Meta-Analysis of Observational Studies in Epidemiology

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Cobra-PLA provides higher oropharyngeal leak pressure than LMA-Classic and LMA-Unique

A meta-analysis with 22 studies

Yuan Tan, MD, Guangyou Duan, PhD, Qin Chen, MD, Feng Chen, MD, Hong Li, PhD*

Abstract

Cobra Perilaryngeal Airway (Cobra-PLA) is a relatively new single-use supraglottic device employed during general anesthesia. This meta-analysis includes randomized controlled trials (RCTs) yielding extensive comparison results among Cobra-PLA, Laryngeal Mask Airway (LMA)-Classic, and LMA-Unique.

Two authors performed searches in EMBASE, CENTRAL, PubMed, and ScienceDirect to identify RCTs that compared Cobra-PLA with LMA-Classic and with LMA-Unique in patients undergoing general anesthesia. Both random- and fixed-effects models were used. Begg's funnel plot was used to evaluate publication bias.

Twenty-two RCTs with a total of 1845 patients were included. Cobra-PLA offered significantly higher oropharyngeal leak pressure than LMA-Classic [mean difference (MD) = 3.56 (1.56, 5.55), $P=.0005$] and LMA-Unique [MD = 4.44 (2.12, 6.76), $P=.0002$]. First-insertion success rate, ease of insertion, insertion time, and reported complications among Cobra-PLA, LMA-Classic, and LMA-Unique were similar.

Compared with the commonly used LMA-Classic and LMA-Unique, Cobra-PLA provides superior airway sealing.

Abbreviations: Cobra-PLA = Cobra-Perilaryngeal Airway, LMA = Laryngeal Mask Airway, MD = mean differences, NMB = neuromuscular blocker, OLP = oropharyngeal leak pressure, RCT = randomized controlled trial, RR = relative ratio.

Keywords: Cobra perilaryngeal airway, laryngeal mask airway, supraglottic devise

1. Introduction

Since its inception by Archie Brain in 1981, the Classic Laryngeal Mask Airway (LMA) have shown unexpectedly high popularity among anesthetists.[1,2] In the past decades, new airway devices, such as Cobra Perilaryngeal Airway (PLA) and LMA-Unique, have been fabricated by modifying the LMA-Classic.

Cobra-PLA contains a polycarbonate transparent breathing tube, a high volume low-pressure cuff, and a far end cobra-shaped head. The soft pointed end of the cobra head is devised to provide passage of the device into the hypopharynx via crooking in the direction of the glottis. At the time of insertion, the distal head keeps the throat soft tissue and the epiglottis in place and connects to the throat inlet, allowing spontaneous or controlled breathing through the slotted opening.[3]

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Oropharyngeal leak pressure (OLP) is used to quantify the efficacy of airway sealing in devices and indicates airway protection, successful placement, and positive pressure ventilation.[4,5] Several randomized controlled trials (RCTs) compared Cobra-PLA with LMA-Classic and LMA-Unique. Four RCTs[6–8] found higher OLP values in Cobra-PLA compared with LMA-Classic, whereas 3 other studies[2,9–10] found no difference. Comparison with LMA-Unique also provides contested results across studies. Therefore, RCTs alone cannot sufficiently provide a clear evaluation of the Cobra-PLA.

To solve this problem, we conducted a meta-analysis including 22 RCTs that compared the supraglottic devices during general anesthesia. OLP was the primary outcome, and rate of first-insertion success, ease of airway insertion, insertion time, and reported complications associated with the device were the secondary outcomes. And furthermore, subgroups analysis were performed considering confounding factors, such as age, surgery type, neuromuscular blocker (NMB) use, and the possible effect of the measurement method on the OLP.

2. Materials and methods

This meta-analysis was performed based upon the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statements.[11]

2.1. Literrature search

Electronic databases EMBASE, CENTRAL, and PubMed, as well the ScienceDirect, were searched for eligible studies. All researches were conducted in May 2018. The search items were as follows:

(i) Cobra Perilaryngeal Airway, CPLA, or Cobra-PLA;
(ii) Laryngeal Mask Airway Classic (CLMA), LMA-Classic, Laryngeal Mask Airway-Unique (LMAU), or LMA-Unique; and
(iii) randomized controlled trial, randomly, or randomized. The key words were linked using "AND" (for "Cobra-PLA," "LMA Classic," and "randomized") and "OR" (for "Cobra Perilaryngeal Airway," "Cobra-PLA," and "CPLA").

The search was performed across English language content.

2.2. Study selection

We included only published prospective RCTs comparing Cobra-PLA with other 2 LMAs during general anesthesia. The exclusion criteria included correspondence, case reports, reviews, animal studies, and non-English papers.

2.3. Data collection

The following data were collected: name of the first author, publication year, age, patients' number, surgical type, premedication, neuromuscular blocker use, type of ventilation, OLP and its measurement method, the rate of first-insertion success, insertion ease, insertion time, and complications associated with the devices (sore throat, laryngospasm, dysphagia, blood-soiled device, or other rare complications). Two independent authors gathered the data. Disagreements were resolved by discussion.

2.4. Risk of bias assessment

Cochrane Collaboration standards were used to evaluate the risk of bias in RCTs. The standards were as follows: randomization, allocation concealment, blinding, incomplete outcome data, selective reporting, and other bias. A judgment of high, unclear, or low risk of material bias was assigned for each item.

2.5. Statistical analysis

Review Manger 5.3 software was used to count data. Weighted mean differences (MD), relative ratio (RR), and associated 95% confidence intervals were applied to pool data. An $I^2 > 50\%$ denotes heterogeneity, and the random-effects model was used. Sensitivity analysis was used to search for possible explanations for significant heterogeneity. Subgroups were analyzed considering confounding factors, such as age, surgery type, NMB use, and the possible effect of the measurement method on the OLP.

If 1 trial contained more than 1 intervention group, each group was regarded as a study. Publication bias of eligible studies was tested by visual inspection of funnel plots (if the number exceeded 10).

