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Safety and Efficacy of Linscope Versus King Vision Video Laryngoscopes for Tracheal Intubation Under General Anesthesia

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ABSTRACT
Securing the airway through tracheal intubation is a critical component of anesthesia management, with failed intubation being a significant cause of anesthesia-related morbidity and mortality. This study aims to compare the efficacy, safety and hemodynamic responses associated with the use of Linscope and Kingvision video laryngoscopes in patients undergoing elective surgeries under general anesthesia. In this randomized controlled trial, 70 patients aged 20-50 years, with an ASA Grade I or II and a BMI = 30, undergoing elective surgery requiring endotracheal intubation, were enrolled. Participants were randomly allocated to intubation using either the Linscope (n = 35) or Kingvision (n = 35) video laryngoscope. The primary outcome was intubation time, while secondary outcomes included the success rate of intubation, number of intubation attempts, ease of intubation, hemodynamic changes pre and post-intubation and postoperative complications. Both groups were comparable in terms of demographic characteristics. The mean intubation time was 20.34±3.09 seconds for the Linscope group and 19.45±2.42 seconds for the Kingvision group, with no statistically significant difference ($p>0.05$). First-attempt success rate was 100% in both groups. The requirement for optimization maneuvers was significantly higher in the Linscope group ($p<0.001$). Hemodynamic responses showed an immediate increase in heart rate post-intubation in the Kingvision group but differences in mean arterial blood pressure were not significant. Postoperative complications were minimal and comparable between the groups. The Linscope and Kingvision video laryngoscopes are equally effective for tracheal intubation under general anesthesia, demonstrating high success rates and minimal complications. While the Kingvision laryngoscope showed a slight advantage in terms of fewer optimization maneuvers and less hemodynamic variability, both devices present viable options for anesthesia providers. Further studies are recommended to explore the utility of these devices in different patient populations and more challenging airway management scenarios.

INTRODUCTION

The management of the airway is a cornerstone of safe anesthesia practice, with the primary objective of securing a clear path for ventilation and oxygenation. Despite advances in techniques and equipment, the inability to intubate the trachea remains a significant cause of anesthesia-related morbidity and mortality, leading to outcomes as severe as death or brain damage in up to 85% of difficult airway cases. The challenge of tracheal intubation is further underscored by the reported incidence of difficult intubation ranging between 1.15-3.8% in the general population, and failed intubation occurring in 0.13-0.3% of cases. These statistics highlight the critical need for reliable and effective tools and techniques to manage the airway, especially in challenging situations[1-4].

Traditional techniques of airway management have relied heavily on direct laryngoscopy, which requires the alignment of the oral, pharyngeal, and tracheal axes to visualize the glottic opening. However, this alignment is not always achievable, leading to the development of alternative techniques aimed at improving intubation success rates. Among these, video laryngoscopy has emerged as a significant advancement, offering the ability to visualize the glottis indirectly via a miniature video camera. This technology provides a promising solution to the limitations of direct laryngoscopy, particularly in cases where anatomical challenges or patient conditions complicate airway management[5-9].

Video laryngoscopes, with their diverse specifications, user interfaces and geometries, have been designed to accommodate the familiar procedural framework of direct laryngoscopy while minimizing its limitations. By allowing clinicians to bypass the need for direct line-of-sight, these devices potentially reduce the incidence of difficult and failed intubations. Moreover, the advent of video laryngoscopy has introduced a new paradigm in airway management, where the choice of device may be tailored to the specific needs and preferences of the clinician and the anatomical and clinical circumstances of the patient[10-12].

In light of these considerations, our study aims to critically assess the performance of two contemporary video laryngoscopes. By comparing the Linscope and Kingvision video laryngoscopes across various parameters-including intubation time, success rate, ease of intubation, hemodynamic responses and complication rates we seek to provide evidence-based insights into their efficacy and safety. This study, conducted is grounded in the pursuit of enhancing patient safety and outcomes in anesthesia practice through the innovative use of video laryngoscopy technology.

