Original Article

Video Laryngoscopic Endotracheal Intubation in Cardiac Operation Theater - Experience at a Peripheral Tertiary Healthcare Centre of Bangladesh

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Abstract:

Background: Endotracheal intubation is an essential primary skill for all anesthesiologists. For cardiac anesthesiologists rapid and proper intubation is more important as failure may cause serious consequences. Video laryngoscope provides a better real time view of the larynx, epiglottis and vocal cords. It also keeps the intubating anesthetist away from the patient as compared to conventional laryngoscopy. This may be very important in this COVID-19 era. To the best of our knowledge the Department of Cardiac Surgery and Cardiac Anesthesia of Chattogram Medical College & Hospital is the first center in Bangladesh to introduce video laryngoscope in cardiac OT. The objective of this study was aimed to compare the intubation time, hemodynamic response to laryngoscopy, success rates and operator's comfort using the conventional Macintosh laryngoscope and video laryngoscope in adult patients undergoing cardiac surgery.

Materials and Methods: A total of 60 adult patients were included in this comparative study, subjected to general anesthesia for cardiac surgery, intubated using either conventional Macintosh direct laryngoscope or video laryngoscope. Patients were intubated by 3 different consultant anesthesiologists with equal competency of our department.

Results: There was not much difference between Video laryngoscopy and conventional laryngoscopy in terms of intubation time and success rate. Video laryngoscopy exhibited less hemodynamic response to laryngoscopy and intubation; however, the difference was not statistically significant in this small group of patients. Operators were much more comfortable with Video laryngoscope than conventional laryngoscope particularly with the cases of difficult intubation because of the better glottic view with the former.

Conclusion: Video laryngoscope is preferred by cardiac anesthetists because of better glottic view.

Key Words: Video laryngoscope, Macintosh direct laryngoscope, Hemodynamic response, Intubation time.

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Introduction:

Anesthetic techniques have changed over the years to ensure safety and comfort of patients undergoing cardiothoracic surgery. Endotracheal intubation is an important maneuver routinely performed by the anesthesiologists in the operation theaters, intensive care units and in emergency departments. It is an

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essential primary skill for all anesthesiologists. For Cardiac Anesthesiologists, rapid and proper intubation is even more important as failure may cause serious consequences. Direct laryngoscopy has been the standard technique of endotracheal intubation for almost a century. But alternative intubation devices with video, optical or fiber optical imaging have seen to develop in the last two decades.

Traditionally, tracheal intubation is performed using direct laryngoscope. Video laryngoscope (VL) is an indirect laryngoscope, a new device that contains a miniaturized camera at the blade tip to indirectly visualize the glottis. Video laryngoscope was designed by Canadian vascular and general surgeon John Allen Pacey[1]. It has a high-resolution camera and light source embedded within the laryngoscope blade, which is bent through 60° at the midline and is available in four different sizes[1,2].

Video laryngoscope provides a better real time view of the larynx, epiglottis and vocal cords with much easier laryngeal exposure without alignment of the oral, pharyngeal and tracheal axis. By Video Laryngoscopy multiple doctors can observe the procedure at a time. Moreover, the regional supraglottic tissue tension which elicits a vagal response and stimulates cardio-accelerator fibers is less in case of video laryngoscopic endotracheal intubation. Considering its advantages over direct laryngoscopic endotracheal intubation, the Department of Cardiac Surgery of Chattogram Medical College Hospital is the first center in this region introduces this novel device in cardiac operation theater.

Objectives of the Study:

The objective of this comparative study was aimed to compare the intubation time, hemodynamic response to laryngoscopy, success rates and operator's comfort using the conventional Macintosh direct laryngoscope (ML) and video laryngoscope (VL) in adult patients undergoing cardiac surgery. In addition, this study would help to compare the success rate of endotracheal intubation in difficult cases by using the conventional Macintosh and the video laryngoscope.

Materials and Methods:

This study was conducted by the Department of Cardiac Surgery and Cardiac Anesthesia, Chattogram Medical College & Hospital between July 2019 and March 2020. After obtaining written informed consent, a total of 60 adult patients were randomly included in this prospective randomized comparative study, subjected to general anesthesia for cardiac surgery, were intubated using either conventional Macintosh direct laryngoscope (ML) or video laryngoscope (VL). Patients with known left main coronary artery disease, patients who needed rapid sequence intubation and patients with Mallampati class 4 airway score were excluded from this study. Patients were randomly allocated to two groups. Patients were intubated by 3 different consultant anesthesiologists with comparable competency of our department.

