Original Research Article

Comparision of Hemodynamic Effect Inendotracheal Tube and Supraglottic device in Elective Surgery

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Abstract

Introduction: Insertion of the laryngeal mask airway after induction of anaesthesia has been described to cause less haemodynamic changes than tracheal intubation

Aim: The purpose of the study was to compare hemodynamic response during insertion of Supraglottic device (laryngeal mask airway) and cuffed endotracheal tube.

Materials and Methods: This was a randomized double blinded prospective study of 60 patient of age group of 17-60 years and ASA I and II who were posted for elective surgeries requiring general anaesthesia. Patients were randomly allocated into two groups (n=30) Group “A” and “B” comprising of 40 patients each. Group A – included patients who were intubated with endotracheal tube. Group B – included patients in whom supraglottic device (LMA) was inserted. Patients were continuously monitored in the intra –operative period for the following parameters Pulse rate, percentage saturation of oxygen (SPO2), Non – invasive blood pressure (NIBP), Mean arterial pressure (MAP), Rate pressure product (RPP) and ECG.

Results: The rise in mean pulse rate in ETT group higher – following laryngoscopy and intubation, than supraglottic device group. All the groups were associated with significant increase in mean arterial but in LMA group this rise was significant. Similarly the rate pressure product was significantly raised in group A as compared to group B.

Conclusion: There was significant rise in mean pulse rate, mean arterial pressure, rate pressure product in group A during insertion of the endotracheal tube after two, five minutes than the LMA group. A significantly higher numbers of attempts were required for LMA as compared to endotracheal intubation there was a significant increase in the incidence of post-operative cough and sore-throat in the endotracheal group as compared to the LMA group B.

Keywords: Mean pulse rate, LMA, rate pressure product, hemodynamic.

Introduction
Airway management is of utmost importance during delivery of general anaesthesia. Patients who have been anaesthetized are unable to maintain an adequate airway on their own and artificial airway maintenance devices are employed.¹ Though intubation has many advantages including provision of a reliable
airway, prevention of aspiration and delivery of anaesthetic gases, it is not without complications. These can be seen during insertion, after insertion and during extubation and they include airway trauma, physiological reflexes like hypoxia, tachycardia and hypertension, malposition, laryngospasm, narrowing and increased airway resistance as well as negative pressure pulmonary edema.\textsuperscript{1-2} The supraglottic devices offers a much less invasive way of maintaining the airway. Laryngoscopy and tracheal intubation or supraglottic device insertion are noxious stimuli which provoke a transient but marked sympathetic response. In susceptible patients particularly those with systemic hypertension, coronary heart disease, cerebrovascular disease and intracranial aneurysm, even these transient changes can result in potentially deleterious effects like left ventricular failure, arrhythmias, myocardial ischaemia, cerebral haemorrhage and rupture of cerebral aneurysm.\textsuperscript{3-6} Insertion of the laryngeal mask airway after induction of anaesthesia has been described to cause less haemodynamic changes than tracheal intubation.\textsuperscript{8} The purpose of the present study was to compare hemodynamic responses during insertion of Supraglottic device (laryngeal mask airway) and cuffed endo-tracheal tube.

**Material and Methods**

This was a randomized study of 60 patient of age group of 17-60 years and ASA I and II who were posted for elective surgeries requiring general anaesthesia, in department of Anaesthesiology of a tertiary care hospital for period of 1 yr (JULY 2017 to AUG 2018).

After obtaining approval from institute research and ethical committee and written consent from patient’s parent, this study was undertaken.

**I. Inclusion Criteria**

1. ASA grade I and II
2. Age group 17-60 years of elective procedures.

**II. Exclusion Criteria**

1. Not giving consent
2. Obese
3. Pregnancy
4. Difficult intubation (mallampatti III & IV)
5. History of respiratory problems.
6. History of angina, palpitations, syncopal attack.
7. Cardiac and renal problems.
8. Gastric outlet obstruction.