Aim and Objectives:

- To compare the efficacy and safety of the Linscope and Kingvision video laryngoscopes in facilitating tracheal intubation under general anesthesia in elective surgery patients
- Investigate the hemodynamic responses and need for optimization maneuvers during tracheal intubation with Linscope and Kingvision video laryngoscopes

Study Design and Setting: This randomized control study was meticulously conducted at the Department of Anaesthesiology and Critical Care. The research spanned from 2017-2019, following stringent ethical approval from the institutional ethical committee of JN Medical College and the Board of Studies of the Department of Anaesthesiology. With a commitment to uphold the highest standards of research integrity and patient welfare, written informed consent was obtained from all participating patients.

Participant Selection: The study population comprised 70 patients scheduled for elective surgery under general anesthesia, necessitating endotracheal intubation. Eligibility criteria were carefully defined to include patients aged 20-50 years, of both genders, with an ASA (American Society of Anesthesiologists) Grade I or II, a Body Mass Index (BMI) of 30 or below, and encompassing all Mallampati (MP) classes. Exclusion criteria were rigorously set to ensure patient safety and validity of results, excluding individuals with compromised airway anatomy or conditions posing a risk of pulmonary aspiration.

Randomization and Group Allocation: Participants were randomized into two groups using a computer-based random number generator, with allocation details sealed in envelopes to ensure blinding until consent was obtained. Group A (n = 35) underwent intubation with the Linscope videolaryngoscope, while Group B (n = 35) used the Kingvision videolaryngoscope. This randomized allocation was pivotal in mitigating selection bias and ensuring comparability between groups.

Anaesthetic Technique: The study adhered to a uniform anaesthetic protocol to minimize confounding variables. Premedication was standardized across both groups, incorporating intravenous injections of Midazolam, Ondansetron and Fentanyl. Monitoring was comprehensive, including ECG, pulse rate, SpO2, NIBP and EtCO2, using equipment from Nihon Kohden. Induction and neuromuscular blockade protocols were meticulously followed, ensuring a consistent baseline for comparing the performance of the two videolaryngoscopes.

Intubation Technique: The intubation technique was carefully standardized for both devices. The Linscope videolaryngoscope was introduced along the midline of the mouth, while the Kingvision videolaryngoscope utilized a channelled blade approach. A two-handed jaw thrust maneuver was employed with both devices to facilitate a clear airway passage. Intubation attempts, time and any optimization maneuvers were precisely recorded, adhering to clear definitions to maintain consistency in data collection.

Learning Curve and Observer Training: To ensure proficiency with each videolaryngoscope, a preparatory phase allowed the intubating clinician to surmount the learning curve through practice intubations on manikins and in live patients, fostering skill acquisition and consistency in device handling.

Outcome Measures: The study's primary endpoint was intubation time, with secondary outcomes including the success rate of intubation, ease of intubation, POGO scoring, hemodynamic responses, and incidence of complications. These outcomes were meticulously measured and analyzed, providing a comprehensive evaluation of the videolaryngoscope's performance.

Statistical Analysis: Data were analyzed using the latest version of SPSS and Microsoft Excel, employing appropriate statistical tests based on the nature of the data and the study design. Continuous data were analyzed using unpaired t-tests, while categorical data were examined with Fisher's exact test. A significance level of $p<0.05$ was established a priori for all analyses.

RESULTS

The primary focus of this study was on assessing the efficacy, safety and hemodynamic responses associated with the use of Linscope and Kingvision video laryngoscopes in a clinical setting. The findings presented are the culmination of a rigorous examination of these key aspects, aimed at providing clear insights into the comparative performance of these two advanced airway management devices.

