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Original Research Article

Comparison of Haemodynamic Response to Tracheal Intubation with Macintosh Laryngoscope and Intubating Laryngeal Mask Airway in Adult Patients

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Abstract:

Background: Endotracheal intubation using the Macintosh laryngoscope is the standard technique for securing the airway but is associated with significant haemodynamic stress due to direct laryngoscopy. The Intubating Laryngeal Mask Airway (ILMA) provides an alternative method that may attenuate this response by avoiding direct stimulation of upper airway structures. This study compares the haemodynamic changes, intubation characteristics, ventilation parameters, and complications between ILMA and Macintosh laryngoscope (ML) in adult elective surgical patients.

Methods: A randomized prospective study was conducted on 60 ASA I–II patients aged 18–60 years undergoing elective surgery under general anaesthesia. Participants were allocated into two groups of 30 each: ILMA-guided intubation and ML-guided intubation. Standardized anaesthetic induction was followed by intubation using the assigned device. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and $EtCO_2$ were recorded at baseline, pre-induction, at intubation, and at 3-, 5-, 10-, and 15-minutes post-intubation. Intubation time and complications were also assessed. Statistical analysis was performed using Student's t-test, with $p < 0.05$ considered significant.

Results: Baseline demographic variables were comparable between groups ($p > 0.05$). The ML group exhibited significantly higher HR, SBP, and DBP from intubation through 15 minutes post-intubation ($p < 0.05$), indicating a stronger haemodynamic response. In contrast, ILMA maintained more stable cardiovascular parameters across all time points. $EtCO_2$ values showed no significant difference between groups at any interval ($p > 0.05$), indicating similar ventilation efficacy. Intubation time was significantly longer with ILMA (64.36 ± 6.58 sec) compared to ML (21.33 ± 4.16 sec; $p < 0.0001$). Complication rates were low in both groups; however, dental injury occurred only in ML, while a single case of laryngospasm occurred with ILMA**.**

Conclusion: Both ILMA and Macintosh laryngoscope are effective for airway management, but ILMA offers superior haemodynamic stability during and after intubation, with fewer trauma-related complications. The Macintosh laryngoscope allows faster intubation but is associated with a more pronounced pressor response. ILMA may be preferred in patients where minimising cardiovascular stress is essential, whereas ML remains advantageous in situations requiring rapid airway access.

Keywords: Intubating Laryngeal Mask Airway, Macintosh Laryngoscope, Haemodynamic Response, Intubation Time, Airway Management.

Introduction

Securing the airway is a fundamental component of general anaesthesia, as anaesthetic agents reduce airway tone, protective reflexes, and spontaneous ventilation, necessitating a reliable method for airway control [1]. Endotracheal intubation (ETI) is considered the gold standard for airway management and is traditionally performed using the Macintosh laryngoscope. However, direct laryngoscopy requires alignment of the oral, pharyngeal, and laryngeal axes, a manoeuvre that can cause significant haemodynamic stress due to stimulation of upper airway structures [2]. This stimulation triggers a sympathetic surge mediated by catecholamine release, resulting in tachycardia and hypertension—responses that may be detrimental in patients with cardiovascular or

cerebrovascular disease [3]. To minimize such haemodynamic fluctuations, both pharmacological strategies (including opioids, beta blockers, and dexmedetomidine) and non-pharmacological approaches have been explored [4]. Among non-pharmacological methods, supraglottic airway devices (SADs) such as the Intubating Laryngeal Mask Airway (ILMA) provide an alternative route for intubation that avoids direct lifting of the laryngeal structures.

The ILMA enables ventilation and facilitates blind intubation through a pre-shaped channel with comparatively less stimulation of the oropharynx and larynx [5].

Previous studies have reported mixed results regarding whether the ILMA is superior to the Macintosh laryngoscope in attenuating the pressor response associated with intubation [6,7]. Considering this variability in existing evidence, the present study was designed to compare the haemodynamic response to tracheal intubation performed using the Macintosh laryngoscope versus the ILMA in adult ASA I–II patients undergoing elective surgery.

Methodology:

Study Design and Setting: A hospital-based randomized prospective study was conducted at the Department of Surgery and ENT, GMERS Medical College and Civil Hospital, Gandhinagar, from February 2023 to February 2025.

Study Population: 60 adult patients aged 18–60 years scheduled for elective surgery under general anaesthesia were enrolled. Patients were classified as ASA grade I or II.

