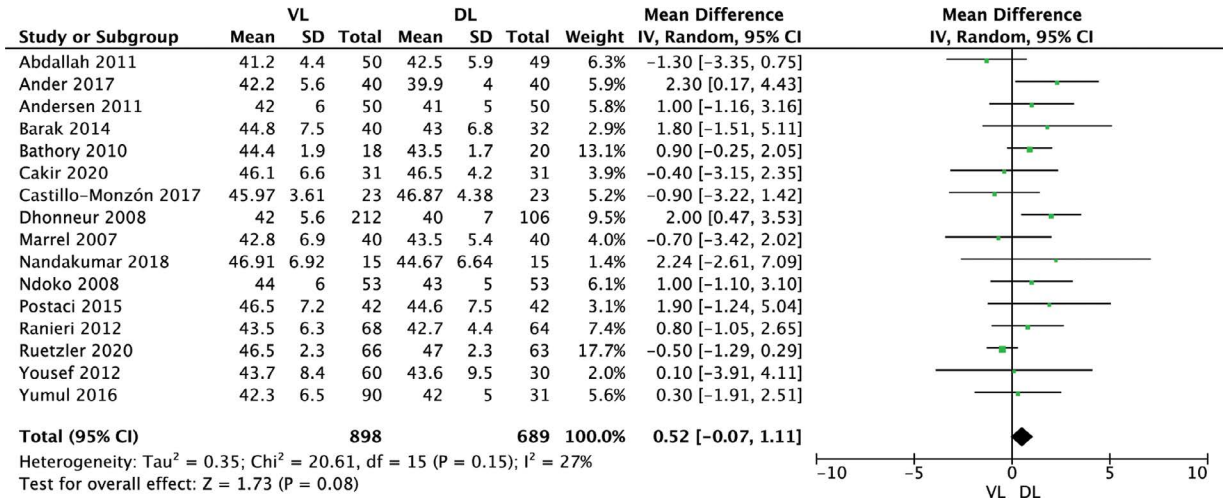

FIGURE S2. Forest plot of body mass index in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

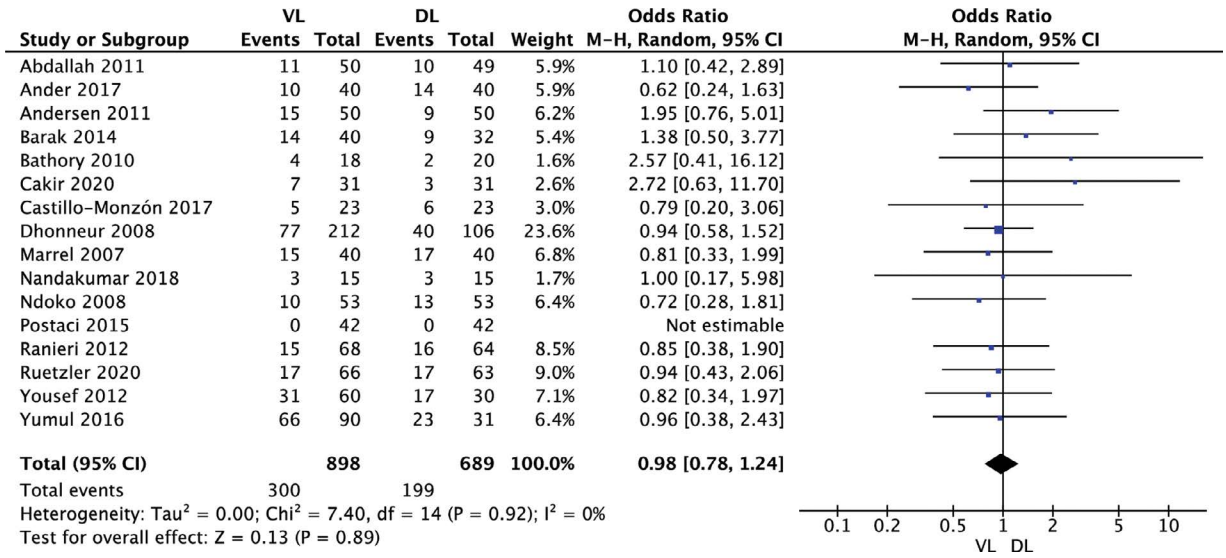

FIGURE S3. Forest plot of male gender in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted odds ratios for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

