Egyptian Journal of Anaesthesia (2013) **29**, 103–107

Egyptian Society of Anesthesiologists

Egyptian Journal of Anaesthesia

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Research Article

Hemodynamic changes occurring with tracheal intubation by direct laryngoscopy compared with intubating laryngeal mask airway in adults: A randomized comparison trial

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Received 17 August 2012; revised 14 November 2012; accepted 21 November 2012
Available online 23 January 2013

KEYWORDS

Intubating laryngeal mask airway;
Laryngoscopy;
Hemodynamic changes

Abstract *Background:* Hemodynamic changes are major problems due to general anesthesia. We designed a prospective randomized study to compare the hemodynamic responses due to direct laryngoscopy (DL) and intubating laryngeal mask airway (ILMA).
Methods: Seventy adult ASA-I and ASA-II patients referred to anesthesia department were randomly divided into two groups: direct laryngoscopy (Macintosh laryngoscope) and ILMA. Systolic, diastolic and mean arterial blood pressure and heart rate were recorded at baseline, preintubation, 1, 3 and 5 min after intubation following intubation. Also some complications including sore throat, laryngospasm, hoarseness and cough were evaluated.
Results: Mean age of studied patients in DL group (including 11 (31.4%) male) was 35.5 ± 12.2 and 35.5 ± 9 years old in ILMA group (including 16 (45.7%) male). There was no significant difference between two studied groups about measured hemodynamic indices ($P < 0.05$, CI = 95%). The results showed that the just difference between increment of diastolic blood pressure and mean arterial pressure after 5 min interval of two studied groups was significant ($P = 0.04$; $P = 0.034$). There was no significant difference between the number of patients with positive complications and those without them ($P < 0.05$).

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Peer review under responsibility of Egyptian Society of Anesthesiologists.

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http://dx.doi.org/10.1016/j.egja.2012.11.003

Conclusion: Laryngoscoy through the intubating laryngeal mask airway was associated with lesser mean arterial pressure and diastolic blood pressure when compared to intubation by direct laryngoscope. Thus this technique seems to reduce hemodynamic response to tracheal intubation.

1. Introduction

Airway managements by direct laryngoscopy and endotracheal intubation during general anesthesia are known to induce clinical changes in hemodynamic variables [1]. Tracheal intubation causes variation in catecholamine concentrations and a reflexive rise in sympathic activity due to hypertension, arrhythmia and tachycardia [2]. Direct laryngoscopy (DL) produces a marked short term stress response [3,4] with detrimental effects on the coronary and cerebral circulation in high risk patients, particularly in those with systemic hypertension, coronary artery or cerebrovascular diseases. [5]. These problems might be reduced by using the alterative devices such as fiber optic bronchoscope [6] or light wand [7]. Today intubating laryngeal mask airway (ILMA) is introduced as new device with high success rate that facilitates the tracheal intubation without laryngoscopy [6,7].

Insertion of ILMA has been shown to pose the least cardiovascular effects, comparable to the oropharyngeal devices [8]. There are conflicting investigations [9,10] about comparing the hemodynamic and endocrine stress responses of endotracheal intubation via an ILM in contrast of DL. The aim of this study was to compare hemodynamic consequences (SBP, DBP, MAP, HR at baseline, preintubation, 1, 3 and 5 min after intubation) between DL and ILMA in the patients undergoing two method of intubation for the operations with general anesthesia.

2. Methods

2.1. Study design and outcome measures

This experimental study was conducted on 70 patients with American Society of Anesthesiologist status level of I and II ranging between 20 and 45 years old administered for elective orthopedic and abdominal surgery, requiring tracheal intubation for general anesthesia. Exclusion criteria included: (1) the patients under 20 years old (2) those with positive history of cardio-respiratory or cerebro-vascular disease, diabetes, chronic obstructive pulmonary disease (COPD), gastro-esophageal reflux, renal or hepatic failure, hyper- or hypothyroidism, hypertension (3) substance addiction and beta blocker users (4) the patients who had anticipated difficult intubation (5) the patients with Mallampati grade III or IV (6) the patients with ILMA process lasted more than 1 to 2 min. Then the selected subjects were divided randomly (with regular sampling method) into two equal groups including thirty five patients in each group.

2.2. Process for tracheal intubation

All the subjects were pre-medicated with intravenous midazolame (40 mcg/kg/min before intubation). Cardiovascular monitoring was started before induction and systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and heart rate (HR) as primary outcome measurements of this trial recorded pre- and post-intubation in the first, third and fifth minutes. Besides, bucking (pre-extubation) laryngospasm (post-extubation) sore throat, hoarseness and coughing (during the first 24 hours after surgery) were, measured in the patients and were the secondary outcomes measures.

