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Research Article

Video laryngoscope versus Macintosh laryngoscope for tracheal intubation in anticipated difficult airways (Mallampati III–IV): a prospective randomized controlled trial

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Background: Airway management is a crucial aspect of anaesthetic practice, and failed tracheal intubation can result in serious complications such as hypoxemia, aspiration, and cardiovascular instability. The Macintosh laryngoscope (ML) has long been the standard device for intubation; however, successful use requires alignment of airway axes, which may be difficult in patients with anticipated difficult airways. Video laryngoscopes (VL) provide indirect glottic visualization and may improve intubation outcomes.

Aim: To compare video laryngoscope and Macintosh laryngoscope for tracheal intubation in adult patients with anticipated difficult airways.

Methods: In this prospective randomized study, 70 ASA I–II patients aged 18–70 years with Mallampati class III or IV airway undergoing elective surgery were allocated into VL (n=35) and ML (n=35) groups. The primary outcome was time to successful intubation confirmed by end-tidal CO_2. Secondary outcomes included first-attempt success rate, glottic view (Cormack–Lehane grade and POGO score), need for optimization maneuvers, airway complications, postoperative sore throat, and hemodynamic responses.

Results: VL provided better glottic visualization, higher first-attempt success, shorter intubation time, and fewer optimization maneuvers compared with ML. Airway-related complications were reduced, while hemodynamic responses were comparable between groups.

Conclusion: Video laryngoscopy improves intubation success and airway safety in anticipated difficult airways and represents an effective alternative to conventional Macintosh laryngoscopy.

Keywords

Video laryngoscope; Macintosh laryngoscope; Difficult airway; Endotracheal intubation; Airway management; Anaesthesia.

Introduction

Airway management sits at the very core of anaesthetic practice. When intubation fails, the consequences are immediate and often severe, including hypoxemia, aspiration, and cardiovascular instability. In extreme cases, it can even lead to neurological injury. These risks show why anesthesiologists focus heavily on airway assessment and preparation[1]. In the last ten years, new devices have emerged to improve visualization and minimize complications. This has changed how clinicians handle difficult airways.

Predicting a difficult airway is part of routine preoperative evaluation. Limited mouth opening, reduced cervical spine mobility, short thyromental distance, obesity, and craniofacial abnormalities are common warning signs. Among these, Mallampati class III and IV are particularly associated with poor laryngoscopic views and higher risk of failed intubation [2]. In our setting, patients frequently present with high Mallampati grades and restricted neck mobility, which makes dependable airway devices especially important in everyday practice.

For decades, direct laryngoscopy with the Macintosh blade has been the gold standard. Its appeal lies in simplicity, affordability, and wide availability. Yet intubation with ML requires the oral, pharyngeal, and laryngeal axes to be properly aligned. In patients with signs of difficulty, this alignment is often not good. The result is multiple attempts, longer apnoea, heightened sympathetic responses, and injury to the airway[1]. These issues have led to the search for alternatives that can offer improved visualization without needing perfect anatomical alignment.

Video laryngoscopes (VL) were introduced to address this need. A small camera near the blade tip gives an indirect view of the glottis. This design reduces lifting force, lessens airway manipulation, and improves the view of the larynx. Several studies have shown that VL improves Cormack-Lehane grading and raises the percentage of glottic opening [3&4]. Better visualization often leads to higher first-pass success rates and less airway trauma. In our practice, we have found that VL reduces the need for external laryngeal manipulation. This makes intubation smoother and less stressful for both the patient and the operator.

Evidence supporting Videolaryngoscopy has steadily increased. A Cochrane review concluded that VL improves first-attempt success and lowers failed intubation rates compared to routine direct laryngoscopy. This is especially true for patients with predictors of difficult airways (Lewis et al.,[5]. Hansel et al.[6] reported better laryngeal views and less intubation difficulty with VL in elective surgical patients. Randomized controlled trials from India have confirmed these findings. They showed shorter intubation times and fewer complications compared with Macintosh laryngoscopy. Meta-analyses support these benefits across different patient populations[6.]

Guidelines now reflect this change. The Difficult Airway Society[7] highlights VL as a crucial part of the difficult airway algorithm. The American Society of Anesthesiologists[8] also emphasizes VL for both expected and unexpected difficult airway situations. These endorsements show a growing agreement that VL should be seen as a first-line device when difficulty is anticipated.

