Original Research

jurnal SAGO gizi dan kesehatan

SAGO: Gizi dan Kesehatan
2024, Vol. 5(2) 475-481
© The Author(s) 2024
DOI: http://dx.doi.org/10.30867/gikes.v5i2.1541
https://ejournal.poltekkesaceh.ac.id/index.php/gikes
Poltekkes Kemenkes Aceh

Differences of hemodynamic responses in patients undergoing endotracheal intubation with conventional laryngoscope compared to video laryngoscope

Perbedaan respon hemodinamik pasien yang menjalani intubasi endotrakeal dengan laringoskop konvensional dibandingkan dengan laringoskop video

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Abstract

Background: In general anesthesia, to facilitate the intubation process, laryngoscopy is used, with various shapes and sizes and additional functions such as use of video cameras, but it also comes with risks, one of which is a cardiovascular response.
Objectives: To compare differences of hemodynamic responses (SBP= Systolic blood pressure, DBP= Siastolic blood pressure, HR= Heat rate, MAP= Mean atrial preassure, and RPP= Rate pressure product) in patients who undergoing endotracheal intubation with conventional laryngoscopes compared to video laryngoscopes at H. Adam Malik General Hospital.
Methods: This is an analytical study with a pretest-posttest controlled group clinical trial design to compare differences of hemodynamic response in patients undergoing endotracheal intubation with conventional laryngoscope compared to video laryngoscope. All patients who underwent elective surgery under general anesthesia and endotracheal intubation and met the inclusion and exclusion criteria were included in the study.
Results: This study showed a significant difference between the conventional laryngoscopy and video laryngoscopy groups on the results of systolic blood pressure measurements. While diastolic blood pressure at T0, T1, and T2 after laryngoscopy did not show significant differences. This significant difference was found at T1, where the HR of subjects in conventional laryngoscopy was significantly higher compared to video laryngoscopy.
Conclusion: The use of a conventional laryngoscope for laryngoscopy and endotracheal intubation further enhances hemodynamic response compared to video laryngoscope, both when the glottis is visualized and when the cuff is inflated.

Keywords
Laryngoscope, intubation, hemodynamics

Abstrak

Latar Belakang: Pada anestesi umum, untuk memudahkan proses intubasi, digunakan laringoskopi, dengan berbagai bentuk dan ukuran serta fungsi tambahan seperti penggunaan kamera video, namun hal ini juga memiliki risiko, salah satunya adalah respons kardiovaskular.
Tujuan: Untuk membandingkan perbedaan respon hemodinamik (TDS= Tekanan darah siastolik, TDD= Tekanan darah diastolik, HR= Detak jantung, MAP= Tekanan arteri, dan RPP= Rate pressure product) pada pasien yang menjalani intubasi endotrakeal dengan laringoskop konvensional dibandingkan dengan laringoskop video di Rumah Sakit Umum Pusat H. Adam Malik.
Metode: Penelitian ini merupakan studi analitik dengan desain uji klinis kelompok terkontrol pretest-posttest untuk membandingkan perbedaan respons hemodinamik pada pasien yang menjalani intubasi endotrakea dengan laringoskop konvensional dibandingkan dengan laringoskop video. Semua pasien yang menjalani pembedahan elektif

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Diterima: 06/10/2023 Revisi: 09/01/2024 Disetujui: 03/02/2024 Diterbitkan: 10/04/2024

dengan anestesi umum dan intubasi endotrakeal serta memenuhi kriteria inklusi dan eksklusi diikutsertakan dalam penelitian ini.
Hasil: Penelitian ini menunjukkan adanya perbedaan yang signifikan antara kelompok laringoskopi konvensional dan laringoskopi video pada hasil pengukuran tekanan darah sistolik. Sedangkan tekanan darah diastolik pada T0, T1, dan T2 setelah laringoskopi tidak menunjukkan perbedaan yang signifikan. Perbedaan yang signifikan ini ditemukan pada T1, dimana HR subjek pada laringoskopi konvensional lebih tinggi secara signifikan dibandingkan dengan laringoskopi video.
Kesimpulan: Penggunaan laringoskop konvensional untuk laringoskopi dan intubasi endotrakeal lebih meningkatkan respons hemodinamik dibandingkan dengan laringoskop video, baik saat glotis divisualisasikan maupun saat manset digelembungkan.

