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Study of Video Assisted Laryngoscope versus Conventional Macintosh Laryngoscope for Management of Predicted Difficult Airway in Minor Elective Surgeries

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ABSTRACT

Background: Video laryngoscopy can manage predicted difficult airway as ordinary Macintosh laryngoscopy rather it does not require a line of sight to do the procedure.

Objective: The aim of this randomized clinical trial was to compare between video assisted laryngoscope and conventional Macintosh laryngoscope in management of predicted difficult airway.

Patients and Methods: Our study included sixty-six patients with predicted difficult airway prepared for elective minor surgery under general anesthesia. Patients were divided randomly into two equal groups; Group V: The video laryngoscope was used. Group M: a Macintosh laryngoscope was used. Laryngoscopic and intubation time were recorded as well as number of intubations attempts and failure rate. Additionally, Heart rate (HR) and oxygen saturation were recorded at different time intervals (baseline value, before intubation, at laryngoscopic time and at intubation time). Also, complications during intubation were recorded as hypoxemia <90 %, dental trauma and lip, gum and oral trauma.

Results: Video laryngoscope group was significantly longer regard laryngoscopy time and intubation time comparing to direct Macintosh group. Patients of direct Macintosh group had higher HR during laryngoscopy time and during intubation time. Oxygen saturation during intubation time was significantly lower among direct Macintosh group. Video laryngoscope group was significantly associated with less attempts, but failure rate was significantly higher among direct Macintosh group compared to video laryngoscope group.

Conclusion: Using video assisted laryngoscope in anticipated difficult intubated patients improves the quality of tracheal intubation and gives the best glottic view, but with longer laryngoscopic and intubation time.

Keywords: Video Assisted Laryngoscope, Conventional Macintosh, Difficult Airway management.

INTRODUCTION

The most critical stage in administering general anesthesia is intubation of the patient's airway. It keeps the airways open, ensures the safety of the procedure, and guards against aspiration damage to the lungs [(1)]. When numerous attempts, multiple operators, multiple devices, significant lifting effort, or external laryngeal manipulation are required to intubate the trachea, it is considered a difficult procedure [(2)]. To insert a flexible polyvinyl chloride tube into the trachea, direct laryngoscopy requires a series of operations, such as elongating the head and opening the mouth, dislocating and compressing the tongue, and elevating the mandible forward [(3)].

Poor glottic exposure may necessitate more efforts and be more time consuming, as well as posing a risk of problems [(4)]. Attempts to ventilate a patient with a difficult airway, such as intubation, on multiple trials may increase the risk of tissue trauma, hemorrhage, and mucosal edema (cannot ventilate, cannot intubate situation), There is a direct correlation between the number of laryngoscopic attempts and the rate of complications [(5)].

Similar to the standard Macintosh approach, a video assisted laryngoscope has been reported that it does not rely on a line-of-sight. Using a camera placed in the blade's underside, the picture is collected and relayed to a monitor, allowing for verifiable glottic exposure and video capture [(6, 7)]. Using a video aided laryngoscope necessitates less force (5-14 N) on the base of the tongue, which reduces the risk of triggering a stress reaction and injuring local tissue. Aside from reducing neck movements, this laryngoscope creates less cervical movement compared to a standard Macintosh laryngoscope. Several of the blades have a characteristic shape. An oropharyngeal and hypopharyngeal anatomy-like curvature allows for a more expansive view [(8)].

The aim of this study was to compare video-assisted laryngoscopy and the standard Macintosh laryngoscope regarding glottic view, time of intubation, number of intubation attempts and failure rate.

PATIENTS AND METHODS

Sixty-six patients undergoing minor elective surgery, at operating theatres, Faculty of Medicine, Zagazig University Hospitals.

Ethical considerations:

Zagazig University's Research Ethics Council approved the study (ZU-IRB#6837) as long as all participants signed informed consent forms and submitted them. We adhered to the Helsinki Declaration, which is the ethical form for human testing established by the World Medical Association.

Inclusion criteria:

Both genders patients aged more than 21 years who

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were admitted for minor elective surgery under general anesthesia with endotracheal intubation, their BMI <35 kg/m^2, physical status according to American Society of Anesthesiologists (ASA) class I and II, patients predictors of a difficult airway were present at the time of admission: (history, length of upper incisor, interincisor distance, overbite, temporomandibular joint limited movement, thyromental distance, cervical range of motion, neck circumference, Mallampati classification, palate shape)[9].