3. Results

Figure 1 described detailed steps and study selection. Electronic database search revealed that 15 trials where Cobra-PLA was compared with LMA-Classic[2,6–10,12–15,16–19] and 8 trials containing a comparison between Cobra-PLA and LMA-

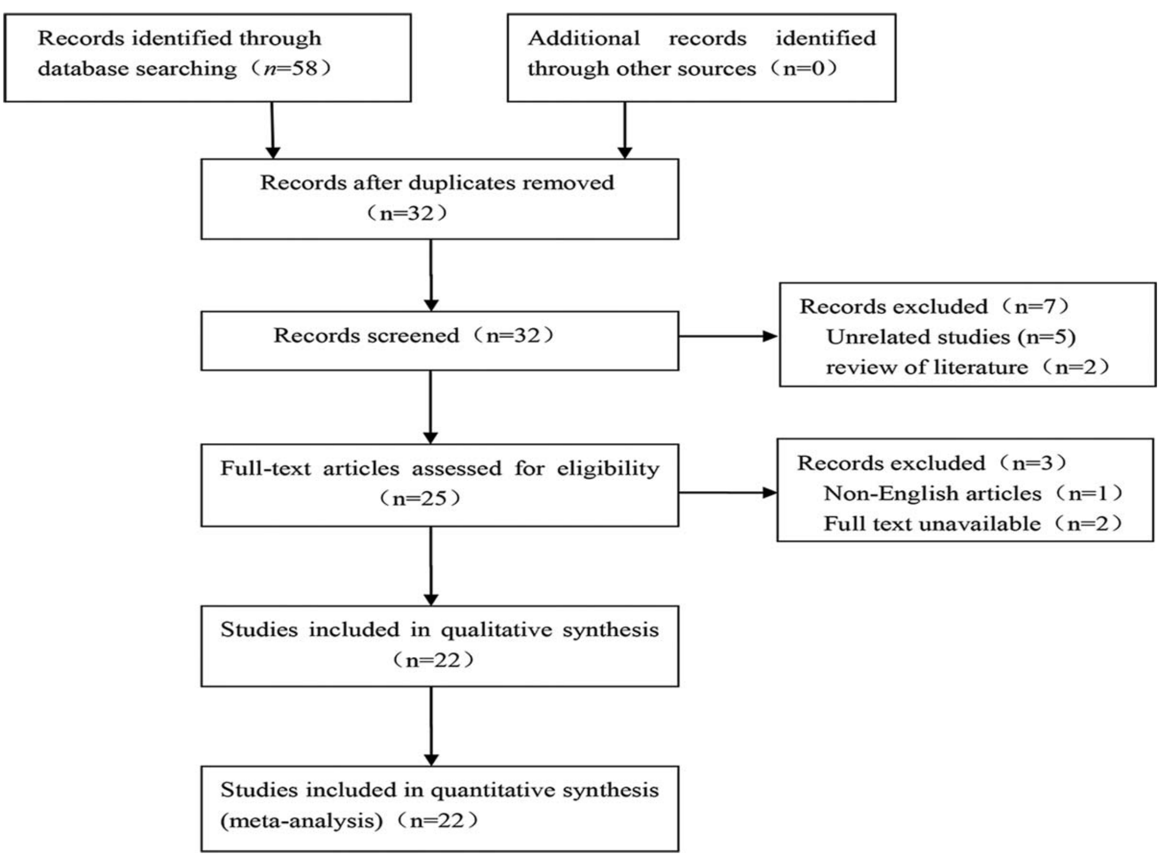

Figure 1. Flow chart of meta-analysis.

Table 1

Characterristics of included trials.

Author/Year	Age, yr	Group	Number	Surgery	Premedication	NMB	Ventilation	OLP measurement method
Gaitini[27] 2003	adult	Cobra-PLA LMA-Unique	25 25	Not reported	No	Vecuronium 0.1 mg/kg	Controlled	Manometric stability
Akcao[17] 2004	>18	Cobra-PLA LMA-Classic	40 41	Orthopedic, gynecologic, and general surgery	Midazolam 1–2 mg	No	Spontaneous	oral capnography
Turan[19] 2006	>18	Cobra-PLA LMA-Classic	30 30	Minor gynaecological and general surgery	Yes	mivacurium 0.2mg/kg	Controlled	Not checked
Van[26] 2006	18–80	Cobra-PLA LMA-Unique	106 106	Elective surgery	10 mg diazepam	No	Controlled	Manometric stability
Van[21] 2006	18–80	Cobra-PLA LMA-Unique	95 96	Elective surgery	No	No	Spontaneous	Not checked
Gaitini[22] 2006	>18	Cobra-PLA LMA-Unique	40 40	Minor routine surgery	No	No	Spontaneous	Manometric stability
Agah,[13] 2006	6-70	Cobra-PLA LMA-Classic	100 100	Ophthalmic surgery	No	Atracurium 0.5 mg/kg	Controlled	Audible noise
Galvin[6] 2007	24–38	Cobra-PLA LMA-Classic	20 20	Gynecological laparoscopy	No	No	Controlled	Audible noise
Nam[18] 2007	adult	Cobra-PLA LMA-Classic	19 19	Orthopaedic surgery of the knee	No	Rocuronium 0.6 mg/kg	Controlled	Not checked
Kaya[20] 2008	6–13	Cobra-PLA LMA-Classic	30 30	Elective surgery	No	mivacurium 0.2 mg/kg	Controlled	Not checked
Szmuk[23] 2008	<12	Cobra-PLA LMA- Unique	100 100	Elective procedures	Midazolam, 0.5 mg/kg	No	Spontaneous	Manometric stability
Gaitini[24] 2008	<8	Cobra-PLA LMA-Unique	40 34	Elective general surgery	No	Rocuronium 0.4 mg/kg	Controlled	Audible noise
Khazin[10] 2008	18–65	Cobra-PLA LMA-Classic	30 30	Elective surgery	Brotizolam 0.25 mg	Rocuronium 0.6 mg/kg	Controlled	Audible noise
Strydom[14] 2008	>18	Cobra-PLA LMA-Classic	20 25	Elective peripheral surgery	No	No	Spontaneous	Not checked
Andrews[3] 2009	>18	Cobra-PLA LMA-Classic	49 41	Elective surgery	No	No	Spontaneous	Audible noise
Schebesta[8] 2010	18–85	Cobra-PLA LMA-Classic	30 30	Routine surgical procedures	No	No	Controlled	Audible noise
Van[2] 2012	<16	Cobra-PLA LMA-Classic LMA-Unique	35 31 31	Elective surgery	No	No	Spontaneous	Audible noise
Karabiyik[16] 2012	18–68	Cobra-PLA LMA-Classic	15 15	Ophthalmic surgery	No	Rocuronium 0.6 mg/kg	Controlled	Not checked
Ratajczyk[15] 2013	26–65	Cobra-PLA LMA-Classic	30 30	Elective surgery	No	No	Controlled	Not reported
Schebesta [25] 2014	18–85	Cobra-PLA LMA-Unique	10 8	Routine gynaecological procedures	No	No	Controlled	Not checked
Peker[11] 2015	1–10	Cobra-PLA LMA-Classic	15 15	Extra-ocular ophthalmic surgery	Midazolam 0.3 mg/kg	No	Controlled	Audible noise
Yaghoobi[9] 2015	>18	Cobra-PLA LMA-Classic	37 36	Surgery of the obese patients	No	Atracurium 0.5 mg/kg	Controlled	Manometric stability