Kata Kunci
Laringoskop, intubasi, hemodinamik

Introduction

In general anesthesia, there are various basic aspects, such as unconsciousness, analgesia, amnesia, decreased motor response to noxious stimulation, muscle relaxation, and reversibility (Urban & Bleckwenn, 2002). Under general anesthesia, it is necessary to perform ventilation using endotracheal intubation due to muscle relaxation. To facilitate the intubation process, laryngoscopes are used, with their various shapes, sizes, and additional functions such as use of video camera for laryngoscopy (Buhari & Selvaraj, 2016).

Laryngoscopy and endotracheal intubation have their own risks, one of which is risk of cardiovascular response (Amini & Shakib, 2015). Post-laryngoscopy stress response that manifests in cardiovascular aspects can be hypertension, tachycardia, to dysrhythmias (Beyer et al., 2009). Cardiovascular response to laryngoscopy is related to pressure and duration of laryngoscopy (Butterworth, Mackey, & Wasnick, 2015). Video laryngoscopy is an alternative to conventional laryngoscopy. The conventional direct laryngoscope uses a line of sight provided by a rigid viewing instrument with a light on the blade or intra-oral portion which requires a direct view of the target larynx; this view is clearly seen in 80-90% of attempts. Video laryngoscopy uses attachments that allow the operator to observe procedure via monitor. In addition to these additional devices, various video laryngoscopes also have special designs, such as a blade design with a certain degree of curvature to reduce the pressure exerted by instrument on oropharynx and larynx structures (Kanchi, Nair, Banakal, Murthy, & Murugesan, 2011).

A systematic review study showed that video laryngoscopy reduced rates of failed intubation, airway trauma, and difficult intubation (Lewis et al., 2017). A study conducted in Turkey also demonstrated a better hemodynamic response (lower heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure) in video laryngoscope laryngoscopy compared to conventional laryngoscopy (Colak et al., 2019).

Video laryngoscopy can provide an indirect view of glottis therefore clinician can adjust for better hand-eye coordination and can perform more adequate intubation using video laryngoscopy. Therefore, in this study, researchers are interested in examining the differences of hemodynamic responses in patients with conventional laryngoscopy compared to video laryngoscopy.

Methods

This study is an analytic study with a pretest-pposttest controlled group clinical trial design conducted at H. Adam Malik General Hospital Medan. The sample of this study were patients who underwent elective surgery under general anesthesia and endotracheal intubation who met the inclusion criteria, namely, willing to participate in the study and signing informed consent; being aged 18–65 years; having ASA physical status 1-2; Mallampati score 1; having an ideal BMI which was 18.5–24.9; and not meeting the exclusion criteria, namely, being at risk for cervical spine instability, hemodynamically unstable patients, patients with cardiovascular disorders, and pregnant patients. Dropout criteria in this study were failed intubation in the first trial with cardiac and pulmonary emergencies. The research sample was selected by consecutive sampling.

In this study, there were two intervention groups (conventional laryngoscopy and video laryngoscopy), and hemodynamic parameters were assessed (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and RPP) before induction of anesthesia and after intervention to determine hemodynamic response to laryngoscopy.

Recording of subject characteristics in form of age, sex, height, weight, body mass index, ASA score, and mallampati score. After the subject was in operating waiting room, the identity, diagnosis, and surgical action plan were re-examined. Measurement of the subject's hemodynamic status (HR= heart rate, SBP= systolic blood pressure, DBP= diastolic blood pressure, MAP= mean arterial pressure, and RPP= Rate pressure product) was done for baseline parameters (preinduction). Fentanyl (2 mcg/kg BW) and midazolam (0,1 mg/kg BW) IV premedication was administered. Five minutes after administration of fentanyl and midazolam, induction was carried out with propofol 1 mg/kg IV, followed by rocuronium 1 mg/kg IV.