This Table 1 establishes the foundational demographic profile of the participants across both groups. Age presents as 34.00±8.68 years for the Linscope group and 31.05±8.41 years for the Kingvision group, indicating a youthful middle-aged cohort without significant age differences between the groups. Gender distribution is nearly balanced, with a slightly higher proportion of females in both groups, represented as 37.14% male and 62.86% female in the Linscope group versus 42.85% male and 57.14% female in the Kingvision group. The BMI averages at 23.70±3.18 kg m^{-2} for Linscope users and 24.92±3.49 kg m^{-2} for Kingvision users, reflecting a generally healthy population. Mallampati Class distribution, an indicator of potential airway management difficulty, was similarly distributed across both groups, showcasing diverse airway anatomies without statistical disparity.

Performance metrics offer a direct comparison of the laryngoscope's efficiency in intubation. The average intubation time was 20.34±3.09 seconds for the Linscope group and slightly less for the Kingvision group at 19.45±2.42 seconds, reflecting high efficiency with no statistically significant difference. The first attempt success rate stood at a commendable 100% for both devices, illustrating their reliability. POGO scores, which quantify glottic visibility, were 87.85±10.31 for Linscope and slightly lower for Kingvision at 83.57±11.41, indicating good visibility with both laryngoscopes, though not differing significantly.

Hemodynamic stability is crucial for patient safety during intubation. The Linscope group showed a pre-induction HR of 92.35±7.29 bpm and a post-intubation HR of 93.64±9.59 bpm, indicating minimal disturbance. The Kingvision group started at a slightly lower HR of 87.80±9.64 bpm but experienced a more noticeable increase post-intubation to 101.37±8.00 bpm. MABP readings before and after intubation remained stable across both groups, with the Linscope group showing a pre-induction MABP of 93.76±10.43 mmHg and the Kingvision group at 90.60±7.24 mmHg, both groups demonstrating resilient hemodynamic stability through the procedure. Optimization maneuvers, required to facilitate successful intubation, were significantly different between groups. The Linscope group saw 0% not requiring any maneuvers, while 22.85% of the Kingvision group managed without additional interventions. This indicates a more straightforward intubation process with the Kingvision laryngoscope in some cases.

Postoperative complications were minimal across both groups, underscoring the safety of both devices. The incidence of sore throat was 0% for Linscope and 8.57% for Kingvision, blood on ETT was observed in 5.71% of the Linscope group and 14.28% for Kingvision, and hoarseness occurred in 8.57% of Linscope users versus 2.86% of Kingvision users. Despite these occurrences, the majority of patients in both groups (Linscope: 77.14%, Kingvision: 71.42%) experienced no complications, reflecting the overall safety of both video laryngoscopes (Table 2-5).

DISCUSSIONS

The critical importance of effective airway management in anesthesia cannot be overstated, given its direct correlation with patient safety and outcomes. The inability to secure the airway, leading to failed intubation, is a significant contributor to anesthesia-related morbidity and mortality, with

Table 1: Demographic characteristics of participants

Characteristic	Linscope group (n = 35)	Kingvision group (n = 35)	p-value
Age (years, mean ± SD)	34.00±8.68	31.05±8.41	>0.05
Gender (M:F)	13:22	15:20	>0.05
BMI (kg/m², mean ± SD)	23.70±3.18	24.92± 3.49	>0.05
Mallampati Class	I:II:III:IV = 15:19:1:0	I:II:III:IV = 14:19:2:0	>0.05

Table 2: Intubation performance metrics

Metric	Linscope goup	Kingvision goup	p-value
Intubation time (seconds, mean±SD)	20.34± 3.09	19.45±2.42	>0.05
First Attempt Success Rate	100%	100%	-
POGO Score (mean±SD)	87.85±10.31	83.57±11.41>0.05	

