Section: Anaesthesia

Original Research Article

A COMPARATIVE STUDY OF FENTANYL PRE-TREATMENT TO PROPOFOL FOR LARYNGEAL MASK AIRWAY INSERTION WITHOUT MUSCLE RELAXANTS

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ABSTRACT

Background: Optimal conditions for laryngeal mask airway (LMA) insertion during intravenous induction are essential to ensure airway patency, hemodynamic stability, and reduced anesthetic requirements. Co-induction strategies using adjunct drugs may improve insertion conditions while minimizing propofol consumption. This study evaluated the effects of fentanyl–midazolam pretreatment compared with midazolam alone on propofol requirements, LMA insertion conditions, and hemodynamic responses.

Materials and Methods: Patients undergoing elective short-duration surgeries under general anesthesia were allocated to receive either fentanyl–midazolam (FM) pretreatment or midazolam alone prior to propofol induction. Propofol induction and total dose requirements were recorded. LMA insertion conditions were assessed using jaw relaxation, ease of insertion, insertion time, and overall insertion grading. Hemodynamic parameters, including heart rate and systolic blood pressure, were monitored at baseline, during induction, at LMA insertion, and post-insertion.

Results: The fentanyl–midazolam group required significantly lower induction and total doses of propofol compared with the midazolam-only group. LMA insertion conditions were markedly superior in the FM group, with a higher proportion of patients demonstrating full jaw opening, easier insertion, and better overall insertion grades. Although LMA insertion time was slightly shorter in the FM group, the difference was not statistically significant. Baseline hemodynamic variables were comparable between groups; however, following induction and during LMA insertion, the FM group exhibited lower heart rate and systolic blood pressure, indicating attenuated hemodynamic responses and greater post-insertion stability.

Conclusion: Fentanyl–midazolam pretreatment significantly improves LMA insertion conditions, enhances jaw relaxation, reduces propofol requirements, and provides better attenuation of hemodynamic responses compared with midazolam alone. This co-induction technique offers a safe and effective approach to facilitate smoother LMA insertion with reduced anesthetic drug consumption and improved cardiovascular stability. Further multicentre studies with larger sample sizes are recommended to confirm these findings and evaluate applicability in diverse clinical settings.

Keywords: LMA, Fentanyl, Laryngeal Mask Airway, Propofol.

INTRODUCTION

The laryngeal mask airway (LMA) is a widely used supraglottic device that allows for secure airway management following the induction of general anaesthesia, whether with inhalational or intravenous agents. Propofol, a short-acting and lipophilic intravenous anaesthetic, is commonly employed for induction due to its ability to relax masticatory muscles and suppress upper airway reflexes,

facilitating LMA insertion.[1,2] However, when used alone at high doses, propofol can cause significant hypotension, respiratory depression, and prolonged apnea.[3,4] To mitigate these adverse effects, co-induction agents such as opioids, benzodiazepines, inhalational anaesthetics, and neuromuscular blockers are often administered to reduce the propofol requirement. Among opioids, fentanyl is frequently used in combination with intravenous anaesthetics to improve insertion conditions, while sub-anaesthetic doses of midazolam have been shown to reduce propofol needs synergistically, enhance jaw relaxation, and maintain hemodynamic stability without delaying recovery. Despite decades of clinical use, there is still no consensus on the optimal anaesthetic combination for LMA insertion that maximizes ease of placement while minimizing complications.[5]

In this context, the present study was designed to compare the effectiveness of midazolam and fentanyl as co-induction agents with propofol for LMA insertion and to evaluate their impact on peri-insertion hemodynamic responses.

MATERIALS AND METHODS

This prospective, randomized, double-blinded, controlled study was conducted at a tertiary care teaching hospital in Nagpur after obtaining institutional ethical committee approval and written informed consent from participants. The study included 120 patients aged 18–60 years, weighing 40–90 kg, and classified as American Society of Anaesthesiologists (ASA) physical status I or II, scheduled for short elective surgeries. Patients with uncontrolled systemic illnesses, drug allergies, pregnancy, abnormal airway anatomy, or increased risk of regurgitation were excluded. The study was conducted in accordance with Good Clinical Practice and the Declaration of Helsinki (1975, revised 2024). Preoperatively, patients underwent a detailed airway assessment and routine investigations. They received oral alprazolam 0.25 mg and pantoprazole 40 mg the night before surgery. On the day of surgery, fasting status was confirmed (8 hours for solids, 2 hours for clear liquids), an IV line was secured, and standard monitoring was applied (ECG, SpO_2 , NIBP, $ETCO_2$, temperature). Baseline parameters were recorded.