Exclusion criteria:

Emergency surgery and rapid sequence induction, significant risk of vomiting or aspiration, patients with advanced renal, hepatic, cardiovascular diseases or with diseases affecting joint mobility as rheumatoid arthritis and ankylosing spondylitis and suspected patients with difficult face mask ventilation. Preoperative evaluation and preparation of the patient the day before surgery and written informed consent was taken from each patient.

Intraoperative:

All patients were premedicated by midazolam 2.5 mg and atropine 0.5 mg immediately after insertion of IV line in patient preparation room then standard monitoring devices (automated oscillometric device for blood pressure, electrocardiography, pulse oximetry and capnography) were applied. Full monitoring including mean arterial blood pressure, heart rate, ECG, respiratory rate and peripheral oxygen saturation were recorded (as baseline readings).

Preoxygenation with 100% oxygen for 3 min was done before induction then general anesthesia was induced with fentanyl (2 μg/kg), propofol (2 mg/kg) and maintained with (end expiratory isoflurane) 2% , then after monitoring face mask ventilation, 0.6 mg/kg rocuronium was administered to paralyse the patients.

Computer generated randomization tables were used to divide the patients into two equal groups for intubation:

Macintosh group (M Group): A Macintosh laryngoscope with a left-handed grip and a right-handed opening mouth was employed assuming a stretched-out neck position. A 7.0-mm endotracheal tube for females and a 7.5-mm tube for males were used to access the larynx and expose the glottis. The use of external laryngeal pressure was documented if needed. Intratracheal tube position was confirmed by capnography curve over 4 breaths or more.

Video laryngoscope group (V Group): Left hand gripped the handle, right hand opened mouth to introduce video laryngoscope. An anti-reflective camera was used to view the plica glossoepiglottica, and a stylet was used to enter a tube into the plica.

Each time the laryngoscope was inserted into the mouth, it was recorded as a single laryngoscopic attempt. Laryngoscopic time was recorded from touching the laryngoscope till the best glottic view was achieved.

Intubation time was calculated from touching the endotracheal tube until cuff inflation of the inserted tube was documented in place. Also failure rate was considered if more than 2 attempts was needed.

Primary outcome (Assessment of quality of intubation):

Assessment of glottic view by Cormack-Lehane classification system (C and L) [10]**:** Grade I: Full view of the glottis. Grade IIa: Partial view of the glottis. Grade IIb: Arytenoids or posterior portion of the cords visible. Grade III: Only the epiglottis visible. Grade IV: Neither epiglottis nor glottis visible.

Secondary outcome (Assessment of hemodynamic response to intubation):

Heart rate, noninvasive mean arterial pressure (MAP) and oxygen saturation were recorded at different time intervals (baseline value (before induction), after induction (before intubation), at laryngoscopic time and at intubation time). Also, complications during intubation were recorded as: hypoxemia (oxygen saturation <90 %), dental trauma, lip, gum or oral trauma. Hemodynamic instability during intubation was recorded.

After intubation:

The patient was ventilated (tidal volume 6-8 mL/kg and I:E ratio 1:2.5). Ventilator parameters were adjusted to keep $EtCO_2$ 35-40 mmHg. Maintenance of anesthesia was done with isoflurane inhalation and muscle relaxant 0.1-0.2 mg/kg rocuronium if needed. I.V fluids were calculated and given.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Quantitative data were presented as mean± standard deviation and were compared by independent t-test. Qualitative data were presented as number and percentage and were compared by Chi-square test (X^2). P value 0.05 was considered statistically significant. It was judged highly significant when the P value was 0.001.

RESULTS

The study flow chart is shown in figure 1.