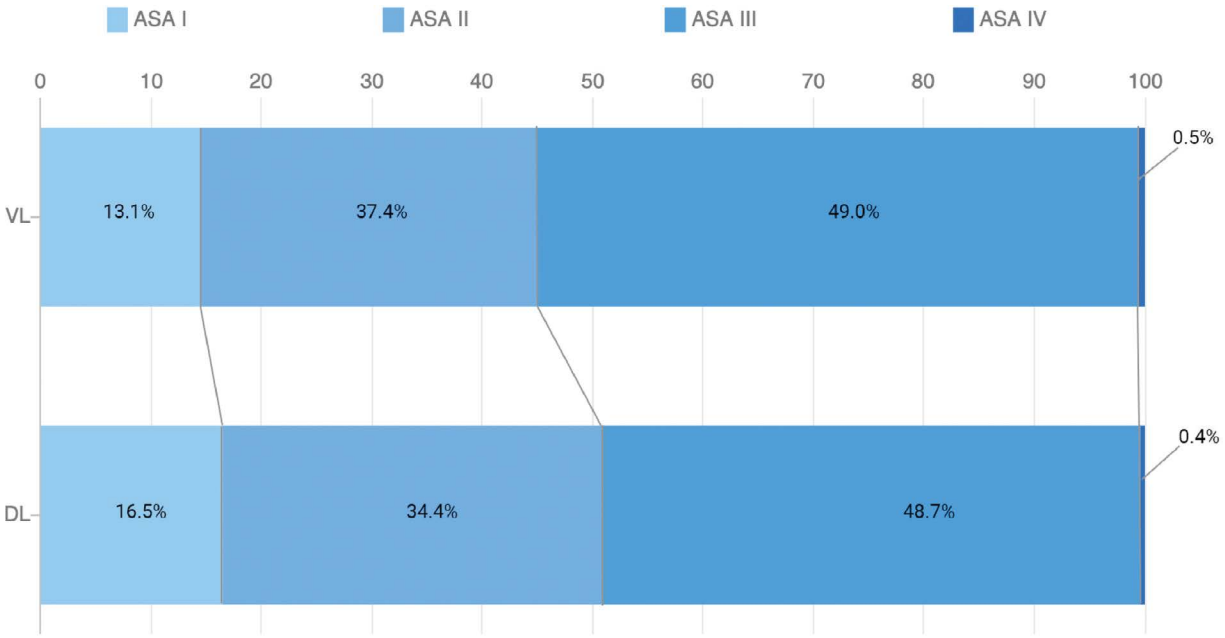

FIGURE S4. Distribution of American Society of Anesthesiologists grades among 1,383 patients