Cobra-PLA = Perilaryngeal Airway, LMA = Laryngeal Mask Airway, NMB = Neuromuscular blocker, OLP = Oropharyngeal leak pressure.

Unique.[2,20–26] The characteristics and methodological quality of RCTs are shown in Tables 1 and 2, respectively.

3.1. Cobra-PLA versus LMA-Classic

3.1.1. OLP. A pooled analysis of data from 8 trials[2–3,6,7–10,16] revealed that Cobra-PLA provided significantly higher OLP than LMA-Classic [MD = 3.56 (1.56, 5.55), I^2 = 88%, P = .0005] (Fig. 2). Sensitivity analysis certified that the pooled outcome was not changed by a single study. Given substantial heterogeneity, we used subgroup analysis to determine the impact of confounding factors (Table 3). On the basis of age subgroup analysis, the pooled results showed that Cobra-PLA provided slightly higher OLP in the child subgroup despite the lack of significant difference [MD = 2.36 (−0.02, 4.74), I^2 = 0%, P = .05] and higher OLP in the adult subgroup [MD = 3.90 (1.56, 6.23), I^2 = 91%, P = .001] compared with LMA-Classic. Five trials[2–3,7,10,15–16] that did not use NMB were included, and the combinative result was higher for Cobra-PLA than for LMA-Classic [MD = 3.92 (2.77, 5.07), I^2 = 0%, P < .0001]. With NMB, the combinative result was not significantly different between the 2 groups [MD = 2.95 (−2.74, 8.63), I^2 = 98%, P = .31]. When the pooled analysis was restricted to the subgroup analysis of surgery type, Cobra-PLA also provided higher OLP than LMA-Classic in non-laparoscopic surgery [MD = 3.41 (1.25, 5.57), I^2 = 90%, P = .002]. Data on laparoscopic surgery in only 1 trial[6] were not counted. Studies[2–3,6,7,9–10] using the measurement of audible noise found that Cobra-PLA exhibited comparatively high OLP [MD = 2.70 (0.86, 4.54), I^2 = 65%, P = .004].

3.1.2. Rate of first-insertion success, insertion ease, and insertion time. Thirteen trials[2–3,6,7–8,10,14–19] examined the rate of insertion success at the first attempt and found no significant difference between the 2 devices [RR = 1.03 (0.95, 1.12), I^2 = 62%, P = .45]. Heterogeneity was significantly decreased (I^2 = 0%, P = .10) upon the removal of 5 studies[8,15,17–19] that used NMB. The funnel plot of first-insertion success rate did not

Table 2

Risk of bias assessment for evaluation the quality of each included trials.

Study (author, year)	Random sequence generation	Allocation con cealment	Blingding of participant and personnel	Blingding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Gaitini 2003[27]	Low	Unclear	Low	Unclear	Unclear	Unclear	Unclear
Akcao 2004[17]	Low	Low	high	Low	Low	Low	Low
Turan 2006[19]	Low	Low	Low	high	Low	Low	Low
Van Z 2006[26]	Low	Low	Unclear	high	Low	Low	Low
Van 2006[21]	Low	Low	Unclear	Unclear	Low	Low	Low
Gaitini 2006[22]	Low	Low	Unclear	Unclear	Low	Low	Low
Agah 2006[13]	Low	Unclear	Unclear	Unclear	Low	Low	Low
Galvin 2007[16]	Low	Unclear	Low	Low	Low	Low	Low
Nam 2007[18]	Low	Low	Unclear	Unclear	Low	Low	Low
Kaya 2008[20]	Low	Low	high	Low	Low	Low	Low
Szmuk 2008[23]	Low	Low	Unclear	Low	Low	Low	Low
Gaitini 2008[24]	Low	Low	Low	Low	Low	Low	Low
Strydom 2008[14]	Low	Low	Low	Unclear	Low	Low	Low
Khazin 2008[10]	Low	Unclear	Unclear	Low	Low	Low	Low
Andrews 2009[3]	Low	Unclear	Low	Low	Low	Low	Low
Schebesta 2010[8]	Low	Low	Low	Unclear	Low	Low	Low
Van 2012[2]	Low	Low	Low	Low	Low	Low	Low
Karabiyik 2012[16]	Low	Unclear	Unclear	Unclear	Low	Low	Low
Ratajczyk 2013[15]	Low	Low	Unclear	Unclear	Low	Low	Low
Schebesta 2014[25]	Low	Low	Unclear	Unclear	Low	Low	Low
Yaghoobi 2015[9]	Low	Low	Unclear	Unclear	Low	Low	Low
Peker 2015[11]	Low	Unclear	Low	Low	Low	Low	Low

indicate evident substantial asymmetry (Fig. 3). Insertion ease and insertion time were similar between the 2 devices [RR = 1.10 (0.95, 1.27), I^2 = 30%, P = .22; MD = 2.80 (−0.68, 6.28), I^2 = 71%, P = .11, respectively]. When we removed individual studies, the heterogeneity of insertion ease and insertion time was not markedly decreased. Figure 2 lists the forest plot of this analysis.

3.1.3. Complications.

The incidence of reported complications was assessed: blood staining on the device was reported in 10 studies,[2,6,8,12–16,18–19] sore throat was found in 7 studies,[3,6,8,12,14,16,18] and laryngospasm was observed in 5 studies.[6,9,14,16,19] The 2 groups exhibited a similar incidence of blood staining, sore throat, and laryngospasm [RR = 1.45 (0.75, 2.80), I^2 = 78%, P = .27; RR = 0.90 (0.65, 1.26), I^2 = 56%, P = .54; RR = 1.01 (0.24, 4.22), I^2 = 0%, P = .99, respectively] (Fig. 4). The funnel plot of blood staining indicated possible asymmetry (Fig. 3). None of the serious complications were reported in any included studies.