Pre-anesthetic checkup was done a day prior to the proposed day of surgery. According to standard protocol all patients were kept nil per orally and received premedication as required. Following arrival at the OT, patients were placed into supine position by placing a cushion under the head and connected to the standard monitors including ECG and pulse oximeter. Oxygen face mask was put with 5 liter of oxygen. After intravenous access and intra-arterial cannulation followed by placement of intra-arterial pressure monitoring line, setup was done with all standard facilities. All the patients were preoxygenated with 8-10 liters of 100% oxygen for 5 minutes. Anesthesia was induced with 0.05 mg/kg Midazolam, 1 ¼g/kg Fentanyl, 0.1 mg/kg Vecuronium bromide and titrated doses of Thiopental sodium was administered to facilitate endotracheal intubation and anesthetic depth. Ventilation was maintained with mask using 100% oxygen until tracheal intubation. Endotracheal intubation was attempted 3 minutes after the administration of Vecuronium bromide. In video laryngoscope (VL) group a "J" shaped stylet bent through 60° was inserted into the endotracheal tube (ETT) to facilitate intubation.

The parameters documented during the study were the intubation time (time to achieve endotracheal intubation), hemodynamic response to intubation, success rate of intubation and operator's ease (requirement of external laryngeal pressure to facilitate glottic visualization and the number of attempts required to secure the endotracheal tube). Intubation time was recorded as the time from the insertion of the laryngoscope blade into the mouth to the time the blade was removed from the mouth after successful intubation by using a stopwatch. Preinduction, preintubation, immediate postintubation and 3 minutes postintubation arterial blood pressures (ABP) and heart rates were recorded. If laryngoscopy exceeded 120 seconds or if the oxygen saturation dropped below 90% or if the handle of the laryngoscope was removed out of the mouth to facilitate proper insertion, intubation was stopped and bag-mask ventilation was commenced with airway tube. Patients were mask ventilated for 1 minute with 1% halothane in 100% oxygen between the attempts if repeated attempts for intubation were required. After successful intubation, the cuff of the ETT was inflated with air. Anesthesia was maintained with 1% halothane in 50% oxygen and 50% nitrous oxide.

Statistical analysis:

SPSS software (Version 23.0) was used to analyze the data. Mean and standard deviation were calculated for different parameters. Data were statistically described as frequency (number of cases) when appropriate. The observed results were analyzed using Student's *t*-test for quantitative data. P <0.05 was considered statistically significant.

Results:

A total of 60 patients were included in the study. The study population was divided into two groups: ML (Macintosh direct laryngoscope) and VL (video laryngoscope) group. 15 patients in ML group and 14 patients in VL group had Mallampati class 1 airway score. 11 patients in ML group and 10 patients in VL group had Mallampati class 2 airway score. 4 patients in ML group and 6 patients in VL group had Mallampati class 3 airway score [Table 1]. Patients of Mallampati class 4 airway score were excluded from this study. There was no statistical significant difference between the two groups regarding Mallampati class distribution.

Continuous data are expressed as mean +SD. P<0.05 was considered statistically significant. ML=Macintosh laryngoscope, VL= Video laryngoscope, SD= Standard deviation

The mean intubation time was less in group ML (33.63 + 2.98 seconds) compared to group VL (36.11 + 5.99 seconds). But the results were not statistically significant (P >0.05) [Table 2].

Data is expressed as mean +SD. P<0.05 was considered statistically significant. ML=Macintosh laryngoscope, VL= Video laryngoscope, SD= Standard deviation

Patients in ML group had a higher rise than VL group in mean systolic, diastolic, mean arterial pressures and heart rate immediately and 3 minutes after intubation but the difference was not statistically significant [Table 3, 4].

Data is expressed as mean +SD. P<0.05 was considered statistically significant. ML=Macintosh laryngoscope, VL= Video laryngoscope, SD= Standard deviation

Cormack-Lehane (CL) laryngoscopic view is used to describe the glottic view. Regarding CL laryngoscopic view significantly less number of patients had grade 1 CL laryngoscopic view in group ML (16 patients) as compared to group VL (26 patients). 10 patients from ML group and 3 patients from VL group had grade 2 CL laryngoscopic view. 4 patients from ML group had grade 3 CL laryngoscopic view against 1 patient in ML group [Table 5]. Requirement of external laryngeal pressure to facilitate endotracheal intubation was significantly (P <0.05) more in group ML (14 patients) as compared to group VL (4 patients). Four patients in group ML required the second attempt to facilitate glottic visualization and intubation whereas all the patients in group VL were intubated at the first attempt. No patient from either group required more than 120 seconds for laryngoscopy nor had a drop in oxygen saturation below 90% requiring mask ventilation.