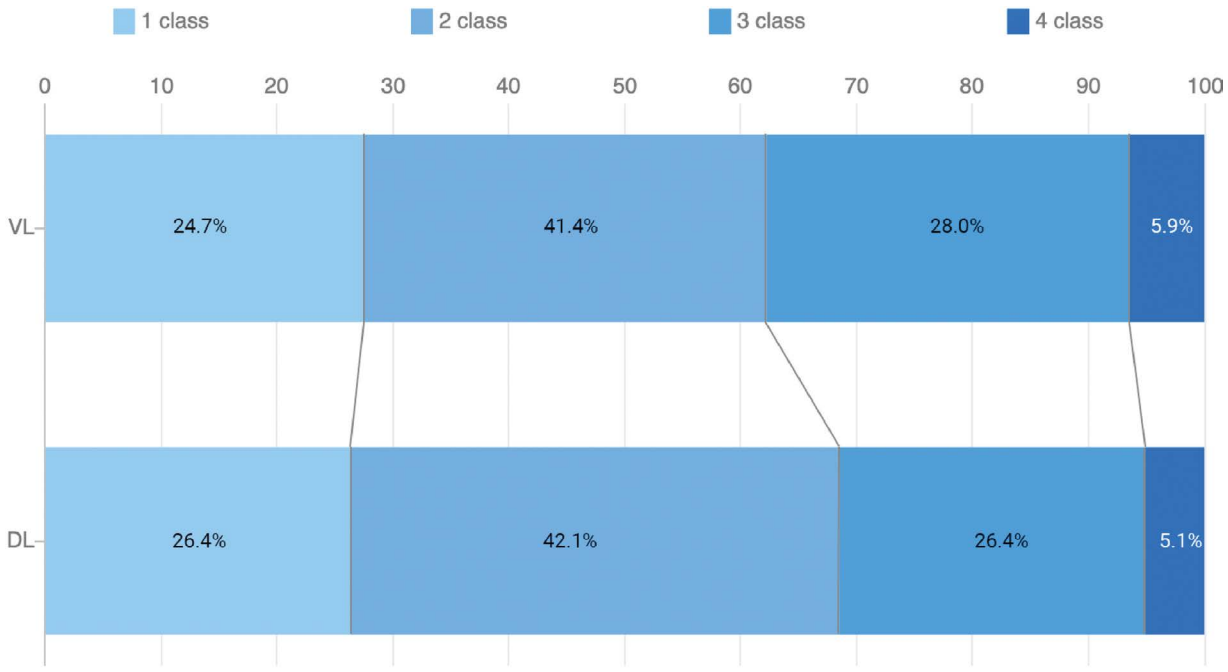

FIGURE S5. Diustribution of Mallampati class among 1,573 patients

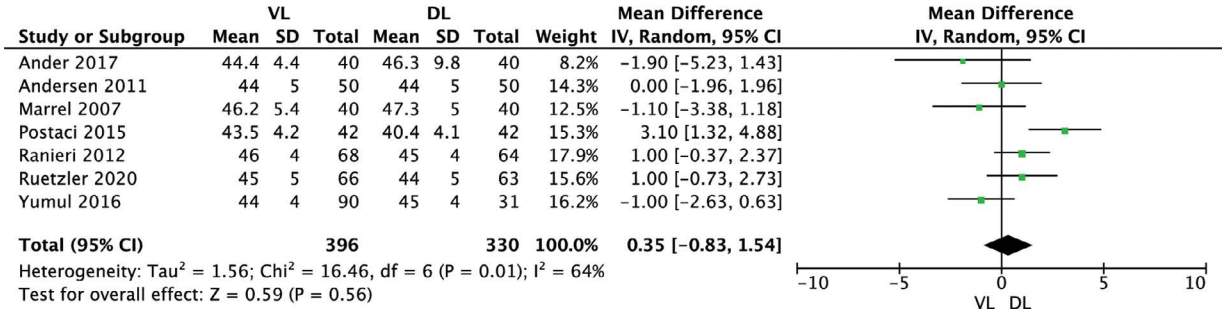

FIGURE S6. Forest plot of neck circumference (cm) in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation.

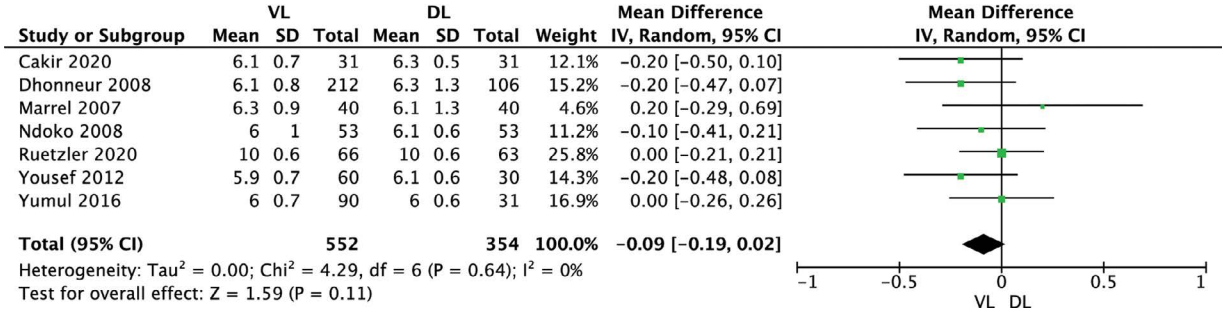

FIGURE S7. Forest plot of thyromental distance (cm) in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

