

Comparative Study between Intubating Laryngeal Mask Airway and Macintosh Laryngoscope in Patients with Simulated Cervical Spine Injury

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Abstract

The aim of this prospective randomized study is to compare intubating laryngeal mask airway (ILMA) with Macintosh laryngoscope (ML) in patients with simulated cervical spine injury, to compare the hemodynamic variables and to see any complications associated with their use in the peri-operative period.

Methods: We selected 60 ASA physical status 1 and 2 patients posted for elective surgeries under general anaesthesia. These patients were randomly allocated into two groups of 30 each: Group ML was intubated using Macintosh laryngoscope and Group ILMA was intubated using ILMA. Baseline hemodynamic parameters (BP, HR), 3 min and 5 min post intubation readings and number of attempts taken for successful intubation were recorded.

Results: The mean duration of intubation was more in Group ILMA (28.93 +/-8.98 seconds in Group ML vs 74.83 +/-16.03 seconds in Group ILMA) with a P value of <0.01. The rise in hemodynamic parameters was comparatively higher in Group ILMA than in Group ML but it was statistically insignificant.

Conclusion: Macintosh laryngoscope is a faster method to secure tracheal intubation than Intubating Laryngeal Mask in patients with cervical collar. The success rate of intubation through Intubating Laryngeal Mask is similar to that of Macintosh laryngoscope.

Key-words: Intubating Laryngeal Mask airway; Macintosh Laryngoscope; Cervical spine injury; Difficult intubation.

Key Messages: ILMA can be safely used for intubation in patients with cervical spine injuries.

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Introduction

Endotracheal intubation in a patient with limited cervical spine movement is always a challenge even to the most experienced anaesthesiologist 1. Laryngoscopy requires flexion of the lower cervical spine and atlanto-occipital extension for alignment of the oral, pharyngeal and laryngeal axes & to create a direct line of vision from the mouth to the vocal cords. In patients with cervical spine injury, airway management poses a bigger challenge due to risk of neurological damage related to neck movements; thus manual-in-line stabilization is commonly applied to minimize neck movement during tracheal intubation. Such immobilization can render intubation under direct laryngoscopy more difficult.

The intubating laryngeal mask airway (ILMA) is a modified version of the Laryngeal mask airway (LMA) which, in addition to permitting ventilation, is designed to facilitate blind tracheal intubation with a tracheal tube in an anaesthetized patient. ILMA is an alternative device to direct laryngoscope and can be used to secure an endotracheal tube in patients with cervical collar.²

Various reports have shown that ILMA has advantage over conventional laryngoscope guided tracheal intubation especially in patients with cervical trauma and difficult airways. It does not require head and neck manipulation for insertion and facilitate better alignment of tracheal tube. It is an effective means of maintaining ventilation and oxygenation.³ Studies using ILMA in patients with cervical spine injuries were very less which prompted us to use this device for intubation. Hence, we compared the efficacy & feasibility of ILMA to secure an endotracheal tube in patients with simulated cervical spine immobility using a cervical collar.

Aims

The aim of this prospective randomized controlled study is to compare ILMA with Macintosh laryngoscope in patients with simulated cervical spine injury, to compare the hemodynamic variables and to see any complications associated with their use in the peri-operative period

Settings and Design

The study was conducted in a tertiary care hospital, operating around 2500 cases in a year.

Methods and Material

The institutional ethical committee approved the

study protocol and written informed consent was obtained from each patient preoperatively. Sixty ASA physical class 1 and 2 patients undergoing various procedures under general anaesthesia were randomly allocated into two groups using computer generated randomized chart. Inclusion criteria were patients with ASA physical status 1 and 2, age group of 20-60 years, Mallampati grades 1-2, thyro-mental distance of >4 cm & inter-incisor distance of >4 cm. Exclusion criteria were patient refusal, upper airway pathologies, ASA physical status 3 and 4 patients, emergency surgeries, patients with H/o asthma, COPD & morbid obesity.

After shifting the patient to operation theatre, peripheral line secured under local anaesthesia and standard ASA recommended monitors were connected. Cervical collar was placed in position after explaining to the patient. All patients were premedicated with Glycopyrrolate 5mcg/kg and Midazolam 0.05mcg/kg, induced with Fentanyl 2mcg/kg, Propofol till the loss of verbal response. Vecuronium 0.1mg/kg was administered after checking adequacy in bag mask ventilation to facilitate muscle relaxation and tracheal intubation in both the groups.

Group ML were intubated routinely using Macintosh laryngoscope. Group ILMA were intubated using ILMA and Parker flex tube. Backup plan for intubation was kept ready in case of any desaturation or difficulty encountered during the study process. If patient desaturated (SpO₂ <92%) or could not be intubated using ILMA then cervical collar was taken out and patient was intubated using Macintosh laryngoscope in case of ILMA group and using Bougie in case of ML group.

Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Mean arterial pressure (MAP), Heart rate (HR) were recorded at baseline, immediately after intubation, 3min and 5min after intubation in Group ML. Similarly, SBP, DBP, MAP, HR were recorded in Group ILMA after inserting ILMA, after passing Parker flex tube through ILMA and 3 min, 5 min thereafter. Time taken for intubation, ease of intubation, number of attempts taken for successful intubation was also recorded. Insertion time is calculated as time taken from the time of insertion of ILMA to the visibility of proper et CO₂ curve, while Intubation time is the time taken from the insertion of parker flex tube through ILMA till the visibility of et CO₂ curve. Total intubation time was calculated by adding insertion time and intubation time. A maximum of 3 attempts were considered before declaring the case as a failure.

Statistical Analysis used

Assuming the overall intubation success rate in the patients without neck immobilization would be 95%,² we decided that a 20% difference in overall intubation success rate between the groups would be clinically important. Thirty patients in each group would thus be necessary with $\alpha=0.05$ and $\beta=0.2$. We therefore enrolled 30 patients per group.

Unpaired scored data were examined and compared using Mann-Whitney U-tests. The incidence of intubation complications, number of ILMA insertion attempts, and overall intubation success rate were tested by Fisher's exact tests or χ^2 -tests, as appropriate. Other descriptive data were compared using unpaired t-tests. Statistical analysis was performed using StatView version 5.0 (SAS Institute Inc., Cary, NC, USA) and Sample Power 2.0 (SPSS, Chicago, IL, USA). Values are expressed as mean and standard deviation (SD) unless otherwise stated; $P<0.05$ was considered statistically significant

Results

The demographic data, Mallampati classes & types of surgeries were comparable in both the groups (Table 1).

Table 1: Comparison of demographic variables between the two groups.

| | GROUP ML | GROUP ILMA | P value |
|--------------------|---------------|----------------|---------|
| Male | 19 | 16 | 0.272 |
| Female | 11 | 14 | 0.228 |
| Age (yrs) | 39.86+/-14.71 | 41.13 +/--13.6 | 0.731 |
| Weight (kg) | 62.2 +/- 8.87 | 63.23 +/- 8.68 | 0.532 |
| Mallampati Class 1 | 21 | 22 | 0.682 |
| Mallampati class 2 | 9 | 8 | 0.712 |
| ASA 1 | 24 | 22 | 0.569 |
| ASA2 | 6 | 8 | 0.627 |

Abbreviations: ASA - American Society of Anaesthesiologists, ML - Macintosh laryngoscope, ILMA - Intubating Laryngeal Mask Airway.

Ease of Intubation

Tracheal intubation was successful in all the 30 cases in both the groups.

In group ML 28 patients were intubated in the first attempt while 2 patients were intubated in the second attempt using a Bougie. In group ILMA 26

patients could be intubated during the first attempt, 3 were intubated in the second attempt after specific manoeuvres and 1 patient in the third attempt (Table 2). Success rate of intubation in first attempt and second attempt was almost same in both the groups while in one case it required a third attempt for successful intubation in group ILMA (Table 2).

Table 2: Comparison of attempts taken to intubate between two groups.

| | 1 st attempt | 2 nd attempt | 3 rd attempt |
|------------|-------------------------|-------------------------|-------------------------|
| Group ML | 28 (93.3%) | 2 (6.6%) | 0 |
| Group ILMA | 26 (86.6%) | 3 (10%) | 1 (3.33%) |

ML - Macintosh laryngoscope, ILMA - Intubating Laryngeal Mask Airway

Time Taken for Intubation

Mean time taken for intubation in Group ML was 28.9 +/- 8.98 seconds while it was 74.83 +/- 16.03seconds in group ILMA and the P value was found to be <0.01 which was statistically very much significant (Table 3)

Table 3: Comparison of total time taken for intubation between two groups.

| | GROUP ML | GROUP ILMA | P value |
|-----------------------------|---------------|-----------------|---------|
| Duration of intubation(sec) | 28.9 +/- 8.98 | 74.83 +/- 16.03 | <0.01 |

Abbreviations: ILMA - Intubating Laryngeal Mask Airway, ML - Macintosh Laryngoscope.

Haemodynamics

Baseline systolic, diastolic and mean blood pressures were similar in both the groups and the difference was not statistically significant (Table 4,5,6).

Table 4: Comparison of systolic blood pressure between the two groups at various time intervals.

| Systolic Blood Pressure | GROUP ML (mm of Hg) | GROUP ILMA (mm of Hg) | P value |
|-------------------------|---------------------|-----------------------|---------|
| Baseline | 130 +/- 12.5 | 133.26+/-15 | 0.3942 |
| After ILMA insertion | - | 143.76+/-21.35 | - |
| After Intubation | 139 +/- 17.3 | 145.4+/-16.16 | 0.1441 |
| After 3min | 121 +/- 16.8 | 122.46+/-14.16 | 0.8953 |
| After 5min | 115 +/- 11.8 | 117.16+/-14.8 | 0.6246 |

Abbreviations: ILMA - Intubating Laryngeal Mask Airway, ML - Macintosh Laryngoscope.

