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A SYSTEMATIC REVIEW OF ADJUSTABLE BOUGIE COMPARED WITH HOOKS AIRWAY CATHETER FOR INTUBATION TO CMAC VIDEO LARYNGOSCOPY

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ABSTRACT:

Aim: This systematic review aims to critically evaluate and compare the efficacy, safety, and overall performance of the adjustable bougie and the hooks airway catheter as adjuncts to CMAC video laryngoscopy for endotracheal intubation.

Materials and method: A systematic review with total number of 319 articles were searched using PubMed, SCOPUS, Elsevier Science Direct, Wiley online library, Cochrane library, Prospero, Cinahl, Ovid Medline, and Grey literature was conducted following PRISMA guidelines. Randomized controlled trials comparing Airway Catheter Intubation and CMAC Video Laryngoscopy in Bougie were included. Three studies meeting inclusion criteria were included for analysis. Bias assessment was done using Cochrane-based assessment tool 2 (ROB2).

Results: Three studies met the inclusion criteria. The first study demonstrated superior success rates with CMAC videolaryngoscopy compared to direct laryngoscopy in challenging airways. The second study found that smoother and swifter intubation with a 60° angled styletted endotracheal tube compared to a bougie when combined with CMAC videolaryngoscopy. The last study observed that slightly prolonged intubation duration with the use of a Frova introducer alongside CMAC videolaryngoscopy.

Conclusion: The findings highlight the efficacy of CMAC videolaryngoscope in facilitating successful intubation, particularly in challenging airway scenarios. While adjunctive devices like the Frova introducer and bougie present additional considerations, standardized protocols and further research are needed to elucidate optimal intubation strategies. Continued investigation and refinement of techniques are essential to enhance patient safety and outcomes in anesthesia practice.

Keywords: CMAC video laryngoscopy, airway catheter intubation, bougie, hooks airway catheter, endotracheal intubation.

INTRODUCTION

Many practitioners now advocate for the use of rigid video laryngoscopy in managing difficult airways. Previous research has illustrated that video laryngoscopes enhance the view of the larynx and alleviate difficulties during intubation (1,2). Studies have consistently demonstrated superior laryngeal views compared to direct laryngoscopy across various airway scenarios. Particularly, novices have exhibited higher success rates with video laryngoscopy in routine airway management (3,4). Additionally, both our research and others findings indicate that video laryngoscopes serve as a valuable backup option when direct laryngoscopy fails (5). Intubation, a cornerstone of airway management in medical practice, demands precision and efficacy, particularly in challenging scenarios. As technology evolves, video laryngoscopy has emerged as a valuable tool, offering enhanced visualization of the airway anatomy during intubation procedures. Within this realm, the choice of adjunctive devices plays a crucial role in optimizing intubation success rates, minimizing complications, and ensuring patient safety.

However, for experienced providers, the potential for video laryngoscopy to enhance intubation success, especially in cases of predicted difficult airways, remains uncertain. Some authors have proposed that patients with indicators of difficult direct laryngoscopy may benefit from the improved visualization of the larynx provided by video technology compared to direct laryngoscopy (6). Despite favorable intubation conditions and high success rates observed with video laryngoscopes in these studies, their interpretative value is limited. They often

focus on isolated predictors of difficulty, create artificially challenging intubation scenarios, or involve small provider populations. Consequently, it remains unknown whether video laryngoscopy offers advantages for managing predicted difficult airways in routine clinical practice, particularly when applied to a large and diverse patient population by various providers. Of particular relevance is the question of whether video laryngoscopy improves the success rate of the initial intubation attempt compared to conventional laryngoscopy a critical concern for anesthesiologists, as multiple laryngoscopy attempts are associated with increased morbidity and mortality (7,8).

The C-MAC is a modified version of the Storz Berci-Kaplan DCI video laryngoscope (Karl Storz, Tuttlingen, Germany). This portable video laryngoscope utilizes standard Macintosh blade designs and incorporates a complementary metal oxide semiconductor video chip positioned at the blade's tip. This chip extends a 60° optical axis vertically to transmit images to a video display monitor.

