Original Article

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Anaesthesia Section

Comparison of Video Laryngoscopy and Direct Laryngoscopy during Endotracheal Intubation: A Randomised Controlled Trial

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ABSTRACT

Introduction: Intubating the trachea and securing the airway always remains an unavoidable challenge for the anaesthesiologist. For Direct Laryngoscopy (DL) and tracheal intubation, the Macintosh laryngoscope has been the gold standard device. With the advent of Video Laryngoscope (VL) in the recent times, it has been one of the major advances in anaesthesia practice.

Aim: To compare the VL {Tuoren (TVL)} versus the Direct Laryngoscope (DL) (Macintosh) for routine airway management.

Materials and Methods: This single-blinded, randomised controlled trial was conducted at Shija Hospitals and Research Institute, Imphal, Manipur, India from April 2021 to March 2022. A total of 100 patients of American Society of Anaesthesiologists (ASA) grades I and II, aged between 18 to 60 years, posted for planned elective surgery under General Anaesthesia (GA), were randomly allocated into two groups (n = 50 each): Group VL and Group DL. Various airway parameters, haemodynamic parameters and airway related complications were assessed and compared using Unpaired t-test for quantitative variables and Chi-square test for qualitative variables. A p-value of <0.05 was considered statistically significant.

Results: Both groups were comparable in demographic characteristics (age group: in Group VL 34.36±11.49 years vs in Group DL 33.52±11.11 years, p-value=0.98, gender: p-value=0.54, ASA grading: p-value=0.76). The duration of intubation was more in Group VL (25.81±6.29 seconds) as compared to Group DL (11.96±3.96 seconds). There was a statistically significant better Modified Cormack and Lehane (MCL) grading view obtained in Group VL as compared to Group DL (p-value=0.01). The Intubation Difficulty Score (IDS) was significantly lower in Group VL as compared to Group DL (p-value=0.04).

Conclusion: Tuoren VL provided a better glottic view and a lower IDS compared to the Macintosh laryngoscope, despite requiring a longer time for intubation. While haemodynamic parameters were comparable overall, the use of the Tuoren VL was associated with a statistically significant increase in Systolic Blood Pressure (SBP) and Mean Arterial Pressure (MAP) at one minute after intubation. Airway related complications were not encountered in either group.

Keywords: Airway management, Laryngoscope, Trachea

INTRODUCTION

Securing a definitive airway through endotracheal intubation is a cornerstone of anaesthetic practice and critical care medicine. Despite being a daily, routine procedure for anaesthesiologists, it remains an unpredictable and unavoidable challenge [1]. The clinical stakes are exceptionally high: failure to manage the airway effectively can precipitate a cascade of adverse events, ranging from minor soft-tissue trauma to catastrophic outcomes such as severe hypoxia, irreversible brain damage and death. Epidemiological data indicates that most of these anaesthetic mishaps occur during the induction phase rather than during extubation, highlighting the critical nature of the initial transition to a secured airway [2].

For over eight decades, the Macintosh laryngoscope has served as the "gold standard" for DL and tracheal intubation [3]. Its design necessitates the physical alignment of the oral, pharyngeal and laryngeal axes to achieve a direct line of sight to the glottis. The forceful displacement of the tongue and epiglottis required to visualise the vocal cords triggers a profound sympathetic "stress response" [4]. This stimulation often results in significant haemodynamic fluctuations, including transient hypertension and tachycardia, alongside elevated intracranial and intraocular pressures.