Patients were randomly allocated into two groups using a computer-generated table: Group M (midazolam) and Group FM (midazolam + fentanyl). Group assignments were sealed in opaque envelopes and opened immediately before the procedure. The study was double-blinded; the anaesthesiologist performing the LMA insertion and recording outcomes was unaware of group allocation, while a separate anaesthesiologist prepared and administered the study drugs.

Premedication included IV glycopyrrolate 4 µg/kg and pantoprazole 40 mg. Group M received IV midazolam 0.03 mg/kg, and Group FM received IV midazolam 0.03 mg/kg plus fentanyl 1 µg/kg, administered slowly over 30 seconds. Two minutes after premedication, anaesthesia was induced with IV propofol 2.5 mg/kg over 15 seconds. Additional 0.5 mg/kg increments were given every 30 seconds until loss of consciousness and verbal response. LMA insertion was attempted 90 seconds after propofol administration by a blinded investigator trained and experienced in airway management to ensure standardized insertion and patient safety.

LMA insertion conditions were assessed using six variables on a 3-point scale: jaw opening, ease of insertion, gagging, coughing, limb/head movements, and laryngospasm/airway obstruction. Overall insertion conditions were graded according to the modified Lund and Stovener scheme: excellent, good, poor, and unacceptable. If insertion failed on the first attempt, incremental doses of propofol 0.5 mg/kg were given, with a maximum of three attempts. Ventilation was provided via face mask between attempts. Patients in whom LMA insertion was unsuccessful after three attempts were intubated.

After successful LMA placement, anaesthesia was maintained with isoflurane (0.8–1%) in 66% N_2 O with oxygen, and spontaneous respiration was allowed. Hemodynamic parameters, including heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP), mean arterial pressure (MAP), ETCO2and SpO_2 , were recorded at baseline, immediately before insertion, and every minute for 5 minutes post-insertion. Incision was delayed until 5 minutes post-insertion. Further anaesthesia maintenance included isoflurane 0.8–1%, N_2 O, and IV atracurium 0.5 mg/kg with intermittent positive pressure ventilation until surgery completion. Patient's LMA was removed ensuring adequacy of reversal with neostigmine 0.05mg/kg and glycopyrrolate 0.08mg/kg.

Data were analysed using SPSS version 20. Statistical methods included chi-square tests, analysis of variance (ANOVA) with Bonferroni's t-test, Student's t-test, frequencies, and cross-tabulations. A P-value <0.05 was considered statistically significant.

RESULTS

Values are expressed as mean ± standard deviation (SD) or number (percentage) as appropriate. p-values were calculated using the independent samples t-test for continuous variables and the Chi-square (χ^2) test for categorical variables.

A total of 120 patients were enrolled, with 60 patients in each group (Group M: midazolam; Group FM: midazolam + fentanyl). All patients completed the study, and there were no significant differences in demographic parameters (age, gender, weight) or surgical parameters between the groups (P > 0.05).

Table 1: Demographic and surgical parameters

Parameters	Group M(n=60)	Group FM (n=60)	P value
Age in years (Mean±SD)	30.97±9.57	34.28±9.61	1.93
Gender			
Male(%)	21(35%)	23(38.3%)	0.72
Female(%)	39(65%)	37(61.6%)	
Weight (kg) (Mean±SD)	51.68± 8.85	54.5. ±11.42	1.46
Type of surgery			
Gynaecology	25	29	
Orthopaedics	14	13	
General surgery	21	18	
Duration of surgery in minutes	24.78 ±7.49	26.72 ±5.29	1.56
Recovery time in minutes	7.72 ±3.08	7.87± 2.76	0.27

Table 2: Propofol requirement perioperatively

Parameters	Group M(n=60)	Group FM (n=60)	P value
Induction dose	113.83 ±27.93	80.25 ±23.44	<0.001
Additional dose	27.67± 10.15	24.75 ±15.07	0.17
Total dose	141.50±29.39	105.22±27.22	<0.001

Values are expressed as mean ± standard deviation (SD). p-values were calculated using the independent samples t-test.