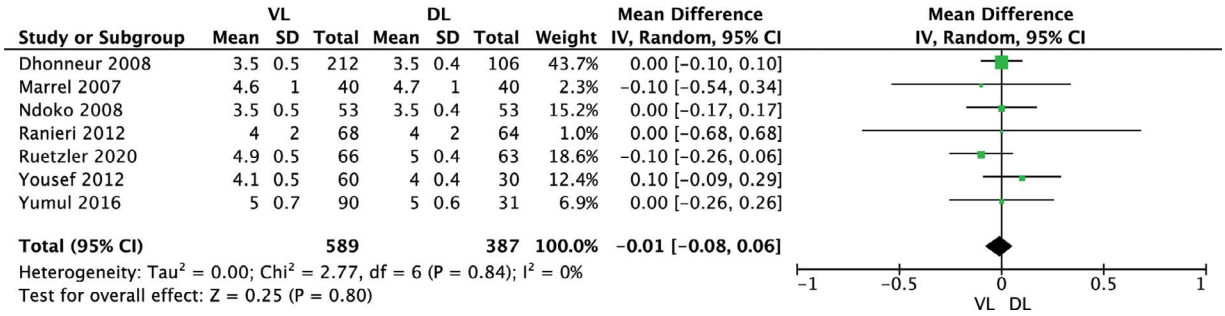

FIGURE S8. Forest plot of interincisior distance (cm) in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

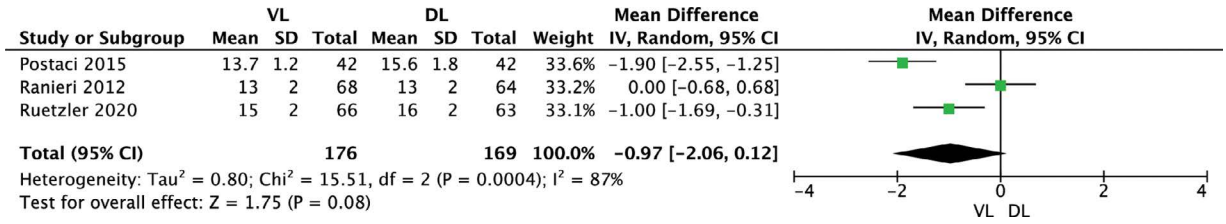

FIGURE S9. Forest plot of sternomental distance (cm) in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