Among the adjunctive devices used in video laryngoscopy-assisted intubations, both the adjustable bougie and the hooks airway catheter have garnered attention for their potential benefits. These devices aim to facilitate the passage of the endotracheal tube through the glottic opening, especially in cases of difficult airway management. This systematic review seeks to critically evaluate and compare the efficacy, safety, and overall performance of the adjustable bougie and the hooks airway catheter as adjuncts to CMAC video laryngoscopy for endotracheal intubation. By synthesizing existing evidence, this review aims to provide clinicians with valuable insights into the relative merits of these two devices, aiding informed decision-making in clinical practice.

MATERIALS AND METHOD

SEARCH STRATEGY

This systematic review was conducted using PRISMA guidelines. A total of 319 articles were searched using PubMed, SCOPUS, Elsevier Science Direct, Wiley online library, Cochrane library, Elsevier Science Direct, Prospero, Cinahl, Ovid Medline and Grey literature among those 3 articles included in this systematic review.

A combination of the following keywords used are ‘CMAC VIDEO LARYNGOSCOPY’, ‘AIRWAY CATHETER INTUBATION’, BOUGIE’.

ELIGIBILITY CRITERIA

INCLUSION CRITERIA:

1. Studies published in the English language
2. Studies with RCT
2. Full-text articles
3. Comparing Airway Catheter Intubation and CMAC Video Laryngoscopy in Bougie

INCLUSION CRITERIA:

1. Unrelated articles
2. Only abstracts available
3. Review articles, case reports or series and cross-sectional studies are excluded

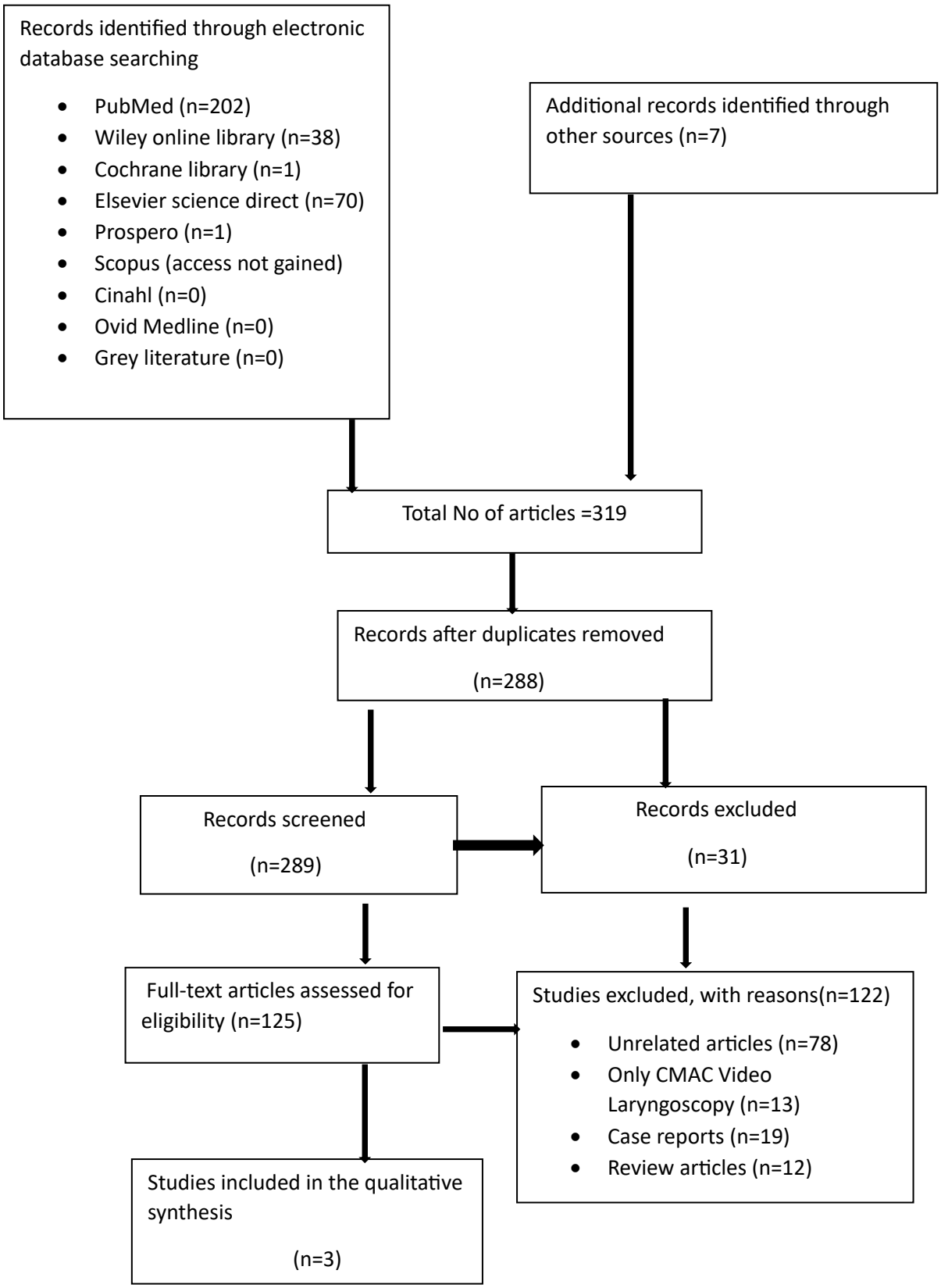
DATA EXTRACTION:

