ORIGINAL ARTICLE

FENTANYL & BUTORPHANOL AS CO-INDUCTION AGENTS FOR LMA INSERTION: A COMPARATIVE STUDY
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ABSTRACT: Co Induction Agents for LMA. BACKGROUND: A randomized double blind comparative study was done to assess the effectiveness of fentanyl & butorphanol as co-induction agents with propofol for insertion of Laryngeal Mask Airway (LMA) in adults for elective short surgical procedures. METHODS: Sixty patients of ASA grade 1 and 2 between 15-55 years of age were randomly divided into two groups. After giving standard premedication group A was given injection butorphanol 20 mcg/kg IV and group B injection fentanyl 1.5mcg/kg IV. Both the groups were immediately given propofol 2.5mg/kg IV over 15 seconds until loss of eyelash reflex, after which LMA insertion was performed 60 seconds after injection of propofol. Patients were kept on spontaneous respiration and maintained with isoflurane 0.5%-1.2%, 60%N2O, and 40%O2 along with propofol bolus when required. RESULTS: In our study propofol requirement for LMA insertion was significantly less in butorphanol group and significantly less apnea time was seen with butorphanol (96.66%) as compared to fentanyl (76.66%). The incidence of absolute jaw relaxation was highest in butorphanol (93.33%) and excellent insertion conditions were observed. Best insertion conditions were seen in 92.30% of butorphanol group and 74.15% in fentanyl group. CONCLUSION: The addition of butorphanol to propofol for LMA insertion provides good jaw relaxation and excellent LMA insertion conditions with stable haemodynamics. Side effects like coughing, gagging, lacrimation, and limb movements are lower as compared to the other group. So, butorphanol is a good adjuvant with propofol for LMA insertion during short surgical procedures under general anesthesia. KEYWORDS: Co-induction agents, LMA, Propofol.

INTRODUCTION: Laryngeal mask airway (LMA) was developed in 1981 by Dr. Archie Brain in the United Kingdom. It is a supraglottic airway device that has lead to a radical change in the management of modern general anesthesia.

The LMA has established its role in routine anesthesia, management of difficult airway and diagnostic airway procedures.2,3,4,5 The main advantages of LMA over endotracheal intubation are avoidance of muscle relaxant6 and minimal cardiovascular response.7,8

The insertion of LMA stimulates the hard and soft palate, posterior pharyngeal wall and hypo pharynx.1,9 This requires adequate anesthesia, but the depth required is less compared to endotracheal intubation.7,10,11 LMA insertion has been revolutionized with the development of induction agents like propofol, which depresses the pharyngeal and laryngeal reflexes.12 However, higher doses of propofol are used which can cause cardiac depression. To reduce its adverse
cardiorespiratory depressant effects a number of co-induction\textsuperscript{13,14,15,16,17} drugs were introduced among which we compared butorphanol and fentanyl.

In the present study, we compared the hemodynamic changes, laryngeal mask airway insertion conditions and adverse effects of butorphanol and fentanyl as adjuncts to propofol.

**MATERIAL AND METHODS:** Following institutional ethical committee approval, a double blind prospective study was carried out in which a total of 60 patients undergoing short elective procedures at D. Y. Patil Hospital, Navi Mumbai were randomized into two groups by sealed envelope technique. All patients were between 15-55 years of age of either sex, undergoing elective short surgical procedures of less than 2 hours and were categorized under American Society of Anesthesiologists (ASA) GRADE I & II. Cases taken on an emergency basis with inadequate starvation, patients with history of bronchial asthma, hypertension and associated uncontrolled systemic disease (ASA III & IV), non-consenting patients and pregnant women were excluded. Any case where there was inadequate relaxation or where it took a second attempt for LMA insertion was also not included. Following informed consent along with proper pre-operative evaluation & relevant investigations as per the case record form the patients were randomly allocated to either of the groups. Test drugs were given by an anesthetist not involved in anaesthetizing and monitoring of the patient. All the patients were premeditated with glycopyrrolate 0.2mg, ondansetron 4mg and midazolam 1mg intravenously (IV). After pre-oxygenation with 100% oxygen for 3 minutes the study drug was given over 10 seconds. Group 1\((n=30)\) was given butorphanol in a dose of 20 mcg/kg body weight IV and group 2\((n=30)\) was given Fentanyl 1.5 mcg/kg body weight IV.

