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REVIEW ARTICLE

The efficacy of utilizing bougie versus stylet in patients requiring endotracheal intubation: updated systematic review and meta-analysis

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ABSTRACT

Introduction: Endotracheal intubation is a high-risk procedure that can be lifesaving for critically ill or injured patients. Assisted devices, such as the bougie and stylet, are commonly used to improve success rates and reduce complications. The bougie facilitates the passage of the endotracheal tube through the vocal cords while the stylet is inserted into the endotracheal tube prior to intubation. However, there is variation in clinical practice regarding the preference for using these devices in difficult airway management.

Methods: This systematic review and meta-analysis included randomized controlled trials (RCTs) that compared the efficacy of bougie versus stylet in tracheal intubation. Medline, Embase, Cochrane Central of Controlled Trials, and Clinical trials.gov were searched for studies discussing the same topic. The primary outcome was the first-attempt intubation success rate between the bougie and stylet. Our secondary outcomes were to compare the duration of intubation and the complication rates between bougie and stylet.

Results: A total of 7 RCTs that enrolled participants (number) were eligible. The bougie approach had a slightly higher success rate on the first attempt, but there was no significant difference between the method's risk ratio (RR, 1.01; 95% CI, 0.90–1.15). The duration of intubation, pooled analysis indicated a statistically significant reduction in the duration of intubation with the stylet approach compared to the bougie approach (MD, 8.39; 95% CI, 2.87–13.91). Subgroup analysis revealed lower rates of esophageal intubation (RR, 0.65; 95% CI, 0.26–1.61, I^2 = 0%) and pneumothorax (RR, 0.94; 95% CI, 0.54–1.66, I^2 = 0%) in the bougie group.

Conclusion: This study reported that no significant difference between the use of bougie versus stylet in terms of first-attempt intubation success rates and the complication rates of endotracheal intubation. However, stylet displayed a significantly shorter duration of intubation in comparison to bougie.

Keywords: Endotracheal intubation, tracheal intubation, bougie, gum elastic bougie, stylet.

Background

Endotracheal intubation is a life-saving practice performed to maintain the airway in an emergency setting. It is an advanced procedure that poses a risk of morbidity and mortality if performed incorrectly [1]. The success of intubation relies heavily on the provider's expertise, and intubation may sometimes be difficult or fail on the first attempt. Furthermore, even though skilled personnel have higher chances of better outcomes, the

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presence of an assisted device would increase the success rate and decrease the risk of failure or adverse events [2,3].

Two common assisting devices used in endotracheal intubation are: Bougie, an instrument to assist the endotracheal tube by passing through the vocal cords either with a clear visual of the airway or blindly. The stylet is a metal inserted to ease the insertion of the endotracheal tube into the airway [4]. Clinical practice varies between healthcare systems and providers, as some may recommend stylet and bougie for difficult airway management, and others prefer bougie as part of airway intubation management [5–7]. To the best of our knowledge, studies offer a conflicting point of view regarding the efficacy of the methods of intubation. For instance, a conducted study in prehospital settings in 2008, reported that there was no statistically significant benefit between endotracheal tube and other airway procedures [7]. Furthermore, another study done in 2019 recommended that stylet should be preferred for ease of intubation in rapid sequence induction but with more caution needed upon the removal steps [8]. Thus, our study aims to assess the efficacy of stylet and bougie and determine whether one is more effective and carries less risk of adverse events than the other.

Methods

This systematic review and meta-analysis was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines and checklist. This systematic review was registered in PROSPERO (CRD42023395752).