**Selection of group**

Patients were randomly assigned to two demographically identical groups (with respect to age, weight, sex and height): Group “A” and “B” comprising of 40 patients each.

- **Group A** – included patients who were intubated with endotracheal tube.
- **Group B** – included patients in whom supraglottic device (LMA) was inserted.

Preanaesthetic check-up was done in the previous evening. Pre-medication was done overnight with Tab. Ranitidine hydrochloride 150mg and Tab. Alprazolam 0.5mg.A 18 or 20-gauge intravenous catheter was inserted in the operating room and an infusion of crystalloid lactated ringer’s solution was started. Standard monitoring of vital signs (PR, ECG, NIBP, SPO2) was instituted and baseline reading was recorded Patients were premedicated with inj. Midazolam (0.1mg/kg) and inj. Glycopyrrolate (0.004 mg/kg) IV at least 15 minutes before induction. All patients were induced with a dose (2mg/kg) of 1% propofol IV after adequate preoxygenation with 100% O2 for 3 minutes.

- **Group A**– Patients intubated with the appropriate sized cuffed endotracheal tube after relaxation of larynx by succinylcholine (1.5 mg/kg) under direct laryngoscopy.
- **Group B**– Appropriate size laryngeal mask airway inserted by standard technique of digital insertion after adequate jaw relaxation by succinylcholine (1.5 mg/kg) without laryngoscopy. Maintenance of anaesthesia was similar in both groups, with Isoflurane 0.5%, Nitrous Oxide in oxygen (2:1) and intermittent doses of vecuronium as muscle relaxant inclosed circuit with a circle absorber and IPPV.
Patients were continuously monitored in the intra-operative period for the following parameters:
Pulse rate, percentage saturation of oxygen (SPO2), Non-invasive blood pressure (NIBP),
Mean arterial pressure (MAP), Rate pressure product (RPP) and ECG were monitored.

1. Before induction which reflected baseline values - BL
2. At induction – AIND
3. Just after endotracheal intubation, Supraglottic (LMA) – AINST
4. 2 minutes after endotracheal intubation, Supraglottic (LMA) insertion – A2
5. 5 minutes after endotracheal intubation, Supraglottic (LMA) insertion – A5
6. 10 minutes after endotracheal intubation, Supraglottic (LMA) insertion – A10

Intraoperative and postoperative complications (upto 24 hrs) due to use of Supraglottic device (LMA) or endotracheal tube.

Statistics
The data generated was statistically analyzed. The tools employed for statistical analysis are: Mean, Standard deviation, students t test, Chi-square test. The description of the data was done in the form of mean± SD for quantitative data. For quantitative data Student’s t-test was used to compare between two groups. The Chi-square test was used to compare the intubation scores.

Significant figures
- Significant p < 0.05
- Strongly significant p < 0.01
- Not significant P>0.05

Results
After statistical analysis using chi square test, there was no statistical difference (p>0.05) found between the groups and the sex distribution between the two groups were comparable (Table 1)

<table>
<thead>
<tr>
<th>Table 1: Sex distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
</tr>
<tr>
<td>GROUP A</td>
</tr>
<tr>
<td>GROUP B</td>
</tr>
</tbody>
</table>

Table 2: Age and weight distribution

<table>
<thead>
<tr>
<th>Groups</th>
<th>AGE(Mean±S.D)</th>
<th>WEIGHT (Mean±S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP A</td>
<td>34.63 ±7.41</td>
<td>48.00 ±7.6</td>
</tr>
<tr>
<td>GROUP B</td>
<td>33.18 ± 7.24</td>
<td>47.03 ± 7.8</td>
</tr>
<tr>
<td>P value</td>
<td>0.94(NS)</td>
<td>0.86(NS)</td>
</tr>
</tbody>
</table>