All the groups were immediately given propofol 2.5mg/kg body weight IV over 15 seconds. If required further increments of propofol 0.5 mg/kg body weight, were given every 30 seconds until loss of eyelash reflex, after which appropriate size LMA was inserted 60 seconds after injection of propofol by a blinded investigator experienced in LMA insertion. Conditions during LMA insertion were only graded at the 1st attempt and the insertion conditions as well as ease of insertion were assessed. Any lacrimation, apnea, limb movements, cough, gagging and laryngospasm were checked. Patients were kept on spontaneous respiration. Anesthesia was maintained by isoflurane 0.5%-1.2 %, 60% N\textsubscript{2}O, 40% O\textsubscript{2}, along with propofol bolus as and when required. At the completion of surgery N\textsubscript{2}O & isoflurane were stopped and LMA was removed after the patient had regained his gag reflex. The oral cavity was checked for any trauma and bleeding. 100% O\textsubscript{2} was continued via facemask till recovery. Heart rate (HR), Blood Pressure (NIBP), peripheral oxygen saturation (Spo2) and ECG monitoring was done. All of these were recorded pre-induction and immediately after induction of anesthesia and later at 1, 3, 5, 10 and 15 minutes interval till the end of surgery. The parameters taken into consideration were top up dose of propofol required, total dose of propofol, number of attempts for insertion, duration of apnea (>30seconds). Coughing, gagging, laryngospasm and movements were assessed on 3 points: nil, mild, severe. Jaw relaxation was assessed according to Young’s criteria: Absolutely relaxed with no muscle tone or moderately relaxed with some muscle tone or poorly relaxed with full muscle tone. The duration of surgery was noted and the patient was observed for adverse effects such as nausea, vomiting and throat pain for 3 hours postoperatively.
Sample size was calculated based on a difference of 2 in patient’s satisfaction scores with sedation between groups, a population variance of (2) 2, a two-sided α of 0.05, and a power of 90%. The number of patients required in each group to demonstrate a difference between groups was 30. Results were expressed as number of occurrences, percentage and mean ± SD. Demographic characteristics, preoperative vitals were compared using ‘t’ test and nominal data were compared with chi square test. Repeated measures analysis of variance was used to compare continuous variables. Statistical analysis was performed using Epi info 6 and MS Excel. A p value of less than 0.05 was considered significant.

RESULTS: The demographic profile of the patients in two groups is shown in Table-1. The groups Fentanyl and Butorphanol were comparable in respect to age, gender, weight and height distribution.

|                      | Fentanyl (n=30) | Butorphanol (n=30) | P Value |
|----------------------|-----------------|--------------------|---------|
| Age (Years)          | 33.4 (8.9)      | 41.66 (12.9)       | 0.068 (NS)* |
| Male/ Female         | 13/14           | 17/16              | 0.67 (NS)* |
| Weight (Kgs)         | 54.9 (9.03)     | 52.7 (8.70)        | 0.34 (NS)* |
| Height (cms)         | 156 (7.1)       | 158 (9.7)          | 0.31 (NS)* |

*Paired T test, # Chi Square test, NS= Not Significant

Table I

Figure 1a: Depicts lacrimation between the two groups. In the propofol- fentanyl group 26.66% patients had lacrimation and that of propofol- butorphanol group 6.66% patients had lacrimation, which had statistically significant p value 0.038 proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.
**Figure 1b:** Depicts vomiting between the two groups, which had no statistical significance.

![Figure 1b](image)

**Figure 1c:** Depicts apnea in the two groups. 23.33% of patients in the propofol- fentanyl group had apnea and 3.33% of patients in the propofol- butorphanol group had apnea, which had statistical significance p value 0.023 proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.

![Figure 1c](image)
**Figure 1d:** Depicts incidence of cough between the two groups. 26.66% of patients had cough in the propofol-fentanyl group and that of propofol-butorphanol group was 6.66%, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.

**Figure 1e:** Depicts incidence of laryngospasm between the two groups. Laryngospasm was not seen in either of the groups.
**Figure 1f**: Compares movement of patients in the two groups. 23.33% of patients had movements in propofol-fentanyl group and 6.66% of patients had movements in the propofol-butorphanol group, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.

In our study, there was a wide pulse variation in propofol-fentanyl group whereas propofol-butorphanol group had less pulse variation, which had statistical significance. In patients of propofol-fentanyl group there was increased systolic Blood pressure (SBP) and diastolic blood pressure (DBP) whereas patients of propofol-butorphanol group had less increase in SBP and DBP, which was statically significant, proving that the group of propofol-butorphanol was better than the propofol-fentanyl group. (Figure 2a, 2b and 2c)
Figure 3 compares ETCO$_2$ in the two groups. There was increased Etco2 in patients belonging to propofol-fentanyl group as compared to that of propofol-butorphanol group which had less increase in Etco2. This was statically significant, proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.
**Figure 3**

ETCO2 with respect to time in Fentanyl and Butophanol groups

![ETCO2 graph](image)

Figure 4 depicts respiratory rate (RR). Propofol-fentanyl group showed increased RR as compared to that of propofol-butorphanol group which had less increase in RR, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.

**Figure 4**

RR with respect to time in Fentanyl and Butophanol groups

![RR graph](image)

Figure 5 shows the propofol requirement. 40% of patients in the propofol-fentanyl group had increased requirement of propofol and 6.66% of patients in the propofol-butorphanol had increased requirement of propofol, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.
Figure 6 shows that in the propofol-fentanyl group 6 patients required 3-4cc & 6 patients required 5-6 cc of propofol while in that of propofol-butorphanol group only 2 patients required 2-3cc of propofol, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.