Concerns do remain. Early reports showed that intubation times with VL were longer because users were not familiar with it and needed to coordinate their hands and eyes[9]. Hemodynamic responses differed among studies, reflecting variations in operator technique and patient characteristics[10]. However, as people gain more experience with VL, intubation times generally decrease. Hemodynamic responses begin to resemble those seen with Macintosh laryngoscopy. This shows that the learning curve for VL can be managed with regular use and training.

The present study was designed to compare VL and ML in adult patients with anticipated difficult airways defined by Mallampati class III and IV. The primary objective was to compare time to successful intubation. Secondary objectives included assessment of glottic visualization, number of intubation attempts, requirement for optimization maneuvers, airway-related complications, and hemodynamic responses. By focusing on elective surgical patients in an Indian tertiary care setting, we aim to provide region-specific evidence to guide clinical practice and support the integration of VL into routine airway management strategies.

Materials and Methods

Study Design

This investigation was conducted as a prospective, open-label, randomized controlled trial. The design allowed for direct comparison between video laryngoscopes (VL) and Macintosh laryngoscopes (ML) in patients with anticipated difficult airways.

Study Setting

The study was carried out in the Department of Anaesthesiology at Vinayaka Mission's Medical College and Hospital, Karaikal, where elective surgical procedures under general anaesthesia are routinely performed. Ethical clearance was obtained from the Institutional Ethical Committee, the study was registered in Clinical Trials Registry - India (CTRI NUMBER: CTRI/ 2024/06/069663), and informed consent was obtained from all participants before enrolment

Inclusion Criteria

Adult patients aged between 18 and 70 years, belonging to ASA physical status I or II, and classified as Mallampati class III or IV were considered eligible. Both male and female patients were included in the study population.

Exclusion Criteria

Patients with severe heart disease, cervical spine instability, limited mouth opening or neck extension, obesity, or those needing rapid sequence induction were not allowed to participate. These criteria protected patient safety and reduced confusing factors.

Patient recruitment and randomization

Patients were recruited during their pre-anaesthetic check-up and screened based on the inclusion and exclusion criteria. Patients meeting the eligibility criteria provided informed written consent in a language they understood. Participants were recruited and then randomized into two study groups using a computer-generated random sequence to ensure unbiased allocation

Group A - Using Video Laryngoscope (VL) - 30 subjects

Group B - Using Macintosh Laryngoscope (ML) - 30 subjects

Methodology:

After obtaining approval from the Institutional Ethics Committee, patients were recruited during the pre-anaesthetic evaluation. The study protocol and associated risks were explained in a language understandable to them, and written informed consent was obtained. Eligible patients were then randomized and enrolled.

In the operating room, intravenous access was secured and standard monitoring (ECG, non-invasive blood pressure, and pulse oximetry) was instituted. Preoxygenation was performed for 3 minutes using a Bain's circuit. Anaesthesia was induced with intravenous propofol (2 mg/kg), followed by ventilation with 60% nitrous oxide in oxygen and 2% isoflurane. Neuromuscular blockade was achieved with either succinylcholine or vecuronium as per group allocation.

Direct laryngoscopy was performed and the Cormack–Lehane grade and POGO score were recorded. Ease of intubation, time to intubation (appearance of capnography), haemodynamic parameters, number of attempts, optimization manoeuvres, device change, and airway complications were documented.

Statistical Analysis

All data were analyzed using SPSS software. Continuous variables were compared using the Student's t-test, while categorical variables were assessed with the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Result

A total of 70 patients was included in the study, with 35 patients in the Video Laryngoscope group and 35 patients in the Macintosh Laryngoscope group.

Baseline Characteristics

The baseline demographic characteristics of the study participants are presented in Table 1. The mean age of patients in the Video Laryngoscope group was 43.03 ± 14.92 years, whereas it was 39.86 ± 13.27 years in the Macintosh Laryngoscope group. The difference between the two groups was not statistically significant (p = 0.351). The comparison of mean age between the two groups is illustrated in Figure 1. Similarly, the sex distribution was comparable between the two groups (p = 0.290). Females constituted 77.1% of the Video Laryngoscope group and 65.7% of the Macintosh Laryngoscope group.The mean BMI was 24.71 ± 3.79 kg/m² in the Video Laryngoscope group and 25.83 ± 2.88 kg/m² in the Macintosh Laryngoscope group, with no statistically significant difference (p = 0.168).

