

Haemodynamic Changes Associated with Tracheal Intubation Using Direct Laryngoscopy and Intubating Laryngeal Mask Airway: A Comparative Analysis

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ABSTRACT

Background: Haemodynamic changes can result from airway manipulations during direct laryngoscopy (DL) and endotracheal intubation and this may increase morbidity and mortality in patients. This can be attenuated either by medications or by modifying intubation technique such as use of Intubating Laryngeal Mask Airway (ILMA) which can lessen hemodynamic responses. This study compares the hemodynamic responses during intubation by either DL or ILMA. **Methodology:** Eighty-six ASA I and II patients aged between 18-50 years scheduled for elective surgeries under general anaesthesia were randomized into two groups. Each received IV fentanyl 2µg/kg and glycopyrrolate 4µg/kg 4 minutes before induction with IV propofol 3mg/kg, followed by suxamethonium 2mg/kg to a maximum of 100mg to facilitate intubation. Forty-three patients in each group were intubated using either DL or ILMA. Anaesthesia was maintained with isoflurane, muscle relaxation was with atracurium. At the end of the surgery patients were extubated following reversal of residual blockade. Hemodynamic parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), and oxygen saturation (SpO₂) at the immediate post intubation period, then at 1st, 3rd, 5th, 10th, 15th, 20th, 25th, and 30th minutes were assessed. **Results:** Baseline haemodynamic variables were comparable between the DL (88.28±12.19) and ILMA (90.79±10.71) groups. Mean heart rate ranged from 97.88 to 107.47 in the DL group and 104.98 to 115.28 for ILMA which were insignificant. MAP changes were also insignificant. There was a significant difference in mean time for intubation between the DL (19.93 + 6.17) and ILMA groups (46.54 + 11.63). **Conclusion:** Haemodynamic responses were not both clinically and statistically significantly different when ILMA was compared with DL during endotracheal intubation following the use of propofol, fentanyl and suxamethonium. Mean time for Intubation was significantly higher in the ILMA group.

Keywords: Haemodynamic response, intubating laryngeal mask airway, Direct laryngoscopy, Endotracheal intubation



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INTRODUCTION

Airway management is an important and fundamental aspect of anaesthesia delivery, in emergency medicine and in the care of critically ill patients. Endotracheal intubation is an optimal method of securing the airway for assisting ventilation and/or protecting the airway from the risk of aspiration, and direct laryngoscopy (DL) has relatively become the “yard stick” over which other intubation techniques are measured.¹

Direct laryngoscopy and endotracheal intubation during general anesthesia are known to induce clinical changes in patient's hemodynamic parameters. This hemodynamic stress response to airway manipulation characterized by an increase in heart rate and blood pressure was demonstrated by Saurabh et al.² Tracheal intubation results in variable catecholamine concentrations with a reflective rise in sympathetic activity.³ Direct laryngoscopy (DL) produces a marked transient stress response, this may be insignificant in healthy patients but causes detrimental effects on coronary and cerebral circulations in high risk patients, particularly in those with systemic hypertension, coronary artery or cerebrovascular diseases.⁴ If this response has to be minimized or prevented during rigid laryngoscopy, the use of other drugs have to be employed, and high doses of induction agents used thus increasing the risk of complications from either poly-pharmacy or increased dosage of drugs.

Theoretically, the sympathoadrenal hemodynamic response to laryngoscopy and intubation is said to be majorly caused by the distention of supraglottic tissues, this could be minimized when tracheal intubation techniques that avoid or minimize oropharyngeal stimulation are used,⁵ as obtained with the intubating laryngeal mask airway (ILMA). The ILMA was introduced by Dr. A. I. J Brain in 1997 with the aim of achieving better intubating conditions (as compared with the LMA). It is anatomically curved, rigid, with an integral guiding handle, an epiglottic elevator that replaces

the LMA laryngeal bars and a guiding ramp to direct the tracheal tube anteriorly as it exits the mask aperture.⁶ ILMA placement does not require any head manipulation and facilitate better alignment of tracheal tube, there is less distortion of pharyngeal structures which leads to less airway stimulation with less hemodynamic changes.

