Original Article

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Anaesthesia Section

Videolaryngoscopy versus Direct Laryngoscopy for Endotracheal Tube Placement in Patients Undergoing Emergency Surgical Procedures: A Prospective Observational Study

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ABSTRACT

Introduction: Endotracheal intubation during the induction of general anaesthesia is a routine procedure in the operating room. Traditionally, this procedure has been accomplished using Direct Laryngoscopy (DL) with the Macintosh blade for adults and the Miller blade for children. However, advancements in laryngoscopy techniques have led to the development of Video Laryngoscopes (VL), which have markedly improved the success rates for tracheal intubation in emergency situations and for difficult airways.

Aim: To compare the intubation characteristics using VL and direct laryngoscopes for emergency surgical procedures.

Materials and Methods: This prospective observational study was conducted in the Department of Anaesthesiology at SKIMS, Soura, Srinagar, Jammu and Kashmir, India, from October 2022 to September 2024. A total of 118 patients of either gender, undergoing emergency surgical procedures, were divided into two groups: Group I (intubated with direct laryngoscope) and Group II (intubated with VL). Each group comprised 59 patients. The efficiency of both techniques was assessed in terms of intubation time, ease of intubation, number of attempts, use of a gum elastic bougie, or external laryngeal manipulation, along with any associated complications. The compiled data were exported to the data editor of Statistical Package for the Social Sciences (SPSS) Version 20.0 and subjected to appropriate statistical analysis. A p-value of <0.05 was considered statistically significant.

Results: This study included 118 patients of either gender, aged >18 years, with American Society of Anesthesiologists (ASA) Class I to III, undergoing emergency surgeries. The patients were distributed into two groups: Group I (DL) and Group II (VL), with 59 patients in each group. The mean age of patients in Group I was 47.9±17.68 (mean±SD) years, while in Group II it was 42.9±17.32 (mean±SD) years. The mean glottic visualisation time was shorter for Group I (DL) compared to Group II (VL) (12.8 seconds vs. 13.6 seconds; p-value=0.523). The mean tracheal intubation time was 25.5 seconds in Group I and 27.8 seconds in Group II (p-value=0.322). A greater number of patients in Group I were classified as having a Cormack-Lehane (CL) grade III compared to Group II (27.1% vs. 10.2%; p-value=0.046). Additionally, a greater number of patients in Group I experienced difficult laryngoscopy compared to Group II (27.1% vs. 10.2%; p-value=0.018). A higher proportion of patients in Group I required external laryngeal manipulation for intubation compared to Group II (47.5% vs. 11.9%; p-value <0.001).

Conclusion: We observed that VL provides better glottic visualisation and superior ease of intubation compared to the direct laryngoscope. Significantly less external laryngeal manipulation was required for visualising the larynx. We can conclude that VL offers definitive advantages over conventional DL for the management of both difficult and routine airways.

Keywords: Airway management, Glottis, Intubation, Video recording

INTRODUCTION

Endotracheal intubation is the preferred method for managing the airway during general anaesthesia and in critical care situations. It enables the delivery of anesthetic gases and oxygen without gastric insufflation, allows for pulmonary toileting, facilitates the administration of medications, and reduces the risk of aspirating gastric contents [1]. Securing the airway during the induction of general anaesthesia through endotracheal intubation is a routine procedure in the operating room. Traditionally, this has been accomplished using DL with the Macintosh blade for adults and the Miller blade for children. Over the years, advancements in laryngoscopy techniques have led to the development of VLs, which have markedly improved the success rates of tracheal intubation in emergency situations, as well as enhancements in glottic exposure [2].

The aim of DL is to establish a clear line of sight from the operator's eye to the larynx. To achieve this, most patients are positioned with a 35 degree flexion of the lower cervical spine and head extension at the atlanto-occipital joint, creating a 15 degree angle between the facial plane and the horizontal, commonly referred to as the sniffing position [3,4].

However, DL is associated with complications such as dental injuries, postoperative sore throat, injuries to the oral and pharyngeal tissues, risk of aspiration, cardiovascular changes, and cervical spinal cord injuries [5,6]. In 1829, Benjamin Guy Babington introduced the first "glottoscope," which utilised a speculum (tongue depressor) and a mirror system to visualise the larynx using sunlight [7]. In 1998, Marcus Weiss advanced this concept by integrating fiberoptic technology into a direct laryngoscope with a Macintosh blade [8]. In 2001, John Pacey developed the first VL, known as the Glidescope®. Since then, the use of VLs has expanded significantly [9]. The ASA Difficult Airway Task Force recommends having a VL available as either a first-line or rescue device for all intubations [10].