After 90 seconds of muscle relaxant administration, laryngoscopy using a Macintosh 3 or 4 blade (Group A) or a McGrath video laryngoscope (Group B) was performed by the investigator. The duration of laryngoscopy was recorded in both groups. Both conventional laryngoscopy and video laryngoscopy were carried out by researchers themselves with the level of independence which was green badge in the ninth semester.

Intubation with an ETT 7 Fr (female) or 7,5 Fr (male) was performed by the researcher. After intubation, fill the ETT cuff with air until there is no leakage with positive pressure ventilation. The depth of the ETT was determined by auscultation of the right lung breath, which sounded the same as the left lung breath, then fixed.

Hemodynamic status was measured before laryngoscopy (T0), when the vocal folds were clearly visible during laryngoscopy (T1), and when the ETT cuff was inflated after entering the vocal folds (T2). There was no inhalation gas used during the measurement. After the measurement is complete, inhalation of gas and surgical manipulation can be performed. The data collected in this study will be analyzed using statistical data processing software SPSS version 26 (IBM). The normality test was carried out by Shapiro-Wilk test. If the data is normally distributed, the difference test used is T-dependent test. If the data is not normally distributed, the Wilcoxon test is used to test the difference $p < 0,05$ was chosen as the significance level (p).

Result

In this study, 56 subjects were willing to participate. The 56 subjects were divided into two groups who underwent different laryngoscopy methods, 28 underwent conventional laryngoscopy and 28 underwent video laryngoscopy. Subject characteristics data can be seen in table 1.

Table 1. Subjects characteristics

		Conventional laryngoscopy	Video laryngoscopy	p-value
Age (Mean ± SD)		38,3 ± 10,6	37,4 ± 12,2	0,63
Mallapati score I		28 (100%)	28 (100%)	1.00
ASA				
I		15 (53,6%)	18 (64,3%)	0.55
II		13 (46,4%)	10 (35,7%)	
Type surgery				
Abdomen surgery		20 (71,4%)	25 (89,3%)	0.80
Extremity surgery		8 (28,6%)	3 (10,7%)	
Gender (%)	Male	17 (30,4%)	13 (23,2%)	0,98
	Female	11 (19,6%)	15 (26,8%)	
BMI (Mean ± SD)		22,24 ± 1,19	21,21 ± 1,86	0,77
Surgery Types (%)	Digestive	15 (26,8%)	9 (16,1%)	
	Orthopedics	5 (8,9%)	3 (5,4%)	
	Gynecology	0 (0%)	4 (7,1%)	
	Oncology	4 (7,1%)	4 (7,1%)	0,10
	ENT	2 (3,6%)	3 (5,4%)	
	Ophthalmology	0 (0%)	1 (1,8%)	
	Urology	2 (3,6%)	2 (3,6%)	
	Plastic Surgery	0 (0%)	2 (3,6%)	
Intubation Duration		18,3 ± 6,3	23,5 ± 7,7	0,45

The results of systolic blood pressure measurements at T0, T1, and T2 in this study showed significant differences between conventional laryngoscopy and video laryngoscopy groups. Systolic blood pressure data for each group can be seen in table 2. The pattern of differences in systolic blood pressure between treatment groups also did not show a significant difference.

Diastolic blood pressure measurements at T0, T1, and T2 after laryngoscopy did not show significant differences, both in conventional laryngoscopy and video laryngoscopy groups. In both conventional laryngoscopy and video laryngoscopy groups, there was a pattern of increasing diastolic blood pressure at T1, then decreasing again at T2. The mean diastolic blood pressure in video laryngoscopy group was lower but not significantly lower compared to conventional laryngoscopy group.