Data extracted from 2012 to 2020. The information was collected utilizing the methodologies and techniques established in the study. This extracted data aimed to ascertain specific attributes within each study, including the year of publication, patient count, and demographics such as age and sex, as well as the type of laryngoscope.

QUALITY ASSESSMENT METHODS:

The bias assessment were done using the Cochrane based assessment tool 2 (ROB2) for assessing randomized controlled trials. This risk-of-bias evaluation encompassed several domains, including bias stemming from the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, selection of reported results, and any other potential biases. The authors' assessments were categorized as "low risk," "high risk," or "unclear" regarding bias.

FIGURE 1: Flow Diagram showing the number of studies identified, screened, assessed for eligibility, excluded, and included in this systematic review using the PRISMA Flow chart


Records identified through electronic database searching
PubMed (n=202)
Wiley online library (n=38)
Cochrane library (n=1)
Elsevier science direct (n=70)
Prospero (n=1)
Scopus (access not gained)
Cinahl (n=0)
Ovid Medline (n=0)
Grey literature (n=0)
Additional records identified through other sources (n=7)
Total No of articles =319
Records after duplicates removed (n=288)
Records screened (n=289)
Records excluded (n=31)
Full-text articles assessed for eligibility (n=125)
Studies excluded, with reasons(n=122)
Unrelated articles (n=78)
Only CMAC Video Laryngoscopy (n=13)
Case reports (n=19)
Review articles (n=12)
Studies included in the qualitative synthesis (n=3)

RESULTS

TABLE 1: CHARACTERISTICS OF THREE STUDIES INCLUDED IN THIS SYSTEMATIC REVIEW:

AUTHOR NAME AND YEAR	PATIENT CHARACTERISTICS	MEAN AGE	BMI	GROUPS
Aziz et al 2012[13]	296 Patients ages ranging from 18 years and all patients are male	The mean age were 54 in group A and in group B were 55	The mean BMI were 34 in both groups	Group A: C-MAC Video Laryngoscope Group B: Direct Laryngoscopy
Tosh et al 2018[14]	36 Patients ages ranging from 18 to 70 years	Mean age were 42.2 in group S and in group B were 40.1	BMI was not mentioned	Group S: Intubated with a 60° angled stylletted endotracheal tube Group B: Bougie was introduced into the trachea and endotracheal tube
Arasu et al 2020[15]	140 Patients ages ranging from 18 to 60 years among that 62 patients were male in both groups and 78 were females in both groups	The mean age were 43 in group F and in group WF were 45	The mean BMI were 24.5 in group A and in group B were 22.12	Group F: C-MAC video laryngoscope intubated using tracheal tube over Frova Group WF: C-MAC video laryngoscope intubated using tracheal tube without Frova

Table 1: shows the characteristics of the intervention in the included studies. The first study by Aziz et al. (2012) involved 296 male patients aged 18 years and older, comparing outcomes between the C-MAC Video Laryngoscope and Direct Laryngoscopy. Tosh et al. (2018) examined intubation using a 60° angled stylletted endotracheal tube versus a bougie in 36 patients aged 18 to 70 years. In the third study by Arasu et al. (2020), 140 patients aged 18 to 60 years were included, with both male and female participants, comparing intubation outcomes using the C-MAC video laryngoscope with and without a Frova introducer. This table highlights mean age, BMI, and the specific techniques employed in each group, providing valuable insights into the patient populations and interventions evaluated across these studies.