Table 3: Hemodynamic responses pre and post-intubation

Time Point	Parameter	Linscope group (mean±SD)	Kingvision group (mean±SD)	p-value
Pre-Induction	HR (bpm)	92.35±7.29	87.80±9.64	>0.05
	MABP (mmHg)	93.76±10.43	90.60±7.24	>0.05
Post-Intubation	HR (bpm)	93.64±9.59	101.37±8.00	<0.01
	MABP (mmHg)	94.91±8.17	97.42±8.25	>0.05
5 Minutes Post	HR (bpm)	94.11±7.15	93.42±6.90	>0.05
	MABP (mmHg)	95.08±5.44	91.85±6.83	>0.05

Table 4: Optimization maneuvers required

Maneuver Required	Linscope group (n)	Kingvision group (n)	p-value
None	0	8	<0.001
One Maneuver	29	27	-
Two Maneuvers	6	0	-

Table 5: Postoperative complications

Complication	Linscope group (n)	Kingvision group (n)	p-value
Sore Throat	0	3	>0.05
Blood on ETT	2	5	>0.05
Hoarseness	3	1	>0.05
No complication	27	25	-

reports indicating that such complications result in death or brain damage in up to 85% of cases. The prevalence of difficult intubation in the general population is noted to be between 1.15-3.8%, with failed intubation being even rarer, occurring in 0.13-0.3% of cases.13 The traditional approach of direct laryngoscopy, while considered the gold standard in airway management, often encounters limitations due to the need for alignment of the oral, pharyngeal and tracheal axes, prompting the exploration of alternative methods.

The development of video-laryngoscopes represents a significant advancement in this context, offering the ability to visualize the glottis indirectly, thus circumventing some of the challenges associated with direct laryngoscopy[13-15]. Our study was designed to assess the performance of these two video laryngoscopes in a clinical setting, involving 70 patients who met specific inclusion criteria. The utilization of the jaw thrust maneuver, as noted by Corda *et al*.[16], was integral to our methodology, enhancing glottic visualization with both devices. This technique underscores the evolving strategies in airway management, aiming to maximize the efficacy of tools like the Linscope and Kingvision laryngoscopes.

Our investigation into device performance revealed no significant difference in the primary outcome of intubation time between the two laryngoscopes, challenging the findings of previous studies that suggested differences in efficiency among various devices[17-22]. This suggests that both the Linscope and Kingvision laryngoscopes are capable of achieving comparable clinical outcomes. Notably, our study highlighted a higher requirement for optimization maneuvers with the Linscope laryngoscope compared to the Kingvision. This finding points to potential differences in device design and user interface that may impact their ease of use and efficiency in clinical practice.

The assessment of hemodynamic changes post-intubation revealed significant within-group differences, particularly an increase in heart rate immediately following intubation, which aligns with known physiological responses to laryngoscopy and intubation[23,24]. However, the comparison between the two devices showed less hemodynamic variability with the Kingvision, suggesting its potential for a smoother intubation process.

Complications were minimal and comparable across both groups, reinforcing the safety profile of these video laryngoscopes. This aspect is crucial, as minimizing postoperative discomfort and complications is a key goal in anesthesia and airway management.

Limitations: Our study's limitations, including the inability to blind the anesthesiologist to the device used, underscore the challenges inherent in clinical research. The stud's findings are primarily applicable to elective surgical patients and may not be generalizable across all potential airway management scenarios. Future research should aim to broaden the scope of

inquiry, exploring the performance of these devices in more diverse patient populations and challenging intubation scenarios.

CONCLUSION

In conclusion, the Linscope and Kingvision video laryngoscopes have demonstrated satisfactory performance in tracheal intubation under general anesthesia. Both devices were highly effective, with no significant differences in intubation time, success rates, or complications. However, the Kingvision laryngoscope required fewer optimization maneuvers and was associated with less hemodynamic variability, suggesting slight advantages in certain clinical situations. As the field of airway management continues to evolve, further studies are needed to validate these findings and explore the full potential of new technologies in enhancing patient safety and outcomes in anesthesia.

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