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Original Research Article

COMPARISON OF C-MAC VIDEOLARYNGOSCOPE AND FLEXIBLE FIBREOPTIC LARYNGOSCOPE FOR NASOTRACHEAL INTUBATION IN ANTICIPATED DIFFICULT AIRWAY: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Management of anticipated difficult airway remains a cornerstone of safe anaesthetic practice. Flexible fibreoptic laryngoscope (FFLS) is regarded as the gold standard, while the C-MAC videolaryngoscope offers rapid glottic visualization with a potentially shorter learning curve. Comparative evidence in predicted difficult airway patients, particularly during nasotracheal intubation, is limited. **Materials and Methods:** This randomized controlled trial was conducted in 80 ASA I–II patients aged 18–65 years with anticipated difficult airway (El-Ganzouri risk index ≥7) scheduled for elective surgery under general anaesthesia. Patients were randomized into two groups: Group C-MAC (n=40) underwent nasotracheal intubation using the C-MAC videolaryngoscope; Group FFLS (n=40) using flexible fibreoptic laryngoscope. Primary outcomes were ease of intubation (Intubation Difficulty Scale [IDS], time to vocal cord visualization, time to intubation, number of attempts, success rate). Secondary outcomes included haemodynamic responses (HR, SBP, DBP, MAP) and complications. Data were analysed using SPSS v21.0 with $p<0.05$ considered significant. **Result:** Baseline demographic and airway parameters were comparable between groups. Mean IDS score was slightly higher with C-MAC (1.73 ± 0.91) than FFLS (1.38 ± 0.77; p=0.067). Time to visualize vocal cords (40.2 ± 5.4 s vs 55.9 ± 5.4 s) and time to intubation (54.4 ± 5.7 s vs 70.1 ± 6.4 s) were significantly shorter in the C-MAC group (both $p<0.001$). First attempt success rates (85% vs 90%) and overall success were similar ($p>0.05$). Haemodynamic parameters showed no significant intergroup differences at any time point. Complication rates were low and comparable, with nasal bleeding most frequent. **Conclusion:** C-MAC videolaryngoscope enables faster glottic visualization and intubation in anticipated difficult airway without compromising success rate, haemodynamic stability, or safety compared with FFLS. It may be a preferred alternative in situations requiring rapid airway control, provided operators are proficient in both techniques.

INTRODUCTION

Difficult airway management continues to pose one of the greatest challenges in anaesthesiology, as failure to secure the airway promptly may result in severe adverse outcomes, including hypoxia, brain injury, or death.[1,2] The American Society of Anesthesiologists defines a difficult airway as a scenario in which an anaesthesiologist experiences difficulty with face mask ventilation, tracheal intubation, or both, reflecting a multifactorial interplay between patient anatomy, clinical circumstances, and practitioner skill.[3]

Pathophysiology and pathogenesis of difficult airway may involve limited mouth opening, reduced thyromental distance, altered neck mobility, obesity, short neck, or unfavourable Mallampati classification. These anatomical factors hinder the alignment of the visual and airway axes, making visualization of the glottis and passage of the tracheal tube particularly challenging.[4] The El-Ganzouri Risk Index, incorporating parameters such as Mallampati score, mouth opening, thyromental distance, neck movement, and previous intubation history, is commonly used to predict difficult intubation.[5]

Fiberoptic intubation, particularly with flexible bronchoscope, has long been considered the gold standard for managing anticipated difficult airways due to its ability to navigate complex anatomy under direct visualization. It allows for awake, spontaneously breathing intubation and is highly effective when performed by experienced operators.[6] However, its limitations include the need for extensive training, high costs, difficulty in visualization in the presence of blood or secretions, and a steeper learning curve.[7,8]

Emerging as a modern alternative, video laryngoscopy, such as with the C-MAC Videolaryngoscope, offers indirect visualization of the glottis via a camera mounted on the laryngoscope blade. This technique has been associated with improved glottic view, higher first-pass success rates, and shorter intubation times, especially in patients with risk factors for difficult airways.[9,10] Moreover, video laryngoscopes are more intuitive to use and often easier to master than fiberoptic devices.[11]