VLs seem to offer certain advantages over conventional laryngoscopy during a variety of difficult airway situations. They facilitate the collaborative efforts of team members during airway management by displaying real-time glottic images on a screen. Additionally, VLs require less manipulation from the operator, leading to reduced strain on adjacent tissues and being technically less demanding [11-13].

Elective intubation in the operating room and securing the endotracheal tube in the emergency department represent distinct procedures. The incidence of difficult DL during emergency department intubations has been reported to be around 3.0% to 5.3% in the literature, with rates as high as 2% to 14.8% reported in some studies [14,15]. DL, requiring significant skill, can be especially challenging in emergency situations. Multiple attempts at intubation and extended intubation times may theoretically increase the risks of hypoxemia and aspiration [16]. Previous studies have demonstrated that VLs enhance glottic visualisation, a critical factor for effective airway management [17,18]. Our study aims to compare the UESCOPE® VL400, which is used at our institution, with the Macintosh laryngoscope for tracheal intubation in emergency surgical procedures. We seek to evaluate the efficiency and complication rates of both laryngoscopes in this context.

MATERIALS AND METHODS

This prospective observational study was conducted at the Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, India, over a period of 24 months from October 2022 to September 2024. Ethical clearance was obtained from the Institutional Ethics Committee, under reference number IEC/SKIMS Protocol #178/2023, and written informed consent was obtained from all the participants.

Sample size calculation: The sample size was calculated based on previous literature [19], with a required sample size of 118 patients.

Inclusion criteria: Patients aged more than 18 years, of either gender, with ASA physical status I, II, or III, undergoing emergency surgeries, were included in the study.

Exclusion criteria: Patients were excluded if they had airway trauma or bleeding, required an urgent surgical airway, presented with an anticipated difficult airway necessitating fiber optic intubation, or had known bleeding disorders. Among the 142 patients screened, 118 were included in the study, while 24 who failed to meet the eligibility criteria were excluded.

Study Procedure

Methodology and parameters studied: Patients who underwent direct laryngoscopy with the Macintosh laryngoscope were placed in Group 1 (DL), while those who underwent video laryngoscopy were placed in Group 2 (VL); each group comprised 59 patients. In our study, patients were intubated using an alternating sequence of the two techniques. Every odd numbered case was intubated with a direct laryngoscope, starting with the first patient enrolled in the study, while every alternate case was intubated with a VL. This alternating sequence of both techniques ensured that the anesthetist had no influence on the choice of laryngoscopy for a given patient, thereby eliminating bias. The UESCOPE VL400® was used for this study.

Patient characteristics and airway measurements were recorded preoperatively, including interincisor distance, thyromental distance, and hyomental distance [20]. The Modified Mallampati Score (MPS) of each participant was noted [21]. Upon arrival in the emergency theatre, standard monitoring (electrocardiogram, non invasive blood pressure, oxygen saturation, heart rate, end-tidal carbon dioxide) was instituted, and intravenous access was established. Anesthetic induction was standardised for the study subjects. Propofol (1.5 to 2.5 mg/kg) was administered intravenously for induction. For muscle relaxation, intravenous rocuronium (0.8-1.2 mg/kg) was used. Intubation was attempted 90 seconds after rocuronium administration and was performed by a senior anesthesiologist with more than three years of experience. Glottic exposure time was recorded, defined as the time from the cessation of oxygen supply until glottic exposure was achieved. The Cormack and Lehane grade (CML) was noted by the intubating anesthetist [22].

A cuffed PVC endotracheal tube with an inner diameter of 7.5 mm was used for adult female patients, while a size 8.0 mm inner diameter tube was used for adult males. Tracheal intubation time was recorded, defined as the time from the cessation of oxygen supply until confirmation on the capnograph with end-tidal carbon dioxide monitoring. The use of a gum elastic bougie and external laryngeal manipulation to facilitate intubation were also noted. The ease of intubation was assessed and graded as follows [20]:

- Grade I: No extrinsic manipulation of the larynx required;
- Grade II: External manipulation of the larynx necessary to intubate;
- Grade III: Intubation possible only when aided by a stylet;
- Grade IV: Failed intubation.

The number of intubation attempts required, any change of operator if needed, and any switch to an alternate mode of laryngoscopy in both groups were documented. Difficult laryngoscopy was defined as the inability to see any portion of the larynx (Cormack and Lehane III and IV). Difficult intubation was defined as requiring more than three attempts or taking longer than 10 minutes [23]. Post-intubation, an assessment was made for any oral mucosal, dental, pharyngeal, or laryngeal injuries.