3.2. Cobra-PLA versus LMA-Unique

3.2.1. OLP.

A combined result from 6 trials[2,17–19,25–26] demonstrated that Cobra-PLA offered significantly higher OLP than LMA-Unique [MD = 4.44 (2.12, 6.76), I^2 = 91%, P = .0002] (Fig. 4). Based on age subgroup analysis, the pooled results showed that Cobra-PLA provided higher OLP in child and adult subgroups than LMA-Unique [MD = 2.79 (0.25, 5.34), I^2 = 89%, P = .03; MD = 7.85 (3.44, 12.26), I^2 = 90%, P = .0005, respectively]. Regardless of the presence or absence of NMB during anesthesia induction, pooled data showed that Cobra-PLA presented higher OLP compared with LMA-Unique [MD = 9.45 (2.76, 16.14), I^2 = 93%, P = .006; MD = 3.05 (0.95, 5.16), I^2 = 85%, P = .004, respectively]. All trials involved non-laparoscopic surgery. Four trials[15,18,25,26] measured manometric stability, and Cobra-PLA yielded higher combined result in comparison with LMA-Unique [MD = 4.73 (1.90, 7.56), I^2 = 92%, P = .001]. However, the result was not significantly different between the 2 groups [MD = 3.42 (−2.32, 9.16), I^2 = 90%, P = .24] (Table 4) when audible noise measurement was used.

3.2.2. First-insertion success rate, insertion ease, and insertion time.

Six studies[2,17,18,20,25–26] investigated the insertion success rate at the first attempt, and no significant difference was observed between the 2 devices [RR = 0.98 (0.94, 1.02), I^2 = 0%, P = .31]. Ease of insertion is similar between 2 devices [RR = 0.94 (0.73, 1.22), I^2 = 87%, P = .67]. Insertion time is also similar [MD = 0.37 (−1.35, 2.08), I^2 = 67%, P = .68]. Figure 5 lists the forest plot of these analyses.

3.2.3. Complications.

The incidence of reported complications was assessed: blood staining on the device, sore throat, and laryngospasm were reported in 4,[2,21–23] 4,[2,21–22,26] and 3 studies,[2,22–23] respectively. The 2 groups showed similar incidence of blood staining, sore throat, and laryngospasm [RR = 0.71 (0.42, 1.20), I^2 = 26%, P = .20; RR = 1.10 (0.76, 1.60), I^2 = 0%, P = .60; RR = 0.49 (0.12, 1.95), I^2 = 0%, P = .31, respectively] (Fig. 6). None of the serious complications were reported in any of the included studies.

4. Discussion

The main finding of the present meta-analysis is that Cobra-PLA offers significantly higher OLP than LMA-Classic and LMA-Unique undergoing general anesthesia. First-insertion success rate, ease of insertion, insertion time, and reported complications were similar among 3 devices.

Airway sealing pressure or airway leak pressure is also referred to OLP, which is the most important indicator for assessing the safety and efficacy of airway devices.[27] OLP decides the practicability of degree of airway protection and safe positive