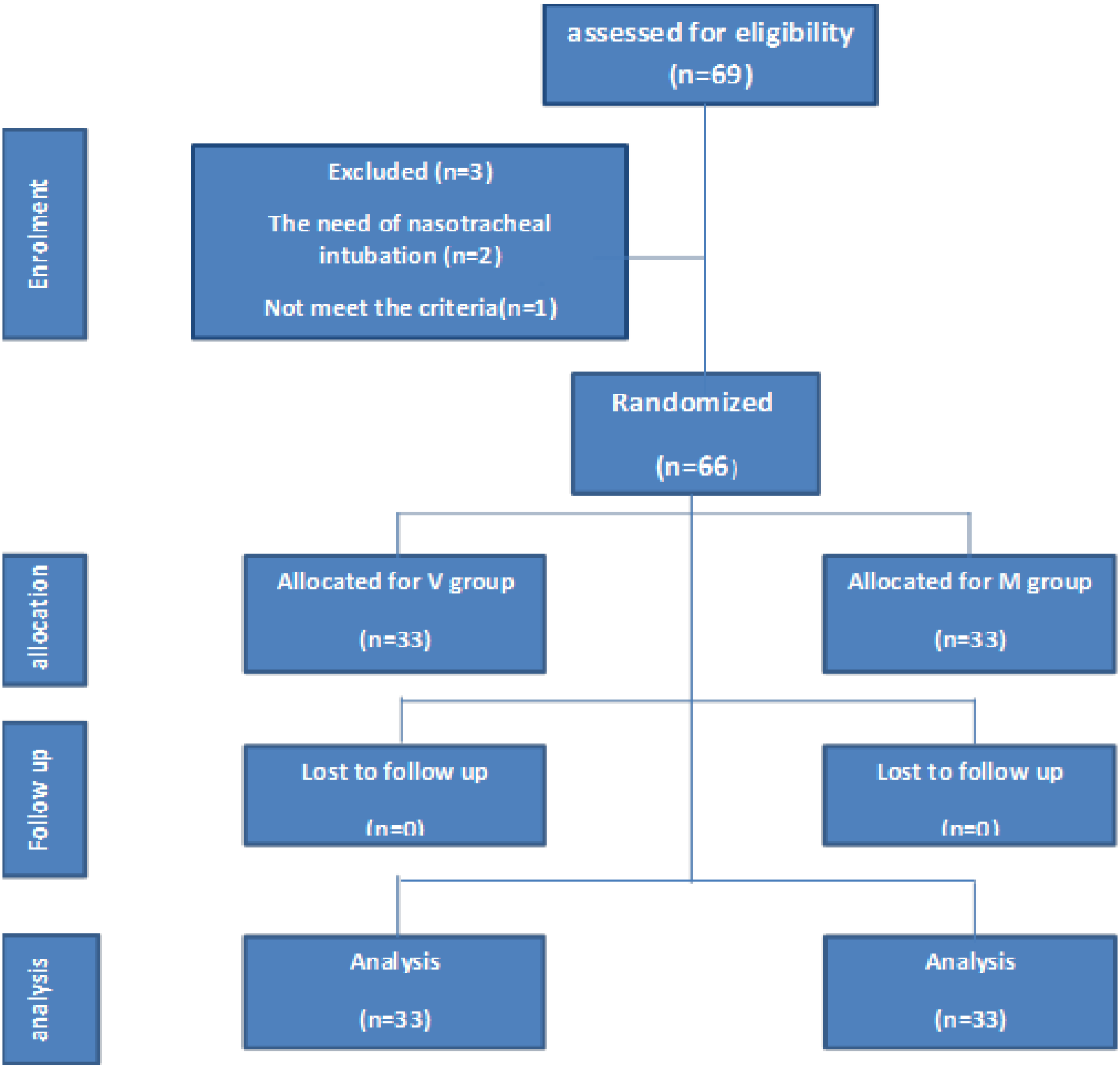

Figure (1): Study flow chart

Regarding patient characteristics (age, sex, body mass index), there was no significant difference between studied groups (**Table 1).**

Table (1): Patients' demographic and clinical information

			M Groupn=33	**V Groupn=33**	**t/X^2**	**P**
Age (years)			58.66±5.78	57.24±7.22	0.884	0.380
BMI (kg/m2)			31.73±2.69	31.57±1.07	0.300	0.765
Sex	**Female**	**N**	20	15		
		%	60.6%	45.5%		
	Male	**N**	13	18	1.52	0.22
		%	39.4%	54.5%		
Total		**N**	33	33		
		%	100.0%	100.0%		

Quantitative data were presented as mean± standard deviation, Qualitative data were presented as number and percentage

Glottic view was evaluated using Cormack and Lehane classification (C and L), patients of V group had the best glottic view, which was significantly better than M group **(Table 2).**

Table (2): Glottis view distribution between studied groups

			Type of laryngoscope		x^2	P
			M Groupn= 33	**V Groupn=33**		
Glottisview	**I**	**N**	3	17		
		%	9.1%	51.5%		
	II a	**N**	9	16		
		%	27.3%	48.5%		
	II b	**N**	13	0	32.76	<0.001**
		%	39.4%	0.0%		
	III	**N**	8	0		
		%	24.2%	0.0%		
Total		**N**	33	33		
		%	100.0%	100.0%		

**: Highly significant

Regarding predictors of difficult airway, there were no significant difference found between studied groups **(Table 3).**