TABLE 2: OUTCOME DATA AS REPORTED IN INCLUDED STUDIES:

AUTHOR NAME AND YEAR	STUDY DESIGN	COUNTRY	OUTCOME
Aziz et al 2012[13]	single-blinded randomized controlled trial	Oregon	An extensive array of anesthesia providers attained a heightened rate of successful intubation on the first attempt using the C-MAC across a wide spectrum of patients exhibiting indicators of challenging intubation. C-MAC laryngoscopy appears to represent a valuable method for the initial management of potentially complex airways
Tosh et al 2018[14]	prospective randomized study	Germany	Use of 60° angled styletted endotracheal tube led to smoother and swifter intubation compared to intubation via a bougie when utilized alongside the C-MAC videolaryngoscope
Arasu et al 2020[15]	prospective randomized study	USA	In patients with normal airways, utilizing the Frova introducer to guide endotracheal intubation alongside the C-MAC videolaryngoscope resulted

			in a slightly longer intubation duration. However, it notably decreased the requirement for external laryngeal maneuvers while demonstrating a comparable number of redirections and attempts

Table 2: shows the different intubation techniques and outcomes of this included studies. Aziz et al. (2012) conducted a single-blinded randomized controlled trial in Oregon, demonstrating a heightened success rate of first-attempt intubation using the C-MAC videolaryngoscope across a diverse patient population with challenging airways. Tosh et al. (2018) conducted a prospective randomized study in Germany, highlighting that the use of a 60° angled styletted endotracheal tube facilitated smoother and quicker intubation compared to a bougie when combined with the C-MAC videolaryngoscope. In another prospective randomized study conducted in the USA by Arasu et al. (2020), it was observed that employing a Frova introducer alongside the C-MAC videolaryngoscope resulted in slightly prolonged intubation duration among patients with normal airways. However, this approach significantly reduced the need for external laryngeal maneuvers, while maintaining a comparable number of redirections and attempts. These studies collectively provide valuable insights into various intubation strategies and their effectiveness in different clinical settings.

TABLE 3:- BIAS ANALYSIS OF INCLUDED STUDIES

AUTHOR NAME AND YEAR	Randomisation process	Deviation from the intended intervention	Missing outcome data	Measurement of the outcome	Selection of the reported result
Aziz et al 2012[13]	-	-	-	?	-
Tosh et al 2018[14]	-	+	-	-	-
Arasu et al 2020[15]	-	-	-	-	-

Table 3: shows the bias analysis of all the included studies. It is categorized as high-risk bias "+", low risk bias "-" and unclear "?".

DISCUSSION

This systematic review provides a comprehensive overview of various intubation techniques and their outcomes across three distinct studies. Table 1 presents key characteristics of the interventions employed in each study, including patient demographics such as mean age and BMI, as well as the specific techniques utilized. The findings highlight the diversity of patient populations and interventions evaluated, offering valuable insights into the factors influencing intubation success rates. Table 2 summarizes the outcomes reported in the included studies, shedding light on the effectiveness of different intubation strategies.