Previous studies have shown differing conclusions on hemodynamic responses following endotracheal intubation with ILMA in contrast to DL. While Kavitha et al⁷ and Zhang et al⁸ found no significant difference in the hemodynamic parameters (blood pressure and heart rate), and hence concluded that the ILMA has no advantage in attenuating pressor response as compared with DL, Joo and Rose⁹ who conducted a randomized controlled feasibility study in 90 adult females with ASA physical status of I and II concluded that the hemodynamic stress response is more marked with DL causing larger increases in mean arterial blood pressure (MAP) as compared to the ILMA. We conducted this prospective study which was carried out to compare haemodynamic responses during endotracheal intubation using DL and ILMA in Nigerian adult patients.

METHODOLOGY

This randomized prospective study was carried out at Aminu Kano Teaching Hospital in the year 2020 in eighty-six ASA I and II patients of either sex aged between 18 and 50 years. Patients who were scheduled for elective surgical procedures requiring endotracheal intubation and relaxant technique were included in this study. Institutional ethical committee approval was sought and approval obtained, a written informed consent was taken.

Patients enrolled for the study were randomly allocated to one of two groups by a research assistant (a designated resident doctor). Eighty-six

(86) pieces of uniformly sized sheets of paper were labeled group DL or group ILMA with 43 each representing the two study groups. These papers were folded and shuffled in a large box. Each patient was made to pick one folded sheet of paper from the box and hand over to the research assistant, the investigator was blinded at this point. Patients were reviewed a day before surgery, history and thorough physical examination including an airway assessment was carried out. Demographic parameters including patient's age, gender weight, height were recorded, baseline investigation reviewed include full blood count (FBC), and serum electrolytes. The patients were each assigned a physical status using the ASA classification and instructed to fast according to the ASA fasting guidelines. Patients with Mallampatti of III, morbid obesity ($BMI > 30 \text{ kg/m}^2$), respiratory tract pathology, limited mouth opening, risk of aspiration/regurgitation, cardiovascular disease, COPD, and anticipated difficult airway were excluded from the study.

In the theatre, anaesthetic machine safety checklist was performed and resuscitation equipment and drugs were made readily available. On arrival of the patient in the operating room, the patient was positioned supine on the operating table. All the patients were connected to multi parameter patient monitor and baseline heart rate, blood pressure, SpO₂ and ECG were recorded.

Intravenous access was secured using size 16G cannula for fluid and drug administration. Intravenous Fentanyl $2 \mu\text{g/kg}$ and intravenous glycopyrrolate $4 \mu\text{g/kg}$ were served 4 minutes before induction, and patient pre-oxygenated for 5 minutes. Intravenous propofol 3 mg/kg , followed by suxamethonium 2 mg/kg to a maximum of 100 mg was used for induction and to facilitate intubation respectively. The airway management was carried out by a single investigator in both groups, while the research assistant (a dedicated resident doctor) was responsible for carrying out the timing and other entries on the data collection form.

After achieving loss of verbal communication and

jaw relaxation, endotracheal intubation was performed by the method of assigned group. In the DL group, intubation was done by using sizes 3 or 4 Macintosh laryngoscope with polyvinyl chloride (PVC) cuffed endotracheal tube of appropriate size (sizes 7.0mm or 7.5mm for females, and sizes 8.0mm or 8.5mm for males) and in the second group, an appropriately sized ILMA (size 4 for those weighing more than 75 kg and size 3 for those weighing less than 75 kg) was used for endotracheal intubation.

Hemodynamic parameters were assessed by measuring the Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) at the immediate post intubation period, then at the 1st, 3rd, 5th, 10th, 15th, 20th, 25th, and 30th minutes and recorded by the research assistant using the data collection form. The data obtained was analyzed using Statistical Package for Scientific Solutions (SPSS) version 21.0. Quantitative variables were summarized using measures of central tendency (mean) and measures of variation (standard deviation) and percentages. Test of quantitative data was done using student's t-test and repeated measure ANOVA. Categorical variables were analyzed using chi-square, and summarized as frequencies and percentages, *p*-value of less than 0.05 was considered as significant.

RESULTS

Our study included a total of 40 males and 46 females, (Table I) overall mean age was 35.92 ± 9.28 (mean \pm standard deviation), mean age in DL group was 36.45 ± 9.42 years, and 34.86 ± 9.52 years for ILMA (*p* - 0.244). Mean BMI in the DL and ILMA groups were 25.86 ± 1.75 and 26.47 ± 2.06 respectively (*p* - 0.159). There were 46 males and 40 females (*p*-0.663)

Patients with Mallampati I or II and ASA I or II were comparable in the two groups with *p* values of 0.655 and 0.392 respectively.