Inclusion and Exclusion Criteria: Patients fulfilling the criteria of being 18–60 years old, classified as ASA grade I or II, with a body mass index (BMI) of less than 30 kg/m², and posted for elective surgery under general anaesthesia were included.

Patients were excluded if they refused participation, were pregnant or lactating, were undergoing emergency surgery, or had an anticipated difficult airway such as Mallampati grade III or IV.

Randomization: Patients were randomly allocated into two groups (n = 30 each):

- Group ML – Intubation using Macintosh laryngoscope
- Group ILMA – Intubation using Intubating Laryngeal Mask Airway

Anaesthesia Technique: All patients underwent pre-anaesthetic evaluation and fasting confirmation. Standard monitors were applied (HR, NIBP, SpO_2, $EtCO_2$).

Premedication

- Glycopyrrolate 0.2 mg IV
- Midazolam 1 mg IV
- Fentanyl 2 µg/kg IV
- Ondansetron 4 mg IV
- Pantoprazole 40 mg IV

Induction: Induction of anaesthesia was achieved with five minutes of preoxygenation using 100% oxygen, followed by propofol 2 mg/kg IV. Succinylcholine 2 mg/kg IV was administered to facilitate muscle relaxation before intubation.

Intubation Procedure:

- Group ML: Intubation with conventional Macintosh laryngoscope (Blade 3 for females, 4 for males).
- Group ILMA: ILMA size 3 or 4 inserted in neutral head position, ventilation confirmed, and reinforced ETT passed through ILMA. Adjusting manoeuvres (extension, up-down, optimisation, and head-neck manoeuvre) were used if resistance was encountered.

Only two attempts were permitted; failures were excluded.

Measured Parameters:

- Heart Rate (HR)
- Systolic Blood Pressure (SBP)
- Diastolic Blood Pressure (DBP)
- $EtCO_2$

Additional parameters:

- Intubation time
- Complications (sore throat, mucosal injury, dental trauma, laryngospasm)

Statistical Analysis: All collected data were expressed as mean ± standard deviation (SD). Statistical comparison between the two groups was performed using the student's t-test, and a p-value of less than 0.05 was considered statistically significant.

Results

Table 1: Baseline Characteristics (Age, Weight, Gender) of Study Subjects

Variable	ILMA (Mean ± SD)	ML (Mean ± SD)	p-value
Age (years)	38.20 ± 11.94	37.73 ± 14.09	0.89
Weight (kg)	60.56 ± 7.34	58.23 ± 11.16	0.34
Gender (M/F)	22/8	18/12	0.28

The demographic variables of the study population show that both groups, ILMA and ML, are well matched. The mean age in the ILMA group is 38.20 ± 11.94 years, while in the ML group it is 37.73 ± 14.09 years. The p-value of 0.89 indicates that the difference in age distribution between the two groups is statistically insignificant. Similarly, when comparing body weight, the ILMA group has an average weight of 60.56 ± 7.34 kg, whereas the ML group has an average of 58.23 ± 11.16 kg. The p-value of 0.34 shows that there is no meaningful difference between the groups in terms of weight. For gender distribution, the ILMA group consists of 22 males and 8 females, while the ML group includes 18 males and 12 females. The p-value here is 0.28 again suggesting that the gender ratio between the two groups is not significantly different. Overall, these demographic comparisons confirm that the ILMA and ML groups are comparable at baseline. Since there are no significant differences in age, weight, or gender, any observed outcomes in the study can be attributed more confidently to the interventions rather than demographic variations. This means that age, weight and Gender are not likely to influence or bias the comparison of outcomes between the two techniques.

Table 2: Comparison of Heart Rate at Different Time Intervals

Time Interval	ILMA (Mean ± SD)	ML (Mean ± SD)	p-value
Baseline	85.1 ± 10.53	82.86 ± 11.64	0.43
Pre-induction	91.23 ± 9.32	90.53 ± 12.13	0.80
At Intubation	88.93 ± 8.73	94.33 ± 12.60	0.05
3 min	86.53 ± 9.46	94.6 ± 11.62	0.004
5 min	84.13 ± 9.09	92.2 ± 10.67	0.002
10 min	82 ± 10.94	90.5 ± 10.94	0.001
15 min	80.86 ± 9.07	88.2 ± 10.66	0.005

This table compares the Heart Rate values between the ILMA group and the ML group at different time intervals during the procedure. At baseline and pre-induction, both groups have similar values, and the p-values (0.43 and 0.80) show no significant difference.