Aziz et al in the year 2012 was designed to determine the comparative effectiveness of the C-MAC in a large patient and provider population compared with direct laryngoscopy in the predicted difficult airway. In this study, the C-MAC demonstrated a higher success rate (93%) in intubating predicted difficult airways compared to direct laryngoscopy using a traditional Macintosh blade (84%). Additionally, the C-MAC provided superior laryngeal views and required fewer maneuvers to facilitate intubation. Although laryngoscopy time was slightly prolonged with the C-MAC, the incidence of intubation-related trauma was similar for both devices. The increased rate of successful intubation observed in the C-MAC group holds significant importance. In contrast, the success rate of direct laryngoscopy in this investigation was 84%. Consequently, the findings of this study possess considerable validity, as they depict the performance of both devices within the context of typical anesthesia practice. This environment encompasses a diverse range of providers attending to a broad spectrum of patients with anticipated difficult airways. Indeed, the data presented in this study reveals a similar frequency of failure to intubate the trachea despite achieving an adequate laryngeal view in both the C-MAC group (6 out of 11 cases) and the DL group (8 out of 23 cases). This implies that the likelihood of unsuccessful tracheal intubation despite a satisfactory laryngeal view was comparable for both devices. Hence, the overall higher success rate observed with the C-MAC in this investigation is likely attributed to the anterior extension and magnification of the laryngeal view displayed on the screen, a feature not available during conventional direct laryngoscopy. Additionally, unlike other video laryngoscopes with more curved blade designs, the C-MAC #3 and #4 blades resemble a standard Macintosh blade. Therefore, achieving an adequate laryngeal view using a C-MAC blade provides the laryngoscopist with an endotracheal tube passage experience similar to that of direct laryngoscopy. This prompts the need for comparative studies of various video laryngoscopes to determine which device designs yield the highest intubation

success rates. The ability of the C-MAC to minimize the requirement for additional intubation maneuvers further strengthens the evidence supporting the superior efficacy of video laryngoscopy over conventional direct laryngoscopy. Our findings indicate that tracheal intubation using the C-MAC necessitated fewer instances of external laryngeal manipulation or the use of a gum-elastic bougie. This suggests that the improved laryngeal view and the familiar curvature of the C-MAC blades contributed to easing the difficulty of intubation. There was no disparity in the occurrence of complications, including lip trauma, dental injury, pharyngeal trauma, tracheal injury, or sore throat, between the utilization of the C-MAC device and direct laryngoscopy (13).

Tosh et al in the year 2018 stated that to compare the ease of oral intubation with the use of 60° angled styletted endotracheal tube versus that performed over bougie inserted under videolaryngoscopic guidance. And also assessed the incidence of airway loss, hemodynamic changes, and time and number of attempts at intubation. Videolaryngoscopes featuring blades with increased curvature have been a subject of controversy due to the frequent necessity of supplementary airway tools like a stylet or bougie to achieve oral endotracheal intubation. However, the employment of these tools has been linked to decreased intubation duration and a dampened hemodynamic stress response. The endotracheal tube introducer, commonly known as the "gum elastic bougie," serves as a cost-effective and efficient adjunct in managing unexpected difficult airways. Constructed from a braided polyester base coated with resin, it maintains flexibility while offering stiffness at room temperature. Typically, a 15 Fr, 60 cm long bougie is utilized for adult intubation, and it has been recommended as a viable alternative to a stylet, particularly when employing videolaryngoscopes. Its angled tip facilitates easy insertion into the larynx. A common challenge associated with using a styletted endotracheal tube is the risk of the angled tip contacting the anterior laryngeal wall, necessitating stylet withdrawal to advance the tube further. However, this maneuver poses a risk of airway loss, potentially resulting in esophageal intubation if the tube slips out when pushed in. Introducing a bougie into the trachea and then guiding the endotracheal tube over it significantly mitigates this risk, as the bougie's sufficient length within the trachea enhances stability during these maneuvers. The drawbacks associated with employing a bougie as an intubation aid include the potential risk of damaging or perforating the trachea, bronchi, or even the esophagus due to its rigidity, particularly if not handled with care. It is recommended to introduce the bougie only up to the mid-trachea, and an assistant should stabilize it in place while the endotracheal tube is being inserted to prevent inadvertent advancement deeper into the trachea and mitigate the risk of airway trauma. This study findings suggest that intubation was facilitated and less time-consuming with the styletted endotracheal tube, likely due to its curvature being more aligned with that of the laryngoscope blade. In contrast, the bougie utilized in our study had an angled tip but a straight body. We observed that during laryngoscopy, the bougie tip was often positioned posterior to the arytenoid cartilages, requiring multiple attempts and consuming considerable time to manipulate it into the glottis. Even efforts to align the glottic opening by adjusting the force applied during laryngoscopy or through external manipulation were not consistently successful. The bougie group experienced repeated attempts, prolonged intubation time, and increased force during laryngoscopy, contributing to the heightened hemodynamic response observed. It is plausible that bending the bougie to match the curvature of the laryngoscope blade could potentially enhance alignment and improve the speed and comfort of intubation. Common challenges encountered during videolaryngoscopy include view obstruction caused by fogging, blood, or secretions, as well as the loss of depth perception due to the two-dimensional nature of the view, which may result in substantial upper airway injury. Fogging can be effectively minimized by applying an anti-fog solution or by immersing the blade in warm water. But this study was reported with no complication issues or problems (14).