Comparative studies and meta-analyses have highlighted that video laryngoscopy may achieve faster intubation and better first-attempt success than fiberoptic bronchoscope, particularly in patients with cervical immobilization or other predictors of difficult intubation.[12,13] Some research, including a recent randomized controlled trial, has shown that the C-MAC may allow significantly faster tube placement and glottic visualization compared to flexible fiberoptic scopes in anticipated difficult intubations.[14]

Despite the documented advantages of both techniques, there remains inadequate high-quality evidence directly comparing these devices in patients with anticipated difficult airway characteristics defined by El-Ganzouri index. This study is designed to address this gap by rigorously comparing the ease of intubation, hemodynamic responses, and adverse events between C-MAC videolaryngoscope and flexible fibreoptic laryngoscope during nasotracheal intubation in this high-risk population.

MATERIALS AND METHODS

This randomized controlled trial was conducted in the Department of Anaesthesiology, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala, over 18 months after approval from the Institutional Ethics Committee. Eighty ASA I–II adult patients (18–65 years) with anticipated difficult airway (El-Ganzouri risk index ≥7) undergoing elective surgery under general anaesthesia were included. Patients with ASA III–V, reactive airway disease, pregnancy, high aspiration risk, non-fasting status, inability to mask ventilate, nasal pathology, bleeding disorders, paediatric age group, or emergency surgery were excluded.

Participants were randomly allocated (sealed envelope method) into two groups (n=40 each): Group C-MAC (C-MAC videolaryngoscope) and Group FFLS (flexible fibreoptic laryngoscope). All patients underwent standardized preoperative evaluation, fasting, premedication, and nasal preparation. Anaesthesia was induced with midazolam, glycopyrrolate, fentanyl, and propofol, followed by succinylcholine for neuromuscular blockade.

In Group C-MAC, a lubricated flexometallic ETT was advanced nasally to the oropharynx, and the C-MAC blade was used to visualize the cords and guide tube placement with Magill forceps. In Group FFLS, the ETT was preloaded on a lubricated fibreoptic bronchoscope, introduced nasally, and advanced into the trachea under direct visualization. Tube position was confirmed by auscultation and capnography in both groups.

Primary outcomes were ease of intubation (Intubation Difficulty Scale, time to vocal cord visualization, time to intubation, number of attempts, and success rate). Secondary outcomes included haemodynamic changes (HR, SBP, DBP, MAP) at baseline, during induction, and at 1, 3, and 5 minutes post-intubation, and peri-procedural complications. All intubations were performed by the same experienced anaesthesiologist.

Statistical analysis was done using SPSS v21.0, with Student's t-test, Mann–Whitney U test, and chi-square/Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

Eighty patients were analysed, with 40 in each group. Baseline demographics and airway characteristics [Table 1] were comparable between the groups. Mean age, gender distribution, ASA grade, mouth opening, thyromental distance, Mallampati classification, and neck movement showed no statistically significant differences (p>0.05). Both groups had similar proportions of high-risk airway predictors as per the El-Ganzouri index.

Table 1: Baseline Demographics & Airway Characteristics

Variable	C-MAC	Fiberoptic	p-value
Age (years)	44.9 ± 13.29	45.28 ± 13.78	0.902
Female (%)	16 (40.0%)	19 (47.5%)	0.499
Male (%)	24 (60.0%)	21 (52.5%)	
ASA I (%)	19 (47.5%)	20 (50.0%)	0.823

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ASA II (%)	21 (52.5%)	20 (50.0%)	
Mouth opening ≤4 cm (%)	40 (100.0%)	40 (100.0%)	1
TMD ≤6 cm (%)	37 (92.5%)	38 (95.0%)	
Mallampati Grade 3 (%)	17 (42.5%)	16 (40.0%)	0.82
Mallampati Grade 4 (%)	23 (57.5%)	24 (60.0%)	
Neck movement <90° (%)	0 (0.0%)	1 (2.5%)	0.451

Ease of intubation outcomes [Table 2] demonstrated that mean IDS scores were slightly higher with the C-MAC than the FFLS (1.73 ± 0.91 vs 1.38 ± 0.77, p=0.067), though not statistically significant. However, mean time to visualize the vocal cords and mean time to successful intubation were significantly shorter in the C-MAC group compared to the FFLS group (40.2 ± 5.41 vs 55.88 ± 5.4 seconds, and 54.38 ± 5.72 vs 70.13 ± 6.45 seconds, respectively; both p<0.001). First attempt success rates were slightly higher in the FFLS group (90.0% vs 85.0%), but this difference was not statistically significant (p=0.558).