Table-I

Demographic data with ASA and Mallampati class of ML and VL groups -

Variable	Group ML	Group VL	*P*	
Age (Years)	48.96 + 10.94	49.66 + 9.61	0.79	
Height (Cm)	157.23 + 8.34	160.21 + 9.01	0.19	
Weight (Kg)	57.93 + 10.43	61.86 + 10.10	0.14	
BMI	23.46 + 4.24	24.16 + 3.66	>0.05	
Sex (no. of patient)	Male	17 (28%)	18 (30%)	>0.5
	Female	13 (22%)	12 (20%)	
ASA (no. of patients)	Grade 2	4 (7%)	3 (5%)	
	Grade 3	15 (25%)	21 (35%)	
	Grade 4	11 (18%)	6 (10%)	
Mallampati (no. of patients)	Class 1	15 (25%)	14 (23%)	
	Class 2	11 (18%)	10 (17%)	
	Class 3	4 (7%)	6 (10%)	

Table-II

Intubation time in ML and VL groups

Variable	Group ML	Group VL	*P*
Intubation time (seconds)	33.63 + 2.98	36.1 + 5.99	>0.05

Table-III

Hemodynamic variables (systolic blood pressure and diastolic blood pressure in mm Hg) in ML and VL groups

Variable	Group ML	Group VL	*P*
Systolic blood pressure (mm of Hg)			
Pre-induction	124.46 + 11.79	127.73 + 10.18	0.26
Pre-intubation	92.06 + 5.86	92.01 + 4.51	0.96
Immediate post-intubation	158.53 + 18.65	163.83 + 16.83	0.25
3 minutes post-intubation	126.83 + 14.09	130.66 + 13.12	0.28
Diastolic blood pressure (mm of Hg)			
Pre-induction	81.83 + 4.97	81.66 + 4.48	0.89
Pre-intubation	60.53 + 4.19	59.33 + 3.14	0.22
Immediate post-intubation	104.11 + 8.786	104.56 + 8.17	0.83
3 minutes post-intubation)	82.76 + 7.66	83.86 + 6.31	0.55

Data is expressed as mean +SD. *P* <0.05 was considered statistically significant. ML=Macintosh laryngoscope, VL= Video laryngoscope, SD= Standard deviation

Table-IV

Hemodynamic variables (MAP in mm Hg, HR in beats/min) in ML and VL groups

Variable	Group ML	Group VL	*P*
Mean arterial blood pressure (mm of Hg)			
Pre-induction	96.03 + 7.02	97.11+ 6.24	0.54
Pre-intubation	71.03 + 4.39	70.16 + 3.32	0.49
Immediate post-intubation	122.26 + 11.7	124.41 + 10.87	0.47
3 minutes post-intubation	97.36 + 9.79	99.43 + 8.35	0.38
Heart rate (beats/minute)			
Pre-induction	84.53 + 6.74	86.76 + 7.45	0.23
Pre-intubation	71.63 + 5.22	74.71 + 5.87	0.037
Immediate post-intubation	98.96 + 7.13	102.43 + 6.87	0.06
3 minutes post-intubation	84.26 + 7.79	87.71 + 6.51	0.069

Table-V

Conditions for intubation with ML and VL

Variable (no. of patient)		Group ML	Group VL	*P*
Intubation in the 1st attempt		30	26	>0.05
Application of BURP		14	4	<0.05
Cormack-Lehane (CL)	Grade-1	16	26	<0.05
laryngoscopic view	Grade-2	10	3	<0.05
	Grade-3	4	1	<0.05

The results are expressed as number of patients. *P*<0.05 was considered statistically significant. VL= Video laryngoscope, ML=Macintosh laryngoscope, BURP= Backward, Upward, Rightward pressure

Discussion:

Our study demonstrated that there was not much difference between conventional Macintosh direct laryngoscopy and video laryngoscopy in terms of intubation time and success rate. A little longer time was required for video laryngoscopic intubation due to the time required to negotiate the endotracheal tube (ETT) through the vocal cords. The exaggerated curvature of the video laryngoscope blade with enhanced optics, offers the advantage of being able to “look around the corner,” allowing better view of the glottis. Improved glottic view with video laryngoscopy did not shorten the intubation time, as it does not provide line of sight view of the glottis. A greater number of patients in ML group required the application of external laryngeal pressure to facilitate glottic visualization, but intubation time was shorter. Proper positioning of the laryngoscope in VL group took a greater number of attempts and required removal and repositioning in a greater number of patients when compared to ML group, this may be due to operators’ relative inexperience with this newly acquired device. However, though the intubation time was less in ML group, the time needed for intubation was not statistically significant between the two groups. The duration of laryngoscopy is important for the cardiovascular responses to endotracheal intubation[3]. The intubation time is longer with various VL than ML[4,5]. However, this did not affect the hemodynamic parameters for a long time. It was also similar to the study by Kanchi and colleagues[5].