The Mallampati score distribution was also comparable between the groups (p = 0.803), indicating similar airway characteristics at baseline (Table 1).

Hemodynamic Parameters and Intubation Time

The comparison of hemodynamic parameters and intubation time between the two groups is shown in Table 2. The mean pulse rate was significantly lower in the Video Laryngoscope group (78.63 ± 9.25 bpm) compared to the Macintosh Laryngoscope group (83.26 ± 9.20 bpm) (p = 0.040). This comparison is depicted in Figure 2.

Similarly, the mean blood pressure was significantly lower in the Video Laryngoscope group (128.57 ± 9.44 mmHg) compared to the Macintosh group (134.00 ± 10.35 mmHg) (p = 0.025). The graphical representation of blood pressure comparison between the two groups is shown in The graphical representation of blood pressure comparison between the two groups is shown in Figure 3.

However, the mean oxygen saturation (SpO_2) levels were comparable between the two groups (99.91 ± 0.28% vs 99.89 ± 0.40%, p = 0.733).

The mean time required for intubation was significantly shorter in the Video Laryngoscope group (46.06 ± 18.63 seconds) compared to the Macintosh Laryngoscope group (54.69 ± 17.06 seconds) (p = 0.047) (Table 2). This difference is illustrated in Figure 4, while the distribution of intubation time between the two groups is further demonstrated using a box plot in Figure 6.

Airway Assessment and Intubation Characteristics

The airway assessment and intubation characteristics are summarized in Table 3. The distribution of POGO scores was identical between the two groups, and no statistically significant difference was observed (p = 1.000).

Similarly, the Cormack–Lehane grades were comparable between the Video Laryngoscope and Macintosh Laryngoscope groups (p = 1.000).

The requirement for additional airway maneuvers, such as the BURP maneuver and bougie guidance, was slightly higher in the Macintosh group; however, the difference was not statistically significant (p = 0.453).

The number of intubation attempts was also comparable between the groups (p = 0.284), with most patients requiring only a single attempt for successful intubation. Likewise, the ease of intubation grades did not differ significantly between the two groups (p = 0.327) (Table 3). The distribution of ease of intubation grades between the two groups is presented graphically in Figure 5.

Post-Intubation Complications

Post-intubation complications are also presented in Table 3. Sore throat was reported in 5 patients (14.3%) in the Video Laryngoscope group and 9 patients (25.7%) in the Macintosh Laryngoscope group; however, this difference was not statistically significant (p = 0.232).

No cases of hoarseness of voice, airway trauma, or device change during intubation were observed in either group. Overall, the Video Laryngoscope demonstrated significantly lower pulse rate, lower blood pressure, and shorter intubation time compared to the Macintosh Laryngoscope. However, airway visualization parameters, intubation success rates, and complication rates were comparable between the two groups.

Table 1

Baseline Characteristics of the Study Population

Variable	Video Laryngoscope (n = 35)	Macintosh Laryngoscope (n = 35)	P value
Age (years), Mean ± SD	43.03 ± 14.92	39.86 ± 13.27	0.351
Female, n (%)	27 (77.1)	23 (65.7)	0.290
Male, n (%)	8 (22.9)	12 (34.3)	
BMI (kg/m²), Mean ± SD	24.71 ± 3.79	25.83 ± 2.88	0.168
Mallampati score III, n (%)	23 (65.7)	22 (62.9)	0.803
Mallampati score IV, n (%)	12 (34.3)	13 (37.1)	

Data expressed as Mean ± SD or number (percentage).

Table 2

Comparison of Hemodynamic Parameters and Intubation Time

Variable	Video Laryngoscope (n = 35)	Macintosh Laryngoscope (n = 35)	P value
Pulse Rate (bpm), Mean ± SD	78.63 ± 9.25	83.26 ± 9.20	0.040*
Blood Pressure (mmHg), Mean ± SD	128.57 ± 9.44	134.00 ± 10.35	0.025*
SpO_2 (%), Mean ± SD	99.91 ± 0.28	99.89 ± 0.40	0.733
Time for intubation (seconds), Mean ± SD	46.06 ± 18.63	54.69 ± 17.06	0.047*