However, starting from intubation onwards, the ML group shows higher values than the ILMA group. At intubation, the difference is borderline significant (p = 0.05). From 3 minutes to 15 minutes, the p-values (0.004, 0.002, 0.001, 0.005) indicate statistically significant differences, meaning the ML group consistently maintains higher readings compared to the ILMA group.

Both groups start similarly, but after intubation, the ML group shows significantly higher values, suggesting a better hemodynamic stability compared to the ILMA group.

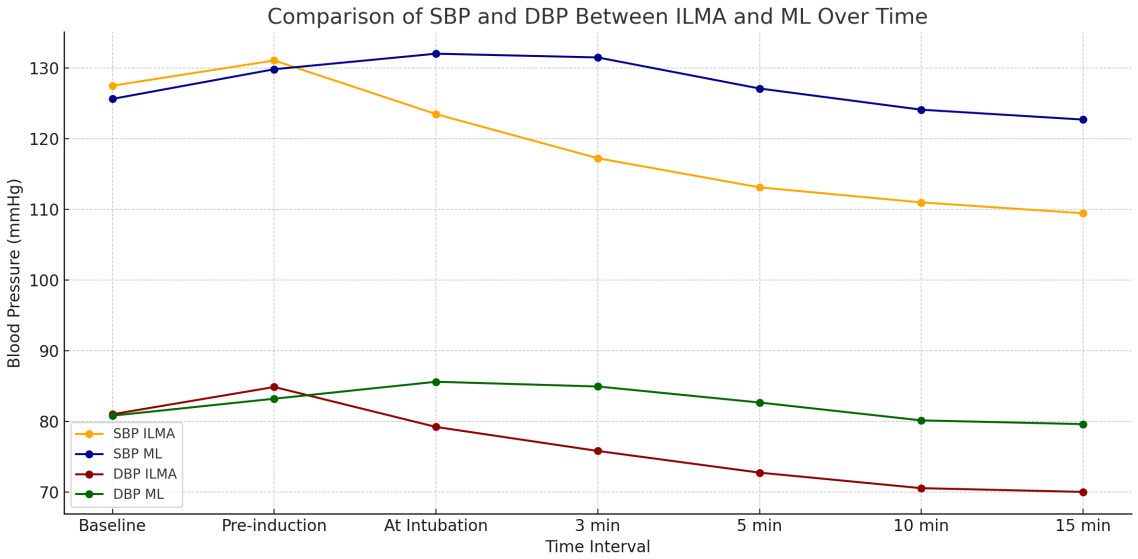

Figure 1: Trend of Systolic and Diastolic Blood Pressure between ILMA and ML Over Time

This graph compares systolic (SBP) and diastolic (DBP) blood pressure changes over time between the ILMA and ML groups. At baseline, the systolic blood pressure (SBP) values of the ILMA and ML groups are quite similar, with ILMA showing 127.53 ± 5.7 mmHg and ML showing 125.66 ± 6.2 mmHg, and the difference is not statistically significant (p = 0.23). This similarity continues at the pre-induction stage, where ILMA records 131.1 ± 7.16 mmHg and ML 129.86 ± 7.04 mmHg, again with no significant

difference (p = 0.51). However, a marked divergence appears at the time of intubation. The ILMA group shows a drop to 123.5 ± 7.08 mmHg, while the ML group rises sharply to 132.06 ± 8.7 mmHg, a difference that is highly significant (p < 0.0001). This trend continues throughout the subsequent time intervals. At 3 minutes, ILMA decreases further to 117.26 ± 8.74 mmHg, whereas ML remains elevated at 131.53 ± 7.04 mmHg. At 5 minutes, the ILMA value is 113.13 ± 9.36 mmHg, and ML remains higher at 127.13 ± 7.61 mmHg. This pattern persists at 10 minutes (ILMA 111, ML 124.13 mmHg) and at 15 minutes (ILMA 109.46, ML 122.73 mmHg), with all comparisons showing highly significant differences (p < 0.0001). Overall, the data clearly indicate that while both groups begin with comparable SBP values, the ML group exhibits a consistently stronger and sustained increase in blood pressure following intubation, whereas the ILMA group demonstrates a steady decline, suggesting better hemodynamic stability with ILMA.