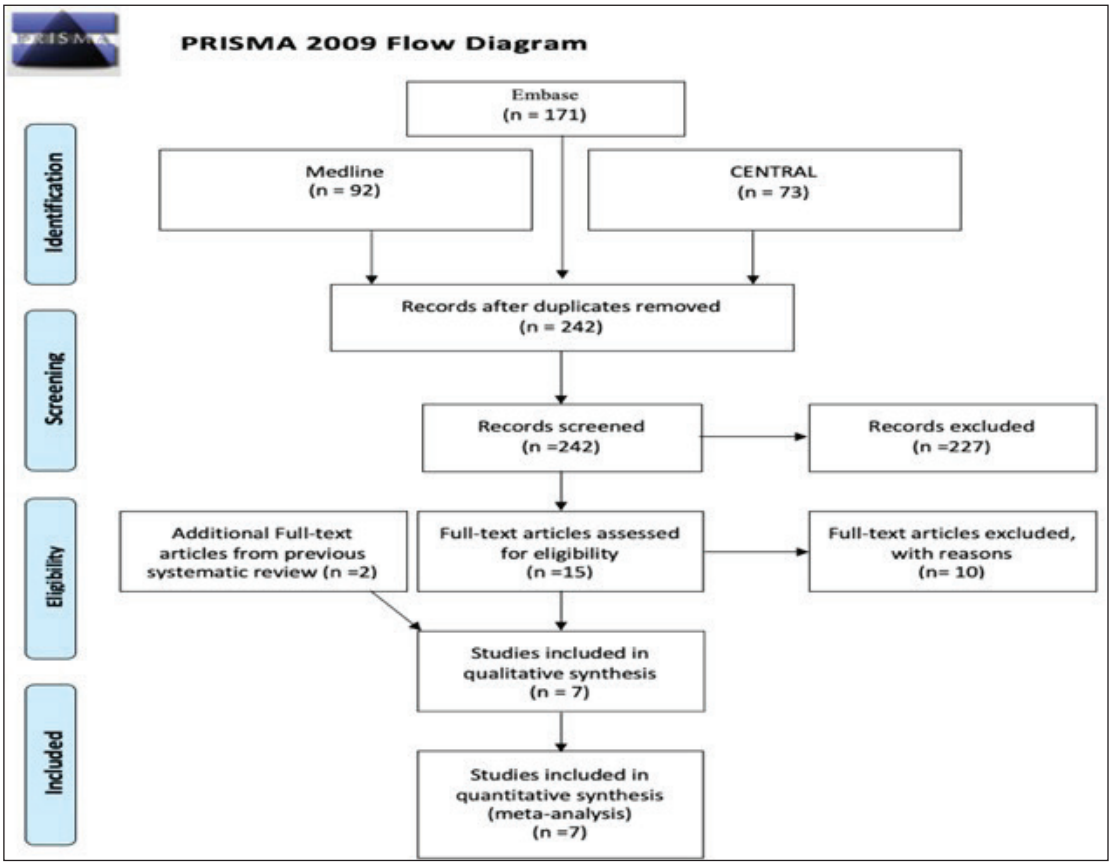

Figure 1. *PRISMA flow chart summarizing the literature search.*

Table 1. *Details of the included studies.*

Author (Year)	Country	Settings	No. patients bougie/ stylet
Bawa et al. [8]	India	OR	50/50
Driver et al. [4]	United States	ER/ICU	556/546
Driver et al. [9]	United States	ER	381/376
Tosh et al. [10]	India	OR	35/35
Heegaard et al. [11]	United States	Prehospital	20/31
Noguchi et al. [12]	Japan	OR	30/30
Gataure et al. [13]	United Kingdom	OR	50/50

OR: Operating Rooms; ER: Emergency Rooms; ICU: Intensive Care Unit.

Figure 1 shows a flowchart of the systematic review. In the literature search, we identified 336 records, 242 of which were screened after duplicates were removed. Only 7 RCTs were deemed eligible, and all were included in the meta-analysis (Table 1).

Electronic databases, including Medline, Embase, Cochrane Central of Controlled Trials, and ClinicalTrials.gov, were used to access the clinical trials that discussed the topic. The keywords used for the search were tracheal intubation, endotracheal intubation, orotracheal intubation, bougie, gum elastic bougie, GEB, GIST, Eschmann introducer, endotracheal tube introducer, endotracheal tube, stylet, randomized controlled trial, RCT, trial, and clinical trial.

Study selection

Two independent researchers reviewed the studies initially based on titles, then by screening abstracts, and finally full paper screening to determine whether inclusion and exclusion criteria were met or not. Disagreements were resolved by discussion and justification between the two reviewers. An additional independent reviewer was consulted once the disagreement was not resolved. The inclusion criteria were RCTs that included patients undergoing tracheal intubation either with stylet or bougie. The exclusion criteria were the usage of mannequin intubation scenarios.

Data extraction

The data were extracted independently by two researchers from the full-text reports and supplemental materials. We organized the following information into a data extraction form: number of successful first attempts, duration of intubation, and complications. Disagreements were resolved through discussion among the research team.