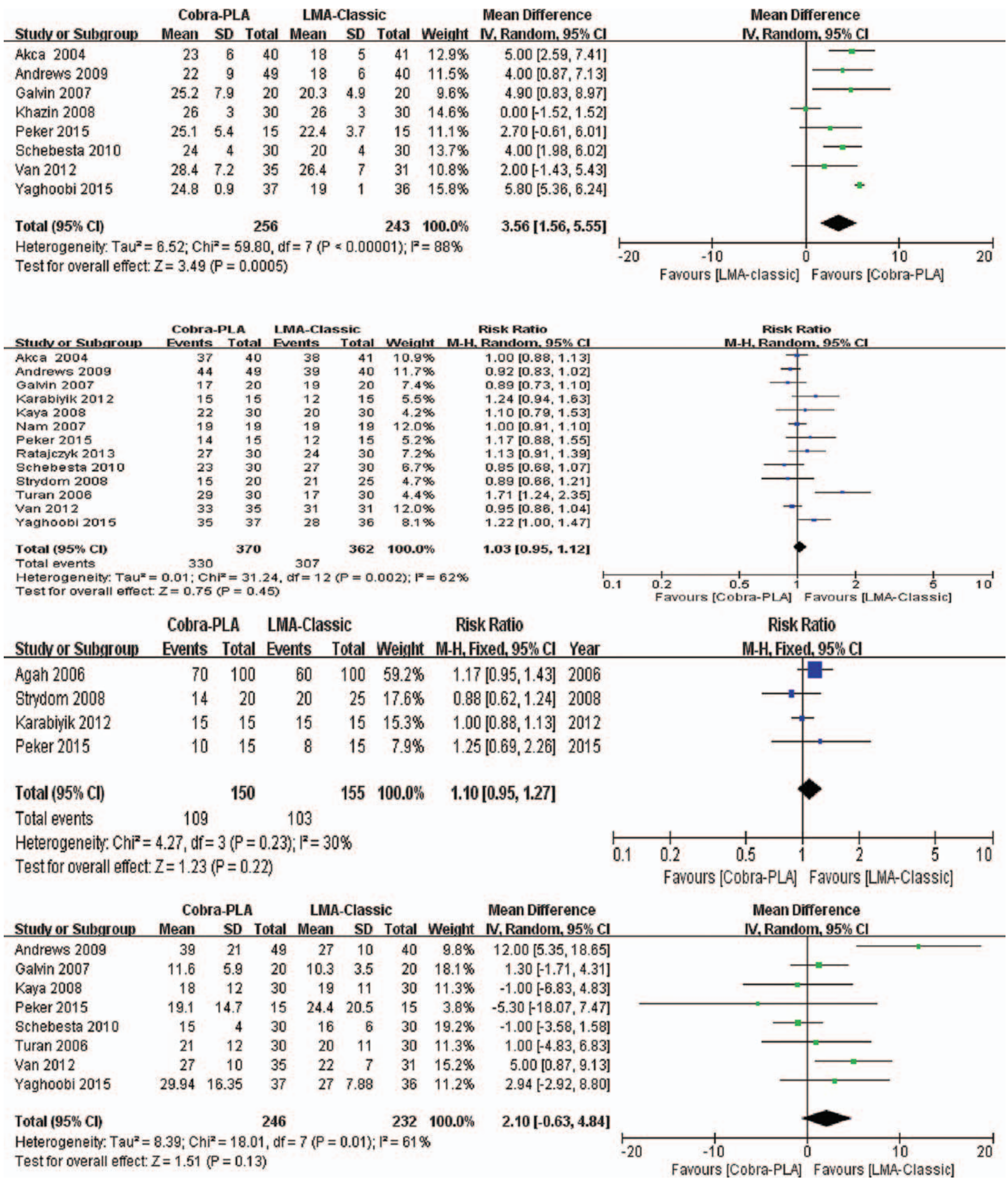

Figure 2. Forest plot for comparison of Cobra-PLA and LMA-Classic for OLP (cmH2O); insertion success rate at the first attempt; ease of insertion; and insertion time (s). CI = confidence interval, Cobra-PLA = Perilaryngeal Airway, I^2 = I-square heterogeneity statistic, IV = inverse variance, LMA = Laryngeal Mask Airway, OLP = Oropharyngeal leak pressure.

pressure ventilation and is determined by the strength of the seal between the cuff of the mask and the surrounding soft tissue of the neck.[4,28]

Several studies showed that LMA-Classic can provide safe and effective airway management.[29,30] However, certain limitations were found in this reusable device, especially its low-pressure seal, which may be insufficient for positive pressure ventilation.[31] Gastric distention with a risk of regurgitation may be caused by leaks in certain cases.[31] In the present meta-analysis, we found significantly higher OLP with Cobra-PLA than LMA-Classic. The higher OLP in the Cobra-PLA group compared with those of other groups may be due to the larger cuff structure compared with those of the other devices. Increased OLP offers particular advantage in obese patients, lithotomy position, restrictive lung

Table 3

Subgroup meta-analysis for OLP with Cobra-PLA and LMA-Classic.

	Subgroup	References	*P* value	MD	95% CI	I-square; *P* value
Age	children	[2,11]	.05	2.26	(−0.02,4.74)	0%; .77
	adults	[3,8–10,6,31]	<.00001	3.90	(1.56,6.23)	91%; .001
NMB	No	[6,3,8,2,11,31]	<.00001	3.92	(2.77,5.07)	0%; .74
	Yes	[10,9]	.31	2.95	(−2.74,8.63)	98%; <.00001
Laparoscopic surgery	No	[2–3,8–11,31]	.002	3.41	(1.25,5.57)	90%; <.00001
	Yes	[6]	.01	5.20	(1.13,9.27)	NA
OLP measurement method	Audible noise	[2–3,8,10–11,6]	.004	2.70	(0.86,4.54)	65%; .004
	oral capnography	[31]	<.00001	5.00	(2.59,7.41)	NA
	Manometric stability	[9]	<.00001	5.80	(5.36,6.24)	NA

CI = confidence interval, MD = mean difference, NA = not applicable.

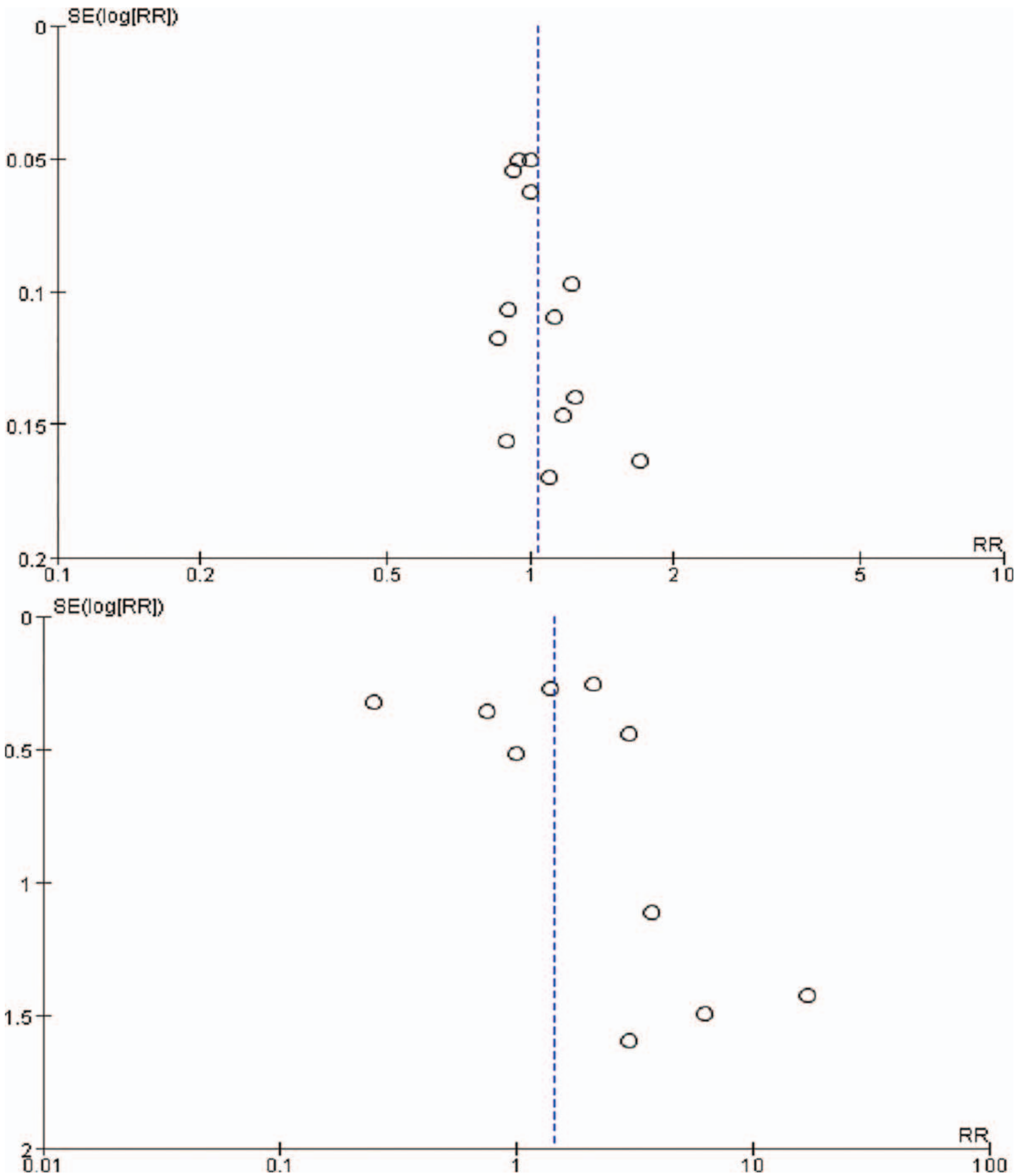

Figure 3. Funnel plots for comparison of Cobra-PLA and LMA-Classic for insertion success rate at the first attempt and blood staining. Cobra-PLA = Perilaryngeal Airway, LMA = Laryngeal Mask Airway.