Table 3: Comparison of $EtCO_2$ Values between ILMA and ML over Time

Time	ILMA	ML	p-value
Intubation	34.87 ± 2.81	34.53 ± 2.33	0.61
3 min	35.6 ± 3.08	35.26 ± 2.14	0.62
5 min	36.5 ± 2.97	36.16 ± 2.05	0.61
10 min	37.3 ± 2.61	36.64 ± 2.07	0.27
15 min	37.9 ± 2.75	37.22 ± 1.95	0.36

- $EtCO_2$ values were almost identical between ILMA and ML at every time point.
- At intubation, ILMA was 34.87 mmHg and ML 34.53 mmHg (p=0.61).
- At 3 and 5 minutes, both groups increased slightly to around 35–36 mmHg, with p-values 0.62 and 0.61, showing no difference.
- At 10 minutes, ILMA 37.3 vs ML 36.64 (p=0.27), still not significant.
- At 15 minutes, ILMA 37.9 vs ML 37.22 (p=0.36).
- Overall, all p-values > 0.05, indicating no significant difference in $EtCO_2$ between ILMA and ML.

Table 4: Comparison of Intubation Time between ILMA and ML

Variable	ILMA	ML	p-value
Intubation Time (sec)	**64.36 ± 6.58**	**21.33 ± 4.16**	**<0.0001**

The table compares the intubation time between the ILMA and ML groups. The ILMA group required a significantly longer time to achieve successful intubation, with an average of 64.36 ± 6.58 seconds, whereas the ML group completed intubation much faster, averaging 21.33 ± 4.16 seconds. The p-value < 0.0001 indicates that this difference is highly statistically significant, meaning the faster intubation time in the ML group is not due to chance. Overall, this shows that the Macintosh Laryngoscope provides a quicker intubation compared to the ILMA technique.

Table 5: Incidence of Complications in ILMA vs Macintosh Laryngoscope Groups

Complication	ILMA (N/%)	ML (N/%)
Sore throat	3 (10%)	5 (16.6%)
Dental injury	0	1 (3.3%)
Mucosal injury	0	0
Hoarseness of voice	0	0
Laryngospasm	1 (3.3%)	0

The table presents the incidence of complications observed in the ILMA and ML groups. Sore throat was the most common complication in both groups, occurring in 3 patients (10%) with ILMA and 5 patients (16.6%) with ML, showing a slightly higher rate with the Macintosh laryngoscope.

Dental injury was reported only in the ML group, affecting 1 patient (3.3%), while no such cases occurred with ILMA, indicating that ILMA may be less traumatic to oral structures. Mucosal injury and hoarseness of voice were not seen in either group, suggesting that both techniques are generally safe in terms of airway tissue injury. Laryngospasm occurred in one patient (3.3%) in the ILMA group but was absent in the ML group. Overall, both devices showed low complication rates, with ILMA demonstrating fewer trauma-related complications but having one instance of laryngospasm.

Discussion

In the present study, both the ILMA and ML groups were comparable at baseline, as indicated by similar age, weight, and gender distribution. The absence of significant demographic differences strengthens the reliability of the comparative outcomes, ensuring that any variations observed between the groups are attributable to the airway device rather than patient-

related factors. Such baseline matching is essential in airway studies to reduce confounding variables, a practice emphasized in previous research on airway instrumentation [8].

A key finding of this study is the difference in hemodynamic response between the two techniques. Although both groups had similar blood pressure values at baseline and pre-induction, the ML group demonstrated a significantly higher systolic and mean blood pressure response immediately after intubation and throughout the subsequent 15-minute period. This exaggerated response is consistent with known physiological reactions to direct laryngoscopy, which stimulates the oropharyngeal and laryngeal structures more intensely, leading to sympathetic activation [2,9]. In contrast, the ILMA displayed a more stable and attenuated hemodynamic profile, supporting previous evidence that supraglottic-guided intubation produces less cardiovascular stress [5]. These findings suggest that ILMA may be particularly advantageous in patients where minimizing hemodynamic fluctuations is critical, such as those with cardiovascular comorbidities.

