

Lidocaine Spray versus Other Forms for Local Anesthesia in Upper Gastrointestinal Endoscopy: A Systematic Review and Meta-analysis

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Lidocaine Spray: Better Procedural Ease, Lower Patient Satisfaction in Upper Endoscopy

Evidence from this meta-analysis suggests that using lidocaine spray for pharyngeal local anesthesia in EGD improves the ease of instrument insertion and shortens procedural time. However, it results in lower patient satisfaction scores than other forms.



Randomized controlled trials (RCTs)

including

3,711 participants

undergoing pharyngeal local anesthesia for Esophagogastroduodenoscopy (EGD).

Material & Methods

Intervention: Standard lidocaine spray was compared with other forms, including

- 1 **lidocaine gel**
- 2 **lozenges**
- 3 **nebulized solutions**
- 4 **popsicles**
- 5 **viscous solutions**



Conclusion



Lidocaine Spray



Other Forms

was associated with the following benefits:

- ✓ **better ease of instrumentation (RR 1.19)**
- ✓ **decreased participant pain, and shorter procedural time.**

However, it was also linked to drawbacks, including lower participant satisfaction (RR 0.83) and lower participant tolerance scores.

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ABSTRACT

Objective: To evaluate the effectiveness of various lidocaine forms compared to the traditional spray during esophagogastroduodenoscopy (EGD).

Materials and Methods: We searched PubMed, Scopus, EMBASE, the Cochrane Central Register of Controlled Trials, CENTRAL, Web of Science Core Collection, World Health Organization, International Clinical Trials Registry Platform, and ClinicalTrials.gov databases in December 2022. Selection criteria were randomized controlled trials comparing lidocaine spray with other forms of pharyngeal anesthesia. Outcomes of interest included ease of instrumentation, participants' satisfaction scores, tolerance scores, pain, endoscopist's satisfaction scores, and procedural time.

Results: We included 13 trials with 3,711 participants. The quality of trials was poor. Lidocaine spray provided better ease of instrumentation (risk ratio (RR) 1.19, 95% confidence intervals (CI) 1.06, 1.34; $I^2 = 66\%$; very low certainty of evidence), decreased participants' pain (mean difference (MD) 0.38, 95% CI 0.25, 0.5; $I^2 = 92\%$; very low certainty of evidence), and shorter procedural time (MD 0.22, 95% CI 0.10, 0.35; $I^2 = 13\%$; low certainty of evidence). However, spray had lower participants' highest satisfaction scores (RR 0.83, 95% CI 0.76, 0.92; $I^2 = 62\%$; very low certainty of evidence), participants' mean satisfaction scores (MD -0.61, 95% CI -0.29, -0.04; $I^2 = 92\%$; very low certainty of evidence), participants' tolerance scores (RR 0.83, 95% CI 0.71, 0.97; $I^2 = 0\%$; low certainty of evidence), and endoscopist's satisfaction scores (MD -0.33, 95% CI -0.45, -0.21; $I^2 = 94\%$; very low certainty of evidence).

Conclusion: Evidence suggests that lidocaine spray may improve the ease of EGD instrumentation, although limitations in trial quality warrant cautious interpretation.

Keywords: Anesthesia; esophagogastroduodenoscopy; lidocaine (Siriraj Med J 2025; 77: 725-737)

INTRODUCTION

EGD is a widely used procedure for screening, diagnosing, and treating upper gastrointestinal diseases. It can be performed with no sedation, mild sedation, or moderate/conscious sedation with or without the use of topical pharyngeal anesthesia.¹ During the procedure, an endoscope is inserted through the oral cavity into the upper gastrointestinal tract, which often causes discomfort or pain, particularly in patients with a strong gag reflex.² Sedation during EGD may also lead to adverse events, including cardiopulmonary complications such as hypoxia, respiratory depression, hypertension or hypotension, arrhythmias (tachycardia or bradycardia), pulmonary edema, cardiovascular collapse, and vasovagal reactions.³

Topical anesthesia with lidocaine reduces cough, suppresses the gag reflex, and mitigates overall airway hyperreactivity. This improves patient compliance and enhances operator satisfaction during endoscopic procedures.⁴ Performing EGD under topical lidocaine, with or without sedation, decreases adverse events, reduces the gag reflex, and increases patient comfort, especially in patients at higher risk of complications, such as those with cardiopulmonary disease, high ASA physical status, advanced age, or obesity.⁵⁻⁷

Lidocaine spray is a commonly used local anesthetic for EGD in Thailand due to its convenience and safety. However, it has some drawbacks, including a bitter

taste and the potential to provoke a gag reflex.⁸ Recent studies have compared lidocaine spray with alternative delivery methods, such as gel, viscous solutions, lozenges, popsicles, and nebulized forms, by evaluating ease of procedure, pain levels, gag reflex intensity, procedure duration, patient tolerance, and satisfaction among both patients and endoscopists.^{7,9-12} Despite this, no study has yet comprehensively assessed the effectiveness of these alternative forms of local anesthesia compared to conventional topical spray during EGD.

MATERIALS AND METHODS

The protocol was developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting systematic reviews and meta-analyses^{13,14} as well as the PRISMA Extension Statement for Systematic Reviews Incorporating Network Meta-analyses of Health Care Interventions.¹⁵

Search strategy

We searched the PubMed, Scopus, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science Core Collection, World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP), and ClinicalTrials.gov databases up through 31 December 2022. The search used the following medical

search terms: 'gastroscope' [Mesh] OR 'gastroenteroscopy' [Mesh] OR 'esophagogastroduodenoscopy' [Mesh] OR 'upper gastrointestinal scope' [Mesh] NOT colonoscope NOT lower; lidocaine spray OR local anesthesia OR lidocaine nebulizer OR lidocaine solution OR lidocaine. These terms were combined using AND and were limited to clinical trials involving human participants. We also reviewed reference lists from previous meta-analyses and research for additional relevant studies.

Study selection

Two authors (SO, TC) independently screened the titles and abstracts of the studies retrieved from the electronic searches. Full texts were reviewed when eligibility could not be determined based on the title and abstract alone. The remaining studies were read in full by the same authors, whose eligibility was assessed according to predefined criteria. Disagreements were resolved through discussion with other authors [SM, NS]. Duplicated publications were combined into a single study for analysis.

Inclusion criteria

Randomized controlled trials (RCTs) were eligible if they involved patients undergoing EGD and compared lidocaine spray with at least one of the following interventions: viscous lidocaine solution, lidocaine nebulizer, popsicle, gel, or lozenge. Studies had to report at least one of the following outcomes: ease of instrumentation, endoscopist satisfaction, participant satisfaction, tolerance, pain or discomfort, or procedural time. Studies were excluded if they lacked usable data.