Table 3: Oxygen Saturation (SPO2) - (Mean ± SD)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>Before induction</th>
<th>Induction</th>
<th>Instrumentation</th>
<th>After instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>AIND</td>
<td>AINST</td>
<td>A2</td>
</tr>
<tr>
<td>GROUP A(E)</td>
<td>99.77 ±0.41</td>
<td>98.60 ±1.05</td>
<td>98.35 ±0.94</td>
<td>99.42 ±0.71</td>
</tr>
<tr>
<td>GROUP B(S)</td>
<td>99.77 ±0.45</td>
<td>98.68 ±0.98</td>
<td>98.48 ±0.94</td>
<td>99.37 ±0.68</td>
</tr>
</tbody>
</table>

There is no significant change in percentage saturation of oxygen (SPO2) in the two groups at any stage of time (p> 0.05).

Table 4: Pulse Rate (Beats/Mins) - Mean ± S.D.

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>Before induction</th>
<th>Induction</th>
<th>Instrumentation</th>
<th>After instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>AIND</td>
<td>AINST</td>
<td>A2</td>
</tr>
<tr>
<td>GROUP A(E)</td>
<td>86.76 ±13.4</td>
<td>91.8 ±29.76</td>
<td>120.87 ±14.71</td>
<td>134.66 ±14.71</td>
</tr>
<tr>
<td>GROUP B(S)</td>
<td>84.20 ±10.23</td>
<td>86.77 ±8.81</td>
<td>99.07* ±10.56</td>
<td>109.4* ±11.11</td>
</tr>
</tbody>
</table>

There were significant rise in mean pulse rate (*) within the group A during laryngoscopy and intubation, at two, five, ten minutes as compared to baseline values. Also significant rise in mean pulse rate (*) seen in Group B during insertion and at two minute after insertion as compared to baseline values.
### Table 5: Systolic Blood Pressure in mm of Hg (Mean ± S.D)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>Before induction</th>
<th>Induction</th>
<th>Instrumentation</th>
<th>After instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>AIND</td>
<td>AINST</td>
<td>Two minutes A2</td>
</tr>
<tr>
<td>GROUP A (ETT)</td>
<td>121.93 ± 4.59</td>
<td>144.33</td>
<td>161.90 ± 6.58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>115.83 ± 7.86</td>
<td>± 8.40</td>
<td>± 6.58</td>
<td></td>
</tr>
<tr>
<td>GROUP B (Supraglottic device)</td>
<td>123.46 ± 3.2</td>
<td>134.33</td>
<td>146.04 ± 4.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>121.7 ± 3.78</td>
<td>± 4.54</td>
<td>± 3.2</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05 (statistically significant) – For intra group comparison.
♯ p < 0.05 (Statistically significant) – For inter group comparison.

Significant rise (♯) in mean atrial pressure ( ⃰ ) within the group A during laryngoscopy and intubation, at two, five, ten minutes as compared to baseline values.

### Table 6: Diastolic Blood Pressure in mm of Hg (Mean ± S.D)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>Before induction</th>
<th>Induction</th>
<th>Instrumentation</th>
<th>After instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>AIND</td>
<td>AINST</td>
<td>Two minutes A2</td>
</tr>
<tr>
<td>GROUP A (ETT)</td>
<td>82.67 ± 4.01</td>
<td>79.73 ± 4.32</td>
<td>98.33 ± 5.55</td>
<td>103.2 ± 5.21</td>
</tr>
<tr>
<td></td>
<td>91.40 ± 4.76</td>
<td>± 5.13</td>
<td>± 5.55</td>
<td></td>
</tr>
<tr>
<td>GROUP B (Supraglottic device)</td>
<td>81.06 ± 3.2</td>
<td>84.33 ± 2.85</td>
<td>85.86 ± 3.71</td>
<td>82.07 ± 2.85</td>
</tr>
<tr>
<td></td>
<td>80.03 ± 2.85</td>
<td>± 2.97</td>
<td>± 3.71</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05 (statistically significant) – For intra group comparison.
♯ p < 0.05 (Statistically significant) – For inter group comparison.