STATISTICAL ANALYSIS

The recorded data were compiled and entered into a spreadsheet (Microsoft Excel) and subsequently exported to the data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD, while categorical variables were summarised as frequencies and percentages. Graphically, the data were presented using bar diagrams. The Shapiro-Wilk test was applied to assess the normality of the data. The Student's independent t-test or Mann-Whitney U-test, whichever was appropriate, was employed for comparing continuous variables. The Chi-square test or Fisher's exact test, whichever was suitable, was used for comparing categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic characteristics among the groups exhibited marked similarities and were comparable with respect to mean age, gender distribution, and MPS (p-value >0.05) [Table/Fig-1]. The baseline airway parameters, including interincisor distance, thyromental distance, and hyomental distance, were comparable between the two groups, with differences that were statistically non-significant (p-value >0.05) [Table/Fig-2]. The table indicates a better visualisation of the laryngeal structures with videolaryngoscopy, as demonstrated by the CML grading achieved (p-value=0.046). A greater number of subjects in the DL group experienced difficulty in intubation compared to the VL group (p-value=0.018). Fewer participants from the VL group required external laryngeal manipulation to visualise the laryngeal structures (p-value <0.001), and intubation was comparatively easier in the VL group than in the DL group (p-value=0.003). The remaining parameters in the

Parameters	Group-I (DL)	Group-II (VL)	p-value
Number (N)	59	59	-
Age in years mean±SD (Range)	47.9±17.68 (18-80)	42.9±17.32 (18-84)	0.129
Gender N (%) M/F	33 (55.9)/26 (44.1)	31 (52.5)/28 (47.5)	0.712
MPS (I/II/III/IV) N (%)	14 (23.7)/25 (42.4)/17 (28.8)/3 (5.1)	17 (28.8)/30 (50.8)/9 (15.3)/3 (5.1)	0.361

[Table/Fig-1]: Demographic characteristics of the study participants (N=118).

Parameters	Group-I (DL) Mean±SD	Group-II (VL) Mean±SD	p-value
Interincisor distance (cm)	4.18±0.413	4.24±0.409	0.434
Thyromental distance (cm)	6.27±0.375	6.19±0.524	0.315
Hyomental distance (cm)	5.24±0.625	5.37±0.716	0.276

[Table/Fig-2]: Baseline airway parameters in the two groups (N=118).

table were comparable between the two groups [Table/Fig-3]. A greater number of immediate intubation-related (dental and/or mucosal) injuries were noted in the DL group; however, the statistical significance was primarily related to mucosal injuries (p-value=0.013), while the occurrence of dental injuries between the two groups was statistically non-significant (p-value=0.496) [Table/Fig-4].

Parameters	Group-I (DL)	Group-II (VL)	p-value
Glottic visualisation time (sec.) Mean±SD	12.8±8.63	13.6±5.30	0.523
Tracheal intubation time (sec.) Mean±SD	25.5±16.09	27.8±7.62	0.322
Cormack Lehane grade I/II/ III N(%)	21 (35.59)/22 (37.28)/16 (27.11)	30 (50.84)/23 (38.98)/6 (10.16)	0.046*
Difficult laryngoscopy N (%) yes/no	16 (27.11)/43 (72.88)	6 (10.16)/53 (89.83)	0.018*
Use of gum elastic bougie N (%) yes/no	15 (25.42)/44 (74.57)	11 (18.64)/48 (81.35)	0.374
Use of external laryngeal manipulation N (%) yes/no	28 (47.45)/31 (52.54)	7 (11.86)/52 (88.13)	<0.001*
Ease of intubation N (%) Grade I/II/III	28 (47.45)/16 (27.11)/15 (25.42)	44 (74.57)/4 ((6.77)/11 (18.64)	0.003*
No. of intubation attempts N (%) 1/2/3/4	55 (93.2)/1 (1.7)/2 (3.4)/1 (1.7)	58 (98.3)/0 (0.0)/1 (1.7)/0 (0.0)	0.432
Difficult intubation N (%) yes/no	1 (1.7)/58 (98.3)	0 (0.0)/59 (100)	0.315
Change of operator required N (%) yes/no	2 (3.4)/57 (96.6)	1 ((1.7)/58 (98.3)	0.559
Change to alternative mode of laryngoscopy N (%)yes/no	1 (1.7)/58 (98.3)	0 (0.0)/59 (100)	1.000

[Table/Fig-3]: Intubation characteristics between the two groups (N=118).
*Statistically significant p-value <0.05
**Number of subjects

Immediate intubation injury	Group-I (DL) N (%)	Group-II (VL) N (%)	p-value
Dental injury	2 (3.4)	0 (0.0)	0.496
Mucosal injury	7 (11.9)	0 (0.0)	0.013*