Table 2: Ease of Intubation Outcomes

Variable	C-MAC	Fiberoptic	p-value
IDS score	1.73 ± 0.91	1.38 ± 0.77	0.067
Time to visualize vocal cords (sec)	40.2 ± 5.41	55.88 ± 5.4	0.0
Time to successful intubation (sec)	54.38 ± 5.72	70.13 ± 6.45	0.0
First attempt success (%)	34 (85.0%)	36 (90.0%)	0.558

Haemodynamic responses [Table 3] revealed no statistically significant intergroup differences at any recorded time point for HR, SBP, DBP, or MAP (all p>0.05). Both groups exhibited mild, transient increases in HR and blood pressure during intubation, which returned toward baseline by 5 minutes post-intubation.

Table 3: Hemodynamic Parameters

Parameter	Time point	C-MAC (±SD)	Fiberoptic (±SD)	p-value
Heart Rate (beats/min)	Pre-intubation	84.65 ± 6.54	83.6 ± 7.19	0.497
	During intubation	83.15 ± 5.73	81.0 ± 6.96	0.135
	1 min post-intubation	81.65 ± 4.38	80.05 ± 6.64	0.207
	3 min post-intubation	81.05 ± 4.98	80.6 ± 6.85	0.738
	5 min post-intubation	80.28 ± 12.66	79.0 ± 6.34	0.571
Systolic BP (mmHg)	Pre-intubation	119.8 ± 5.41	118.7 ± 5.81	0.384
	During intubation	120.9 ± 5.53	120.0 ± 5.02	0.448
	1 min post-intubation	121.2 ± 5.34	119.8 ± 4.75	0.219
	3 min post-intubation	119.8 ± 5.41	118.7 ± 5.81	0.384
	5 min post-intubation	122.05 ± 7.46	123.6 ± 7.32	0.351
Diastolic BP (mmHg)	Pre-intubation	59.15 ± 4.50	59.05 ± 5.40	0.929
	During intubation	68.20 ± 4.59	66.85 ± 4.85	0.205
	1 min post-intubation	68.15 ± 4.63	67.30 ± 5.09	0.437
	3 min post-intubation	61.15 ± 4.50	61.05 ± 5.40	0.929
	5 min post-intubation	55.15 ± 4.50	55.05 ± 5.40	0.929
Mean Arterial Pressure (mmHg)	Pre-intubation	79.35 ± 4.04	78.95 ± 4.85	0.690
	During intubation	85.75 ± 3.98	84.53 ± 4.17	0.183

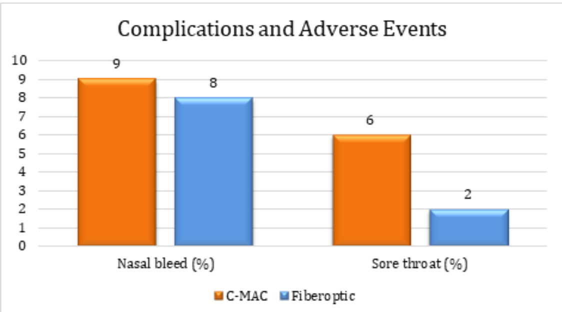

Figure 1: Complications and Adverse Events

Complications and adverse events (Table 4) were infrequent and comparable between groups. Nasal bleeding occurred in 22.5% of patients in the C-MAC group and 20.0% in the FFLS group (p=0.285). Sore throat was more frequent with C-MAC (15.0%) compared to FFLS (5.0%), though not statistically significant. The majority of patients in both groups had no complications.