*Statistically significant ($p < 0.05$)

Table 3

Airway Assessment, Intubation Characteristics, and Complications

Variable	Video Laryngoscope (n = 35)	Macintosh Laryngoscope (n = 35)	P value
POGO score, n (%)			
0	3 (8.6)	3 (8.6)	1.000
50	13 (37.1)	13 (37.1)	
100	19 (54.3)	19 (54.3)	
Cormack–Lehane grade, n (%)			
Grade 1	19 (54.3)	19 (54.3)	1.000
Grade 2a	7 (20.0)	7 (20.0)	
Grade 2b	6 (17.1)	6 (17.1)	
Grade 3	3 (8.6)	3 (8.6)	
Maneuvers used, n (%)			
None	25 (71.4)	20 (57.1)	0.453
BURP	7 (20.0)	10 (28.6)	
BURP + Bougie	3 (8.6)	5 (14.3)	
Intubation attempts, n (%)			
One attempt	31 (88.6)	28 (80.0)	0.284
Two attempts	4 (11.4)	7 (20.0)	
Ease of intubation, n (%)			
Grade 1	25 (71.4)	19 (54.3)	0.327
Grade 2	6 (17.1)	9 (25.7)	
Grade 3	4 (11.4)	7 (20.0)	
Sore throat, n (%)			
No	30 (85.7)	26 (74.3)	0.232
Yes	5 (14.3)	9 (25.7)	
Hoarseness of voice	0	0	–
Device change	0	0	–
Trauma airway	0	0	–