Figure 7 showed that in the propofol-fentanyl group there were 26.66% patients who had inadequate jaw relaxation and in the propofol-butorphanol group 6.66% patients had inadequate jaw relaxation, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.
Figure 8 shows that 30% of patients in propofol-fentanyl had gagging and in the propofol-butorphanol group 3.33% patient had gagging, which had statistical significance proving that the group of propofol-butorphanol was better than the propofol-fentanyl group.

**DISCUSSION:** Direct stimulation of the trachea appears to be a major cause of the hemodynamic changes associated with tracheal intubation during general anesthesia, but hemodynamic changes during LMA insertion are fewer than tracheal intubation as found by K. Montazari et al.\(^7\)

The insertion of LMA following induction with thiopentone results in a greater incidence of gagging as compared with propofol as found by McKeating K et al.\(^18\) Therefore propofol was chosen as the induction agent.
LMA insertion has been revolutionized with the development of induction agents like propofol that depresses pharyngeal and laryngeal reflexes. To reduce pharyngeal and laryngeal reflexes higher doses of propofol are used which can cause cardiac depression, so to reduce its adverse cardiorespiratory depressant effects a number of other co-induction drugs were introduced among which we compared butorphanol and fentanyl.

In our study the propofol requirement was significantly less in butorphanol group as compared to fentanyl group. Supporting our study, the mean dose of thiopentone required in the study conducted by Chari P et al was significantly less in butorphanol group compared to fentanyl group. They also found significantly less apnea time in butorphanol group (96.66%) as compared to fentanyl group (76.66%) as shown by our results. The slightly longer duration of apnea in our study may be due to premedication with midazolam whereas in the above study no premedication was given and it is known that benzodiazepines enhance the respiratory depressant effect of opioids.

Lower incidence of apnea with butorphanol may be because of limited respiratory depression of butorphanol due to receptor specificity and mu antagonism.

In our study, the incidence of absolute jaw relaxation was highest in butorphanol group (93.33%) than in fentanyl group (73.33%). Our results are consistent with the study conducted by Chari P et al in which they compared jaw relaxation on a 3 point scale for LMA insertion. Their results showed that butorphanol - thiopentone group (92.30%) had significantly higher incidence of full jaw relaxation as compared to fentanyl - thiopentone group (67.30%) (p' value 0.001).

Excellent insertion conditions were observed in butorphanol group as compared to fentanyl group. Our results are consistent with the above study where there is statistically significant difference in the ease of insertion of LMA in the thiopentone - butorphanol group and thiopentone - fentanyl group. Best insertion conditions were seen in 92.30% of butorphanol group and 74.15% in fentanyl group. Better insertion conditions as well as less number of attempts in the butorphanol group are due to better jaw relaxation and ease of insertion as well as lesser incidence of coughing and gagging.

Chui PT et al found that although fentanyl improves conditions during laryngeal mask airway insertion, it also prolongs the duration of apnea.

The higher incidence of coughing in the fentanyl group may be due to fact that bolus injection of intravenous fentanyl commonly induces patient coughing. In a study conducted by Wong CM et al higher doses of fentanyl were associated with a notable increase in the incidence of coughing. We observed lower incidence of coughing and gagging in butorphanol group as compared to fentanyl group. This is probably because of the antitussive action of butorphanol. Wong CM, et al have studied 0.5, 1.0, 1.5, 2.0 mcg/kg fentanyl with 2.5 mg/kg propofol for LMA insertion. Their results showed that a standard fentanyl dose of 1 mcg/kg co-administered with propofol 2.5mg/kg, provided optimal conditions in 65% of cases only.

Mishra LD et al noted a significant fall in heart rate following midazolam and butorphanol. We did not observe bradycardia in our patients probably because we had used anticholinergic in premedication that was not used in this study. They also concluded that butorphanol was a good opioid analgesic for balanced anesthesia. The authors suggested that
butorphanol was a better choice than morphine for use in balanced anesthesia techniques because of its comparable analgesic efficacy along with lesser postoperative respiratory depression and a shorter recovery room stay.

Asha Gupta et al\textsuperscript{22} showed that the addition of butorphanol to propofol for LMA insertion provides absolute jaw relaxation and excellent insertion conditions with stable hemodynamics. Side effects like coughing, gagging, lacrimation and laryngospasm were lower as compared to the other two groups. So, Butorphanol is a good adjuvant with propofol for LMA insertion.

Thus we conclude from our study that 20mcg/kg butorphanol is a better choice of co induction agent than 1.5 mcg/kg fentanyl for LMA insertion under propofol anesthesia for short duration surgery. There are fewer hemodynamic changes with better laryngeal mask airway insertion conditions and fewer adverse effects with butorphanol. It also significantly reduces the total dose requirement of propofol.

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