Table 5: Comparison of diastolic blood pressure between the two groups at various time intervals.

| Diastolic Blood Pressure | GROUP ML (mm Hg) | GROUP ILMA (mm Hg) | P value |
|--------------------------|------------------|--------------------|---------|
| Baseline | 77.8 | 78.66 | 0.731 |
| After ILMA | - | 90.56 | - |
| After Intubation | 85.46 | 89.23 | 0.257 |
| After 3min | 74.56 | 78.36 | 0.153 |
| After 5min | 70.83 | 76.36 | 0.170 |

Abbreviations: ILMA – Intubating Laryngeal Mask Airway, ML – Macintosh Laryngoscope.

Table 6: Comparison of mean arterial pressures between the two groups.

| Mean Blood Pressure | GROUP ML (mm of Hg) | GROUP ILMA (mm of Hg) | P value |
|---------------------|---------------------|-----------------------|---------|
| BASELINE | 88.36 | 90.16 | 0.528 |
| After ILMA | - | 102.46 | - |
| After intubation | 96.16 | 100.2 | 0.105 |
| After 3min | 84.23 | 87.3 | 0.281 |
| After 5min | 79.2 | 84.46 | 0.217 |

Abbreviations: ILMA – Intubating Laryngeal Mask Airway, ML – Macintosh Laryngoscope.

Heart Rate

The rise in heart rate was higher in group ILMA than that of group ML after intubation and at 3 min post intubation. However, this rise was statistically insignificant in both the groups (Table 7).

Table 7: Comparison of heart rates between the two groups.

| | GROUP ML (mm Hg) | GROUP ILMA (mm Hg) | P value |
|------------------|------------------|--------------------|---------|
| BASE LINE | 90.16 | 84.46 | 0.621 |
| After ILMA | - | 101.86 | - |
| After intubation | 97.1 | 100.10 | 0.197 |
| After 3min | 89 | 90.42 | 0.606 |
| After 5min | 83.16 | 87.75 | 0.07 |

Abbreviations: ILMA – Intubating Laryngeal Mask Airway, ML – Macintosh Laryngoscope.

Table 8: Comparison of post-operative complications between the two groups.

| | GROUP ML (n) | GROUP ILMA (n) |
|----------------------------|--------------|----------------|
| Lip injury | - | 2 |
| Sore throat/ Hoarseness | 1 | 2 |

Abbreviations: ILMA – Intubating Laryngeal Mask Airway, ML – Macintosh Laryngoscope.

Discussion

In our study we compared the total time taken for intubation using a Macintosh laryngoscope and ILMA in patients with simulated cervical spine immobility using a rigid cervical collar.

Demographic data, ASA physical status and Mallampati classes were similar in both the groups. Also types of surgeries were nearly same in both the groups. The mean duration of intubation was more in ILMA group than the Macintosh group, with a mean duration of 28.93+/-8.98 seconds in Group ML, while it was 74.83+/-16.03 seconds in Group ILMA and P value was found to be <0.001, which was statistically significant.

The mean duration of intubation found in our study was similar to Kavitha et al⁴ and Sharma VS et al.³ The success rate of intubation was 100% in both the groups; however, it was 93.33% (28/30) in first attempt in group ML while 86.6% (26/30) in group ILMA. These findings were similar to studies conducted by Ruchi bola et al¹, Komatsu et al² and Choyce et al.⁵

In our study, hemodynamic response to intubation was more in ILMA group but the variation in hemodynamic response was not statistically significant. But when looked at individual steps of intubation, it was observed that insertion of ILMA and passing of Endo-Tracheal Tube (ETT) through ILMA generates more pressor response compared to laryngoscopy and intubation with Macintosh laryngoscope. All the changes in HR and MAP remained within acceptable 20% from the baseline values in both the groups. These findings were in accordance with studies conducted by Nakazawa et al⁷, Naveed et al⁶, Joo et al⁸ and Singh et al⁹ who also had similar hemodynamic variations in using ILMA but they are also statistically insignificant.

Our findings were in contrast with Kihara et al¹⁰, who showed that during insertion and intubation with ILMA there was no significant increase in MAP, and HR. To prevent accidental extubation during removal of ILMA we tend to advance a tracheal tube towards the carina by pushing with the stabilizing rod. Movement of the tracheal tube probably provides the stimulus¹¹ which produces the magnitudes of hemodynamic responses with the use of ILMA.

Our incidence of oesophageal intubation and mucosal trauma was comparable to previous studies.^{5,12} Higher incidence of mucosal trauma was seen in ILMA group compared to that of Macintosh group, this may be because of high pressure exerted by ILMA against pharyngeal mucosa.¹² However,

there was no statistically significant difference in the incidence of sore throat or hoarseness of voice during postoperative period in both groups.

Conclusions

Macintosh laryngoscope is a faster method to secure tracheal intubation than Intubating Laryngeal Mask in patients with cervical collar. The success rate of intubation through Intubating Laryngeal Mask is similar to that of Macintosh laryngoscope.

Acknowledgement

None

Conflict of Interest

None

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