2.3. Conduct of anesthesia

Anesthesia was inducted by using fentanyl 3–4 microgram (mcg) per Kilograms and propofol 2 mg/Kg was administrated over 30 s followed by Atracarium 0.5 mg/Kg intravenously.

Endotracheal intubation was performed by the method of assigned group. In group DL, intubation was done by using Macintosh laryngoscope and in the second group, by laryngeal mask air way (ILMA). Primary and secondary outcome measures recorded in both groups.

Appropriate laryngoscope head was selected for each patient according to body size. Also in group ILMA, intubation laryngeal mask was inserted using one handle rotational technique with the head and neck in neutral position. In both groups, anesthesia continued by 50% O2, 50% Nitrous oxide, propofol 100 mcg/kg/min infusion and fentanyl 0.02 mcg/kg/min. Intubation in both groups was conducted by Anesthesiologists with at least 3 years work experience in operation room.

2.4. Statistical analysis

All the variables before extubation including baseline, preintubation, 1, 3 and 5 min after intubation were presented as the mean with standard deviation (SD). Patients' characteristics were compared using the student *T*-test and rates of HR, SBP, DBP and MAP were analyzed with analysis of variance. *P*-value less than 0.05 was considered statistically significant. The sample size was calculated by comparing means of difference between groups by confidence interval 95% and study power 80%.

3. Ethical consideration

All the patients were randomly selected to groups, they all were aware of attending a clinical trial with signing an informed consent form and the proposal of the study was approved by the ethical committee of Mashhad University of Medical Sciences. All of the patients were ensured that their privacy will be kept and their personal information will not disclosed in any circumstance.

4. Results

Our study included 11 (31.4%) male and 24 (68.6%) female in direct laryngoscopy (DL group) and 16 (45.7%) males and 19 (54.3%) females in ILMA (ILMA group). Mean age of studied patients in DL group was 35.49 ± 12.2 and 35.46 ± 9 years old in ILMA group. There was no significant statistical difference between the groups with respect to age and gender ($P = 0.22$, $P = 0.26$). Measurement of baseline and before intubation hemodynamic indices including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) are presented in Table 1. This table presents that there was no significant difference between two studied groups about measured hemodynamic indices.

Table 2 presents the difference between each hemodynamic index after intubation in three interval times (after 1, 3 and 5 min) contrary to period before the intubation rates. This table shows that only the difference between rise of diastolic blood pressure and mean arterial blood pressure after 5 min interval of two studied groups were significant ($P = 0.04$; $P = 0.034$). However rise in diastolic, systolic and mean arterial pressure was observed after intubation in both groups (see Table 2), however when both groups were compared, the rise was not statistically significant.

Bucking (pre-extubation) laryngospasm (post-extubation) sore throat, hoarseness and coughing (during the first 24 hours after surgery) were measured in extubation time. Subsequent findings demonstrated that there was no significant difference between the number of patients with or without positive symptoms (Table 3, $P < 0.05$).

5. Discussion

Both direct laryngoscopy and endotracheal intubation induced the patients' cardiovascular system reaction, due to reflexive

Table 1 Comparison of some hemodynamic variables measured in admission time (base line) and before intubation (before) into group I (direct laryngoscopy) and group II (ILMA).

Variable	Group I (mean ± SD)	Group II (mean ± SD)	*P* value
Heart rate			
Baseline	94.63 ± 15.91	89.91 ± 9.82	0.14
Before	83.97 ± 13.7	81.29 ± 15	0.43
SBP			
Baseline	130.86 ± 13.63	134.69 ± 11.64	0.21
Before	96.51 ± 16.9	98.51 ± 10.5	0.55
DBP			
Baseline	82.8 ± 12.3	86.3 ± 7.6	0.15
Before	63.63 ± 14.8	67.7 ± 18.5	0.30
MAP			
Baseline	98.81 ± 11.83	102.43 ± 8.26	0.1
Before	74.59 ± 13.79	78.01 ± 13.44	0.29

Systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP).

Table 2 Comparison of some hemodynamic variables measured at three points (1, 3 and 5 min after intubation) into group I (direct laryngoscopy) and group II (ILMA).