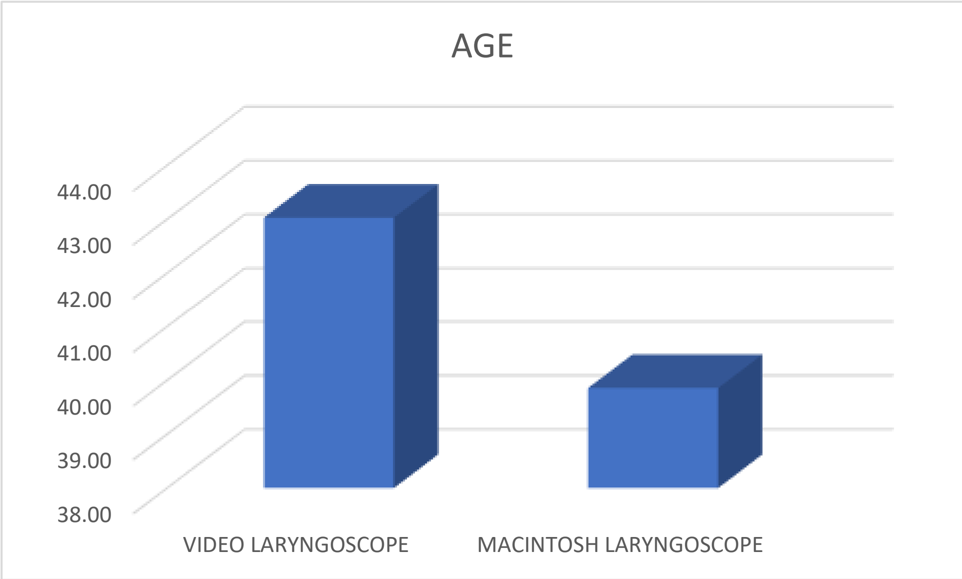

Figure 1: Age comparison

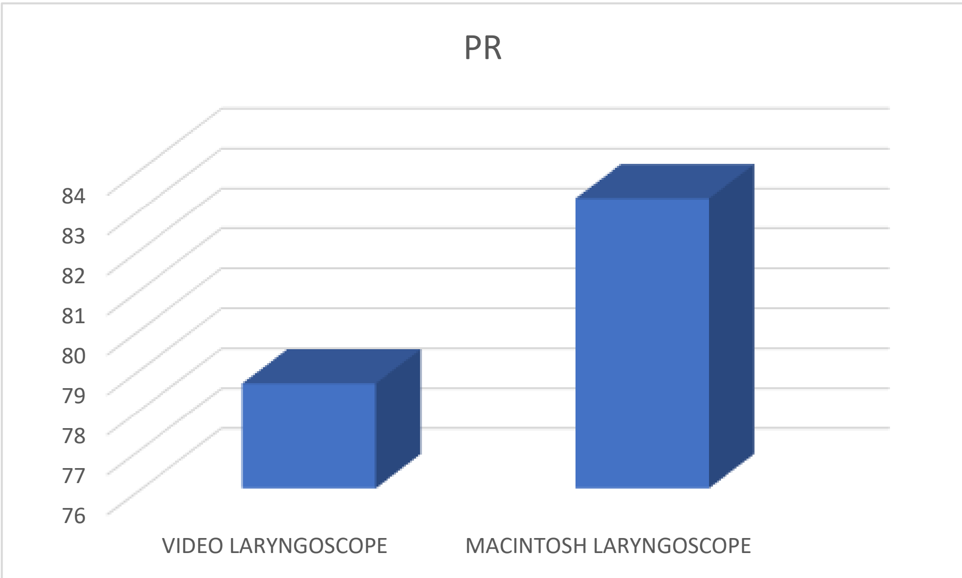

Figure 2: Pulse rate comparison

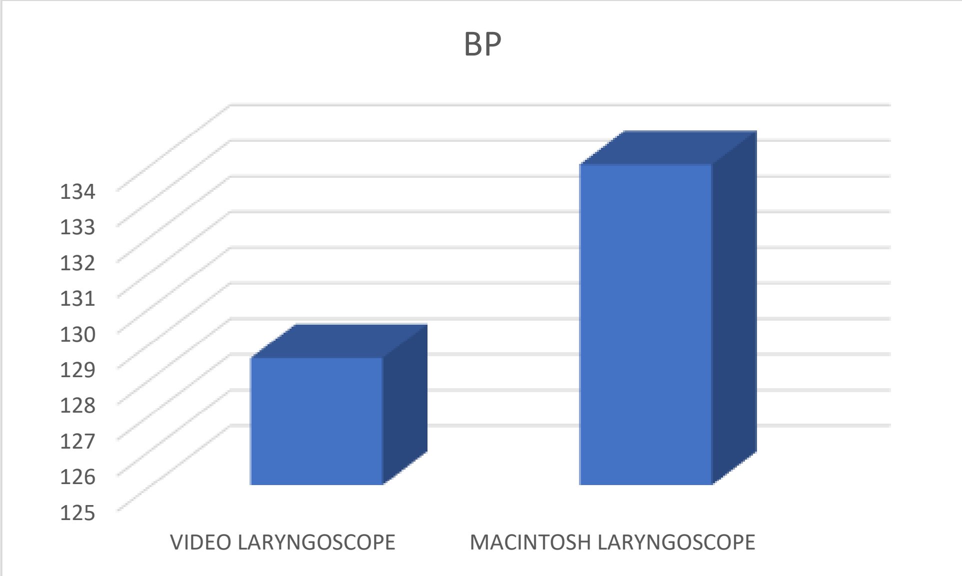

Figure 3: Blood pressure comparison

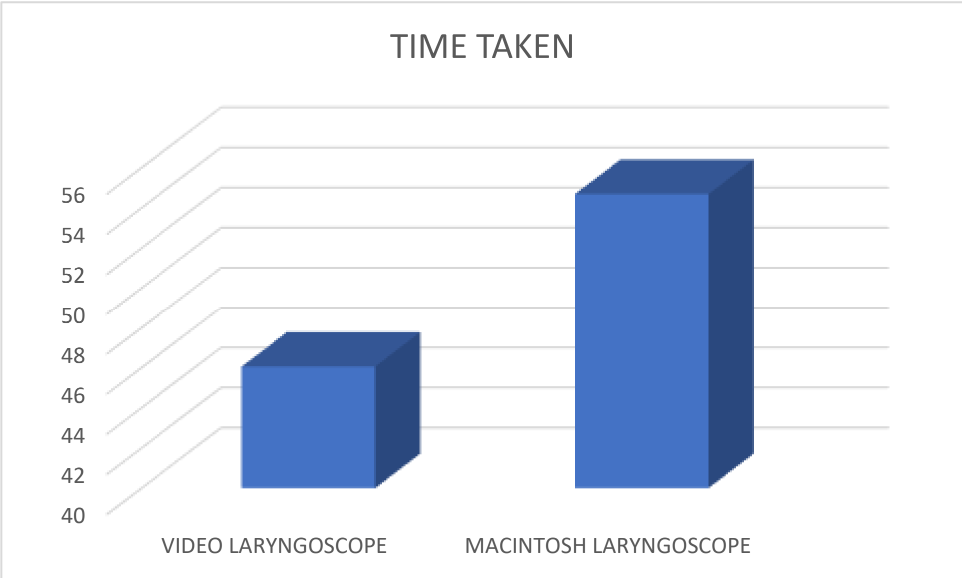

Figure 4: Intubation time comparison

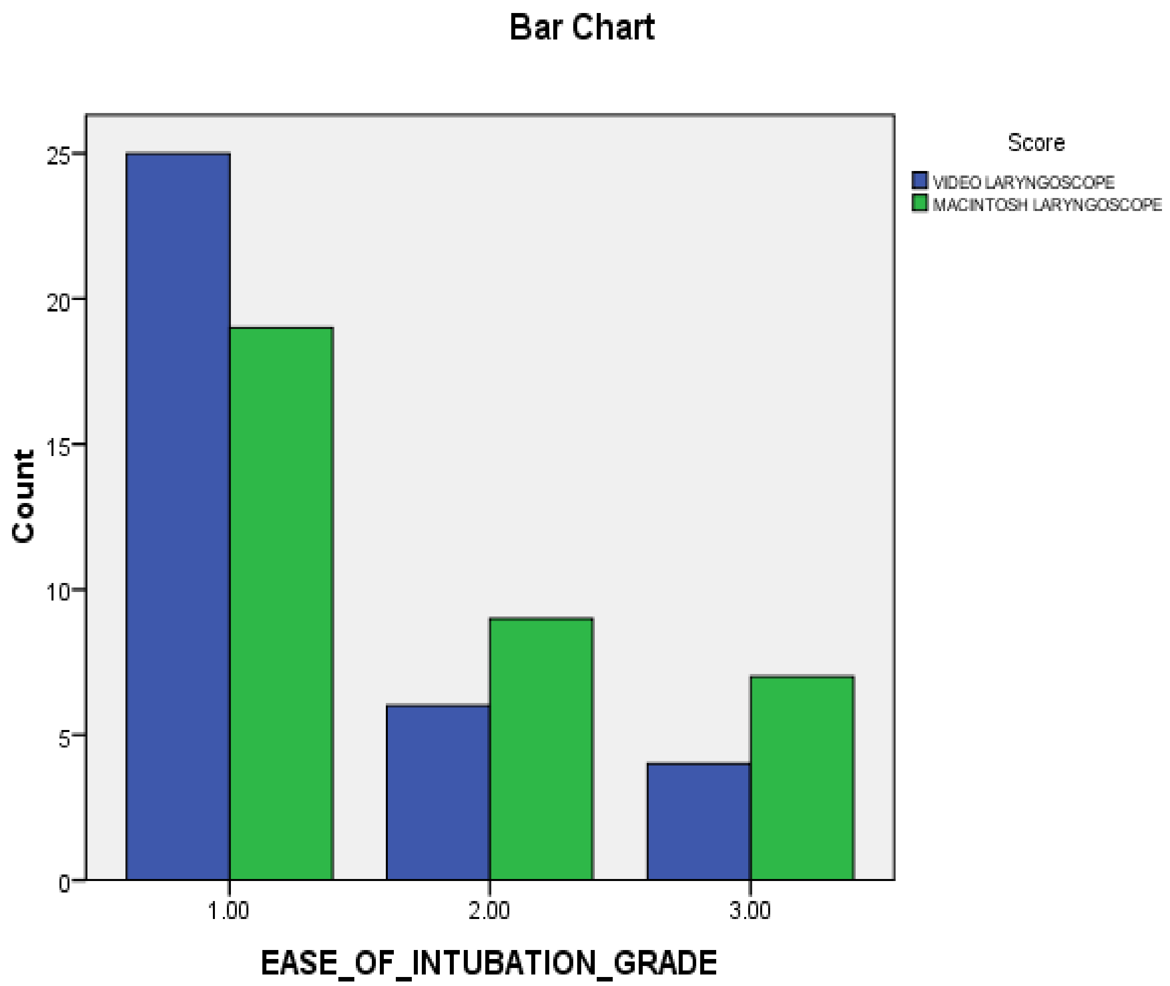