DISCUSSION

In our study, the baseline characteristics [Table 1] were well matched across the C-MAC and fibreoptic groups, ensuring fair comparison. Similarly, randomized trials by Salama et al.^5 and Kumar et al.^1 also demonstrated no significant differences in patient demographics or airway predictors, establishing robust comparability for analysis.

Regarding ease of intubation [Table 2], although the Intubation Difficulty Scale (IDS) scores were slightly higher in the C-MAC group (1.73 ± 0.91) compared to the FFLS group (1.38 ± 0.77), this difference was not statistically significant, mirroring the findings of Kumar et al., who noted a marginally higher but non-significant Nasal Intubation Difficulty Scale (NIDS) with videolaryngoscopy.^1 More strikingly, our C-MAC group achieved significantly shorter times both

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to visualize the vocal cords (40.2 ± 5.4 s vs 55.9 ± 5.4 s; p<0.001) and to complete intubation (54.4 ± 5.7 s vs 70.1 ± 6.4 s; p<0.001). These outcomes align well with Kumar et al., who reported a median intubation time of 38 s (IQR 26–43 s) with C-MAC D-Blade versus 60 s (IQR 52–65 s) with fibreoptic bronchoscopy (P<0.001), and a shorter time to glottis view (8 s vs 22 s, P<0.001).^1 Salama et al. similarly found a mean intubation time of 27.9 ± 3.7 s with C-MAC compared to 66.8 ± 4.2 s with FFLS (P<0.001).^5 Thus, our findings reinforce that C-MAC videolaryngoscopy significantly expedites both glottic visualization and ETT placement in anticipated difficult airway scenarios.

First-attempt success was comparable (C-MAC 85% vs FFLS 90%; p=0.558), echoing broader evidence. In a meta-analysis of patients with cervical spine immobilization (n=694), video laryngoscopy demonstrated a superior first-attempt success rate and faster intubation compared to fibreoptic bronchoscopy (P<0.05), although no differences were seen in success rate per se, complications, or haemodynamic response.^2 Our results, showing equivalent first-pass success rates and overall intubation success, align with the meta-analysis which noted faster intubation but similar ultimate efficacy.

Turning to hemodynamic responses [Table 3], there were no significant intergroup differences in HR, SBP, DBP, or MAP at any time point (all p>0.05). Both groups exhibited mild transient increases post-intubation with return to baseline by five minutes. This mirrors findings in both elective and anesthetized difficult airway contexts. For instance, Salama et al. found comparable HR and MAP in both groups, with significantly greater increases in the fibreoptic group at 1 and 5 minutes (P<0.001).^6 Another randomized study by Yumul et al. reported reduced maximal HR rise with C-MAC compared to fibreoptic in cervical spine stabilization patients.^4 Some studies observed a blunted sympathetic response with C-MAC, likely due to less airway manipulation.^4,7 Overall, these data suggest C-MAC may offer hemodynamic stability comparable—or potentially superior—to fibreoptic scopes.

Finally, complication rates (Table 4) were low and similar in both groups: nasal bleeding in ~22% versus 20%, and sore throat in 15% vs 5% (not significant). Kumar et al. similarly reported no difference in airway trauma (2 vs 7 cases; P=0.30) or postoperative sore throat (10 cases each; P=0.56).^1 Meta-analyses also noted no difference in tissue injury or sore throat between video laryngoscopy and fibreoptic bronchoscopy.^2 Thus, our findings confirm that both techniques have comparable safety profiles in difficult airway management.

Our study demonstrates that C-MAC videolaryngoscopy provides significantly faster glottic visualization and tracheal intubation compared with flexible fibreoptic laryngoscopy, without compromising success rates or hemodynamic stability, and with similar complication rates. These results are consistent with recent high-quality RCTs and meta-analyses in similar clinical scenarios. In settings where time is critical—such as in predicted difficult airway cases—C-MAC may offer a practical, efficient, and safe alternative to fibreoptic techniques, especially given its shorter learning curve. Nonetheless, fibreoptic intubation remains valuable where anatomy or secretions challenge video views, or in awake intubations. Thus, both methods have roles, and device choice may be tailored to patient context and operator expertise.