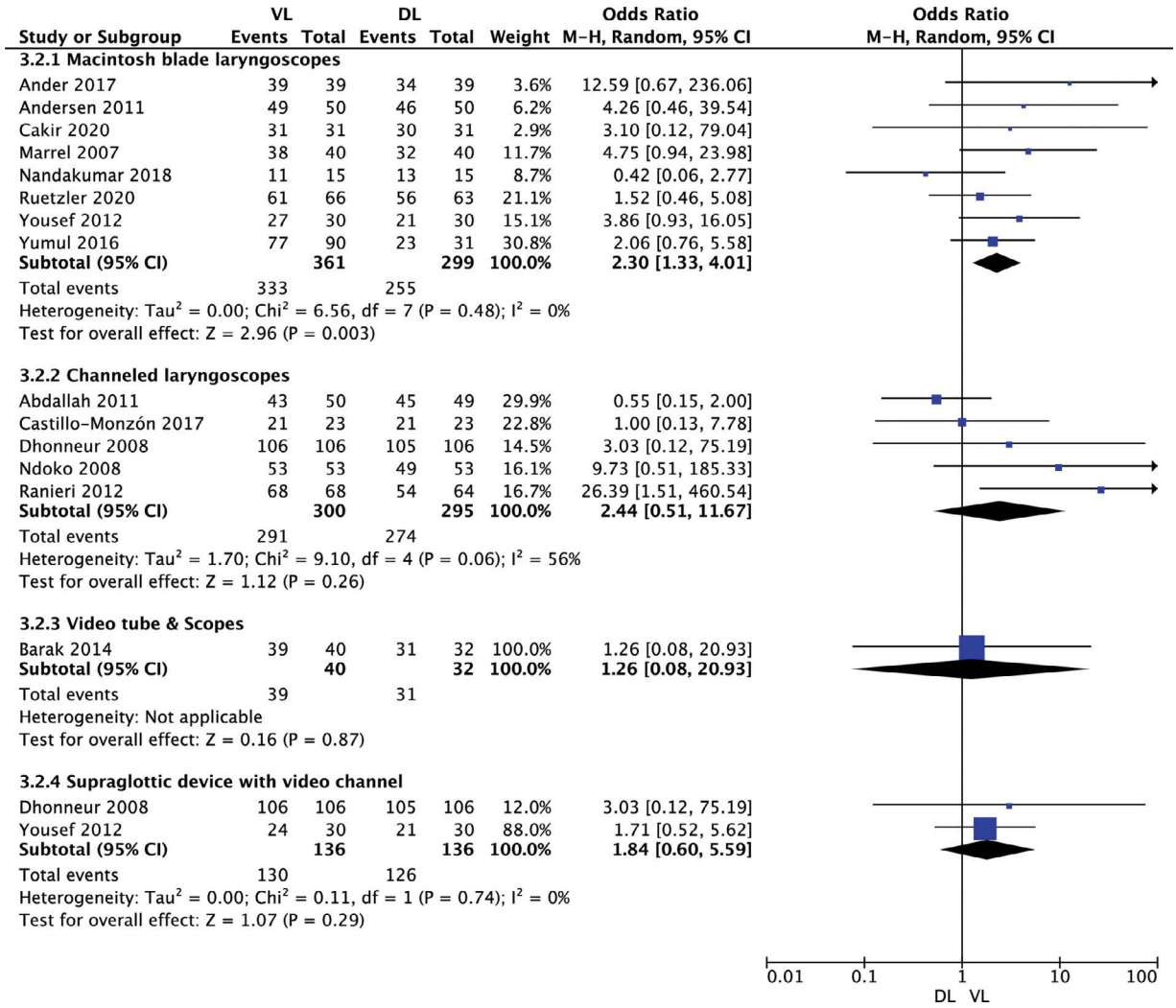

FIGURE S10. Forest plot of first attempts success rate in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted odds ratios for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