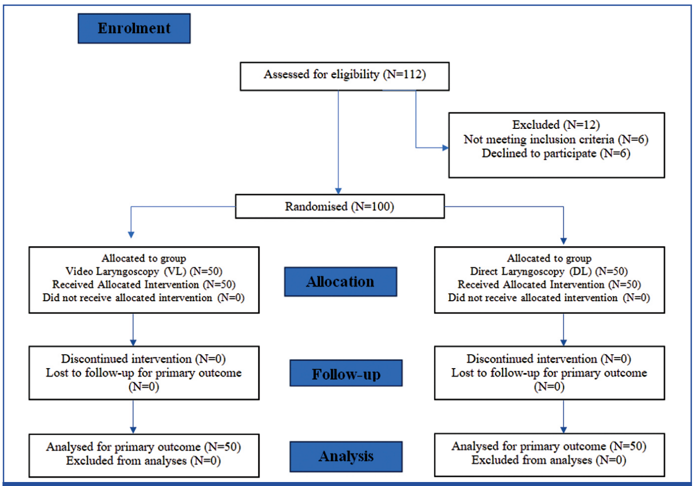
While healthy patients may tolerate these physiological shifts, individuals with significant co-morbidities-such as coronary artery disease, poorly controlled hypertension or cerebrovascular pathology-are particularly susceptible to these deleterious effects. Furthermore, the physical pressure exerted by the rigid Macintosh blade carries the inherent risk of local trauma, including vocal cord oedema, pharyngeal lacerations and dental damage. Consequently, various pharmacological and mechanical methods to attenuate these pressor responses have been extensively scrutinised in the literature [5-7].

The advent of VL represents one of the most significant technological leaps in modern anaesthesia. By integrating high-resolution digital cameras and LED lighting at the distal tip of the blade, these devices allow for a "grade 1" view of the glottis without requiring the aggressive anatomical alignment necessitated by DL. This "around the corner" visualisation typically requires less physical force and may offer a more stable haemodynamic profile during intubation [8-10].

Extensive comparative research has been conducted on established VL platforms, including the GlideScope, Airtraq, C-MAC, Truview and McGrath [11-13]. These studies have generally demonstrated that VL provides superior glottic visualisation as measured by the MCL grading, higher first-pass success rates-especially in anticipated difficult airways- and a reduced IDS compared to the Macintosh blade [14,15].

Despite the proliferation of VL studies, a notable gap remains in the literature regarding the performance of the TVL. Most existing research has focused on the "first generation" or high-cost proprietary systems, while newer, more portable and cost-effective alternatives like the Tuoren remain under-represented [16,17]. Preliminary observations suggest that the Tuoren device may offer comparable, if not superior, ergonomics and visualisation capabilities, yet rigorous, prospective data to support its widespread adoption is lacking [17]. Furthermore, while many studies focus purely on the "view" (visualisation), there is a paucity of data that simultaneously evaluates the haemodynamic footprint and the time-to-intubation specifically for the Tuoren device in a general surgical population [18-20].

To address these gaps, a randomised controlled trial was designed to compare the clinical performance of the TVL against the traditional Macintosh DL. The study was structured to provide a comprehensive evaluation of the Tuoren device's efficacy and safety profile. The primary objectives were to compare the duration of intubation, the visualisation of the airway using MCL grading, and the IDS between the TVL group and the Macintosh DL group. The secondary objectives were to compare the magnitude of haemodynamic responses (Heart Rate (HR), SBP, Diastolic Blood Pressure (DBP), and MAP) and devices' safety profile, specifically the incidence of airway related complications between these two groups.



[Table/Fig-1]: Sample allocation in different groups.

MATERIALS AND METHODS

This single-blinded, randomised controlled trial was conducted at Shija Hospitals and Research Institute, Imphal, Manipur, India from April 2021 to March 2022. In the present study, the participants were blinded. Institutional Ethics Committee (IEC) approval was obtained before the start of the study as per the reference number IEC/SHRI/APL/21. Informed written consent was obtained from all participants.

Inclusion criteria: Adult patients aged between 18-60 years, of either gender and belonging to ASA grades I and II, undergoing elective surgery under GA and Mallampati grades I and II were included in the study.

Exclusion criteria: Patients with ASA grades III or higher, known history of difficult intubation or aspiration or pregnant women with uncontrolled hypertension or type II diabetes mellitus or cardiac disease were excluded from the study.

Sample size calculation: The study of Panwar N et al., observed that mean duration of tracheal intubation in indirect laryngoscopy was 18.50±11.25 seconds and in DL was 11.76±4.44 seconds [21]. IDS was 0 in indirect laryngoscopy in 68% and in DL in 20% of patients. Taking these values as reference, the minimum required sample size, with 80% power of study and 5% level of significance, was 26 patients in each study group.