Table (3): Predictor of difficult airway distribution between studied groups

			Type of laryngoscope		x^2	P
			M Group n=33	**V Group n=33**		
Predictor	**Mallampati III**	**N**	12	8		
		%	36.4%	24.2%		
	Mandibular space indurated by mass	**N**	3	2		
		%	9.1%	6.1%		
	Neck circumference > 40 cm	**N**	4	1	5.96	0.202
		%	12.1%	3.0%		
	Short neck	**N**	11	13		
		%	33.3%	39.4%		
	Thyromental distance <6 cm	**N**	3	9		
		%	9.1%	27.3%		
Total		**N**	33	33		
		%	100.0%	100.0%		

Regarding laryngoscopic and intubation time, they were significantly lower in patients of M group than patients of V Group **(Table 4).**

Table (4): Laryngoscopy time and Intubation time(in seconds) distribution between studied groups

	M Group n=33	V Group n=33	t	P
Laryngoscopy time (sec)	13.21±0.96	14.27±0.78	3.094	<0.001**
Intubation time(sec)	21.54±2.06	27.90±1.46	14.446	<0.001**

Data were presented as mean± standard deviation, **: Highly significant

V group demonstrated significantly less intubation attempts compared to M group **(Table 5).**

Table (5): Number of intubation attempts distribution between studied groups

			Type of laryngoscope		X^2	P
			M Group	**V Group**		
Number of attempts	**One time**	**N**	17	28		
		%	51.5%	84.8%		
	2 times	**N**	12	5		
		%	36.4%	15.2%	9.57	0.008*
	>2 times	**N**	4	0		
		%	12.1%	0.0%		
Total		**N**	33	33		
		%	100.0%	100.0%		

*: Significant

M group was significantly associated with failure rate about 12.1% versus no failure in V group **(Table 6).**

Table (6): Failure rate distribution between studied groups

			Type of laryngoscope		X^2	P
			M Group	**V Group**		
Failurerate	**Success**	**N**	29	33		
		%	87.9%	100.0%		
	Failed	**N**	4	0	4.25	0.039*
		%	12.1%	0.0%		
Total		**N**	33	33		
		%	100.0%	100.0%		

*: Significant

Regarding heart rate, patients of M group demonstrated significantly higher heart rate during laryngoscopic time and during intubation time than V group **(Table 7).**

Table (7): HR (beat/minute) at different time distribution between the studied groups

	M Group	V Group	t	P
HR at baseline(before induction) (b/min)	73.90±5.78	72.51±5.28	1.088	0.215
HR after induction(before intubation) (b/min)	72.33±4.87	70.96±8.17	0.823	0.414
HR during laryngoscopy time (b/min)	84.69±4.24	80.33±6.56	3.208	0.002*
HR during intubation time (b/min)	89.27±4.29	86.24±5.70	2.437	0.018*

Data were presented as mean± standard deviation, *: Significant

Regarding oxygen saturation there was no significant difference at any time between the two studied groups (Figure 2).

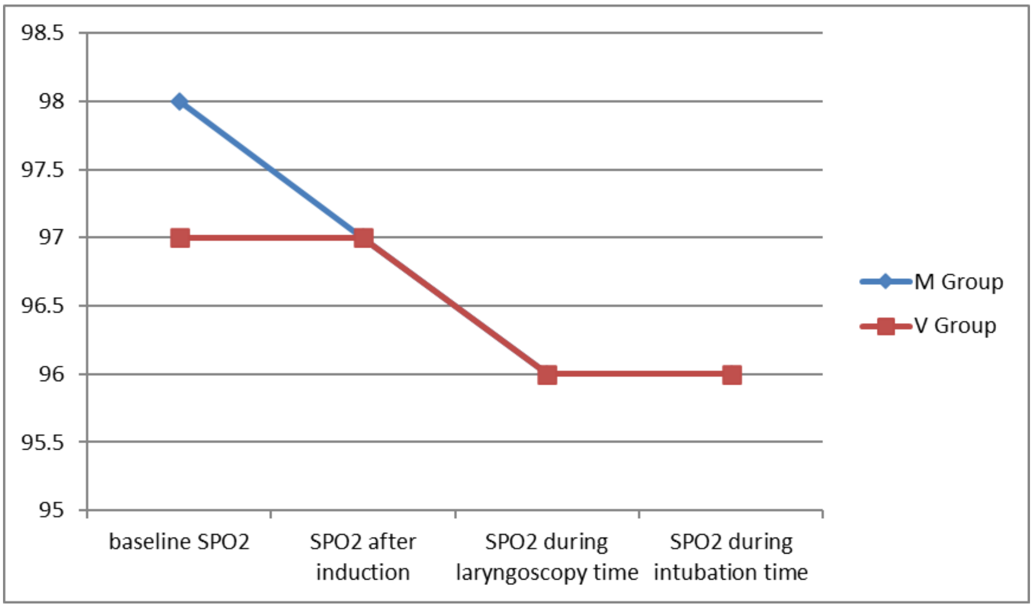

Figure (2): Oxygen saturation (%) of the studied groups before and after induction of general anesthesia