[Table/Fig-4]: Immediate intubation related injuries (N=188).
*Statistically significant (p-value <0.05)

DISCUSSION

The present study aimed to compare DL with VL in terms of glottic visualisation and ease of intubation. We observed in the current study that the mean glottic visualisation time for the DL group was 12.8 seconds compared to 13.6 seconds in the VL group (p-value=0.523). Serocki et al., compared conventional laryngoscopy with video-assisted laryngoscopy and GlideScope, reporting no difference in the median time required to attain the desired laryngeal view between the three methods [24]. However, Kriege et al., reported that the mean time to glottic visualisation was significantly less in the VL group compared to the DL group (p-value <0.001) [25].

The mean time for tracheal intubation in the DL group was 25.5 seconds, compared to 27.8 seconds in the VL group (p-value=0.322). There is significant interstudy heterogeneity regarding tracheal intubation time with either method. These seemingly contradictory results may be due to multiple factors. Studies have either included or excluded non difficult airways, and intubation has been performed by either untrained or trained medical personnel [26]. Sulser et al., reported in their randomised clinical trial that the time to intubation was similar in the VL and DL groups (32±11 seconds vs. 31±9 seconds, p-value=0.51) [27]. These results are consistent with our study. Malik et al., reported similar intubation times across various laryngoscopes, although their study only included patients with predicted difficult intubation [28]. In contrast, Lim and Yeo reported that the intubation time was significantly shorter with video laryngoscopy than with DL [29]. Our study included both patients with predicted difficult airways and patients with normal airways, and intubation was performed by a senior anesthesiologist experienced in using both devices.

We observed a significant enhancement in glottic visualisation with VL (p-value=0.046). In Group 2 (VL), 50.8% of patients had CL grade I, compared to 35.6% in Group 1 (DL). CL grade II was observed in 39.0% of Group 2 patients and 37.3% of Group 1 patients. CL grade III was recorded only in 10.2% of Group 2 patients, compared with 27.1% in Group 1. We did not observe CL grade IV in any patient. These findings demonstrate that VL leads to improved glottic visualisation. Sulser et al., reported that the Cormack-Lehane score was significantly better when VL was used (p-value <0.001) [27]. Sun et al., also concluded that the use of VL provided a laryngeal view equal to or better than that with DL [30]. Many other studies have reported improved glottic visualisation with VL compared to the direct laryngoscope [24,28-32]. This improvement could be attributed to the camera positioning near the laryngoscope blade tip, providing an angle of view of 50-60°, compared to a 15-30° view obtained with the direct laryngoscope [33].

Our study reported a higher incidence of difficult laryngoscopy in patients who underwent DL compared to those who underwent video laryngoscopy (27.1% vs. 10.2%, p-value=0.018). Abhyankar et al., also noted a higher incidence of difficult laryngoscopy in the DL group; however, the difference was statistically insignificant [31]. This discrepancy may be due to Abhyankar et al., excluding anticipated difficult airways and emergency surgeries in their study [31].

The majority of patients in both groups (52.5% in the DL group and 88.1% in the VL group) did not require external laryngeal manipulation. However, among those who needed external laryngeal manipulation for tracheal intubation, a significantly higher number of patients were in the DL group (p-value <0.001), which can also be attributed to the higher prevalence of CL grade III with DL. Kriege et al., and Abhyankar et al., reported similar findings in their studies, where the Backward Upward Rightward Pressure (BURP) maneuver was needed in a significantly higher number of patients undergoing DL [25,31].

We observed in our study that a significantly higher number of patients intubated with VL achieved grade I ease of intubation, as per defined criteria, compared to the DL group (74.6% vs. 47.5%, p-value=0.003). A greater number of patients in the DL group had grade II (27.1% vs. 6.8%) and grade III (25.4% vs. 18.6%) ease of intubation. Abhyankar et al., also reported greater ease of tracheal intubation using VL [31].

Limitation(s)

The study faced several methodological constraints that warrant consideration when interpreting its results. The primary limitation was that the study was observational in nature and excluded patients who required urgent establishment of a definitive airway, such as those needing cardiopulmonary resuscitation. Therefore, the results of our study cannot be generalised to such patients. Additionally, we did not record data on hemodynamic changes as a result of laryngoscopy.

CONCLUSION(S)

We observed that VL provides better glottic visualisation and superior ease of intubation compared to the direct laryngoscope. VL requires significantly less external laryngeal manipulation for visualising the larynx, and it is associated with less soft tissue trauma. Hence, VL is a valuable tool for managing both difficult and routine airways in the operating room for emergency surgical procedures.

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