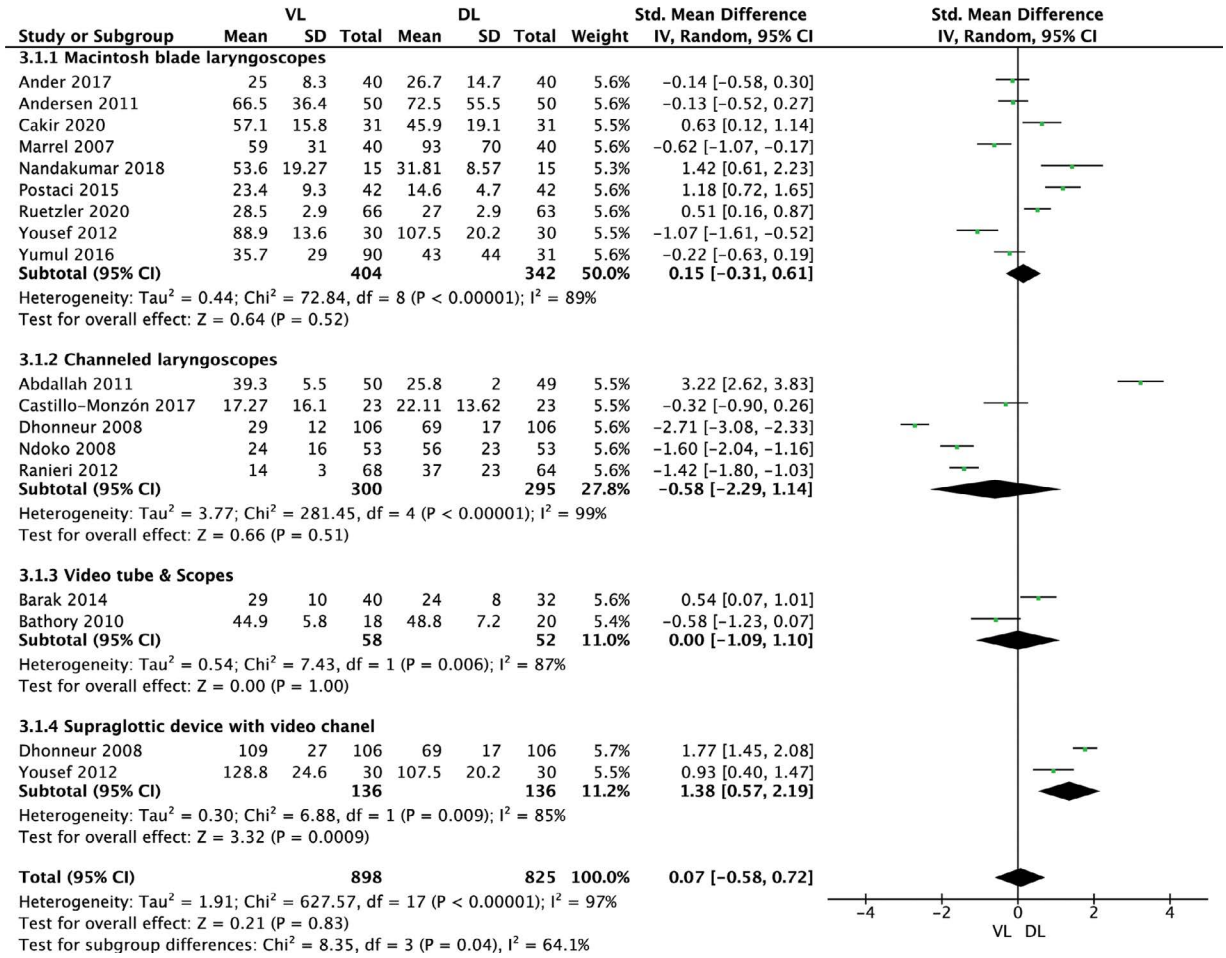

FIGURE S11. Forest plot of intubation time in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