Intervention and control groups

Lidocaine blocks sensations in the glossopharyngeal and superior laryngeal nerves in the upper airway. It is commonly used for pharyngeal anesthesia prior to EGD. Lidocaine is available in various forms, including spray, gel, viscous solution, and lozenges, with spray being the most frequently used. This study compared the standard lidocaine spray with other forms, specifically lidocaine gel, lozenges, nebulized lidocaine, popsicles, and viscous solutions.

Outcomes

The primary objective was to compare the effectiveness of conventional lidocaine spray with other forms of local anesthesia during EGD, without compromising the success of the endoscopic procedure. The outcomes assessed in the study included:

Primary outcome:

Ease of procedure (defined as no gag reflex)

Secondary outcomes:

- Participants' highest satisfaction score
- Participants' mean satisfaction score (NRS 0-10)
- Participants' tolerance score
- Participants' pain or discomfort (NRS 0-10)
- Endoscopist's satisfaction score (NRS 0-10)
- Procedural time (minutes)

Data extraction

Two independent authors (SO and TC) extracted data using standardized forms. The extracted data included study characteristics and interventions, including type of lidocaine administration, composition and preparation of lidocaine, and primary outcome. Data on outcomes, including means, standard deviations (SDs), and frequencies, were extracted for statistical pooling. When summary data were unavailable, we used the mean difference (MD) or risk ratio (RR) for analysis. Any inconsistencies in data were resolved by consulting a third author. We contacted corresponding authors twice for missing data, which were used to explore sources of heterogeneity.

Risk of bias assessment

We assessed the risk of bias using the Cochrane 'Risk of Bias' tool, as described in the Cochrane Handbook for Systematic Reviews of Interventions. Risks were classified as high, low, or unclear for the following areas: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding outcome assessment (detection bias), and incomplete outcome data (attrition bias). Two independent researchers (TC and SM) performed the risk assessments, and disagreements were resolved by discussion with other review authors (NS, PM).

Dealing with missing data

If data were missing, we contacted the corresponding author, first author, or coauthor for clarification. If contact information was unavailable, we attempted to locate the study group through the internet.

Assessment of heterogeneity

Heterogeneity between studies was assessed using the I^2 statistic and the Q test. A value of $I^2 \geq 25\%$ or a significant Q test $p < 0.10$ indicated substantial heterogeneity, and a random-effects model was applied.¹⁶

Grading evidence

The quality of evidence for each outcome was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.¹⁷ Evidence was downgraded if there were serious or very serious concerns in any of the following domains: limitations in study design, inconsistency of results, indirectness of evidence, imprecision, or publication bias. We summarized the findings using GRADE Profiler 3.6, and presented the results and the certainty of the evidence (high, moderate, low, or very low).¹⁹

Statistical analysis

We pooled data directly when at least three studies were available for each comparison. The Mantel-Haenszel method (fixed-effects model) was used for the final analysis of results from the original trials included in the combined analysis. Relative risks with 95% confidence intervals (CIs) were estimated for dichotomous outcomes. For continuous outcomes, we estimated unstandardized or standardized MDs with 95% CIs, depending on whether the studies used the same or different measurement scales, respectively. When a study did not report the mean and standard deviation (SD), we estimated them from the median and range or interquartile range.

We performed subgroup or sensitivity analyses based on factors that could affect heterogeneity. A funnel plot was used to assess publication bias.

All analyses of the intervention's effect were conducted on an intention-to-treat basis, using randomized treatment

allocation. Significant differences between treatment groups were assessed with the log rank test, stratified by study. Absolute treatment effects and their 95% CIs were estimated. Differences in baseline data between trials and treatment groups were tested using the Chi² test or Student's t-test, as appropriate.

All analyses were performed using RevMan 5 and STATA version 16.0 for Mac. A fixed-effects model was used for meta-analysis if clinical, methodological, or statistical heterogeneity were lacking. Statistical significance was defined as $p < 0.05$, except for the heterogeneity test, where $p < 0.10$ was used. A random-effects model was applied to determine whether the conclusions differed, and any differences were noted. A narrative summary was planned if data pooling was not possible or appropriate.

RESULTS

We identified a total of 722 records through database searches in January 2023. After duplication and exclusion of studies with unclear outcome data, 13 RCTs^{7,9,12,20-29} comprising 3,711 participants were included in the quantitative synthesis comparing lidocaine spray with other forms (gel, viscous solutions, lozenges, popsicles, or nebulized lidocaine) (Fig 1).

Risk of bias in the included studies

There were several significant biases in most of the included trials (Figs 2 and 3).

Eight trials had adequate random sequence generation.^{7,9,12, 22,23,26-28}

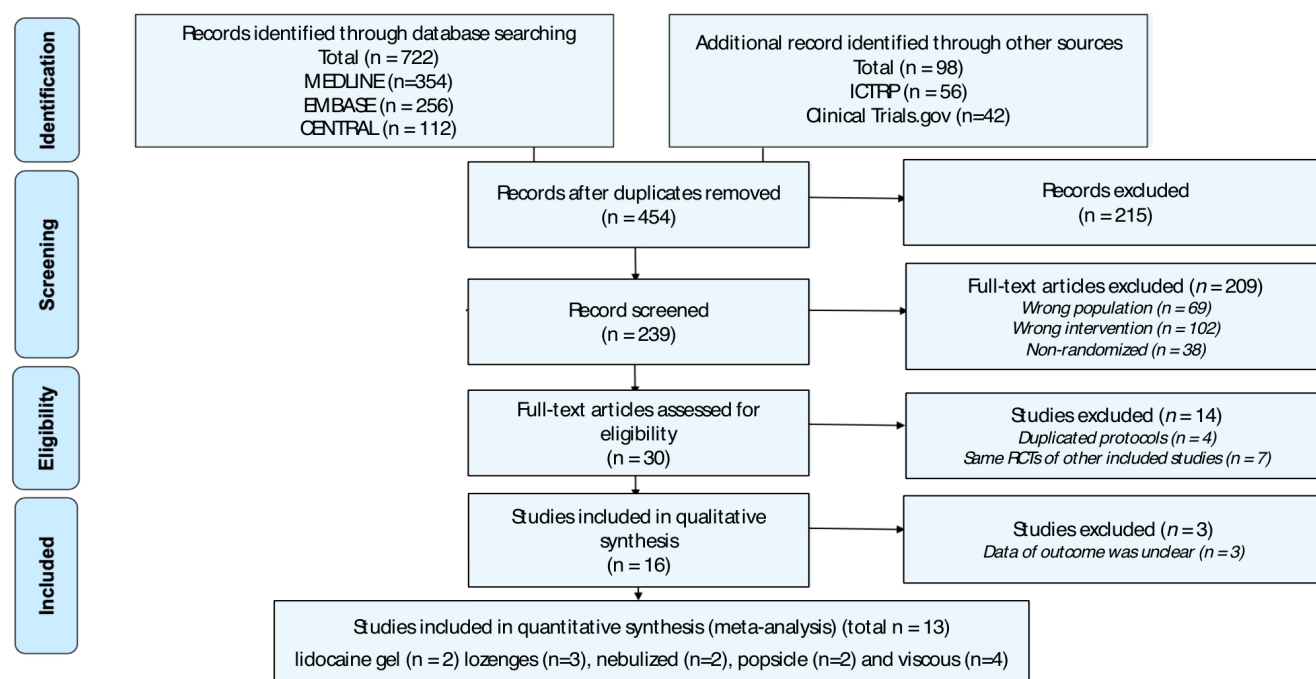


Fig 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram of the literature search results.

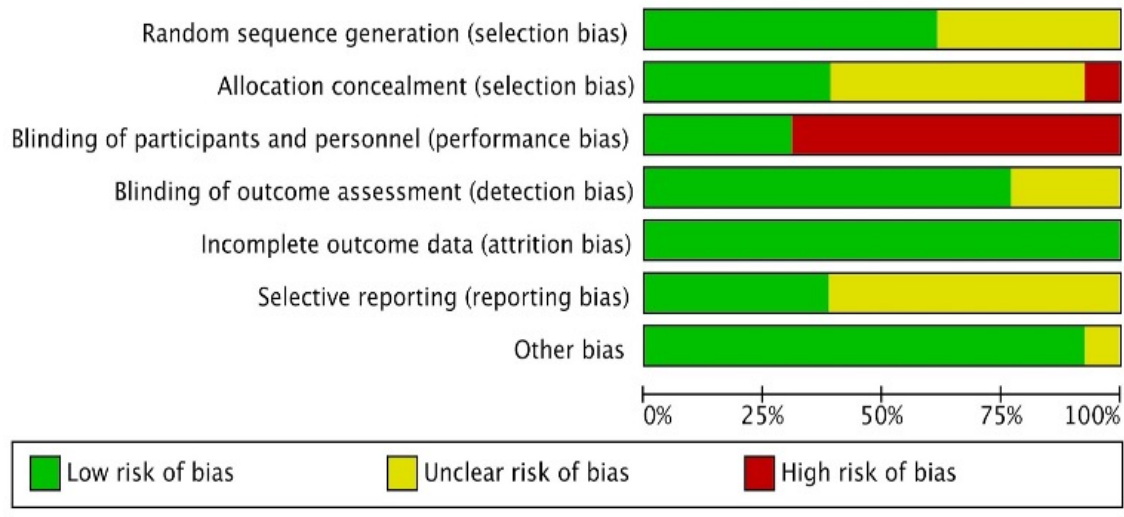


Fig 2. Risk of bias graph.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Amornyotin et al. [7]	+	+	+	+	+	?	+
Ayoub et al. [25]	?	?	+	+	+	?	+
Cam et al. [22]	+	+	+	+	+	?	+
Chan et al. [12]	+	+	+	+	+	?	+
Hayashi et al. [27]	+	?	+	+	+	?	+
Khodadoostan et al. [26]	+	?	+	+	+	?	+
Mahawongkajit et al. [20]	?	+	+	+	+	+	+
Mallik et al. [24]	?	?	+	+	+	?	+
Mizuno et al. [28]	+	+	+	+	+	+	?
Nasiri et al. [21]	?	?	+	?	+	+	+
Noitasaeng et al. [9]	+	+	+	+	+	+	+
Saravanan et al. [29]	?	?	+	?	+	?	+
Supe et al. [23]	+	?	+	?	+	+	+

Fig 3. Risk of bias table.

Allocation concealment was adequate in only five trials^{7,12,9,20,28}, which used numbered, sealed, opaque envelopes as the randomization method.

Blinding is crucial to reduce bias in outcome assessment. Only four trials successfully blinded the interventions^{12,22,27,28}, while ten trials reported blinding of clinical assessors.^{7,9,12,20,22,24-28} No trial reported incomplete outcome data. However, only five trials published results for all planned outcomes.^{9,20,21,23,28} Most studies were judged to be at low risk of 'other' bias, with the exception of Mizuno et al.²⁸

Outcomes

A summary of the findings is presented in Table 1. Lidocaine spray was associated with greater ease of instrumentation (risk ratio (RR) 1.19, 95% confidence interval (CI) 1.06, 1.34; $I^2 = 66\%$; very low certainty of evidence) (Fig 4), reduced participant-reported pain or discomfort (mean difference (MD) 0.38, 95% CI 0.25, 0.5; $I^2 = 92\%$; very low certainty of evidence) (Fig 5), and shorter procedural time (MD 0.22, 95% CI 0.10, 0.35; $I^2 = 13\%$; low certainty of evidence) (Fig 6).

However, lidocaine spray was associated with lower participant-reported highest satisfaction scores (RR 0.83, 95% CI 0.76, 0.92; $I^2 = 62\%$; very low certainty of evidence) (Fig 7), mean satisfaction scores (MD -0.61, 95% CI -0.29, 0.04; $I^2 = 92\%$; very low certainty of evidence) (Fig 8), tolerance scores (RR 0.83, 95% CI 0.71, 0.97; $I^2 = 0\%$; low certainty of evidence) (Fig 9), and satisfaction scores (MD -0.33, 95% CI -0.45, 0.21; $I^2 = 94\%$; very low certainty of evidence) (Fig 10).

TABLE 1. Summary of findings.

Lidocaine spray versus other forms of local anesthesia in EGD.						
Patient or population: participants undergoing EGD with pharyngeal local anesthesia						
Settings: In Esophagogastroduodenoscopy						
Intervention: Lidocaine spray						
Comparison: Other forms e.g. lidocaine gel, lozenges, nebulized, popsicle, and viscous						
Outcomes	Anticipated absolute effects (95% CI)		Relative effect (95%CI)	No. of participants (Studies)	Certainty of the evidence (GRADE)	Comments
	Risk with others	Risk with spray				
Ease of instrument	28 per 100	36 per 100	RR 1.19 (1.06,1.34)	2460 (5 RCTs)	⊕ ⊕ ⊕ ⊕ Very low ♦ ‡ §	No studies could be blinded participants due to the types of anesthetics used
Participants' pain/discomfort	-	MD 0.38 (0.25-0.50)	- (6 RCTs)	2786	⊕ ⊕ ⊕ ⊕ Very low ♦ ‡ §	Some studies could be blinded participants due to the types of anesthetics used
Participants' highest satisfaction score	34 per 100	41 per 100	RR 0.83 (0.76,0.92)	2817 (7 RCTs)	⊕ ⊕ ⊕ ⊕ Very low ♦ ‡ §	Some studies could be blinded participants due to the types of anesthetics used
Participants' mean satisfaction score	-	MD -0.16 (-0.29, -0.04)	-	2504 (6 RCTs)	⊕ ⊕ ⊕ ⊕ Very low ♦ ‡ §	Some studies could be blinded participants due to the types of anesthetics used
Participants' tolerance score	22 per 100	27 per 100	RR 0.83 (0.71-0.97)	1926 (2 RCTs)	⊕ ⊕ ⊕ ⊕ Low ♦ ‡	No studies could be blinded participants due to the types of anesthetics used
Endoscopist's satisfaction score	-	MD -0.33 (-0.45, -0.21)	-	2301 (4 RCTs)	⊕ ⊕ ⊕ ⊕ Very low ♦ ‡ §	Some studies could be blinded participants due to the types of anesthetics used
Procedural time	-	MD 0.22 (0.10,0.35)	- (4 RCTs)	565	⊕ ⊕ ⊕ ⊕ Low ♦ ‡	Some studies could be blinded participants due to the types of anesthetics used

♦ Downgraded one level for risk of bias concerns, as studies did not blind participants^{7,9,20,21,23-26,29}, selective reporting^{7,22,24-27,29,30}, inadequate allocation concealment^{21-27,29} and random sequence generation.^{20,21,24,25,29}

‡ Downgraded one level for imprecision owing to wide confidence intervals.

§ Downgraded one level for inconsistency due to true heterogeneity according to I² statistics and P values, confidence interval overlap, difference in point estimates, and between-study variance.

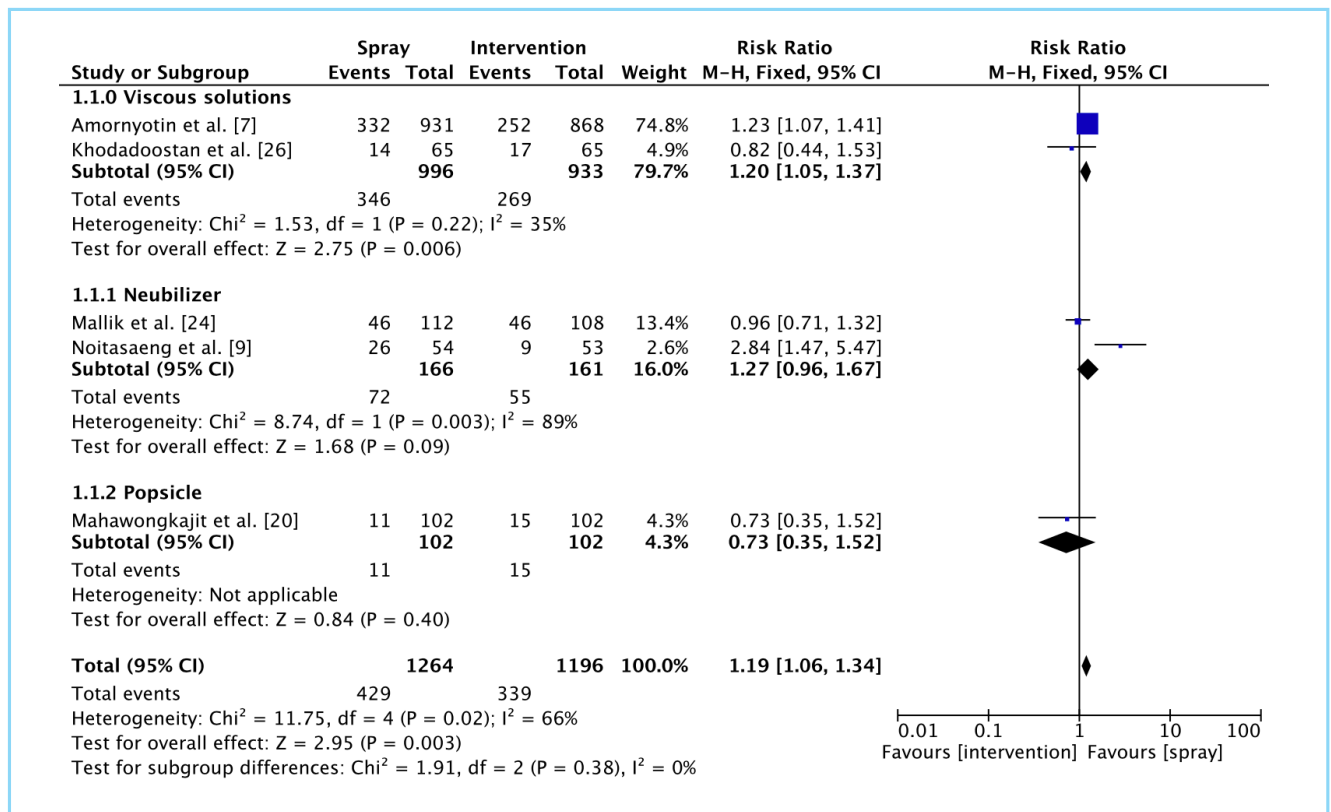


Fig 4. Forest plot of studies comparing the ease of instrumentation between intervention and spray groups, with subgroups of intervention for viscous solution, nebulizer, and popsicle.

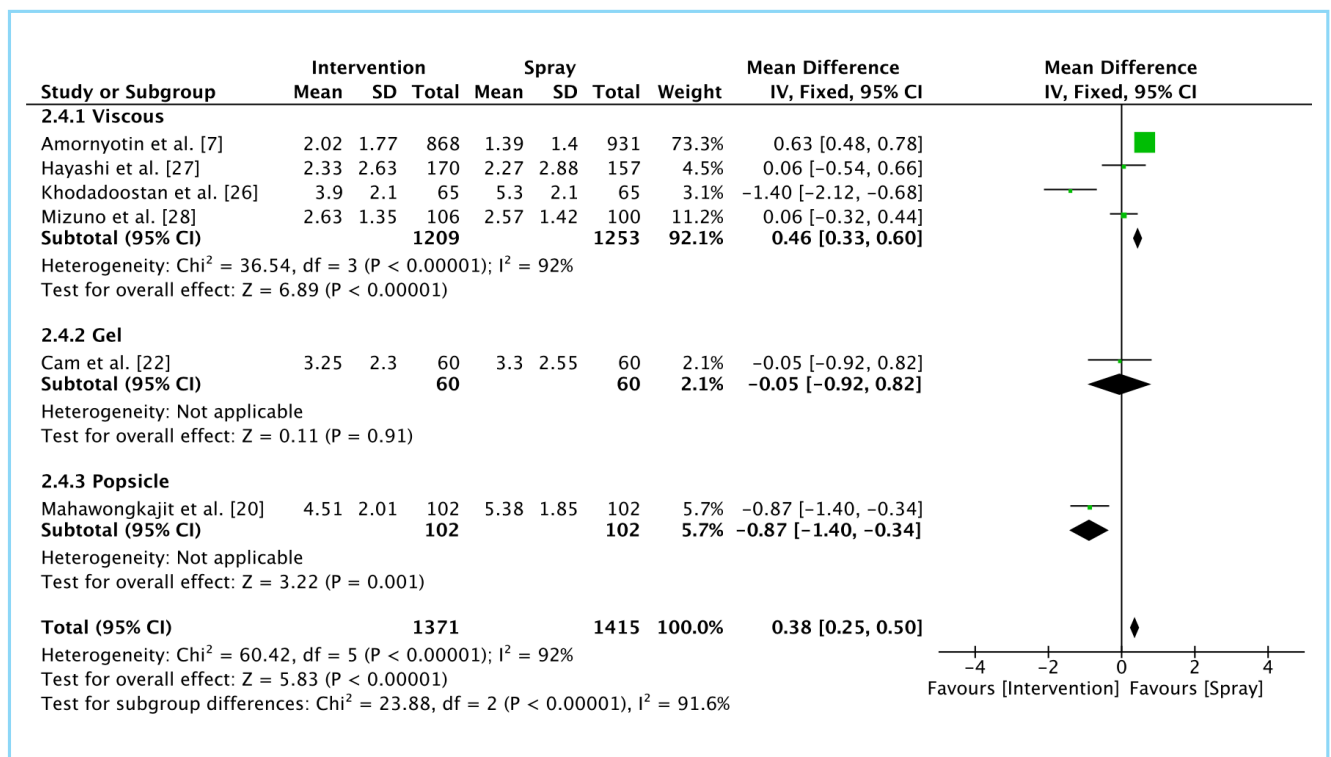


Fig 5. Forest plot of studies comparing the mean score of numeric rating scale for participants' pain/discomfort (0-10) between intervention and spray groups, with subgroups of intervention for viscous, gel, and popsicle.

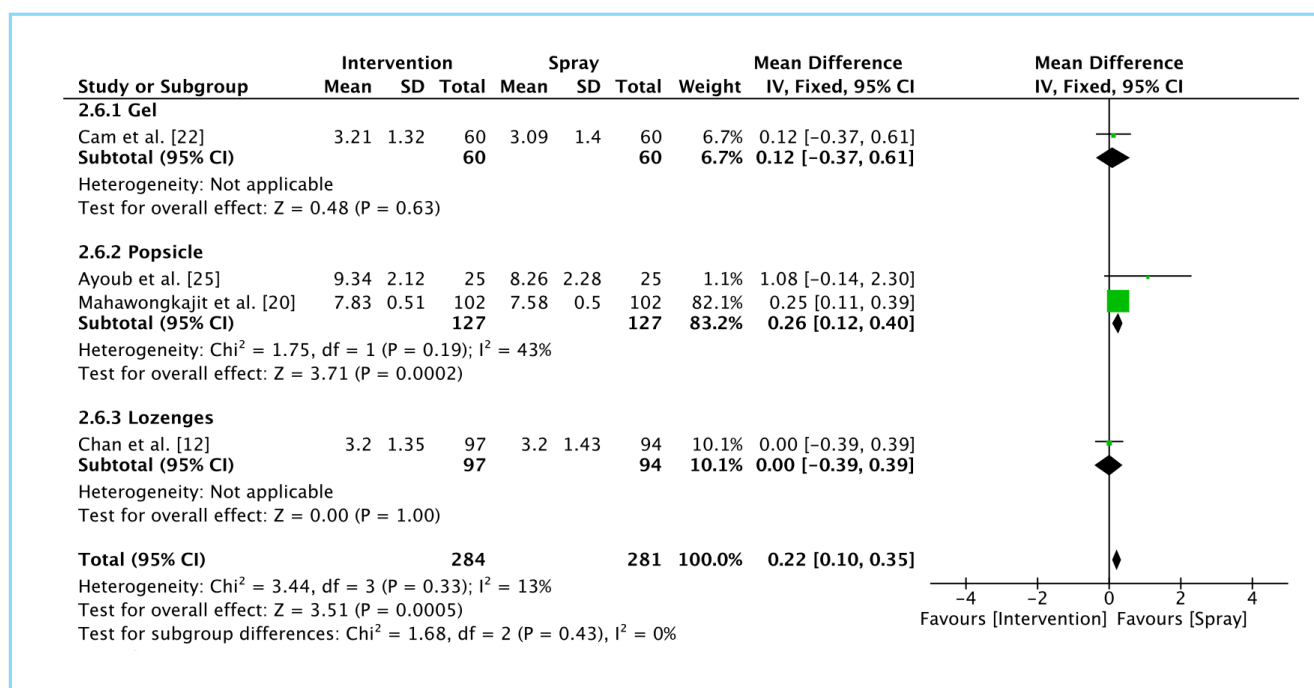


Fig 6. Forest plot of studies comparing procedural time of EGD between intervention and spray groups, with subgroups of intervention for gel, popsicle, and lozenges.

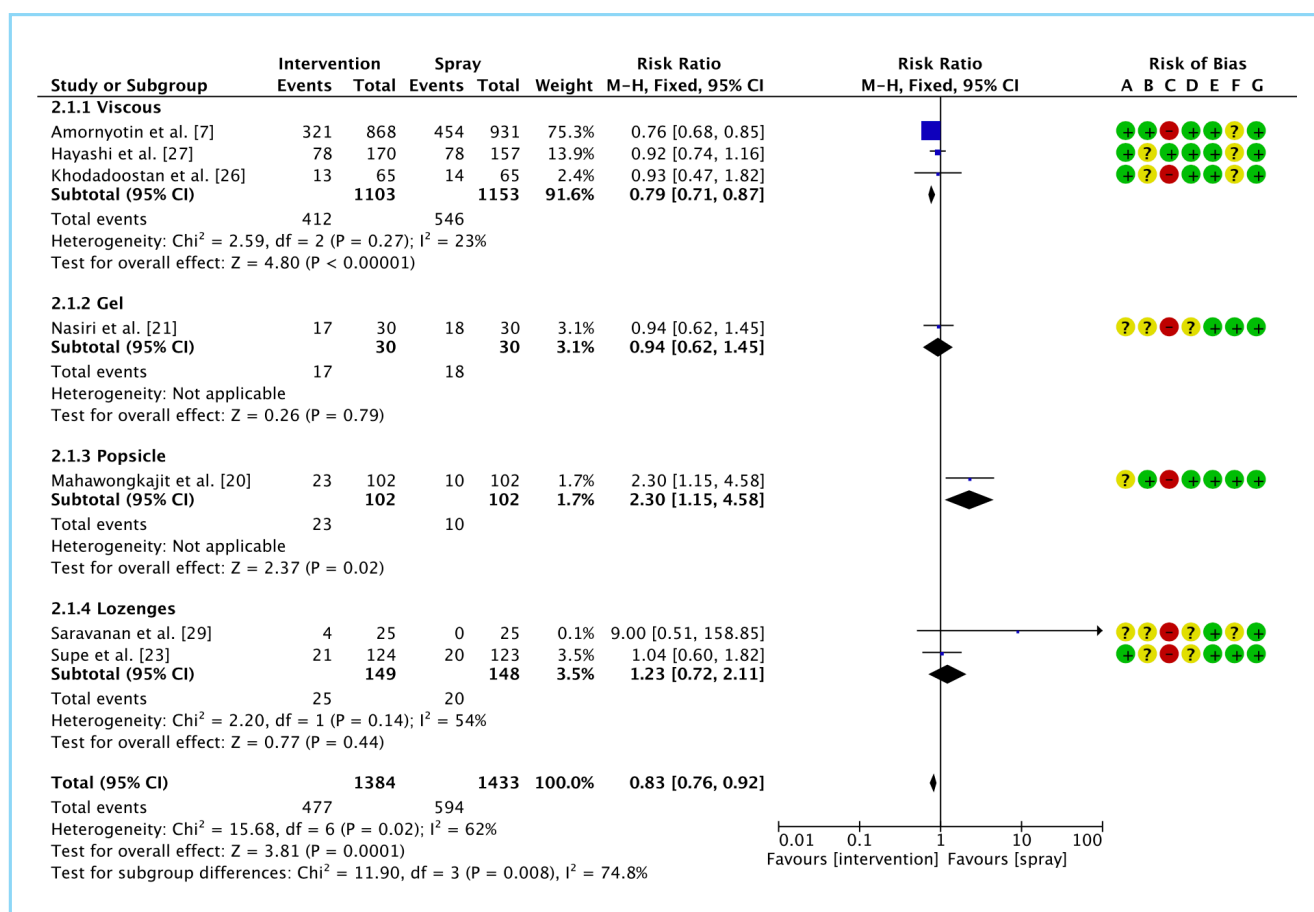


Fig 7. Forest plot of studies comparing the proportion of participants who reported the highest satisfaction score between intervention and spray groups, with subgroups of intervention for viscous, gel, popsicle, and lozenges.

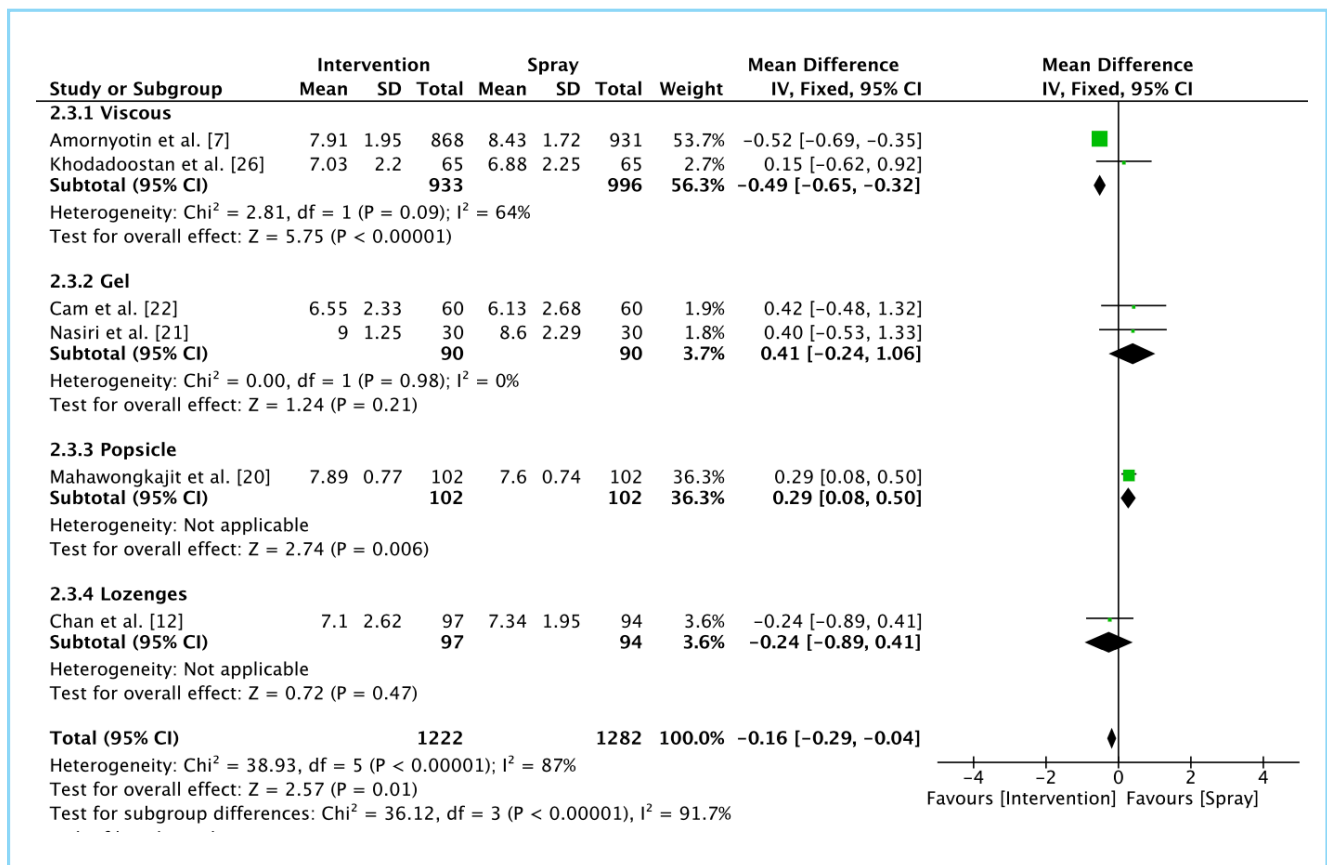


Fig 8. Forest plot of studies comparing the mean participants' satisfaction score (0–10) between intervention and spray groups, with subgroups of intervention for viscous, gel, popsicle, and lozenges.

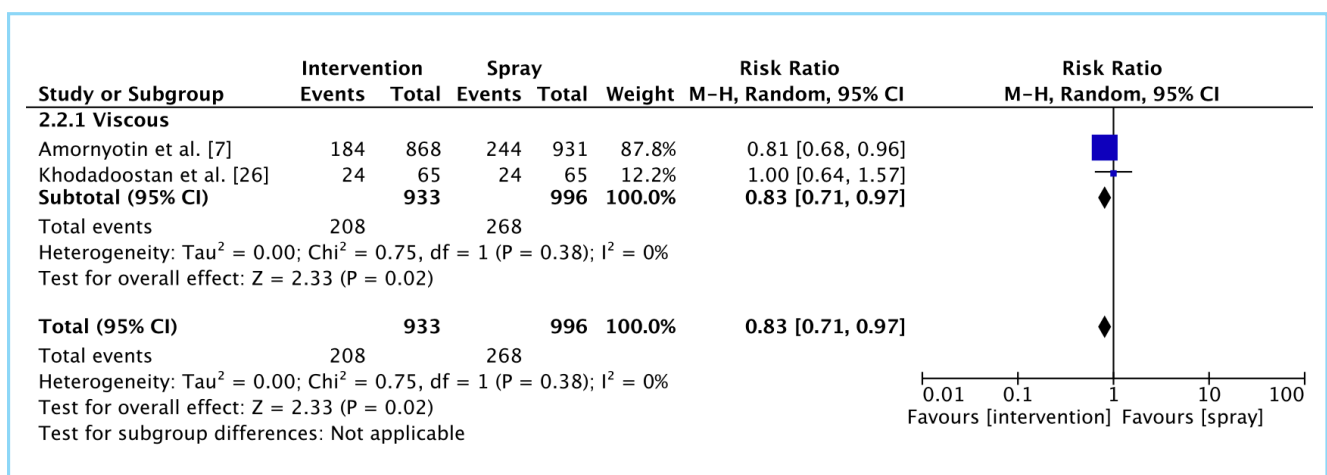


Fig 9. Forest plot of studies comparing the proportion of participants who achieved the highest tolerance score between intervention (Viscous) and spray groups.

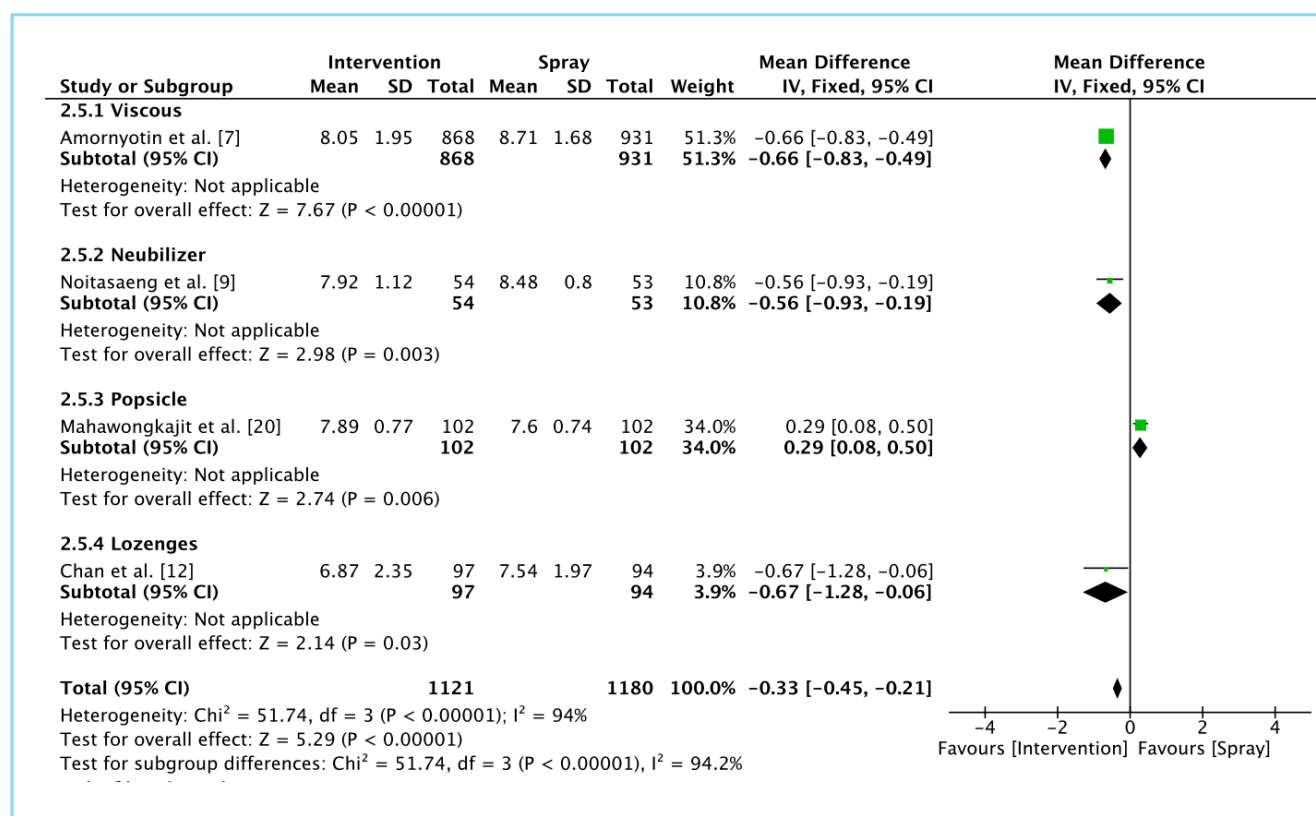


Fig 10. Forest plot of studies comparing the mean endoscopist satisfaction score (0–10) between intervention and spray groups, with subgroups of intervention for viscous, nebulizer, popsicle, and lozenges.