Risk of bias assessment

The risk of bias for the included RCTs was independently assessed by two reviewers using the Revised Cochrane

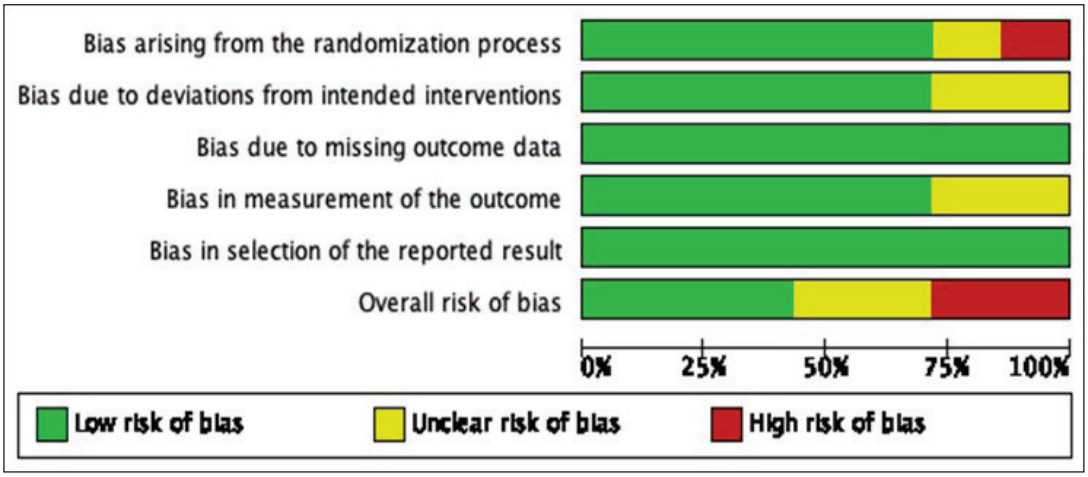

Figure 2. *Risk of bias.*

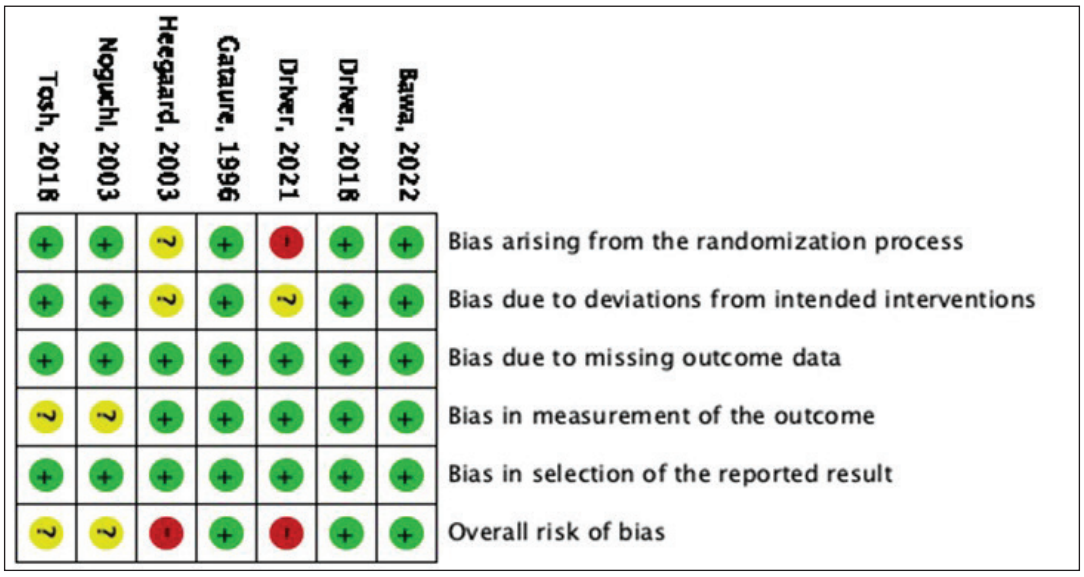

Figure 3. *Risk of bias in summary.*

risk-of-bias tool for randomized trials. Low, some concern, and high risk were determined by assessing the following domains: randomization process, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, incomplete outcome data, selective reporting, and other biases. Disagreements were resolved through discussion among the researchers. Refer to Figures 2 and 3.

Outcome measures

The primary outcome of the current review was the comparison of successful first-attempt intubations using a stylet versus a bougie. The secondary outcomes were the duration of intubation and reported complications between the stylet and bougie groups.