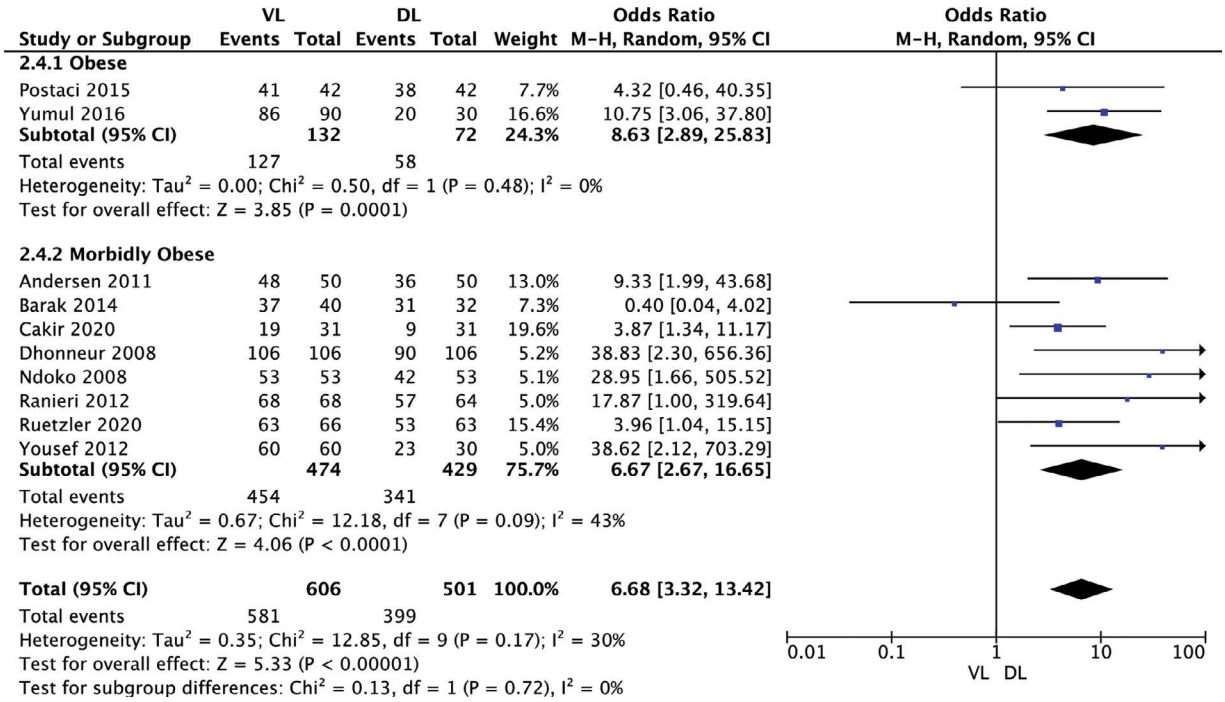

FIGURE S12. Forest plot of glottic visualization rated as 1 or 2 grade in Cormack-Lehane classification in video-assisted intubation and direct-laryngoscope groups. The center of each square represents the weighted odds ratios for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results. Legend: CI = confidence interval; DL = direct-laryngoscope; MD = mean difference; VL = video-assisted intubation

FIGURE S13. A summary table of review authors' judgements for each risk of bias item for each randomized study

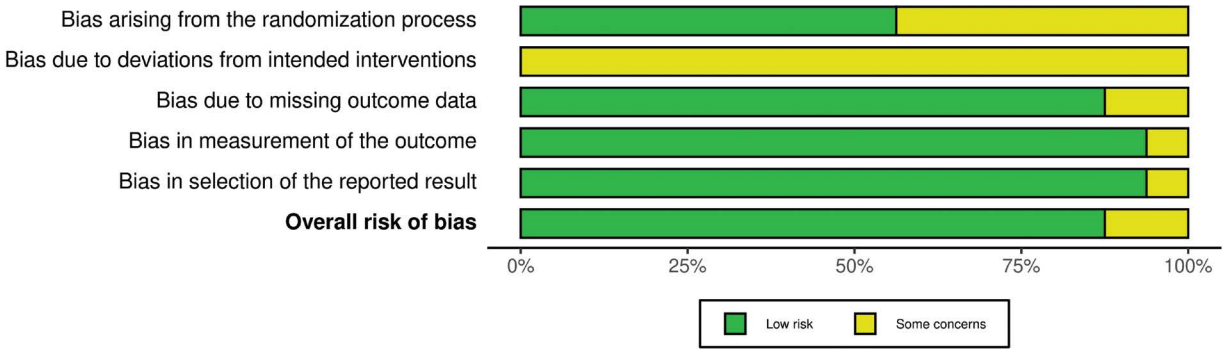

FIGURE S14. A plot of the distribution of review authors' judgements across randomized studies for each risk of bias item

VL compared to DL for Obese intubation

Patient or population: Obese intubation
Setting:
Intervention: VL
Comparison: DL

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with DL	Risk difference with VL
First intubation attempt success rate	1463 (14 RCTs)	⨁⨁⨁⨁ High	**OR 2.04** (1.21 to 3.42)	895 per 1000	**51 more per 1000** (17 more to 72 more)
Overall intubation success rate	1323 (12 RCTs)	⨁⨁⨁⨁ High	**OR 2.20** (0.48 to 10.67)	975 per 1000	**14 more per 1000** (26 fewer to 23 more)
Time to intubation	1963 (16 RCTs)	⨁⨁⨁⨁ High	-	-	SMD **0.73 SD higher** (0.01 lower to 1.46 higher)
Good glottic visualization (Cormack & Lehane grade 1 or 2)	1107 (10 RCTs)	⨁⨁⨁⨁ High	**OR 6.68** (3.32 to 13.42)	796 per 1000	**167 more per 1000** (132 more to 185 more)

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **OR:** odds ratio; **SMD:** standardised mean difference

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

FIGURE S15. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach