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Original Article

Benefits of Video Laryngoscopy in Patients Undergoing Elective Cholecystectomies: A Comparative Study

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Abstract

Background: Several methods have been used to blunt the cardiovascular response associated with laryngoscopy and tracheal intubation in susceptible patients to prevent myocardial ischemia and cerebrovascular events. For almost 75 years measures are taken to prevent such responses with more focus on pharmacological methods as compared to non-pharmacological methods. Our study has focused on non-pharmacological methods in the form of using different kind of laryngoscopes in the American Society of Anesthesiologists (ASA) Group I and II patients to compare hemodynamic responses and electrocardiographic changes in three groups, namely, Macintosh, McCoy, and Video laryngoscope (primary aim) and also to assess the intubation time, number of attempts and complications (bleeding, laceration, dental injury, and sore throat) if any (secondary aim).

Materials and Methods: This study was conducted on 90 patients of the ASA Grade I and II posted for elective open cholecystectomy surgeries under general anesthesia. Patients were allotted into three groups: Group A (Macintosh), Group B (McCoy), and Group C (Video) and they were intubated with their respective laryngoscopes and hemodynamic parameters at 0, 1, 3, 5, 7, and 10 min after laryngoscopy were recorded along with time of intubation and any complications associated with the procedure.

Results: The time of intubation was shortest with Group C (Video) when compared with Group A (Macintosh) and Group B (McCoy). Hemodynamic changes of patients were lowest in Group C (Video) than Group B (McCoy) and highest with Group A (Macintosh). Furthermore, number of attempts at intubation was higher with Macintosh and McCoy as compared to with Video laryngoscope group. Likewise, more complications such as dental injury and injury to oral mucosa were seen with Macintosh laryngoscope than McCoy and least with Video laryngoscope. The results were compiled and analyzed using software IBM SPSS 26 to draw relevant conclusions.

Conclusion: Thus, we can see that with the use of Video laryngoscope, lesser alterations in hemodynamics are produced which can reduce the incidences of myocardial ischemia and cerebrovascular accidents in susceptible patients. Furthermore, lesser time taken by Video laryngoscope in intubation again reduces the stress response to laryngoscopy in susceptible patients. Laryngoscopy by Video laryngoscope is comparatively easy when compared with Macintosh and McCoy laryngoscopes as number of attempts and complication rate was lesser with Video laryngoscope.

Key words: Backward upward rightward pressure, Diastolic blood pressure, Heart rate, Ischemic heart disease, Mean arterial pressure, Optimal laryngeal external manipulation, Saturation, Seconds, Systolic blood pressure

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INTRODUCTION

Laryngoscopy and endotracheal intubation are the essential maneuvers in general anesthesia and in emergency situations where maintaining a patent airway is a prime responsibility of an anesthesiologist. Laryngoscopy and tracheal intubation lead to stimulation of pharyngeal, laryngeal, and tracheal

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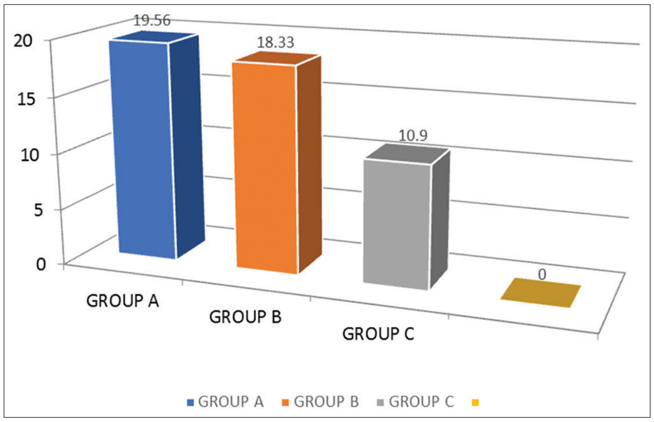

Figure 1: Time of intubation

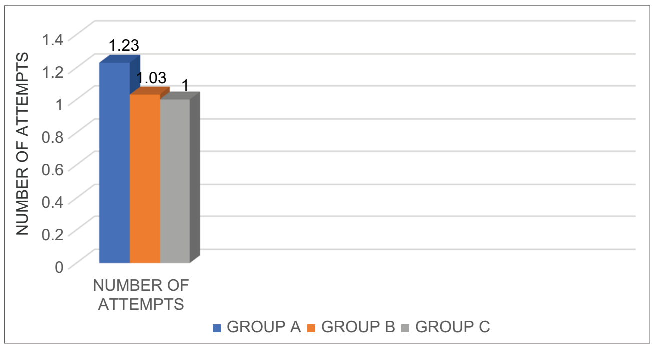

Figure 2 : Number of intubation attempts

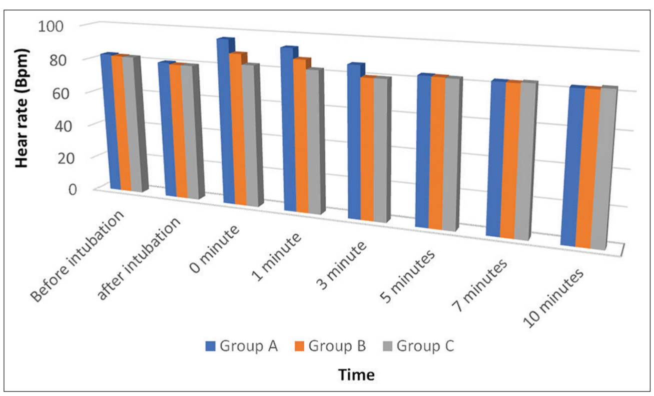

Figure 3: Heart rate changes

nociceptive receptors through vagal and glossopharyngeal afferents and reflex hemodynamic stress response commonly manifested as tachycardia, hypertension, or arrhythmia in adults and adolescents. The response is transient occurring within 30 s after intubation and lasting for <10 min. These can be potentially hazardous in patients with hypertension, coronary artery disease, and cerebrovascular disease.[1]

The magnitude of hemodynamic stress response is related to amount of force applied to expose the glottis and degree of airway manipulation done during endotracheal intubation. During laryngoscopy with Macintosh laryngoscope, a relatively high forward and upward force is applied (approximately 4–5 kg) on laryngoscope handle to visualize glottis by aligning oral, pharyngeal, and laryngeal axis. The magnitude of hemodynamic response correlates with force of laryngoscopy.[2]

McCoy laryngoscope uses a levering mechanism which reduces the force required to align all the three axes to view the glottis.[3] The McCoy laryngoscope with hinged tip has been shown to provide improved view of glottis and lesser hemodynamic response to intubation as compared to Macintosh laryngoscope.[4] Video laryngoscopes do not require alignment of oral, pharyngeal, and laryngeal axes for the visualization of glottis and the force needed to align these three axes is greatly reduced (approximately 1.5 kg). Video laryngoscopes provide a wider viewing angle, making alignment of oral, pharyngeal, and tracheal axis less mandatory.[5]

The first Video laryngoscope named Glidescope was invented in 1999 which is a reusable biomedical device and incorporated a high-resolution digital camera, connected by a video cable to a high-resolution LCD monitor.[6]

Likewise, more hemodynamic instability will occur if intubation time is prolonged. Hence, the laryngoscope which requires less time to intubate will result in lesser hemodynamic fluctuations as compared to laryngoscope which requires more time for intubation.

The primary outcome of our study was to lessen the hemodynamic changes associated with laryngoscopy and intubation with use of Video laryngoscope.

MATERIALS AND METHODS

After obtaining approval from the institutional thesis and ethics committee, the study was conducted on 90 patients of the American society of anesthesiologists (ASA) Grade I and II posted for elective open cholecystectomy surgeries under general anesthesia. The study was registered in the Clinical Trial Registry of India (CTRI/2018/04/019581). The patients were allotted into three groups: Group A (Macintosh laryngoscope), Group B (McCoy laryngoscope), and Group C (Video laryngoscope) of 30 patients each who were intubated using their respective laryngoscopes.

A detailed history and thorough general examination before the surgery were done. All patients included in the study were kept nil orally for 8 h preoperatively. On arrival to operation theatre, baseline vital parameters such as heart rate, systolic blood pressure (SBP), diastolic BP, mean arterial BP, and SpO_2 were recorded. An intravenous line

Table 1: Heart rate changes

Time	Group A			Group B			Group C			*P* value		
	Mean	SD	% age change from baseline	Mean	SD	% age change from baseline	Mean	SD	% age change from baseline	A/B	B/C	A/C
Before induction	83	3.81		82.43	3.73		82.2	5.31		0.56	0.97	0.55
After induction	80.4	3.80	−3.05	79.7	4.13	−3.21	79.63	4.61	−3.29	0.49	0.95	0.48
0 min	96.1	4.55	16.01	88.3	4.34	7.33	82.4	4.03	0.02	0.00	0.00	0.00
1 min	93.40	3.44	12.79	87.53	0.77	6.40	82.26	5.06	0.04	0.00	0.00	0.00
3 min	86.57	2.93	5.9	80.07	2.01	4.66	82.93	3.50	0.64	0.00	0.96	0.49
5 min	83.27	2.49	0.55	83.07	2.11	0.97	82.77	2.87	0.68	0.73	0.64	0.47
7 min	82.83	2.42	0.02	82.73	3.05	0.52	82.23	3.36	0.02	0.88	0.54	0.43
10 min	82.33	2.59	1.84	82.37	2.98	−0.18	83.20	3.04	1.21	0.96	0.28	0.24

SD: Standard deviation

Table 2: Systolic blood pressure changes

Time	Group A			Group B			Group C			*P* value		
	Mean	SD	% age change from baseline	Mean	SD	% age change from baseline	Mean	SD	% age change from baseline	A/B	B/C	A/C
Before induction	121.7	4.85		121.9	5.13		129.5	5.41		0.87	0.88	0.88
After induction	106.43	4.52	−12.44	105.9	5.34	−12.95	105.9	4.11	−12.62	0.71	0.06	0.67
0 min	142.06	2.83	16.95	134.5	3.76	10.53	127.8	5.95	5.33	0.00	0.00	0.00
1 min	140.8	1.58	16.68	132.53	1.38	8.91	122	7.5	0.64	0.00	0.00	0.00
3 min	137.63	5.19	13.27	130.40	3.33	7.15	119.3	8.32	−1.6	0.00	0.00	0.00
5 min	132.53	4.91	9.03	126.17	7.34	3.71	118.37	4.93	−2.3	0.00	0.00	0.00
7 min	120.87	5.37	1.09	124.07	5.39	2.05	119.63	4.72	−1.3	0.39	0.24	0.01
10 min	123.4	5.04	1.6	123.73	4.44	1.71	120.77	3.69	−0.4	0.78	0..80	0.02

SD: Standard deviation

Table 3: Diastolic blood pressure changes

Time	Group A			Group B			Group C			*P* value		
	Mean	SD	% age change from baseline	Mean	SD	% age change from baseline	Mean	SD	% age change from baseline	A/B	B/C	A/C
Before induction	80.96	7.50		80.0	6.75		79.9	5.47		0.95	0.91	0.53
After induction	71.83	6.91	−10.5	74.06	8.11	−7.16	72.1	7.95	−9.27	0.005	0.34	0.89
0 min	89.46	8.13	10.49	84.26	10.48	5.32	83.26	5.91	4.63	0.03	0.18	0.02
1 min	85.13	7.41	5.76	83.36	7.08	5.17	81.1	5.88	1.96	0.34	0.12	0.02
3 min	83.37	6.22	3.81	81.53	6.45	2.69	81.33	5.92	2.23	0.26	0.9	0.2
5 min	79.53	7.17	−0.93	82.63	9.46	3.68	77.47	6.21	−2.7	0.15	0.01	0.23
7 min	77.83	7.41	−2.96	80.67	7.49	1.52	79.9	6.9	0.40	0.14	0.68	0.26
10 min	78.27	6.86	−2.4	79.43	7.07	0.09	79.53	7.06	−1.11	0.51	−0.5	0.48

SD: Standard deviation

Table 4: Mean arterial pressure changes

Time	Group A	SD	% age change from baseline	Group B	SD	% age change from baseline	Group C	SD	% age change from baseline	*P*-value		
										A/B	B/C	A/C
Before induction	91.06	6.84		90.96	6.77		90.26	6.52		0.95	0.68	0.64
After induction	81.5	5.85	−9.97	82.36	6.63	−9.18	81.5	5.85	−8.12	0.59	0.96	0.54
0 min	104.6	4.85	14.9	98	4.32	7.73	95.03	6.23	5.28	0.03	4.27	0.00
1 min	99.63	5.26	9.88	83.36	7.08	6.47	92.46	6.55	2.95	0.04	3.05	0.00
3 min	99.63	5.75	10.04	95.37	6.09	5.37	92.2	5.79	2.67	0.04	2.66	0.00
5 min	95.3	6.79	−0.93	93.53	8.46	3.71	86.8	6.18	−2.39	0.00	1.36	0.00
7 min	88.67	7.88	−2.15	92.3	7.59	2.20	91.1	7.05	1.52	0.52	0.94	0.21
10 min	88.87	7.28	−1.83	90.07	6.88	−0.28	90.17	6.74	0.51	0.95	1.48	0.47

SD: Standard deviation

was secured with 20G cannula and 10 ml/kg/h ringer lactate infusion was started. Pre-medication (injection midazolam 0.02 mg/kg, injection ondansetron 4 mg, and injection butorphanol 1 mg) was given. Injection glycopyrrolate was not given as it can produce tachycardia and could have interfered with the results. Baseline hemodynamic parameters were recorded. Pre-oxygenation with 100% oxygen was done for 3 min. After that, patients were induced with propofol 2.5 mg/kg until the eyelash reflex and spontaneous respiration were abolished followed by injection succinylcholine 2 mg/kg and intubation with respective laryngoscopes in all the three groups.

After that, anesthesia was maintained with isoflurane, injection vecuronium bromide, nitrous oxide, and oxygen.

After laryngoscopy, hemodynamic parameters in the form of SBP, diastolic BP, mean arterial pressure (MAP), heart rate, and electrocardiographic changes at various intervals: Before induction, after induction/before laryngoscopy, and after laryngoscopy and intubation at 0 min, at 1, 3, 5, 7, and 10 min after intubation, then at the interval of every 5 min until the end of the surgery, were recorded. Furthermore, time of intubation, any complication during laryngoscopy and any sore throat after surgery were recorded.

Statistical Analysis

The data from the present study was systematically collected, compiled, and statistically analyzed using software IBM SPSS 26 to draw relevant conclusions. Data were expressed as mean, standard deviation, number, and percentages. The patient characteristics (nonparametric data) were analyzed using the "Chi-square tests" and the intergroup comparison of the parametric data was done using the unpaired "*t*" test and ANOVA test. "*P*" value was determined to finally evaluate the levels of significance. $P < 0.05$ was considered as statistically significant. The power achieved was well above 90%. The results were then analyzed and compared to previous studies.

RESULTS

Hemodynamic variables showed minimal changes in patients of group Video laryngoscope, moderate changes in group McCoy, and maximum changes in group Macintosh laryngoscope after laryngoscopy at 0 min.

Intubation time was seen longest in Group A, then Group B, and shortest in Group C. Maximum number of intubation attempts was required in Group A, then Group B, and least with Group C.