Significant rise (♯) in RPP seen in Group B during supraglottic insertion and at two minute after insertion as compared to baseline values.

### Table 7: Mean Atrial Pressure in mm of Hg (Mean ± S.D)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>Before induction</th>
<th>Induction</th>
<th>Instrumentation</th>
<th>After instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>AIND</td>
<td>AINST</td>
<td>Two minutes A2</td>
</tr>
<tr>
<td>GROUP A (ETT)</td>
<td>95.47 ± 4.03</td>
<td>113.17</td>
<td>122.4 ± 4.64</td>
<td>106.73 ± 3.75</td>
</tr>
<tr>
<td></td>
<td>91.40 ± 4.76</td>
<td>± 5.13</td>
<td>± 3.75</td>
<td></td>
</tr>
<tr>
<td>GROUP B (Supraglottic device)</td>
<td>94.87 ± 3.05</td>
<td>97.43 ± 2.65</td>
<td>99.67 ± 2.50</td>
<td>95.86 ± 2.53</td>
</tr>
<tr>
<td></td>
<td>92.86 ± 2.85</td>
<td>± 2.61</td>
<td>± 2.53</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05 (statistically significant) – For intra group comparison.
♯ p < 0.05 (Statistically significant) – For inter group comparison.

Significant rise (♯) in mean atrial pressure ( ⃰ ) seen in Group B during supraglottic insertion and at two minute after insertion as compared to baseline values.

### Table 8: Rate Pressure Product (RPP) in mm of Hg (Mean ± S.D)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>Before induction</th>
<th>Induction</th>
<th>Instrumentation</th>
<th>After instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>AIND</td>
<td>AINST</td>
<td>Two minutes A2</td>
</tr>
<tr>
<td>GROUP A (ETT)</td>
<td>10582.13 ± 1040.88</td>
<td>16448.67</td>
<td>18810.8 ± 15231.26</td>
<td>11943.6 ± 11943.6</td>
</tr>
<tr>
<td></td>
<td>10628.00 ± 955.30</td>
<td>± 1677.12</td>
<td>± 1767.88</td>
<td>± 838.57</td>
</tr>
<tr>
<td>GROUP B (Supraglottic device)</td>
<td>10393.00 ± 567.98</td>
<td>12376.4 ± 1233.07</td>
<td>14003.2 ± 11242.06</td>
<td>10388.4 ± 10388.4</td>
</tr>
<tr>
<td></td>
<td>10399.27 ± 654.30</td>
<td>± 945.69</td>
<td>± 682.79</td>
<td>± 377.02</td>
</tr>
</tbody>
</table>

*p < 0.05 (statistically significant) – For intra group comparison.
♯ p < 0.05 (Statistically significant) – For inter group comparison.

Significant rise (♯) in RPP within the group A during laryngoscopy and intubation, at two, five, ten minutes as compared to baseline values.

Significant rise in mean atrial pressure ( ⃰ ) seen in Group B during supraglottic insertion and at two minute after insertion as compared to baseline values.

In none of the group study groups ECG abnormality in the form of ectopics, rhythm disturbances or any significant ST changes were observed.

Significant increase (♯) in the incidence of cough and sore throat were observed in the endo-tracheal group as compared to the supraglottic group.
Discussion

In the present study, 80 cases were selected and randomly assigned to demographically two identical groups of 40 each and perioperative and post-operative responses to laryngoscopy & intubation with ETT and supraglottic deviceinsertion were compared. Patients were comparable demographically in all the two groups with respect to age, weight and sex. Oxygenation through the Endotracheal tube (ETT), Supraglottic device (LMA) were adequate in both the groups. None of the patients had an episode of desaturation (SPO2 < 95 %) at any stage in both the groups during our study, as shown in Table –3. Hence this table suggests that ETT & supraglottic device group doesn’t hinder the ventilation. It also implies that LMA dose into interfere with the process of controlled ventilation and function ofendotracheal tube to maintain oxygenation in preserved. This study co-relates with the study done by Berry A., Verghese C.et al (1994). The variation in mean pulse rate at induction, instrumentation, two minutes, five minutes and ten minutes after instrumentation as compared to baseline pre-induction values in all groups were in Table-4.