CONCLUSION

In patients with anticipated difficult airway, C-MAC videolaryngoscope achieved significantly shorter times for glottic visualization and successful nasotracheal intubation compared with flexible fibreoptic laryngoscope, while maintaining comparable success rates, haemodynamic stability, and complication profiles. These findings suggest that C-MAC can be considered a reliable and efficient alternative to fibreoptic intubation in similar clinical settings, particularly when rapid airway control is essential.

REFERENCES

1. Kumar P, Tempe DK, Datt V, Wadhawan S, Garg M, Minhas HS. Comparison of C-MAC D-blade videolaryngoscope and flexible fibreoptic bronchoscope for nasotracheal intubation in anticipated difficult airway: A randomised clinical trial. Indian J Anaesth. 2022;66(8):549-555.
2. Zhao H, Li M, Fang Y, Meng L, Zhou T. Video laryngoscopy vs. flexible fibreoptic bronchoscopy for tracheal intubation in patients with cervical spine immobilization: A systematic review and meta-analysis of randomized controlled trials. BMC Anesthesiol. 2020;20(1):179.
3. Apfelbaum JL, Hagberg CA, Connis RT, et al. 2022 American Society of Anesthesiologists practice guidelines for management of the difficult airway. Anesthesiology. 2022;136(1):31-81.
4. Yumul R, Elvir-Lazo OL, White PF, et al. Comparison of C-MAC videolaryngoscope versus flexible fibreoptic bronchoscope for awake intubation in cervical spine patients: A randomized controlled trial. J Neurosurg Anesthesiol. 2016;28(3):219-224.
5. Salama ER, El-Kasaby AM, Samir EM, et al. C-MAC videolaryngoscope versus fibreoptic bronchoscope for awake nasal intubation in patients with anticipated difficult airway: A randomised controlled trial. Indian J Anaesth. 2017;61(6):505-510.
6. Puthenveettil N, Rajan S, Paul J, Kumar L. Comparison of C-MAC videolaryngoscope with fibreoptic bronchoscope for awake nasotracheal intubation in anticipated difficult airway: A randomised clinical trial. J Anaesthesiol Clin Pharmacol. 2019;35(3):342-347.
7. Aziz MF, Dillman D, Fu R, Brambrink AM. Comparative effectiveness of the C-MAC video laryngoscope versus direct laryngoscopy in the setting of the predicted difficult airway. Anesthesiology. 2012;116(3):629-636.
8. Cavus E, Neumann T, Doerges V, et al. First clinical evaluation of the C-MAC D-Blade videolaryngoscope during routine and difficult intubation. Anesth Analg. 2011;112(2):382-385.
9. Lewis SR, Butler AR, Parker J, Cook TM, Smith AF. Videolaryngoscopy versus direct laryngoscopy for adult

patients requiring tracheal intubation: A Cochrane systematic review. Br J Anaesth. 2017;119(3):369-383.
10. Xue FS, Liu HP, He N, et al. Spray-as-you-go airway topical anesthesia in patients with difficult airways undergoing awake fibreoptic intubation: A randomized controlled trial. Br J Anaesth. 2016;116(3):388-394.
11. Piepho T, Noppens RR, Heid FM, et al. Evaluation of the C-MAC videolaryngoscope in 150 patients requiring tracheal intubation. Br J Anaesth. 2010;105(5):648-654.
12. Ahmad I, El-Boghdadly K, Bhagrath R, et al. Difficult Airway Society guidelines for awake tracheal intubation (ATI) in adults. Anaesthesia. 2020;75(4):509-528.
13. Rosenstock CV, Thøgersen B, Afshari A, Christensen AL, Eriksen C, Gätke MR. Awake fiberoptic or awake video laryngoscopic tracheal intubation in patients with anticipated difficult airway management: A randomized clinical trial. Anesthesiology. 2012;116(6):1210-1216.
14. Liu ZJ, Yi J, Guo WJ, Ma C, Huang YG, Liu YF. Comparison of hemodynamic responses to tracheal intubation with a flexible fibreoptic bronchoscope versus a C-MAC videolaryngoscope in patients with anticipated difficult airway: A randomized trial. J Clin Anesth. 2021;73:110320.