Regarding hemodynamic response to laryngoscopy and intubation, the difference of values of variables were not statistically significant between the two groups in this small number of patients. Both laryngoscopy and endotracheal intubation causes increased blood pressure, heart rate and catecholamine concentrations[6]. The hemodynamic responses during laryngoscopy and endotracheal intubation may vary by premedication, social habits, preoperative medications, narcotic and neuromuscular blocker doses and speed of anesthetic agent administration[7]. Drug combinations may be required in order to minimize both heart rate and blood pressure effectively[8]. Various anesthetic agents, adjuvants and analgesics have been used to blunt the level of stimulation and the stress response to the manipulation and stimulation of airway during laryngoscopy and intubation. Fentanyl, beta-adrenergic receptor blockers and lignocaine have all been used with varying results[9,10]. Weiss-Bloom *et al*. showed reduced hemodynamic responses to endotracheal intubation with induction by 5-10 µg/kg fentanyl and 0.3 mg/kg etomidate in patients scheduled for coronary artery bypass graft surgery[11]. We used fentanyl (1 µg/kg) in both groups to maintain the hemodynamics. Nearly similar and stable hemodynamic responses were achieved with both laryngoscopes.

Our study results were comparable to results of previous studies that reported improved glottic visualization and better Cormack-Lehane (CL) laryngoscopic view with VL when compared to ML[2,12]. A study by Ezri *et al.* found that the ratio of CL laryngoscopic grade 3 and 4 was 5.2% in the overall patient population compared to 10% in patients who had cardiac surgery due to various reasons such as age and restricted neck movement[13]. In both groups, we intubated the grade 3 patients without any problems. VL provides a better laryngeal view; however, an improved laryngeal view does not always mean an easy and successful intubation[14].

This study showed that VL does not possess an added advantage over an ML for endotracheal intubation in patients with uncomplicated airways. Various studies by experienced and novice users, in patients with normal and difficult airways, in adult and pediatric patients have compared VL with direct laryngoscopy, which showed the added advantages of VL[15-17]. In a randomized clinical trial by Sun *et al*., the majority of patients showed improvement in the CL grade ($P < 0.001$) obtained with the VL, when compared with ML[2]. A study by Solimana *et al*. compared VL with ML in 100 adult patients undergoing cardiac surgery and found a higher catecholamine levels after the use of VL. They also demonstrated a longer intubation time, more intubation response and mucosal trauma in VL group. However, VL was found to be useful in patients with anticipated difficult intubation with restricted cervical spine mobility[16,18,19]. Bathory *et al*. evaluated a high tracheal intubation success rate without clinically relevant injuries in patients having their cervical spine immobilized by VL with a better CL laryngoscopic glottic view compared to ML.[18]

COVID-19 crisis in Bangladesh has devastated the medical arena. As of Mid-July, more than 80 doctors have succumbed to the disease. Many of them are anesthetists and critical care specialists. Video laryngoscopy is ideally recommended in patients infected with COVID-19 to increase the distance between the operator’s face and the patient’s face to minimize the risk of contamination.[19] Ibinson *et al*. using a propensity score-matched analysis found a greater first-attempt success rate with a VL than a direct laryngoscopy (Macintosh or Miller blade). VL was found to be 99% successful for intubation after the initial failure of direct laryngoscopy performed by anesthesiologists, nurses or trainees; however, at the expense of a higher rate of minor mucosal injury[20]. The competency of the intubating person might have affected the results. This could be due to the fact that direct laryngoscopy generally requires a steeper learning curve and a longer duration to master the technique as compared with the VL. In a study by Aqil, when comparing VL to a fiberoptic bronchoscope, the VL group required external laryngeal manipulation in more cases to facilitate endotracheal intubation. They reported more hemodynamic response in VL group which could be due to external laryngeal manipulation, despite an excellent CL glottic view in VL group[21].

The limitations of the study were, it was not possible to blind the person performing the endotracheal intubation to the intubation device being use, but the intubation time and hemodynamic measurements were recorded by an independent observer. All the intubations were not done by the same person, but all the consultant anesthesiologists who participated in the study were equally trained to perform endotracheal intubation. Certain measurements such as laryngoscopic grade are subjective and a cross over study would be more ideal as each patient varies in the degree of intubation difficulty.

Conclusion:

Video laryngoscope is preferred by cardiac anesthetists because of better glottic view. Though Video laryngoscope provided a better laryngoscopic view, there is still a need for stylet and it took a little longer time to negotiate the endotracheal tube and thus the intubation time is little more when compared to Macintosh direct laryngoscope. The hemodynamic response during intubation and success rate of intubation were nearly similar in the two groups.

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