Figure 5: Ease of intubation grades

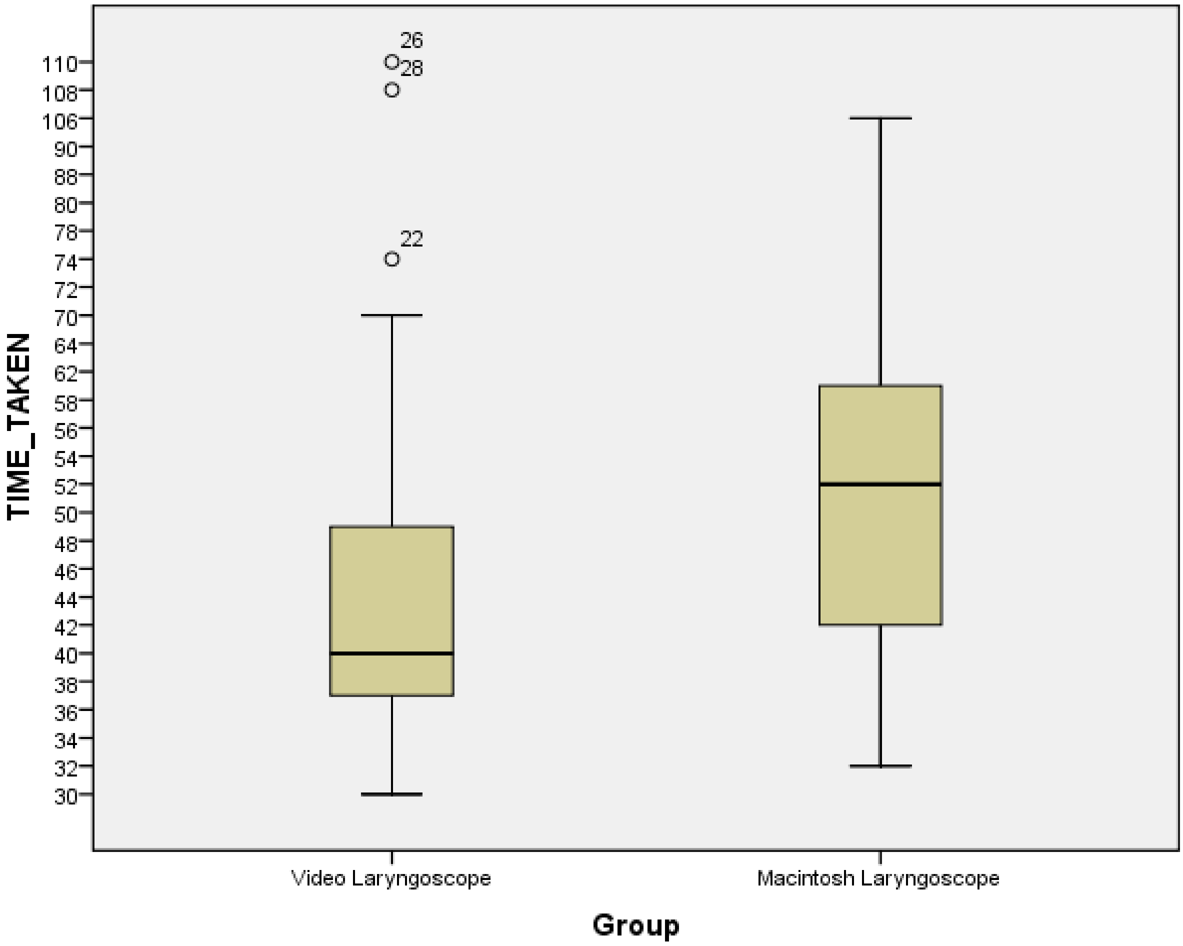

Figure 6: Intubation time distribution

Discussion

In this randomized controlled study, we compared video laryngoscopes (VL) with Macintosh laryngoscopes (ML) in adult patients with anticipated difficult airways, specifically those classified as Mallampati class III and IV. What we found was that VL offered several practical advantages over ML. These were most noticeable in intubation time, ease of tube placement, glottic visualization, hemodynamic response, and airway-related complications. Overall, the results point toward VL as a sensible first choice when a difficult airway is expected.