Despite differences in hemodynamic changes, $EtCO_2$ values remained comparable between both groups at all measured intervals. This indicates that once the airway was secured—whether by ILMA-guided intubation or ML—both methods provided equally effective ventilation and CO_2 elimination. Previous studies have similarly reported no significant difference in ventilation adequacy once successful intubation is achieved with either technique [6].

A notable distinction between the two methods was the significantly longer intubation time with the ILMA. The ILMA required more than three times the duration needed for ML intubation. This finding aligns with literature stating that ILMA-guided intubation involves additional procedural steps and lacks direct glottic visualization, resulting in comparatively slower airway establishment [10]. In contrast, the Macintosh laryngoscope allows rapid visualization and tube placement, making it the preferred option in situations requiring quick airway access, such as emergency settings.

The complication profile in this study demonstrates that both devices are generally safe, with low overall incidence. Sore throat was slightly more common with ML, consistent with reports that direct laryngoscopy can cause increased pharyngeal irritation [11]. Dental injury occurred only in the ML group, supporting evidence that direct laryngoscopy poses a higher risk of trauma to the teeth and oral structures [12]. The absence of mucosal injury and hoarseness in both groups suggests minimal tissue trauma from either device. A single case of laryngospasm in the ILMA group was noted, a recognized but infrequent complication associated with supraglottic airway manipulation [13].

Overall, the findings indicate that while the Macintosh laryngoscope offers faster intubation, it is associated with a more pronounced hemodynamic response and slightly higher trauma-related complications. Conversely, the ILMA provides greater hemodynamic stability and fewer airway injuries, albeit with longer intubation times. These results support the selective use of each device depending on clinical priorities—rapid airway access for emergencies versus hemodynamic stability for high-risk cardiovascular patients.

Conclusion

The present study demonstrates that both ILMA and Macintosh laryngoscope are effective tools for securing the airway in elective surgical patients. However, ILMA offers a significant advantage in terms of hemodynamic stability, producing a much smaller rise in blood pressure during and after intubation. In contrast, the Macintosh laryngoscope results in a stronger pressor response but provides substantially faster intubation times, making it more suitable for situations requiring rapid airway access.

$EtCO_2$ values remained comparable between both groups, indicating equally effective ventilation once intubation was achieved. The complication rates were low in both groups, though ML showed slightly more trauma-related issues. Overall, ILMA is preferable for patients where minimizing cardiovascular stress is crucial, while ML remains advantageous for quick and straightforward intubation.

References

1. Morgan GE, Mikhail MS, Murray MJ. Clinical Anesthesiology. 5th ed. New York: McGraw-Hill; 2013.
2. King BD, Harris LC, Greifenstein FE, Elder JD. Reflex circulatory responses to direct laryngoscopy and tracheal intubation. Anesthesiology. 1951;12(5):556-566.
3. Derbyshire DR, Smith G. Sympathoadrenal responses to laryngoscopy and intubation. Br J Anaesth. 1984;56(8): 857-864.
4. Miller RD, Eriksson LI, Fleisher LA. Miller's Anesthesia. 8th ed. Philadelphia: Elsevier; 2015.
5. Brain AIJ. The intubating laryngeal mask: a new concept in airway management. Br J Anaesth. 1997;79(6): 701-706.
6. Joo HS, Rose DK. The intubating laryngeal mask airway with and without fibreoptic guidance. Anesth Analg. 1999;88(3):662-666.
7. Kundra P, Parida S, Mohan V. Pressor responses following intubation through intubating laryngeal mask airway vs. direct laryngoscopy. Anaesthesia. 2005;60(8):748-753.

8. Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK: NAP4. Br J Anaesth. 2011;106(5):617–31.
9. Shribman AJ, Smith G, Achola KJ. Cardiovascular and catecholamine responses to laryngoscopy with and without intubation. Br J Anaesth. 1987;59(3):295–9.
10. Timmermann A, Russo SG, Crozier TA. LMA Fastrach vs Macintosh laryngoscope: intubation times and success rates. Anaesthesia. 2007; 62(4): 368–74.
11. Maruyama K, Yamada T, Kawakami R. Sore throat after intubation: comparison of devices. J Clin Anesth. 2004;16(4):300–3.
12. Warner ME, Benenfeld SM, Warner MA. Perianesthetic dental injuries. Anesthesiology. 1999;90(5):1302–5.
13. Keller C, Brimacombe J. Respiratory complications with laryngeal mask airways. Anesth Analg. 1999;88(2):467–73.