Table 2. Post-laryngoscopy systolic blood pressure

Measurement Time	Group (Mean ± SD)		p-value
	Conventional laryngoscopy	Video laryngoscopy	
T0	110,21 ± 6,36	109,89 ± 6,42	0,048
T1	119,50 ± 6,41	112,68 ± 6,42	0,032
T2	111,71 ± 4,80	112,96 ± 6,05	0,029

Table 3. Diastolic blood pressure after laryngoscopy

Measurement Time	Group (Mean ± SD)		p-value
	Conventional laryngoscopy	Video laryngoscopy	
T0	69,75 ± 8,62	68,32 ± 7,94	0,597
T1	70,32 ± 60,37	69,36 ± 7,28	0,659
T2	69,18 ± 6,35	69,00 ± 7,17	0,694

Table 4. HR post laryngoscopy

Measurement Time	Group (Mean ± SD)		p-value
	Conventional laryngoscopy	Video laryngoscopy	
T0	80,11 ± 9,52	83,39 ± 10,98	0,268
T1	97,68 ± 4,82	87,11 ± 11,01	0,001*
T2	91,11 ± 6,55	87,82 ± 9,94	0,260

HR measurements in conventional laryngoscopy group and video laryngoscopy at T0, T1, and T2 showed significant differences. This significant difference was found at T1. At T1, it was found that HR of subjects with conventional laryngoscopy was significantly higher than that of video laryngoscopy. HR measurement data can be seen in Table 4. The HR pattern in both groups showed a higher HR T0 in video laryngoscopy group, then at T1 and T2, a higher HR was found in conventional laryngoscopy group, although HR at T2 after laryngoscopy did not show a significant difference.

Discussions

In this study, the hemodynamic parameters that experienced significant differences were HR, systolic pressure, and RPP. Significant HR differences were shown on T1 examination. At the time of examination, it was shown that HR in subjects with conventional laryngoscopy was significantly higher than in subjects with video laryngoscopy. At T2, HR in subjects with conventional laryngoscopy remained higher, but not statistically significant. While at T0, the HR group of subjects with conventional laryngoscopy was lower than subjects with video laryngoscopy, but the difference was not significant. At all examination times, the RPP was also higher in the Macintosh conventional laryngoscopy group than in McGrath video laryngoscopy group.

The significant difference in HR between the use of conventional laryngoscopy and video laryngoscopy is in line with Colak et al. study, who used videolaryngoscopy similar to this study (McGrath) and also presented similar findings on HR differences with Macintosh conventional laryngoscopy. In that study, 96 people with ASA I

and II had elective surgery under general anesthesia and needed endotracheal intubation. Various hemodynamic parameters such as HR, systolic and diastolic BP, and mean arterial pressure were recorded before induction, before laryngoscopy, and 1, 3, and 5 minutes after laryngoscopy. In that study, it was found that there was a significant increase in HR at 1, 3, and 5 minutes post-laryngoscopy in the Macintosh conventional laryngoscopy group compared to McGrath video laryngoscopy. The study also showed a consistently higher average HR pattern in the group with Macintosh conventional laryngoscopy compared to McGrath videolaryngoscopy (Colak et al., 2019). This is because during intubation with videolaryngoscopy, the visualization is clearer compared to conventional laryngoscopes. This advantage reduces the need for cervical joint manipulation and increases intubation success rates up to 98%, and video laryngoscopy also has special designs, such as a blade design with a certain degree of curve to reduce the pressure exerted by the instrument on the oropharynx and larynx structures. All the results of the study were found to have a mallapati score of 1, with ASA degrees 1 and 2 which did not have a significant difference. so that the mallapati score and ASA degree have no influence on the statistical results (Barash, Cullen, Cahalan, & Stoelting, 2013; Kanchi et al., 2011).

Other studies have also shown a significantly higher hemodynamic response in subjects with conventional laryngoscopy than McGrath video laryngoscopy. The study of Liu et al. demonstrated a significantly higher increase in systolic BP in subjects with Macintosh conventional laryngoscopy than in McGrath video laryngoscopy (Liu, Yi, Guo, Ma, & Huang, 2016).