Table II presents the hemodynamic indices at baseline, in the immediate post intubation period, and at

different interval times (after 1, 3, 5, 10, 15, 20, 25 and 30 mins) in the two study groups. Baseline haemodynamic variable including the SBP, DBP, MAP, and HR were found to be comparable between the two groups. Mean heart rate ranged from 97.88 to 107.47 in the DL group, while in the ILMA group, it ranged from 104.98 to 115.28. MAP

also showed an insignificant difference between the two groups with a range of 81.51 to 86.37 in the DL group and 79.58 to 96.23 for the ILMA group. The mean time taken for intubation as seen in **Table III** for the ILMA group (46.54 ± 11.63 seconds) was significantly greater ($p = 0.001$) than was seen in the DL group (19.93 ± 6.17)

Table I

Patient Demographics	DL (n=43)	ILMA (n=43)	p-value
BMI	25.90±1.75	26.48±2.06	0.167
SEX M/F(% in group)	21(48.84%) 22(51.16%)	19(44.19%) / 24(55.81%)	0.665
MALLAMPATI I/II (% in group)	21(48.84%) / 22(51.16%)	19(44.19%) / 24(55.81%)	0.665
ASA I/II (% in group)	25(58.14%) / 18(41.86%)	29(67.44%) / 14(32.56%)	0.372

Table II: Hemodynamic variables at various time intervals

Time interval	Heart rate		SBP		DBP		MAP	
	DL (mean ± SD)	ILMA (mean ± SD) (p)	DL (mean ± SD)	ILMA (mean ± SD) (p)	DL (mean ± SD)	ILMA (mean ± SD) (p)	DL (mean ±SD)	ILMA (mean ± SD) (p)
Base line	88.28±12.19	90.79±10.71	124.61±12.13		78.54±8.09		94.42±8.39	
ILMA	(0.072)		126.95±0.070	(0.083)	80.77±9.22	(0.030)	96.42±7.58	(0.043)
Immediate post int	106.05 ± 8.10		120.47± 17.29		69.56± 13.51		85.91± 14.66	
DL	111.49 ±15.67	(0.047)	130.26± 27.27	(0.008)	75.98± 18.31	(0.068)	96.23± 20.51	(0.009)
ILMA	107.47 ± 12.40		115.14± 17.09		66.67± 12.83		81.51± 15.13	
1 st minute	113.70 ±11.98	(0.020)	122.51± 29.28	(0.018)	72.63± 17.99	(0.081)	93.49± 22.03	(0.014)
ILMA	107.61 ±9.79		112.51± 15.85		68.93± 12.2		84.42± 16.09	
3 rd minute	113.28 ±11.18	(0.071)	117.35± 30.15	(0.355)	66.49± 18.61	(0.474)	86.00± 22.13	(0.706)
ILMA	105.40 ±9.59		108.16± 14.29		66.19± 13.22		82.07± 13.08	
5 th minute	112.67± 13.21	(0.007)	113.30± 21.91	(0.202)	64.84± 14.54	(0.654)	83.16± 16.03	(0.730)
ILMA	106.33± 17.93		108.44± 16.32		67.35± 13.93		82.93± 14.12	
10 th minute	112.56± 12.06	(0.062)	109.33± 20.43	(0.825)	64.02± 13.53	(0.265)	79.58± 14.97	(0.289)
ILMA	104.54± 12.06		114.47± 14.08		70.26± 16.23		86.37± 15.28	
15 th minute	107.19± 13.63	(0.342)	110.30± 19.72	(0.263)	65.63± 15.08	(0.174)	81.09± 19.20	(0.162)
ILMA	101.37± 13.89		112.21± 16.10		68.63± 12.58		85.30± 13.94	
20 th minute	106.42± 14.21	(0.100)	117.09± 20.12	(0.217)	71.98± 17.15	(0.305)	88.77± 18.38	(0.327)
ILMA	99.40± 12.88		113.65± 15.92		67.74± 12.55		84.07± 13.79	
25 th minute	106.26± 12.98	(0.016)	120.65± 18.32	(0.094)	75.61± 15.35	(0.011)	92.42± 19.47	(0.024)
ILMA	97.88± 13.20		113.67± 12.26		69.00± 10.92		84.84± 11.11	
30 th minute	104.98± 12.79	(0.013)	118.26± 13.57	(0.104)	70.00± 8.24	(0.633)	87.93± 9.88	(0.176)
ILMA								