DISCUSSION

This systematic review, which included 13 RCTs involving 3,711 participants, found that lidocaine spray, compared to other forms of lidocaine, provided better ease of instrumentation, reduced pain or discomfort, and shorter procedural time. However, it was associated with lower participants' highest satisfaction scores, mean satisfaction scores, tolerance scores, and overall satisfaction. Most RCTs in this review had low or very low certainty of evidence, based on GRADE methodology. These studies revealed design issues, inconsistent results, imprecise effect estimates, and potential publication bias. These issues seriously limit the reliability of our findings.

Topical lidocaine spray typically uses a water–oil emulsion, which enhances tissue penetration and nerve access. It is rapidly absorbed across the mucous membrane and provides effective anesthesia.

In the spray group, ease of instrumentation improved due to more accurate anesthesia of the posterior pharynx. Using a tongue blade further exposed this region. Lidocaine spray offered more effective topical pharyngeal anesthesia, contributing to a higher procedure success rate. In contrast, viscous lidocaine is rinsed in the oral cavity, where it mixes with saliva and is retained in the mouth, leading to inadequate pharyngeal anesthesia.⁷ Our analysis suggests

that lidocaine spray eases instrument insertion; however, the low certainty of evidence means that these results require caution.

Over 7 million people undergo EGD annually in the United States. EGD procedures in Thailand have also increased significantly over the past decade, reflecting improved healthcare accessibility and diagnostic capacity^{30,31}, with approximately 12% concerned about pain during the procedure.³² Inserting instruments through the oral cavity into the digestive tract may trigger a gag reflex, leading to pain or discomfort.² Lidocaine spray helped suppress or eliminate the gag reflex, improving ease of instrumentation, reducing procedural time, and alleviating pain and discomfort.

The lower satisfaction scores in the lidocaine spray group likely stemmed from its bitter taste and the discomfort associated with administration.³³ Some patients swallowed the drug immediately, and the plastic applicator—being weak, thin, and short—sometimes failed to direct the spray accurately to the posterior pharynx, leading to incomplete anesthesia.³⁴ Additionally, lidocaine itself can trigger a gag reflex. In a study by Mogensen et al.³⁵ patients preferred lidocaine lozenges, which had a better taste during EGD. Similarly, lidocaine ice popsicles provided higher satisfaction, possibly due

to their gradual melting, which prolonged anesthetic exposure to the pharynx.²⁰ Lidocaine nebulizers were also well accepted and increased satisfaction during airway and GI endoscopy.^{9,36}

Patient satisfaction may also be influenced by multiple factors, such as the operator's manner and skill, patient preparation, age, gender, gag reflex sensitivity, and baseline anxiety.²¹ Campo et al.² identified factors reducing EGD tolerance, including a strong gag reflex, apprehension, female sex, younger age, and high anxiety. While some studies show that suppressing the gag reflex increases tolerability³⁷⁻³⁹, others report no significant difference.^{40,41} In our review, tolerance was higher in the non-spray group. This may be due to the more pleasant taste of lozenges or popsicles, or to baseline patient factors such as anxiety, age, or sex.

Interestingly, endoscopist satisfaction in our study was higher in the non-spray group. Previous research found that endoscopist satisfaction was influenced by ease of instrumentation, lower gag reflex, shorter preparation time, less secretion, and overall effortlessness.⁹ Although our findings showed better ease of instrumentation and shorter procedural time with lidocaine spray, endoscopist satisfaction appeared to align more closely with patient tolerance—suggesting that endoscopists may value patient comfort and cooperation as much as procedural efficiency.

Our findings show that while lidocaine spray makes instrumentation easier and procedures shorter, it leads to lower patient tolerance and less endoscopist satisfaction than non-spray methods. This disconnect is unexpected. Technical efficiency does not automatically lead to a better experience for patients or providers. The sensory discomfort of the spray likely outweighs its procedural benefits. Endoscopists seem to value patient comfort as much as ease of the procedure. In practice, this suggests we should balance technical efficiency with patient experience. The best anesthetic approach may be the one offering the best overall experience, not just the easiest instrumentation.

Pain and satisfaction outcomes showed considerable heterogeneity ($I^2 > 90\%$), so the results should be interpreted with caution. This heterogeneity comes from several sources. There are differences in lidocaine formulations and how it is applied. Patient characteristics also play a part, such as age, baseline pain, and anxiety about the procedure. Differences in study methods, such as the timing of outcomes assessment and measurement tools, make direct comparisons more challenging. Still, most studies found that lidocaine had a positive effect in different situations.

Limitations

Our study has several limitations. First, eight of the thirteen included studies had a risk of bias in outcome reporting, potentially affecting the validity of the findings. Second, data extraction was challenging due to incomplete outcome reporting in several studies. We attempted to mitigate this by contacting the study authors to retrieve missing data. Lastly, low and very low certainty evidence in this review limits our ability to draw firm conclusions. We need more rigorous, well-designed studies with larger samples, standardized protocols, and comprehensive reporting to establish more reliable evidence on the efficacy of lidocaine spray in EGD procedures.

CONCLUSIONS

Compared with other forms of lidocaine used for local anesthesia, lidocaine sprays may improve ease of instrumentation, reduce pain and discomfort, and shorten procedural time during EGD. However, it is associated with lower patient satisfaction and tolerance scores. Given the variability in study quality and outcome reporting, further studies are needed to determine the most effective form of pharyngeal anesthesia for EGD with high-quality RCTs.

Data Availability Statement

The data generated and analyzed for this study are available in the databases where individual articles were searched. Upon reasonable request, this information can be provided by the corresponding author.

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DECLARATIONS

Grants and Funding Information

This study was approved by Thammasat University's Ethic Committee (MTU-EC-AN-0-035/66).

Conflict of Interest

The authors declare that they have no conflict of interest.

Registration Number of Clinical Trial

Not applicable.

Author Contributions

TC: Conceptualization, Methodology, Investigation,

Writing - Original draft preparation, Writing - Reviewing and Editing., SO: Conceptualization, Investigation, Formal analysis, Data curation, Writing - Reviewing and Editing, Visualization., PM: Conceptualization, Formal analysis, Data curation, Writing - Reviewing and Editing, Visualization., NS: Conceptualization, Supervision., CS: Conceptualization, Writing - Original draft preparation., TL: Conceptualization, Methodology, Writing - Original draft preparation., SM: Conceptualization, Writing - Reviewing and Editing, Supervision.

Use of Artificial Intelligence

Not applicable.

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