DISCUSSION

The current study was undertaken for evaluation of the quality of tracheal intubation with less complications in predicted difficult airway in patients undergoing minor elective surgery. It was designed to compare between video assisted laryngoscope and conventional Macintosh laryngoscope in patients >21 years, physical status ASA I and II and their BMI < 35 kg/m^2 without significant difference between the two studied groups in patients clinical characteristics.

According to predictors of difficult airway, **Aziz *et al.***[11] did a study that was designed to enroll 147 patients in Macintosh laryngoscope (DL) group and 149 patients in video laryngoscope (VL) group, they found that thyromental distance was< 6 cm in 8% of patients in DL group vs 19% of patients in VL group, obese neck was in 40% of patients in each group. Their study is similar to the present study in which thyromental distance <6 cm was in 9.1% in M group and 27.3% in V group and obese and short neck was in 45.4% in M group and 42.4% in V group.

Serocki, *et al.*[12] studied the glottic view using Cormack and Lehane classification between Macintosh laryngoscope and video assisted laryngoscope, 120 patients were enrolled in this study. They showed superior laryngoscopic view for video laryngoscope than direct laryngoscope, 30% of the patients had insufficient laryngoscopic views, which was concerning (C and L>III) in the case of a direct laryngoscopy (P<0.001). Contrary to this, C and L>III were only in 10.8% of the time did the video laryngoscope yield results (P<0.01). Results of their study were comparable to the present study in which 24.2 % of the patients showed insufficient glottic view in M group (c and L>III), while 0% of the patients showed glottic view C and L>III in V group, which was significantly associated with C and L I and IIa.

In the study by **Serocki *et al.***[12] the laryngoscopic time was not different between the two laryngoscopes, in contrast to the present study in which V group was significantly longer regard laryngoscopy time (14.27±0.8 sec) compared to M group (13.21±0.9 sec)**.**

Also in agreement with our study, **Malik *et al.***[13] did a study of 50 patients comparing video laryngoscope and direct laryngoscope, each group contained 25 patients considered to have qualities that make tracheal intubation more difficult, they found that intubation time by video laryngoscope was longer 17 (12-31s) compared to direct laryngoscope 13 (8-23s).

In contrast with our study regarding intubation time, **Bhat *et al.***[14] did a study which enrolled 100 ASA I and II patients, randomly allocated to direct or video laryngoscopy group. The time taken in direct laryngoscope group was 33.8 ± 9.12 s and in video laryngoscope group was 24.8 ± 8.5 s (P = 0.001). While in our study it was (21.54±2 versus 27.90±1.46).

In this study 29 of 33 patients were successfully intubated in M group and all patients in V group were successfully intubated (P=0.039). **Jungbauer and colleagues**[15] conducted a study in which 200 tracheal intubation attempts were done, 100 of which were successful. 99 intubations went well using video laryngoscopy, while 92 of them went well with direct laryngoscopy.

Regarding hemodynamic changes**, Pournajafian *et al.***[16] did a study to compare hemodynamic changes between direct and video laryngoscope, 95 patients were enrolled in this study in which there was no statistically significant difference between video laryngoscope group, and Macintosh group, in BP and HR 1, 3, and 5 minutes after tracheal intubation, which is similar to our study but the mean arterial pressure showed no significant difference between **M** group and **V** group at any time, and in contrast to our study in HR which was significantly higher in **M** Group during laryngoscopy time and during intubation time comparing to **V** group.

Lascarrou *et al.*[17] did a study which showed a lower oxygen saturation with video laryngoscopy (86%) than with direct laryngoscopy (95%), because video laryngoscopy may necessitate longer intubation procedures (221 seconds) vs (156 seconds) with direct laryngoscopy, in contrast with our study which found no statistically significant differences between the two groups tested.

CONCLUSION

Using video assisted laryngoscope in anticipated difficult airway improves the quality of tracheal intubation and gives the best glottic view. Also, it reveals lesser hemodynamic response to endotracheal intubation than direct Macintosh laryngoscope. Using video assisted laryngoscope had comparable results as regard number of intubation attempts and failure rate but with longer intubation time than direct laryngoscope.

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