The study by Sargin et al. also examined the differences in various aspects, including hemodynamics, between Macintosh conventional laryngoscopy and McGrath video laryngoscopy. In this study involving 100 subjects, mean arterial pressure and HR at basal, post-intubation, and 2 minutes after intubation in Macintosh conventional laryngoscopy group were consistently higher than in subjects with McGrath video laryngoscopy; however, the superiority of McGrath video laryngoscopy in this study was demonstrated. on Cormack-Lehane degree, percentage of glottic opening (POGO) score, number of intubations, and complications. Visualization of the larynx was significantly better in subjects with McGrath video laryngoscopy (Sargin & Uluer, 2016).

The study conducted by Cakir et al. examined the differences between Macintosh conventional laryngoscopy and McGrath video laryngoscopy in a specific type of surgery, namely bariatric surgery. In this study involving 62 subjects, hemodynamic parameters were measured at baseline, 5 and 15 minutes after intubation, and at the end of surgery. Hemodynamic parameters such as HR, systolic and diastolic BP, and mean arterial pressure were consistently higher in subjects with Macintosh conventional laryngoscopy than in subjects with McGrath video laryngoscopy, although the difference between the two was not significant (Çakir & Özyurt, 2020; Xue et al., 2007).

Dashti et al.'s study, which also examined the differences in hemodynamic response to Glidescope video laryngoscopy compared to conventional Macintosh laryngoscopy, showed similar results. However, in this study, 60 of the subjects included suffered from untreated hypertension. The mean arterial pressure, HR, and RPP in subjects with video laryngoscopy were significantly higher at 1 to 3 minutes post-intubation than with conventional Macintosh laryngoscopy. A more significant difference was also shown in systolic BP compared to diastolic BP (Dashti, Amini, Azarfarin, Totonchi, & Hatami, 2014).

The study of Brzanov et al. investigated the difference in hemodynamic parameters between video laryngoscopy and Macintosh conventional laryngoscopy. In a study involving 60 subjects, it was seen that subjects with conventional Macintosh experienced a lower increase in hemodynamic response (HR, systolic and diastolic BP, mean arterial pressure) immediately up to 5 minutes post-intubation than subjects with video laryngoscopy (Gavrilovska-Brzanov et al., 2015).

The study conducted by Marsaban et al. also showed similar findings to this study on HR parameters. The type of video laryngoscopy used in this study was CMAC, but the comparison was the same, namely conventional laryngoscopy using a Macintosh blade. In that study, hemodynamic parameters were measured before induction, after induction, and after laryngoscopy. It was found that there was a difference in hemodynamic

parameters after induction (before laryngoscopy) and after laryngoscopy (p 0,001), which was significantly higher in conventional laryngoscopy compared to CMAC. The difference in HR parameters in this study was also significantly higher in subjects with conventional laryngoscopy than CMAC (Marsaban et al., 2017).

The study conducted by Buhari et al. presented different findings regarding the comparison of the hemodynamic response of CMAC video laryngoscopy with conventional Macintosh laryngoscopy. In this study with 30 subjects, there was a significant increase in HR at 3 minutes post-intubation in the CMAC video laryngoscopy group compared to Macintosh conventional laryngoscopy. In addition, significant increases in systolic and diastolic BP, as well as mean arterial pressure 1 minute post-intubation, were also found in the CMAC video laryngoscopy group compared to Macintosh conventional laryngoscopy (Buhari & Selvaraj, 2016).

Conclusion

The use of a conventional laryngoscope for laryngoscopy and endotracheal intubation further enhances hemodynamic response compared to video laryngoscope, both when the glottis is visualized and when the cuff is inflated. The limitation of this study is that the haemodynamic parameters in this study were not measured invasively, so the results obtained were not real time.

Conflict of Interest Declaration

There are no potential conflicts of interest between the authors and agencies with respect to the research, authorship, and/or publication of this article.

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