Variable	Group I (mean ± SD)	Group II (mean ± SD)	*P* value
Heart rate			
Δ HR1	3.22 ± 15.99.21	3.82 ± 9.84.60	0.73
Δ HR3	0.02 ± 7.08	0.60 ± 13.75	0.82
Δ HR5	−1.82 ± 9.08	−0.14 ± 14.05	0.55
SBP			
Δ SBP1	20.68 ± 18.30	45.77 ± 16.09	0.36
Δ SBP3	20.08 ± 19.83	15.05 ± 11.40	0.19
Δ SBP5	19.42 ± 14.64	14.80 ± 13.14	0.16
DBP			
Δ DBP1	10.22 ± 2.29	7.74 ± 1.50	0.58
Δ DBP3	12.02 ± 1.88	5.74 ± 1.54	0.13
Δ DBP5	13.11 ± 1.53	6.91 ± 0.85	0.04
MAP			
Δ MAP1	13.71 ± 1.87	20.41 ± 1.48	0.49
Δ MAP3	14.71 ± 1.64	8.84 ± 1.18	0.08
Δ MAP5	15.21 ± 1.27	9.54 ± 0.87	0.03

Systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP).

Table 3 Comparison of some complication in extubation time between two studied groups; group I (direct laryngoscopy) and group II (ILMA).

Variable	Group I (%)	Group II (%)	*P* value
Positive bucking	11 (31.4)	14 (40)	0.45
Positive sore throat after recovery	8 (22.9)	4 (11.4)	0.20
Positive sore throat during first 24 h	10 (28.6)	9 (25.7)	0.78
Positive laryngospasm			
Female	34 (97.1)	35 (100)	0.31
Male	1 (2.9)	–	
Positive hoarseness			
Female	28 (70)	28 (82.4)	0.8
Male	7 (20)	6 (17.6)	
Positive cough			
Female	33 (94.3)	32 (94.1)	0.97
Male	2 (5.7)	2 (5.9)	

responses and the physiological presence of an endotracheal tube [11,12]. There are not much controlled studies on ILMA to see the hemodynamic responses associated with intubation through this technique, due to introduction of ILMA as a relatively new facilitating tracheal intubation method, without the need to laryngoscopy [13,14]. Wilson et al. [15] found significant increase in systolic blood pressure after laryngoscopy between two studied groups (51.3% in tracheal intubation versus 22.9% in ILMA). In our study it was demonstrated that both MAP and DBP at 5 min were significantly higher in patients that were intubated by direct laryngoscopy when compared with ILMA.

A previous study showed that the hemodynamic stress response to blind and fiber-optic guided intubation with the ILMA was less than that of direct laryngoscopy [10]. Similar as out findings, they demonstrated a larger increase in the mean blood pressure after 5 min interval between ILMA and tracheal intubation.

Kihara et al. [16] evaluated the hemodynamic response associated with intubation through the intubating laryngeal mask in 120 patients without any cardiovascular disease. They found that there was no significant increase in systolic and diastolic blood pressure, but there was an increase in heart rate 1 min after insertion of ILMA. A finding that did not confirmed in our study.

Also Kihara et al. [17] administrated study on 150 adult patients in order to observe the hemodynamic response to tracheal intubation with Macintosh laryngoscopic versus ILMA. It concluded that blind ILMA-guided intubation offered no advantage over direct laryngoscopy about hemodynamic stress responses. On the other hand, similar to our study, Siddiqui and Khan [18] compared direct laryngoscopy ILMA in randomized controlled trial on 100 adults ASA-1 and ASA-II patients referred to anesthesia department. They found significant rise in systolic and diastolic blood pressure and in mean arterial blood pressure after intubation within both studied groups, compared to baseline. Although the increase in heart rate was observed between groups, but this rise was not meaningful in both groups.

In evaluation of complications including sore throat, coughing, laryngospasm, hoarseness and cough, our study results confirmed the result of Kihara et al. [17], as well.

6. Limitations

It was needed to enroll more patients, but due high expenses of ILMA method and lack of preliminary evidences and restricted funding we could not do so. Besides the hypothesis of this study was better to be evaluated on the subject with cardiopulmonary disease, that are more than the patients without such conditions prone to the risk of being affected by the hemodynamic changes of the method of intubation.

7. Conclusion

We concluded that intubation through the ILMA has similar hemodynamic consequences to DL in adult patients. As the mean arterial blood pressure and diastolic blood pressure at the 5 min interval was significantly less in ILMA group versus the DL group, it may be used for patients in whom a marked pressure response would be undesirable.

Acknowledgements

We are thankful from chancellor for research of Mashhad University of Medical Sciences for funding and approval of this study, the third author as this study was part of his specialty dissertation Project.

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