The sample size was calculated using the formula:

$$N>=\frac{2(\text{standard deviation})^2}{(\text{mean difference})^2} \text{ X } (Z\alpha+Z\beta)^2$$

Where $Z\alpha$ is value of Z at two-sided alpha error of 5% and $Z\beta$ is value of Z at power of 80% and mean difference is difference in mean values of two groups.

Calculation:

$$N>=\frac{2(8.552079)^2 \text{ X } (1.96+0.84)^2}{(6.74)^2}>=25.24=26 \text{ (approx.)}$$

So, to reduce the margin of error, total sample size taken was 100 (50 patients per group).

Study Procedure

Randomisation: A total of 112 potential participants were screened for eligibility, of which 12 were excluded (not meeting inclusion criteria: N=6; declined to participate: N=6). The remaining 100 participants were randomised to either the Video Laryngoscopy (VL) group or the DL group in a 1:1 ratio. The randomisation sequence was generated using an online computer program to ensure an equal allocation ratio [Table/Fig-1].

Participant enrolment and the acquisition of informed consent were managed by a designated research assistant who was independent of the clinical procedures. To ensure strict allocation concealment, the assignment sequence was maintained by this assistant using Sequentially Numbered, Opaque, Sealed Envelopes (SNOSE). The Primary Investigator (PI) remained blinded to the group allocation until the participant was fully recruited, baseline characteristics were documented, and the patient was positioned in the operating theatre. The research assistant only opened the envelope to reveal the assigned airway device to the PI immediately prior to the procedure.

To minimise detection bias, the following measures were implemented: a separate, independent observer recorded the duration of intubation using a stopwatch, and the MCL grading was simultaneously verified by a second consultant anaesthesiologist.

All the patients were preoxygenated with 100% oxygen through a face mask for 3 minutes. GA was induced with Intravenous (i.v.) administration of propofol 2 mg/kg and muscle relaxation achieved with succinylcholine 2 mg/kg. Maintenance of anaesthesia was achieved with a mixture of sevoflurane (1-2%, minimum alveolar concentration, MAC) as inhalational anaesthetic agent, oxygen and air in the ratio 1:2 and muscle relaxation with atracurium 0.5 mg/kg IV. After adequate depth of anaesthesia and complete muscle relaxation had been achieved, laryngoscopy and intubation were carried out using TVL or Macintosh laryngoscope, according to the group they were allocated.

The primary endpoints were to determine the duration of the intubation procedure, to determine IDS [15] and to compare the visualisation of airway between the two groups using MCL grading [22]. Duration of intubation (in seconds) was defined as the time from insertion of the assigned intubating device (VL or DL) into the mouth up to the time the tracheal tube was positioned between vocal cords.

The secondary endpoints were to compare haemodynamic stability during the insertion of the endotracheal tube between the two groups and to assess the incidence of any airway related complications. Haemodynamic parameters including HR, SBP, DBP, and MAP were recorded at the following intervals: baseline (just before premedication), after induction (after propofol administration), one minute postintubation, and five minutes postintubation. Furthermore, any airway related complications associated with the intubation process, such as dental damage, lip or mucosal trauma, bleeding, oesophageal intubation, or oxygen desaturation, were monitored and documented for both groups.

STATISTICAL ANALYSIS

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean±SD. The data analysis was done using Statistical Package for the Social Sciences (SPSS) version 21.0. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected, then non parametric test was used. Statistical tests were applied as follows: Quantitative variables were compared using Unpaired t-test between the two groups. Qualitative variables were compared using Chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

Both groups were comparable regarding demographic characteristics with no significant differences in age group, gender distribution and ASA grading [Table/Fig-2].

Parameters	Group DL	Group VL	χ^2	p-value
Age groups (years)	33.52±11.11	34.36±11.49	0.15	0.98
Gender (Male/Female)	24/26	21/29	0.36	0.54
ASA Grade(I/II)	44/6	43/7	0.08	0.76

[Table/Fig-2]: Comparison of patient demographics between Group DL (Direct Laryngoscopy) and Group VL (Video laryngoscopy).
Values were presented as mean±SD or numbers; Test used was Chi-square test; p-value <0.05*statistically significant; p-value <0.001** statistically highly significant

The two groups were evaluated for comparing the duration of intubation and it was statistically highly significant (p<0.0001), longer in Group VL when compared to Group DL [Table/Fig-3].