A p-value of < 0.05 was considered statistically significant. The induction dose of propofol was significantly lower in Group FM (80.25 ± 23.44 mg) compared to Group M (113.83 ± 27.93 mg, P < 0.001). Similarly, the total propofol requirement was lower in Group FM (105.22 ± 27.22 mg) than in Group M (141.50 ± 29.39 mg, P < 0.001). Additional propofol doses were comparable between the groups (27.67 ± 10.15 mg in Group M vs 24.75 ± 15.07 mg in Group FM, P > 0.05).

Table 3: Patient response to LMA insertion

Parameter	Group M(n=60)	Group FM (n=60)	P value
Jaw Opening			
Full	31(51.3%)	53(88.3%)	<0.001
Partial	29(48.7%)	7(11.6%)	
Impossible	0	0	
Ease of insertion			
Ease	35(58.3%)	55(91.6%)	<0.001
Difficult	25(41.6%)	5(8.3%)	
Impossible	0	0	
Coughing			0.03
No	50(83.3%)	58(96.6%)	
+1	10(16.6%)	2(3.3%)	
+2	0	0	
Gagging			1.00
No	58(96.6%)	58(96.6%)	
+1	2(3.3%)	2(3.3%)	
+2	0	0	

Values are expressed as number (percentage). p-values were calculated using the Chi-square test or Fisher's exact test as appropriate. A p-value of < 0.05 was considered statistically significant.

Jaw opening was excellent in a greater proportion of patients in Group FM (88.3%) than in Group M (51.3%). Ease of insertion was rated as "easy" in 91.6% of patients in Group FM compared to 58.3% in Group M. Both gagging and coughing were minimal in both groups, with slightly better results in Group FM. Limb or head movements were observed in 41.6% of patients in Group M versus 8.3% in Group FM. No laryngospasm or severe airway obstruction occurred in either group.

Excellent LMA insertion conditions were achieved in 47 patients in Group FM versus 24 patients in Group M. Good conditions were observed in 12 patients in Group FM and 29 patients in Group M. The mean time required for LMA insertion was slightly shorter in Group FM (26.50 ± 9.22 s) than in Group M (29.42 ± 8.85 s, P < 0.05).