Statistical analysis

Data analysis was performed using RevMan (Review Manger) version 5.3 (Cochrane Collaboration). All statistical analyses were performed using the random-effects model. We adopted 95% as a confidence level and $p < 0.05$ as a threshold. The statistical heterogeneity was assessed using I^2 and the p-value of the chi^2 test. The continuous outcomes duration of intubation was represented as mean difference and pooled using the inverse variance weighting method. The dichotomous outcomes first- attempt intubation success rate and complications were expressed as risk ratio (RR) and pooled using the inverse variance weighting method.

Results

Primary outcomes

First-attempt intubation success rate

All studies compared the bougie and stylet intubation success rates on the first attempt. In each of the seven included trials, the first-attempt end-tidal capnography was used to determine the first-attempt intubation success rate. The bougie approach had a higher success rate on the first try, but there was no significant difference between the methods (RR, 1.01; 95% CI, 0.90–1.15, I^2 = 88%) as shown in Figure 4.

Secondary outcomes

Duration of intubation

All studies compared the time required for intubation using the bougie and stylet methods. The seven studies' definitions of the intubation duration were different, and they are as follows: Driver et al. [14] evaluated time elapsed between the insertion and removal of a laryngoscope blade from a patient's mouth, Gataure et al. [13] assessed time elapsed from an anesthetist taking a laryngoscope from the assistant to intubation confirmed through both auscultation and capnography, Heegaard et al. [11] evaluated time elapsed from the insertion of an initial laryngoscope until intubation, Noguchi et al. [12] evaluated time elapsed from the removal of the face mask to confirmation through capnography, and Tosh et al. [10] and Bawa et al. [8]measured time elapsed from the introduction of a video laryngoscope into the oral cavity to the appearance of the end-tidal carbon dioxide waveform. The pooled effect estimated showed a statistically significant reduction of the duration of intubation for Stylet over the Bougie approach (MD, 8.39; 95% CI, 2.87–13.91, I^2 = 92%) as shown in Figure 5.

Complications

Six studies compared the complications rate between bougie and stylet methods. Although the complication rate was lower in the bougie group, the analysis showed no significant difference between the groups (RR, 0.93; 95% CI, 0.73–1.19, I^2 = 16%). Upon subgroup analysis, the rates of esophageal intubation (RR, 0.65; 95% CI, 0.26–1.61, I^2 = 0%) and pneumothorax (RR, 0.94; 95% CI, 0.54–1.66, I^2 = 0%) were lower in Bougie group; however, there were no statistically significant differences between the two groups. On the other hand, injury to the oral, glottis, or thoracic area (RR, 0.69; 95% CI, 0.03–16.7, I^2 = 75%) and aspiration (RR, 2.20; 95% CI, 0.68–7.13, I^2 = 0%) rates were not significantly lower in Stylet group when compared to Bougie, as shown in Figure 6.

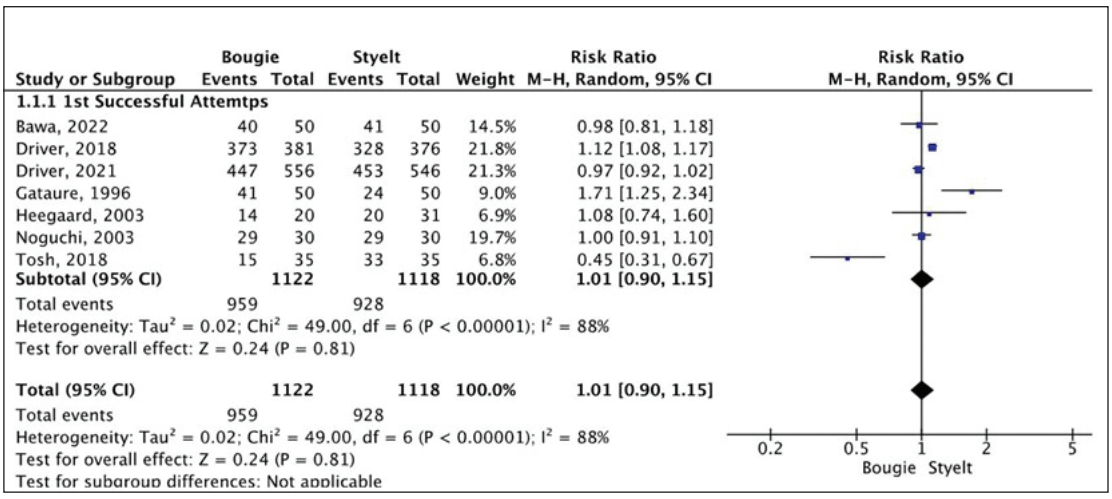

Figure 4. *Forest plot of comparison, bougie versus stylet; outcome, first-attempt intubation success rate.*