Table III: Time taken for intubation

Time taken for intubation	DL	ILMA	p value
Mean ± STD (seconds)	19.93 ± 6.17	46.54 ± 11.63	0.001

DISCUSSION

In this study, an analysis of the haemodynamic parameters shows no statistically significant changes in HR, SBP, DBP and MAP at all points of measurement when either DL or ILMA are employed as means of endotracheal intubation, this result is consistent with that of other studies.^{5,7} This may be attributed to the

methodology employed in this study, these are as follows. At intubation, at least two drugs used (propofol and fentanyl) are used in the attenuation of hypertensive response to laryngoscopy. These two drugs might have acted synergistically to prevent a significant alteration in the HR and blood pressure.^{10,11}

Suxamethonium which is a rapid onset, short acting, depolarizing neuromuscular junction blocker was used to aid endotracheal intubation, it cause flaccid paralysis of the vocal cords and moves them out of the way for easy tube passage (hence less mechanical stimulation on the cords

with less pressor response observed).¹²

Only normotensive patients were involved in the study, Kihara et al⁵ in their study demonstrated that hypertensives react differently to these intubation techniques.⁵ They studied 3 tracheal intubation devices in normotensive and hypertensive patients, and they concluded that the ILMA and lightwand (LW) were able to attenuate haemodynamic response in hypertensives but not in normotensive individuals.

Even though Kavitha *et al*⁷ reported the same finding as ours, there was a slight increase in the haemodynamic parameters (SBP, DBP, MAP and HR) immediately after intubation, at 1 minute and 3 minutes post intubation which they reported as “statistically insignificant.” This slight rise may be attributed to the fact that sodium thiopentone was used as an induction agent in their study as compared to propofol (with a more marked hypotensive effect) used in our study.

There are very few reported adverse cardiovascular events precipitated by haemodynamic response to tracheal intubation, Fobes and Dally¹³ reported acute ischaemic changes in a healthy normotensive man when his blood pressure increased to 190/130mmHg during laryngoscopy and intubation, also Fox et al¹⁴ reported a 28yr old lady with chronic hypertension who developed acute pulmonary oedema when her systolic blood pressure rose to between 240-300mmHg during laryngoscopy and intubation.

In our study, the changes in blood pressures from the baseline were minimal, the heart rate values were however a bit higher when compared with base line heart rates in both ILMA and DL groups. This is similar to the findings by Zhang et al⁸ who reported that the maximum value of blood pressures post intubation and at intervals of 5 minutes did not exceed the baseline values, but the maximum values of the heart rate was observed to be higher than the baseline in both ILMA and DL groups (statistically significant but not clinically relevant), hence they concluded like in our study that ILMA offers no advantage in attenuating the haemodynamic response to orotracheal intubation

as compared with DL.

From this study, it was observed that the ILMA group had higher (though not significant) MAP values in the first few minutes following intubation, this is consistent with the findings of Kihara et al,⁵ they studied the haemodynamic response to ILMA and the effect of timing of removal of the device post intubation in 120 patients without cardiovascular diseases, for which propofol (2mg/kg) was also used to induce the subjects. Their study showed that if removal was done 1-2 minutes post insertion/intubation, the blood pressure and heart rate increase to a greater extent than if the device was removed after 3 minutes. In this study, the removal was carried out immediately after intubation and hence could explain the similar responses observed.

Choyce *et al*¹⁵ while comparing ILMA and DL also measured the plasma level of norepinephrine along with HR and blood pressure, they found a similar magnitude of pressor response to intubation with the use of both DL and ILMA. Even though we did not measure norepinephrine in our study, our clinical measurement and subsequent claim that there is no clinically significant difference in the pressor response exerted by DL when compared to ILMA, is in tandem with their study. They however further stated that delayed removal of the ILMA increase significantly this pressor response rather than decrease it.

In the present study the mean intubation time in ILMA group was 46.54 ± 11.63 seconds and 19.93 ± 6.17 seconds in the DL group. The difference in intubation time between the two groups was statistically significant. ($p = 0.001$) This could have further increased pressor response with ILMA thus accounting for the comparable results seen in the two groups.

Contrary to the findings of this study, Sener et al¹⁶ also compared DL and ILMA in hypertensives, but they reported that ILMA induces a greater pressor response than does DL in hypertensive patients. They however stated that this might be from the intense and repeated oropharyngeal and tracheal stimulation from the ILMA and suggested that the

DL which is more rapid and safe to perform may be preferred in hypertensive patients with normal airways. Their different results from this study could be due to the fact that hypertensive patients were investigated, while our study excluded hypertensives..