The heart rate, SBP, diastolic BP, and the mean arterial BP measured at every 2 min during laryngoscopy and after, until 10 min after intubation showed minimum changes in the patients of Group C that settled after 3 min of intubation. Maximum hemodynamic changes were seen in Group A which settled after 5–7 min of intubation.

Arterial oxygen saturation was well maintained in all the groups and was statistically non-significant. Furthermore, complications such as dental injury and bleeding from oral cavity were seen maximally in Group A, then after that in Group B, and minimally in Group C. Sore throat incidences were seen in maximum number of patients in Group A, then Group B, and least with Group C.

DISCUSSION

Laryngoscopy and intubation can elicit a sympathoadrenal response leading to hypertension, tachycardia, and arrhythmia which can be deleterious in patients with ischemic heart disease (IHD) and low cardiac reserve. This response is caused by stretching of the oropharyngeal tissue in an effort to align the oropharyngeal-laryngeal axis for intubation.

Over the years, many researchers have adopted various methods for attenuating the pressor response caused by laryngoscopy and tracheal intubation using various inhalational and other pharmacological agents such as beta-blockers, calcium channel blockers, lignocaine, gabapentin,[7] nitroglycerin,[8] clonidine,[9] and dexmedetomidine.[10] Earlier methods have been used to blunt the cardiovascular response with the help of pharmacological methods more as compared to non-pharmacological methods. There is limited literature available regarding the influence of the type of laryngoscope blade on the hemodynamic response to laryngoscopy and intubation. Our study used different types of laryngoscope blades that helped to decrease the pressor responses.

All the groups were comparable in mean age, weight, height, body mass index, ASA grading, and duration of surgery. In our study, intubation time in Group A was 19.56 s, in Group B was 18.33 s, and in Group C was 10.90 s as shown in Figure 1. On comparing groups with each other, $P = 0.00$ was statistically significant. Our results were similar to results concluded by Moningi *et al.* and Zia Arshad (2013).

Our results were comparable with the study conducted by Bhandari *et al.* in 2013 who observed that Airtraq was better than the Macintosh laryngoscope as duration of successful intubation was shorter in Airtraq than the Macintosh laryngoscope.

In our study, intubation attempts in Group A were 1.23, in Group B was 1.03, and in Group C was 1 as shown in

Figure 2. 23 out of 30 patients in Group A were successfully intubated with first attempt whereas remaining patients required more than one intubation attempt. Twenty-nine of 30 patients of Group B were intubated at their first attempt whereas in Group C 30 of 30 patients were intubated with their first attempt. After comparing the three groups, $P = 0.14$ was statistically insignificant. Our results were similar with Maharaj *et al.* study.

In our study, heart rate changes from baseline at 0 min of laryngoscopy were 16.1% increase in Group A, 7.33% increase in Group B, and in 0.02% increase from baseline Group C as shown in Table 1. $P = 0.00$ is statistically significant. Figure 3 shows heart rate changes in the three groups after intubation. Heart rate increase is seen maximum in Group A and least in Group C at 1 mint after laryngoscopy which starts to settle around baseline values after 5 mints of laryngoscopy in all groups. Our results were supported by another study conducted by Haidry and Khan[11] in 2013, where maximum change in heart rate after intubation was 18.7% from baseline in the Macintosh and 7.7% from baseline in the McCoy group. Joseph *et al.* in 2012 and Woo in 2011 showed similar results.

The increase in SBP in Group A at 0 min (during laryngoscopy) was 142.06 mmHg (16.95% increase from baseline) and in Group B was 134.5 mmHg (10.53% increase from baseline) and in Group C was 127.8 mmHg (increased by 5.33% from baseline) as shown in Table 2. $P = 0.00$ was statistically significant. After 5 min, SBP started to normalize toward baseline values in Group A and after 3 min in Group B. These results were supported by another study conducted by Haidry and Khan in 2013 where increase in systolic arterial pressure was 22.9% from baseline in the Macintosh and 10.3% from baseline in the McCoy group. Alexandra Gavrilovska-Brzanov *et al.* in 2015 also showed similar results for Macintosh and Video laryngoscope groups.