Duration of intubation (in seconds)	Group DL	Group VL	p-value
	Mean±SD	Mean±SD	<0.0001**
	11.96±3.96	25.81±6.29	
t-test=13.17			

[Table/Fig-3]: Comparison of duration of intubation between Group DL and Group VL.
Test used was Unpaired t-test; **p-value statistically highly significant

Laryngoscopic view was assessed by MCL grading. The MCL grading comparison was statistically significant (p-value=0.01) showing higher MCL grade in Group DL in comparison to Group VL (combination of MCL grades IIa and IIb) IDS was compared between DL and VL groups. There was significantly reduced tracheal intubation difficulty scoring in Group VL (p-value=0.04) [Table/Fig-4].

	Grade/score	Group DL N (%)	Group VL N (%)	χ^2 test	p-value
MCL grade	I	30 (60)	40 (80)	8.47	0.01*
	IIa	17 (34)	5 (10)		
	IIb	3 (6)	5 (10)		
IDS	0	28 (56)	37 (74)	6.05	0.04*
	1	18 (36)	13 (26)		
	2	4 (8)	0 (0)		

[Table/Fig-4]: Comparison of Modified Cormack-Lehane (MCL) Grade and Intubation Difficulty Score (IDS) between Group DL and Group VL.
Test used was Chi-square test; * p-value statistically significant

The HR and SBP were measured before premedication (baseline), after induction, and at one minute and five minutes after intubation. The HR changes were not statistically significant between the two groups at any time interval. The SBP changes were also not statistically significant between the two groups, except at one minute after intubation, where the increase was statistically significant (p-value=0.02) [Table/Fig-5].

The DBP and MAP were measured before premedication (baseline), after induction, one minute five minutes after intubation. The DBP changes were not statistically significant between the two groups. The MAP changes were not statistically significant between the two groups except at one minute after intubation (p-value=0.03) which was statistically significant [Table/Fig-6].

Regarding safety outcomes, no airway related complications associated with the intubation process including dental damage, lip or mucosal trauma, airway bleeding, oesophageal intubation or oxygen desaturation (SpO_2 <90%), were encountered in either the VL or DL groups.

Parameters	Time	Group DL Mean±SD	Group VL Mean±SD	p-value
HR	Baseline	84.62±15.43	82.76±15.20	0.54
	After induction	82.02±14.31	80.88±14.02	0.68
	1 minute	84.06±15.15	85.78±15.71	0.57
	5 minutes	80.12±15.38	80.10±15.58	0.99
SBP	Baseline	126.48±17.70	130.14±15.27	0.27
	After induction	107.80±13.28	111.90±16.98	0.18
	1 minute	121.0±15.88	129.48±20.64	0.02*
	5 minutes	111.08±17.52	114.90±15.04	0.24

[Table/Fig-5]: Comparison of Heart Rate (HR) and Systolic Blood Pressure (SBP) between Group DL and Group VL.
Test used was Unpaired t-test; *p-value statistically significant

Parameters	Time	Group DL Mean±SD	Group VL Mean±SD	p-value
DBP	Baseline	74.78±12.35	77.14±11.26	0.32
	After induction	61.62±8.84	65.18±11.56	0.08
	1 minute	70.54±11.75	74.72±13.10	0.09
	5 minutes	65.38±11.01	64.86±9.50	0.80
MAP	Baseline	92.01±13.07	94.80±11.40	0.25
	After induction	77.01±9.43	80.75±12.31	0.09
	1 minute	87.36±12.20	92.97±14.35	0.03*
	5 minutes	80.61±12.56	81.54±10.41	0.68

[Table/Fig-6]: Comparison of Diastolic blood pressure (DBP) and Mean Arterial Pressure (MAP) between Group DL and Group VL.
Test used was unpaired t-test; * p-value statistically significant

DISCUSSION

In the present study, the Tuoren VL (TVL) was assessed and compared with the Macintosh laryngoscope for orotracheal intubation in an adult population, 18-60 years of age, regarding laryngoscopic view, duration of intubation, IDS, haemodynamic changes and airway related complications. The present study showed that TVL provided a better glottis view when compared with the Macintosh laryngoscope in the adult population. The IDS was less with Group VL, but time to intubation was more as compared to Group DL. There was no statistically significant difference in haemodynamic variables between the two groups except at one minute after intubation, in which SBP and MAP were higher in the Group VL. No airway related complications were recorded in either group.