i. At instrumentation:
   - There is a significant rise in mean pulse rate in all the two groups as compared to the baseline values.

ii. At five minutes after instrumentation:
   - There is decrease in mean pulse rate at five minutes following laryngoscopy and intubation in group A (ETT) and also in Group B ( LMA), but still this value were significantly higher than baseline pre-induction value.
   - A decrease in mean pulse rate at five minutes following Supraglottic device (LMA) insertion was also observed in group B and this value was comparable to baseline value.

iii. At ten minutes after instrumentation:
   - Although the mean pulse rate decreased in the group endotracheal and supraglottic device, this value was still significantly high as compared to baseline values.

   - Mean pulse rate was comparable to baseline values in the LMA groups and was significantly less than endotracheal tube at ten minutes after instrumentation.

   In this study we found that all the groups were associated with significant increase in mean pulse rate. This table also shows as the rise in mean pulserate in ETT group higher– following laryngoscopy and intubation, at two minutes, five minutes and ten minutes following intubation, but in supraglottic device group this rise in mean pulse rate was significant during supraglottic insertion at two minutes, which stabilized at five minutes and maintained throughout the procedure. This finding of our study are in accordance with Holden et al, Lamb et al, Whitford et al, Duman et al, Fox et al (1997) and Shribman (1987).

   Wilson et al all in 1992 conclude from his study on 100 patients regarding supraglottic (LMA) insertion that there is only significant rise of mean pulse rate at one minute after insertion and after that the increase in mean pulse rate is not significant. My study also signifies that there is only significant rise in mean pulse rate after LMA insertion as similar with Wilson et al concluded and after there is no significant rise.

   All the groups were associated with significant increase in mean arterial pressure during instrumentation and after two and five minutes after instrumentation as shown in Table-7. But in LMA group this rise was significant at LMA insertion and at two minute following insertion which stabilized towards baseline values at five minutes and maintain till the end of the surgery and also during extubation and emergence. These finding of our studies are in accordance with Forbes and dally (1970), Holden et al, whit Ford et al. Croak et al (1994) compared the pressure response to Supraglottic insertion (LMA) and endotracheal intubation in 200 patients and found that:
   - MAP change is more in cases of endotracheal intubation group than Supraglottic (LMA) group.
during instrumentation and at two, five and ten minutes after that manoeuvre.

rise of MAP is only significant at two and five minutes after LMA insertion which is less than that of endotracheal intubation response. This is also similar to my findings as written above.

Increases in heart rate and blood pressure from sympathetic stimulation during anaesthesia have great potential for exceeding the limits of that oxygen supply in myocardium. If we are to avoid unidentified periods of intraoperative ischemia a simple means of assessing myocardial oxygenation is clearly needed. Unfortunately, neither MVO2 nor biochemical evidence of myocardial ischemia (lactate production) is readily available in the opening room. The possible usefulness of rate-pressure product as such a practical monitor came from cardiology. In 10 normal exercising subjects, Nelson et al reported in 1974 that MVO2 correlated best with the product of heart rate and blood pressure. In our study the rate pressure product was significantly rise group A as compared to group B. But in group B patients there was minimum increased in rate pressure product from the base line limit during LMA insertion and two minutes following instrumentation, but it came near to the baseline limit after five minutes of LMA insertion. More number of attempts were required for Supraglottic insertion (LMA) than for endotracheal intubation thus demonstrating that a regular practice is required for proper use and insertion of LMA. The findings of the study are similar to Reinhat (1992) \(^{17}\), Walker (1992) \(^{18}\). There was significant increase in the incidence of cough and sore-throat was observed post-operatively in the endo-tracheal group as compared to LMA group. The findings of the study are similar to Burgard, Mollhoff & Prien (1996) \(^{19}\) & Dasey & Mansour (1989) \(^{20}\).