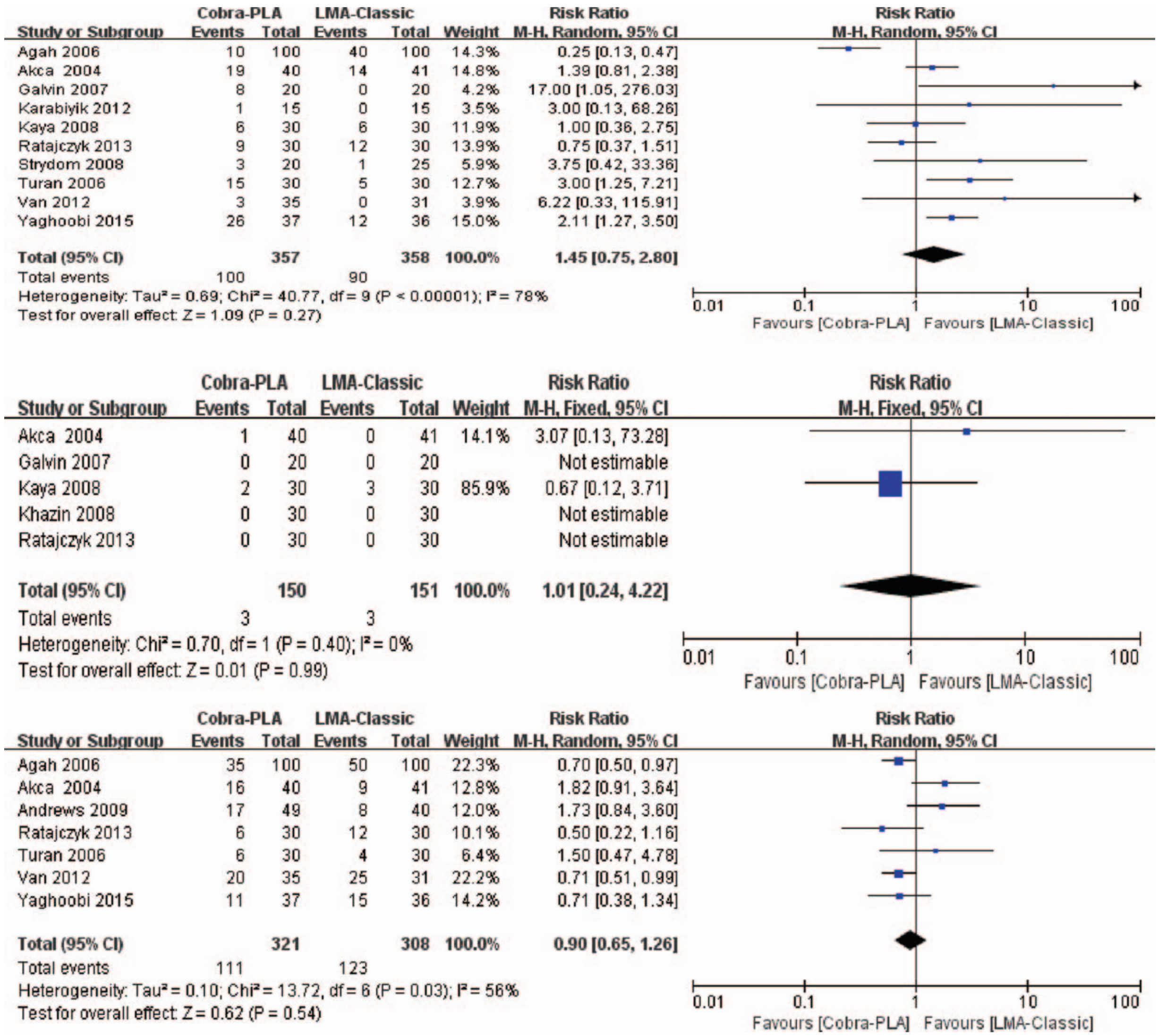

Figure 4. Forest plot for comparison of Cobra-PLA and LMA-Classic for blood staining; sore throat; and dysphagia. CI = confidence interval, Cobra-PLA = Perilaryngeal Airway, I^2 = I-square heterogeneity statistic, IV = inverse variance, LMA = Laryngeal Mask Airway.

diseases, and pneumo-peritoneum patients.[32] Thus, Cobra-PLA may be considered as an alternative to LMA-Classic during general anesthesia.

Other factors that may affect OLP include age, the use of NBM, intra-abdominal pressure during surgery, measurement method, and LMA size selection criteria.[33] In our meta-analysis, substantial overall heterogeneity (I^2 = 88%) was reduced by subgroup analysis based on pediatric patients (I^2 = 0%) and non-use of NMB (I^2 = 0%). A polled data of 8 trials, which did not use NMB, showed similar device insertion time between Cobra-PLA and LMA-Classic. Furthermore, the high heterogeneity (I^2 = 61%) of insertion time was possibly relative to the measurement standards among the studies included in our analysis.

Table 4

Subgroup meta-analysis for OLP with Cobra-PLA and LMA-Unique.

	Subgroup	References	*P* value	MD	95% CI	I-square; *P* value
age	children	[2,19,20]	.03	2.79	(0.25, 5.34)	89%; <.00001
	adults	[18,35,36]	.0005	7.85	(3.44,12.26)	90%; <.00001
NMB	No	[2,18,19,35]	.004	3.05	(0.95,5.16)	85%; <.00001
	Yes	[20,36]	.006	9.45	(2.76,16.14)	93%; <.00001
OLP measurement method	Audible noise	[2,20]	.24	3.42	(−2.32,9.16)	90%; .001
	Manometric stability	[18,19,35,36]	.001	4.73	(1.90,7.56)	92%; <.00001

CI = confidence interval, MD = mean difference, NA = not applicable.