Joo and Rose,⁹ however, reported a higher MAP in patients that had DL and intubation compared to those intubated with aid of ILMA, this might be because orotracheal intubation was done 5 minutes after ILMA insertion, which is not the routine clinical practice and this differs from our study where intubation was almost immediately after ILMA insertion.

CONCLUSION

We conclude that ILMA has no observed advantage in attenuating the sympathoadrenal response when compared with DL following the use of propofol, fentanyl and suxamethonium.

Conflict of interest: We declare no conflict of interest

REFERENCES

1. Teena B, Suresh S, Himani M. A study to evaluate and compare intubating laryngeal mask airway and air-Q intubating laryngeal airway for intubation using Parker Flex Tip tube. *Ind J Anaesth*, 2020; 64(2): 97102.
2. Saurabh T, Bharati. Comparative Study of Changes in Haemodynamic Responses during Intubation- Intubating Laryngeal Mask Airway versus Endotracheal Tube. *J Evo Med Dent Sci* 2020; 9(3): 134-7
3. Halevy O, Nadel Y, Barak M, Rozenboim I, Sklan D. Hemodynamic and catecholamine response to tracheal intubation: direct laryngoscopy compared with fiberoptic intubation. *J Clin Anesth* 2003;15(2):1326.
4. Zeng JY, Yan JJ, Li SY, Xie WQ, Huang YF, Su KY, *et al.* Randomized controlled trial; Hemodynamic variations during tracheal intubation with intubating laryngeal mask airway versus direct laryngoscopy in hypertensive patients. *Zhonghua Yi Xue Za Zhi* 2013;93(31):2467-2469.
5. Kihara S, Brimacombe J, Yaguchi Y, Watanabe S, Taguchi N, Komatsuzaki T. Hemodynamic responses among three tracheal intubation devices in normotensive and hypertensive patients. *Anesth Analg* 2003; 96:890895.
6. Brain AI, Verghese C, Addy EV, Kapila A. The intubating laryngeal mask-I: Development of a new device for intubation of trachea. *Br J Anaesth* 1997;79:699703
7. Kavitha J, Debendra KT, Sandeep KM, Gayatri M, Chandrasekhar JL, Ezhilarasu P. Intubating condition, hemodynamic parameters and upper airway morbidity: A comparison of intubating laryngeal mask airway with standard direct laryngoscopy. *Anesth Essays Res* 2011; 5(1): 4856.
8. Zhang GH, Xue FS, Sun HY, Li CW, Sun HT, Li P, *et al.* Comparative study of hemodynamic responses to orotracheal intubation with intubating laryngeal mask airway. *Chin Med J (Engl)* 2006;119:899904.
9. Joo H, Rose K. Fastrach-a new intubating laryngeal mask airway: Successful use in patients with difficult airways. *Can J Anaesth* 1998; 45:253256
10. Ebert TJ, Muzi M. Propofol and autonomic reflex function in humans. *Anesth Analg*. 1994; 78(20): 369-375.
11. Gurulingappa, Aleem AM, Awati MN, Adarsh S. Attenuation of cardiovascular responses to direct laryngoscopy and intubation- A comparative study between iv bolus fentanyl, lignocaine and placebo(NS). *J Clin Diagn Res*. 2012; 6(10): 1749-1752.
12. Diem TT, Newton KE, Mount VA, Lee JS, Wells GA, Perry JJ. Rocuronium versus suxamethonium for rapid sequence induction intubation. *Cochrane Database Syst Rev*. 2015.
13. Forbes AM, Dally FG. Acute hypertention

- during induction of anaesthesia and endotracheal intubation in normotensive man. *Br J Anaesth* 1970; 42: 618-624.
14. Fox EJ, Sklar CS, Hill CH, Villanueva R, King BD. Complication related to the pressor response to endotracheal intubation. *Anesthesiology* 1977; 47: 524-525.
15. Choyce A, Avidan MS, Harvey A, Patel C, Timberlaka C, Sarang K, et al. The cardiovascular response to insertion of the intubating laryngeal mask airway. *Anaesthesia* 2002; 57: 330-333.
16. Sener EB, Emre U, Burcu U, Sarihasan B. Hemodynamic responses and upper airway morbidity following tracheal intubations in patients with hypertension: conventional laryngoscopy versus an intubating laryngeal mask airway. *Clinics*. 2012; 67(1): 49-54