One of the clearest outcomes was the shorter time to successful intubation in the VL group. Longer laryngoscopy is not just inconvenient; it increases the risk of hypoxia, sympathetic stimulation, arrhythmias, and myocardial ischemia. Cutting down intubation time is therefore clinically important, especially in patients with limited physiological reserve. Our findings support those of Aziz et al.[3] and Lewis et al. [5], who found that VL leads to faster intubation and higher first-pass success. Earlier reports suggested that intubation times were longer because of unfamiliarity and the learning curve. However, growing experience has mostly addressed this issue. In our practice, using VL regularly has made intubation easier and less stressful for both the patient and the operator.

Glottic visualization is another area where VL showed clear advantages. Although the differences in Cormack-Lehane grade and POGO score between groups were not statistically significant, patients in the VL group needed fewer optimization maneuvers and reported greater ease with intubation. Indirect visualization lowers the need for excessive lifting force and external laryngeal manipulation, which likely explains these results. Hansel et al.[6] also noted better CL grades and fewer failed intubation rates with VL. For anaesthesiologists, this means fewer repeated attempts and a safer overall experience for patients.

Hemodynamic responses during laryngoscopy are important signs of stress and cardiovascular strain. In our study, patients intubated with ML had higher heart rate and blood pressure responses compared to those intubated with VL. The reduced sympathetic response with VL is linked to less forceful laryngoscopy and lower stimulation of supraglottic structures. Sarkılar et al.[11] and Sansone P et al.[12] reported similar findings, emphasizing the potential benefits of VL in patients with cardiovascular issues. This reduction in stress response is especially important for patients with limited cardiac reserve.

We saw fewer intubation attempts and a reduced need for maneuvers like BURP or bougie assistance in the VL group, although these differences were not statistically significant. Fewer attempts are important because they lower the risk of airway swelling, mucosal damage, and pain after surgery. In our group, patients who were intubated with VL had less sore throat and hoarseness. This supports findings from Trabelsi Y et al.[13] and Lewis et al.[5], who noted less airway problems with VL. Better visibility and less force during laryngoscopy likely led to less airway injury.

No cases of significant airway or laryngeal trauma occurred in either group, which shows that both devices are safe when used by experienced anesthesiologists. However, the better visualization from Videolaryngoscope adds an extra layer of safety. This is especially important for patients with signs of anticipated difficult intubation. In practice, this results in fewer repeated attempts and a lower risk of hypoxia or airway injury.

Our findings align with current guidelines. The Difficult Airway Society[7&14] recommends using VL early in expected difficult airway situations. The American Society of Anesthesiologists[8] also sees VL as a vital part of difficult airway plans. By showing these advantages in elective surgical patients, our study adds region-specific evidence to support these guidelines.

Limitations

We understand that this study has some limitations. It took place in one tertiary care hospital with a relatively small number of patients, so the results may not represent what occurs in other centers. The anaesthesiologists who carried out the intubations were already familiar with video laryngoscopy, and that experience may have influenced the outcomes, particularly the shorter intubation times. Because the devices look very different, blinding was not possible, and this inevitably introduces some bias. We also excluded emergency cases, rapid sequence intubations, and patients with severe airway pathology. In practice, this means our findings cannot be applied directly to urgent or high-risk situations. Another point worth mentioning is that some of the secondary outcomes did not reach statistical significance, most likely because of the limited sample size. Larger, multicenter studies, especially those including emergency scenarios, would be useful to confirm whether the benefits we observed apply to various populations and clinical settings.

Conclusion

In conclusion, our study reveals the advantages of video laryngoscopy over the Macintosh laryngoscope in patients with likely difficult airways. We found that VL offered clearer views of the glottis, shortened intubation times, and improved the chances of success on the first try. Patients required fewer adjustment techniques, and many experienced less discomfort afterward, such as a sore throat. Importantly, the hemodynamic responses were similar in both groups. This indicates that VL does not add extra physiological stress.

What stood out to us in daily practice was how much smoother intubations felt when VL was used. Repeated attempts were less common, and the process seemed less stressful for both patient and anaesthesiologist. When our findings are considered alongside evidence from other studies, the case for VL becomes stronger. It should be regarded as a first-line device whenever a difficult airway is expected. Making VL part of routine anaesthetic practice has the potential to improve patient outcomes and reduce airway-related complications, especially in populations where difficult airway predictors are frequently encountered.

Declaration of competing interest:

Authors declare there is no conflict of interest

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