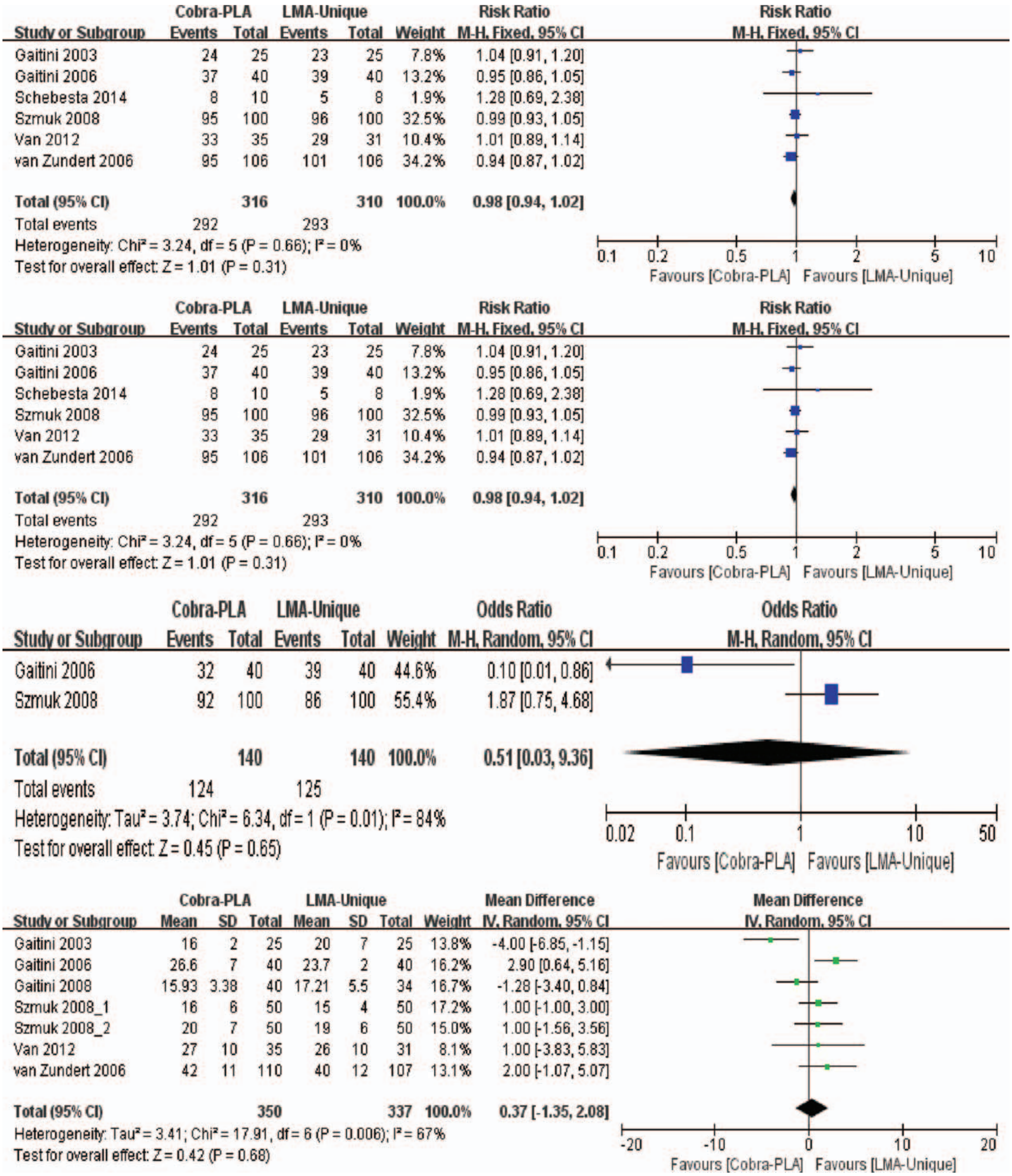

Figure 5. Forest plot for comparison of Cobra-PLA and LMA-Unique for OLP (cmH2O); insertion success rate at the first attempt; ease of insertion; and insertion time (s).CI = confidence interval, Cobra-PLA = Perilaryngeal Airway, I^2 = I-square heterogeneity statistic, IV = inverse variance, LMA = Laryngeal Mask Airway.

LMA-Unique is the 1-off version of the LMA-Classic and is currently used for both adult and pediatric patients.[23] We also found a significantly higher OLP with Cobra-PLA compared with LMA-Unique. The difference in OLP between the 2 groups may be due to the different structure designs.[23] A bowl-shaped cuff of LMA-Unique surrounding the larynx decides the sealing mechanism. The device may tilt to 1 side or the other owing to the posterior placement of the exiting breathing tube from the center of the posterior wall. However, Cobra-PLA can provide evident stability with its wide and flat distal head, which is sufficiently rigid to prevent movement of the device.[34,35]

Evident data heterogeneity in the combined OLP result is one limitation in our finding. High heterogeneity (I^2 = 91%) cannot be decreased despite the use of various subgroup analyses. This finding is probably due to the use of different size of devices in the trials. In 1 trial,[23] sizes 1.5, 2, and 3 of Cobra-PLA and sizes 1.5,