The technique of insertion of LMA is absolutely different from that of inserting an endo-tracheal tube. It involves no use of laryngoscopy as vocal cords do not need to be visualized and LMA doesn’t enter into trachea but instead sits on the hypo pharynx when positioned correctly. So, considering these, the pressure responses to LMA insertion were expected to be different from that of laryngoscopy and tracheal intubation. We believe that not performing laryngoscopy during insertion of LMA is one major reason for the observed attenuated pressure responses to LMA, apart from other reason like no direct laryngeal stimulation. The mechanical stimulation by pressure of laryngoscope on the soft tissue is the major factor in producing stress response to laryngoscopy and tracheal intubation.\(^{21}\) The haemodynamic changes in the LMA group took about 3 minutes to return to pre insertion values while it took about 5 minutes for the changes to return to pre intubation values in the ETT group. Several other studies have demonstrated that the haemodynamic response to LMA is short lived compared to that to ETT.\(^{22-24}\) The greater and more persistent changes in cardiovascular parameters seen with ETT as compared to LMA insertion probably reflect higher catecholamine levels in the ETT group as seen in previous studies.\(^{25-27}\) The LMA offers additional advantages during emergence from anaesthesia and it is not accompanied by complication like coughing. Tracheal extubation, however, causes a marked increase in IOP, coughing and breath holding\(^{21}\).

**Conclusion**

The findings of the study were:

- There was significant rise in mean pulse rate observed in group A during insertion of the endotracheal tube and after two, five minutes following insertion. In Group B (LMA) patients the mean pulse rate significantly rise during insertion of the LMA and after two minutes following insertion as compared to pre-induction value. However the rise is less than that of group A patients. But attenuation of the rise in the pulse rate was observed in group B patients five minutes after LMA insertion.
The significant increase in MAP is also seen in group A and group B patients during instrumentation and after two minutes following instrumentation and after two minutes following instrumentation which is less in group B (supraglottic device) and the response in group B patients was attenuated after five minutes. A significant difference in RPP was also observed in Group A (ETT) during laryngoscopy and intubation and after two and five minutes following intubation. The difference in RPP during insertion of the LMA was observed after five minutes of insertion and came near to the base line after five minutes. A significantly higher numbers of attempts were required for LMA as compared to endotracheal intubation, thus demonstrating that a trick-on-hand is required for the use of these supraglottic instruments. There was a significant increase in the incidence of post-operative cough and sore-throat in the endotracheal group as compared to the LMA group B. Thus it may be concluded that use of supraglottic airway device offers more favorable hemodynamicst ability as compared to endotracheal tube and is associated with less postoperative complication as it is minimally invasive to the airway and it may be considered as an important adjunct in minimizing the pressure responses to laryngoscopy and intubation. Interestingly the supraglottic device that can be most easily placed, has the maximum hemodynamic response. Hence proper selection of the cases and diligent surveillance can also ensure freedom from potentially dangerous complication due to reflex aspiration associated with the use of LMA.

Limitations
This study was conducted on healthy, normotensive patients with normal airways. It is therefore not known how the changes would have been in hypertensive patients. Patients, who were enrolled in this study, were all successfully intubated in the first attempt. Perhaps the haemodynamic parameters would show a different picture in patients with difficult intubation. In this study, intermittent recording of the haemodynamics was used, due to the available resources. This could mean that the maximal change could have been missed especially within the first minute of intubation. Randomization was done but double blinding was not possible due to our theatre setup. This could mean that an element of observation bias was not completely removed from the study.

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