It was observed that the TVL significantly improved glottic visualisation, with 40 patients (80%) in the VL group achieving MCL Grade I, compared to 30 patients (60%) in the Group DL. This statistical significance (p-value=0.01) aligns with several comparative studies where video laryngoscopy consistently outperformed DL in visualisation quality. These findings are consistent with the significant improvements in MCL grading reported by Bag SK et al., (p-value=0.00), Parasa M et al., (p-value=0.0016), and Samal RL et al., (p-value=0.025) [23-25]. The specialised optical system of the Tuoren blade likely enables this enhanced "around the corner" view without requiring the strict anatomical alignment of the oral, pharyngeal and laryngeal axes.

Despite the superior view, the present study found that the duration of intubation was significantly longer with the Group VL (25.81±6.29 seconds) than with the Group DL (11.96±3.96 seconds; p-value <0.0001). This result is supported by the data, which shows a universal trend across multiple studies where Group VL took longer than Group DL, including Parasa M et al., (45.70±11.64 vs. 27.77±5.1 seconds) and Timanaykar RT et al., (33.06±5.6 vs. 23.11±5.7 seconds) [24,26]. This delay is attributed to the indirect nature of the visualisation, which requires different hand-eye coordination than traditional methods, as well as the overall greater clinical experience most practitioners have with the Macintosh blade.

Interestingly, while the time to intubation was longer, significantly reduced IDS were recorded in the Group VL (p-value=0.04), with 74% of patients having an IDS of 0 compared to 56% in the Group DL. This outcome matches the findings of Panwar N et al., (p-value=0.0001) and Bharti N et al., (p-value=0.01) who also demonstrated that TVL significantly reduces the complexity of tracheal intubation [21,27]. These results suggest that while the TVL may take longer to navigate, it provides a more reliable and less strenuous pathway to a secured airway.

Regarding haemodynamic stability, the TVL did not offer a clear advantage over the Macintosh laryngoscope, as parameters like HR and DBP remained largely similar between groups. A statistically significant, though unexplained, increase in SBP and MAP was observed in the Group VL exactly one minute after intubation (p-value=0.02 and p-value=0.03, respectively). The overall results are consistent with Kamewad AK et al., and Inangil G et al., who found that haemodynamic values remained similar between Groups-VL and-DL at nearly all time points [8,28]. This suggests that the improved visualisation provided by the TVL does not necessarily translate to an attenuated sympathetic stress response during induction in the general adult population.

In the present study, no airway related complications were encountered; this was likely due to the exclusion of patients with Mallampati Grades III and IV and those with a history of difficult intubation, as these factors are known predictors of increased technical difficulty and associated trauma [1].

Limitation(s)

Firstly, the study was single blinded, as blinding the laryngoscopist was not practically possible. Secondly, an overall lesser experience of using TVL as compared to Macintosh laryngoscope may have contributed to the longer duration of intubation time. Fogging of lens in Tuoren was another factor contributing for longer intubation time. Thirdly, the study was limited to ASA I and II grade patients and patients with difficult airway were not included in the study.

CONCLUSION(S)

The present study demonstrated that the TVL provides a significantly superior glottic view and lower technical difficulty, as measured by IDS, compared to the Macintosh laryngoscope in adults. However, this improved visualisation did not translate into a faster procedure; the duration of intubation was significantly longer in the TVL group. While haemodynamic parameters were comparable overall, the use of the TVL was associated with a statistically significant increase in SBP and MAP at one minute after intubation. There was no evidence that the TVL attenuates the sympathetic stress response during induction. While the TVL is a reliable tool for enhancing airway visualisation, practitioners should be prepared for a slightly more time-consuming process compared to traditional DL. Both VL and DL provided comparable safety profiles, with no airway related complications observed during the study period. Ultimately, the TVL serves as an effective alternative for securing the airway, offering a more predictable and less strenuous intubation experience.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

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