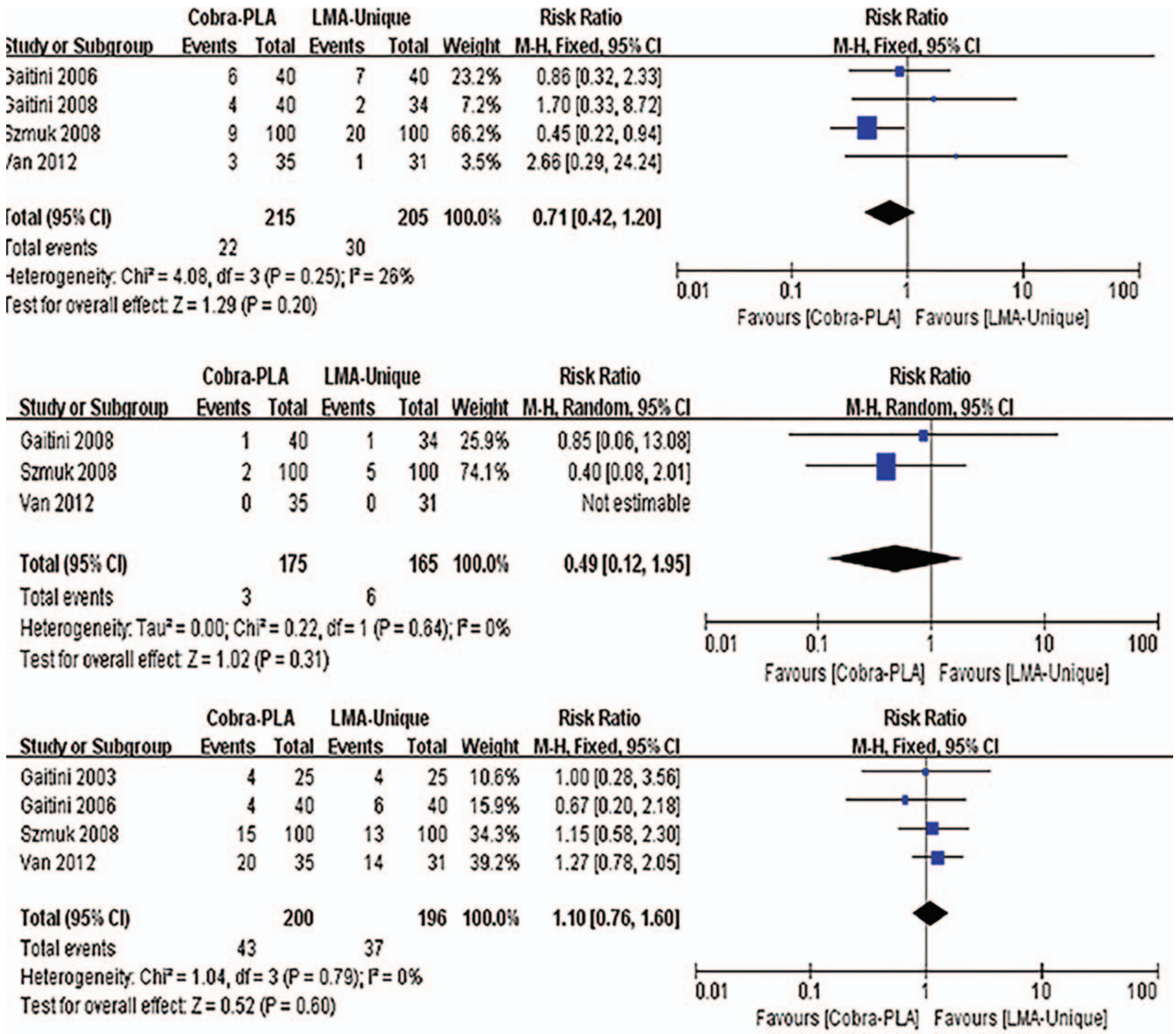

Figure 6. Forest plot for comparison of Cobra-PLA and LMA-Unique for blood staining; laryngospasm; and sore throat. CI = confidence interval, Cobra-PLA = Perilaryngeal Airway, I^2 = I-square heterogeneity statistic, IV = inverse variance, LMA = Laryngeal Mask Airway.

2, and 2.5 of LMA-Unique were compared; 1 trial[2] compared sizes 0.5, 1, 1.5, 2, and 3 of Cobra-PLA and size 1.5, 2, 2.5, 3, 4, and 5 of LMA-Unique; and another study[22] compared sizes 0.5, 1, 1.5, and 2 of Cobra-PLA and sizes 1, 1.5, 2, and 2.5 of LMA-Unique. Notably, larger-sized (1.5, 2) Cobra-PLA possesses the dorsal cuff, which may provide higher OLP than the smaller variants (0.5, 1). In addition, a study comparing Cobra-PLA and LMA-Unique in adult patients found that the former presented higher OLP.[21] The ease of insertion was the same for 2 devices with high heterogeneity ($I^2 = 87\%$). Considering that only 2 trials were included in the analysis, further studies are required to validate the conclusion.

Compared with the Xu' meta-analysis,[36] our study presented different findings. First, 5 eligible RCTs[2,10,12,17,24] were not included in the Xu' study, and we included these RCTs in our study. Second, this work was the first study to show that Cobra-PLA can provide higher OLP than LMA-Classic regardless of age group (children or adults), surgical type (laparoscopic or non-laparoscopic), use of 3 OLP measurement methods, and lack of NMB. Third, Cobra-PLA also offers higher OLP than LMA-Unique regardless of age group (children or adults), with or without NMB, and use of manometric stability of measurement method, Fourth, we also first find that Cobra-PLA did not exhibit higher OLP in comparison with LMA-Classic and LMA-Unique under conditions of NMB and audible noise measurement method. Lastly, significant heterogeneity ($I^2 = 91\%$) was found when the studies were pooled to evaluate the OLP between Cobra-PLA and LMA-Classic in the Xu' meta-analysis, but the study didn't explore the possible causes of such heterogeneity. On the contrary, the heterogeneity seen in our study can be explained by the difference in age and the use of NMB between studies.

Several limitations were found in present work. First, in addition to high heterogeneity discussed above, differences in induction, maintenance, depth of anesthesia, and patient population studied may contribute to the evident data heterogeneity. Although we conducted subgroup and sensitivity analyses in an attempt to control several factors, we cannot account for all possible confounding factors. Second, we comprehensively searched the published studies, but potential publication bias may still exist due to failure to include ongoing or unpublished trials. Finally, several included studies were of poor quality. Two studies[16,19] did not blind the participants, and some included studies did not describe the details of binding the outcome assessment. Therefore, additional high-quality studies are required to certify our results.

In conclusion, our findings show that Cobra-PLA provides significantly higher OLP than both LMA-Classic and LMA-Unique and a similar clinical performance to both devices during general anesthesia.

Author contributions

Study design: Yuan T. Data collection and Wring the draft: Yuan T, Qin C, Feng C. Data interpretation, discussion and preparation of the final manuscript: Yuan T, Guangyou D, Hong L. All authors have read and approved the final manuscript.

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