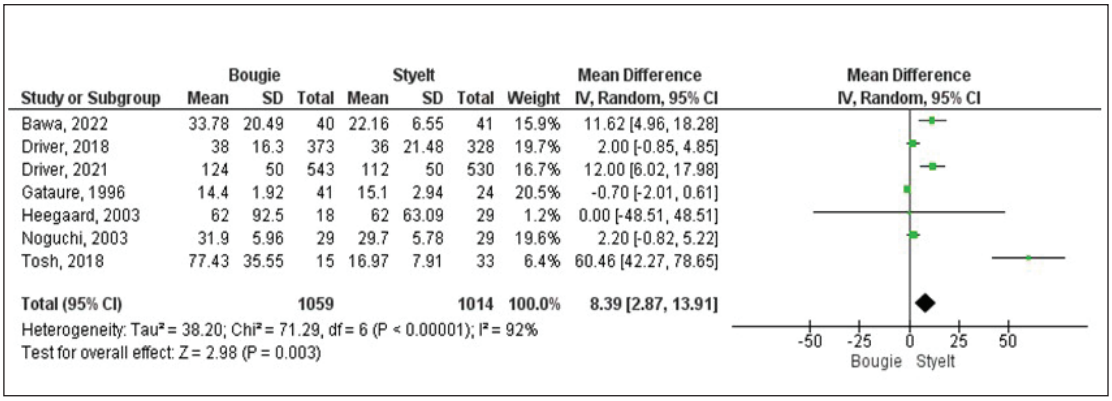

Figure 5. *Forest plot of comparison, bougie versus stylet; outcome, duration of intubation.*