In our study, diastolic BP after intubation at 0 min in Group A was 89.46 mmHg (increased by 10.49% from baseline), in Group B was 84.26 mmHg (increased by 5.32% from baseline), and in Group C was 83.26 mmHg (4.63% from baseline) as shown in Table 3. $P = 0.03$ was statistically significant. Another study conducted by Haidry and Khan in 2013 also showed that rise in diastolic BP from baseline was 27% in Macintosh group and 15% in McCoy group. Furthermore, a study conducted by Gavrilovska-Brzanova *et al.* (2015) showed that diastolic BP after intubation was found to be 89.85 ± 11.7 mmHg in group Macintosh and 76.00 ± 11.3 mmHg in group Airtraq.

MAP in our study, in Group A was 104.6 mmHg (18.6%), in Group B was 98 mmHg (7.73%), and in Group C was 95.03 mmHg as shown in Table 4. Arora *et al.* showed MAP in group Macintosh was 28.08% and in group McCoy was 15.25% ($P = 0.0001$). Our results were comparable with results of Moningi *et al.* as MAP was higher in group McCoy as compared to group Video laryngoscope after laryngoscopy and in group McCoy it took longer time to normalize to baseline values when compared to Video laryngoscope group. Furthermore, a study conducted by Gavrilovska-Brzanov *et al.* (2015) showed that the mean BP was 114.92 ± 13.7 mmHg in group Macintosh and 98.80 ± 12.1 mmHg in group Airtraq.

In our study, saturation changes in Group A, Group B, and Group C were comparable ($P > 0.05$). Arora *et al.* in 2016 also showed comparable SpO_2 changes in both groups. This was attributed to the fact that Mallampati Grade 1 and 2 were chosen as the inclusion criteria and no difficult airway were included in the study; therefore, no patient desaturated due to prolonged intubation time.

No arrhythmias were seen in either of the group in our study as myocardial stressors like tachycardia and hypertension were reduced with the use of video laryngoscopy. Also the choice of patients were from ASA grade I and II, thus reducing the the risk of arrythmias in all groups. Our results were supported by study conducted by Haidry and Khan.

In our study, complication rate was highest in Macintosh group (10%), McCoy (3.3%), and Video (0.0%). Complications included dental injuries and bleeding from oral cavity. Hossali in 2017 also showed that maximum complications occurred with Macintosh and least with Airtraq Video laryngoscope.

Limitations

One limitation of our study was the noninvasive measurement of BP, but it was not justified to use invasive blood monitoring technique in the relatively healthy ASA 1 and 2 patients. We also did not measure the muscle relaxation and the degree of relaxation at the time of tracheal intubation which may affect the response. The study could not be blinded because anesthesiologist could not have been blinded to the type of laryngoscope he is using and the BP and heart rate recordings displayed on the monitor.

CONCLUSION

In our study, we conclude that Video laryngoscope is better to maintain the hemodynamics of the patient during laryngoscopy as it exerts less force and less time to intubate. While doing laryngoscopy with Video laryngoscope, one can get immediate help of the accompanied person by directly looking at the monitor and doing whatsoever is necessary in aiding the intubation (optimal laryngeal external manipulation, backward upward rightward pressure, or handling airway adjuncts such as stylet or bougie). Thus, expert help is provided to the novice laryngoscopist in no time in times of difficult intubations. Hemodynamic alterations produced by laryngoscopy with Macintosh and McCoy can be disastrous in susceptible patients leading to morbidities and mortalities due to myocardial ischemia and cerebrovascular accidents in IHD patients and neurological disease patients. Thus, benefits of Video laryngoscope in providing better hemodynamics and lesser complications produced by it make it a better laryngoscopic technique when compared to conventional Macintosh and McCoy laryngoscopes.

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