Arasu et al in the year 2020 stated that to find whether using Frova introducer with C-MAC
video laryngoscope will reduce the intubation time in trainee anesthesiologists. The emergence of video laryngoscopy in the 20th century has brought about a significant transformation in the management of challenging airways. In this study, we observed that the median total and actual intubation times were slightly extended by approximately 5 seconds when using a tracheal tube (TT) preloaded over a Frova introducer for C-MAC videolaryngoscope (VLS)-guided intubation by anesthesia residents, compared to TT alone, among patients without any indicators of difficult airways. The frequency of redirections towards the glottis and the success rate of first attempt intubation were similar between both groups. However, the requirement for external laryngeal maneuvers (ELMs) was notably higher in the non-Frova group. The ease of intubation, as assessed on an ordinal scale, showed no significant difference between the two groups. Although the Frova introducer is anticipated to expedite intubation by minimizing the number of intubation attempts due to its ease of maneuverability, our study did not observe a reduction in intubation time with its use. The prolonged intubation time noted in group F may be attributed to the time required for advancing the tracheal tube (TT) over the introducer or the necessity for rotating the TT in cases of arytenoid impingement. The similar number of redirections and success rate of first attempt intubation across the groups could be attributed to the inclusion of patients without any challenging airway characteristics. The potential benefits of Frova introducer-guided tracheal intubation might be more apparent in patients presenting with difficult airway features, wherein difficulties in advancing the tracheal tube despite a clear laryngeal view on the video screen may be encountered. The elevated success rate on the first attempt with the bougie observed in prior studies may be attributed to the inclusion of patients presenting with at least one difficult airway predictor, where the utility of the bougie would likely be more advantageous. In contrast, our study did not

demonstrate a potential benefit of the bougie in reducing intubation attempts, possibly due to the enrollment of patients lacking any challenging airway parameters (15).

LIMITATION OF THE STUDY

Despite the valuable insights provided by this systematic review, certain limitations should be acknowledged. Firstly, the heterogeneity across the included studies in terms of patient populations, interventions, and outcome measures may introduce variability in the interpretation of the findings. Additionally, the limited number of studies included in this review restricts the generalizability of the conclusions. Moreover, the inherent biases and methodological limitations within the individual studies could impact the overall reliability of the synthesized evidence. Furthermore, variations in clinical practice and expertise among anesthesia providers across different settings may influence the applicability of the findings to real-world scenarios. Lastly, the absence of long-term follow-up data in some studies may limit the assessment of sustained outcomes beyond the immediate perioperative period.

CONCLUSION

In conclusion, this systematic review offers a comprehensive synthesis of evidence regarding various intubation techniques and their outcomes across diverse clinical contexts. The findings underscore the efficacy of the C-MAC videolaryngoscope in facilitating successful intubation, particularly in challenging airway scenarios. While the C-MAC demonstrated superior performance in terms of success rates and laryngeal views compared to direct laryngoscopy, its utilization may prolong laryngoscopy time. Furthermore, the adjunctive use of tools such as the Frova introducer and bougie presents additional considerations in optimizing intubation outcomes. Despite the observed benefits, challenges remain, including the need for standardized protocols and further research to elucidate optimal intubation strategies across different patient populations and clinical settings. Overall, this review underscores the importance of continued investigation and refinement of intubation techniques to enhance patient safety and outcomes in anesthesia practice.

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