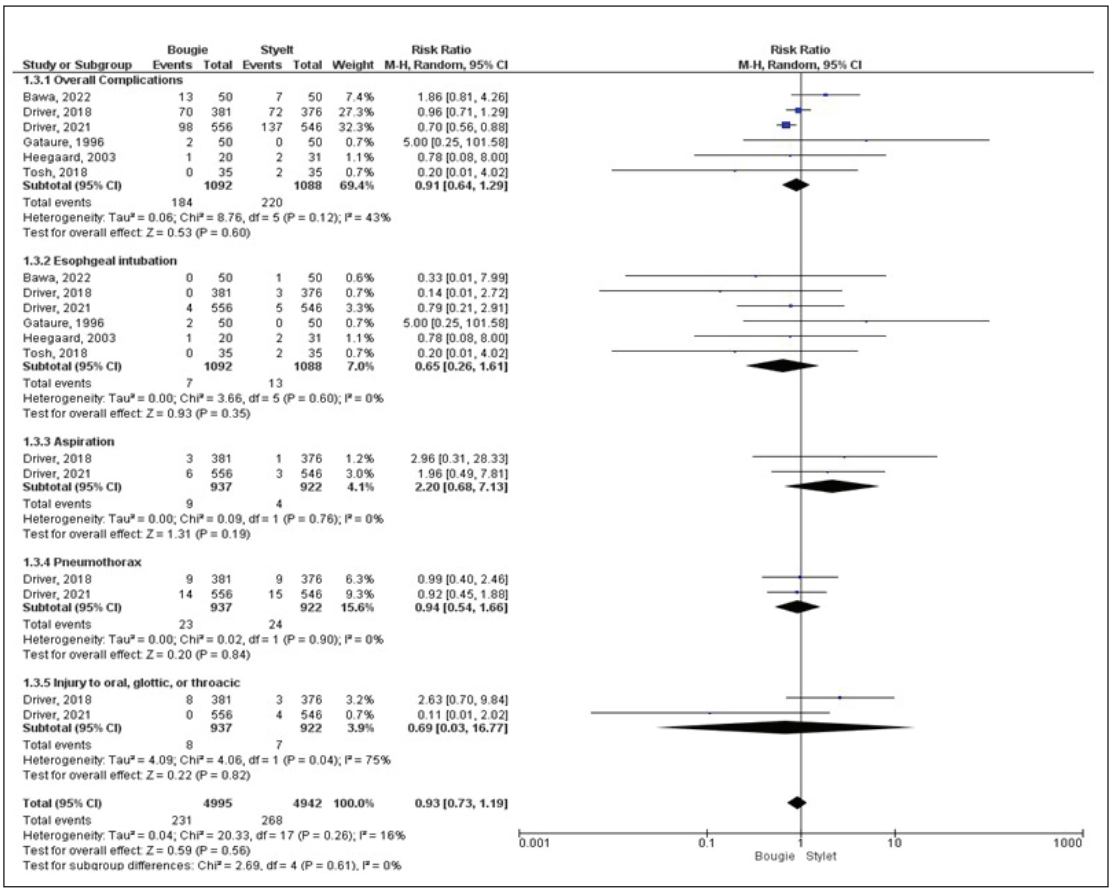

Figure 6. *Forest plot of comparison, bougie versus stylet; outcome, complications.*

Discussion

The risk of adverse events increases with each intubation attempt, making it essential to achieve successful intubation on the first try. Tools such as the gum elastic bougie are often used to improve the chances of successful intubation on the first attempt, particularly in cases where difficult intubation is suspected [9,15]. This study has found that the bougie device had a higher success rate than the stylet on the first attempt, but this difference was not statistically significant. The reason behind bougie first pass success could be explained by the higher utility of video laryngoscopy with bougie [14]. However, according to Tosh et al.'s [10] clinical trial study, 60° angled styleted endotracheal tube intubation was easier and quicker than intubation over a bougie with video technology. A systematic review and meta-analysis done by Tollman and Ahmed [6] have suggested that bougie was statistically significant and more beneficial when accompanied by video technology in a prehospital setting. Additionally, the previous study claimed that if video technology is not available, a combination of the clinical scenario, practitioner expertise, and personal preference may be used to determine the best device [6].

Furthermore, Driver et al. [9] suggested the use of bougie as advantageous when there was an incomplete view of the glottis, which is classified as Cormack–Lehane grades

2-4. Intubation duration is an essential factor to consider when choosing between a bougie and a stylet. This study showed that intubation duration was significantly shorter in the stylet group than in the bougie group. According to Tollman and Ahmed [6] study, which showed a similar result, a stylet has an advantage when securing the airway is needed immediately. However, when a practitioner is less skilled, a bougie's simplicity may boost the likelihood of success [6]. Our study showed no statistically significant differences between bougie and stylet use in terms of complications. The studies included in this review were heterogeneous. They differ in the type of patient, intubation setting, and the type and skills of the healthcare providers who performed the intubation. Therefore, all these factors could influence the choice of airway management device. Ultimately, despite the differences in intubation duration, we agree with the previous suggestion that the appropriate device selection should be based on careful assessment of the patient's needs and the skills and experience of the healthcare team.

Conclusion

This systematic review and meta-analysis showed that there is no significant difference between the use of bougie versus stylet in terms of first-attempt intubation success rates and the complication rates of endotracheal intubation. However, stylet displayed a significantly shorter duration of intubation in comparison to bougie.

Limitation and Recommendations

This study had several limitations. First, we included studies in different settings (ER, ICU, OR, and prehospital settings). Therefore, clinicians may have different approaches and experiences that may affect the outcomes. Second, the method used to measure intubation duration was not unified among the included studies. Third, despite the inclusion of seven RCTs, this systematic review's sample size is still relatively small.

Declarations

This systematic review and meta-analysis was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines and checklist. This systematic review was registered in PROSPERO (CRD42023395752).

Authors' contributions

AA, BA, TA, SB, RB, RA, DH, RA, and RH conducted the study. DH and RH provided statistical advice and study design and meta-analyzed the data. BA, TA, SB, RB, RA, and RA drafted the manuscript. AA took responsibility and supervision of the study as a whole. All authors critically reviewed the study. All authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Acknowledgment

Not applicable.

List of Abbreviations

ER Emergency room
ICU Intensive care unit
OR Operation room
PRISMA Preferred reporting items for systematic reviews and meta-analyses
RCT Randomize control trials
Review Manger RevMan

Conflict of interest

The authors declare that they have no competing interests.

Consent to participate

Not applicable.

Funding

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Ethics approval

Not applicable.

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