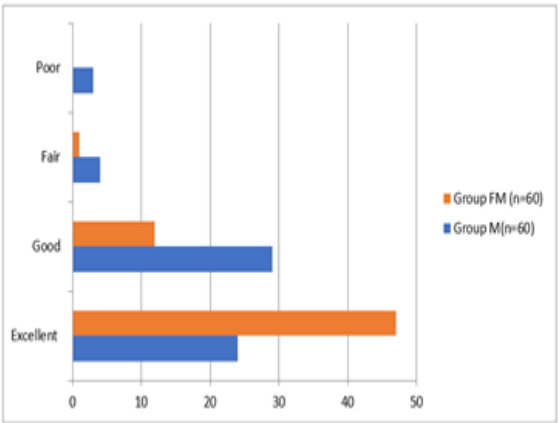

Figure 1: Grades of LMA insertion and time required

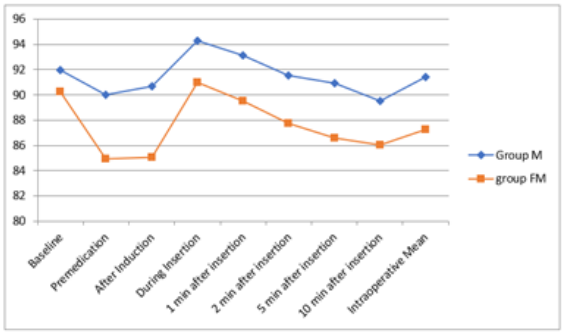

Figure 2: Changes in Heart rate before and after LMA insertion

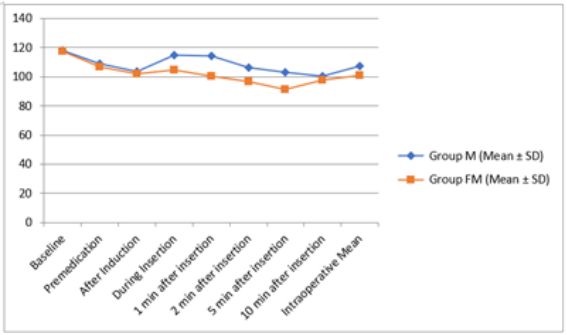

Figure 3: Changes in systolic blood pressure before and after LMA insertion

Hemodynamically, both groups had comparable baseline HR and SBP. Following induction, Group FM maintained lower HR and SBP during and after LMA insertion, with less pronounced rises at insertion and consistently lower values up to 10 minutes post-insertion (intraoperative mean SBP: 100.82 ± 15.05 mmHg vs. 107.45 ± 16.69 mmHg; HR: 87.26 ± 12.84 bpm vs. 91.43 ± 12.95 bpm). [Figure 1 & 2] These results indicate that midazolam-fentanyl pretreatment not only facilitates smoother LMA insertion but also attenuates the hemodynamic response more effectively than midazolam alone Overall, co-administration of midazolam with fentanyl significantly improved the conditions for LMA insertion, reduced the propofol induction dose, and minimized patient movement and jaw rigidity compared to midazolam alone.

DISCUSSION

In the present study, fentanyl–midazolam pre-treatment was associated with a significant reduction in propofol requirements and markedly improved conditions for laryngeal mask airway (LMA) insertion compared with the midazolam-only technique. Patients receiving fentanyl–midazolam required substantially lower induction and total doses of propofol than those receiving midazolam alone.

Airway conditions were significantly superior in the fentanyl–midazolam group. A greater proportion of patients exhibited full jaw opening, easier LMA insertion, and higher-quality insertion grades compared with the midazolam-only group. Although the time required for LMA insertion was slightly shorter with fentanyl–midazolam pre-treatment, this difference was not statistically significant.

Baseline heart rate and systolic blood pressure were comparable between the two groups. Following induction and during LMA insertion, the fentanyl–midazolam group demonstrated lower heart rate and systolic blood pressure values, with attenuated hemodynamic responses at the time of insertion and more stable parameters in the post-insertion period.

The observed advantages of the Fentanyl-midazolam pre-treatment can be attributed to improved jaw relaxation and optimal airway alignment, which reduce resistance during insertion and minimize airway reflexes such as coughing or gagging.[6] Enhanced airway patency likely contributes to the higher proportion of patients achieving full jaw opening, easier insertion, and excellent LMA grades in the FM group. Additionally, the Fentanyl-midazolam pre-treatment may have synergistic effect, allowing adequate sedation with lower propofol doses while maintaining hemodynamic stability.[7] Overall, these findings indicate that fentanyl–midazolam pre-treatment not only facilitates smoother and more favourable LMA insertion conditions but also allows adequate anaesthesia with reduced propofol consumption and more effective attenuation of the hemodynamic response compared with midazolam alone.

The findings of the present study are further supported by previous research on co-induction strategies.[8,9]

Nakazawa et al,[10] demonstrated that pretreatment with midazolam combined with propofol significantly improved LMA insertion conditions and minimized airway obstruction compared to placebo, while fentanyl achieved similar insertion ease but was associated with greater reductions in blood pressure. Similarly, Sivaramakrishnan Dhamotharan et al,[11] reported that both midazolam (0.05 mg/kg) and fentanyl (2 µg/kg) co-administered with propofol (2.5 mg/kg) provided satisfactory conditions for LMA insertion, with midazolam offering superior jaw relaxation. These studies collectively highlight that interventions enhancing upper airway conditions—whether through pharmacologic pretreatment or mechanical/positional optimization with Fentanyl-midazolam pretreatment can improve insertion success, reduce airway reflexes, and decrease anaesthetic requirements. The evidence suggests that combining strategies targeting both airway patency and sedation depth may provide optimal LMA insertion conditions with minimal hemodynamic compromise.

Despite these encouraging findings, the study has certain limitations. It was a single-centre study with a relatively small sample size, which may limit generalizability. Although standardized criteria were used to assess airway conditions and insertion quality, some parameters such as ease of insertion and jaw relaxation are subject to observer interpretation. Furthermore, the study focused on elective short-duration surgeries, and the effects of

the FM technique in emergency cases or patients with difficult airways were not evaluated. Future studies with larger, multicentre cohorts are warranted to confirm these findings and to explore the applicability of the FM technique in varied clinical scenarios, including patients with anticipated difficult airways or comorbidities. Additionally, the impact of the technique on hemodynamic responses and recovery profiles in high-risk populations warrants further investigation.

CONCLUSION

In conclusion, the Fentanyl-midazolam pretreatment significantly improves LMA insertion conditions, enhances jaw relaxation, and reduces propofol requirements compared to the conventional method. By facilitating smoother insertion with fewer airway reflexes, this technique provides a safe and effective approach for airway management during intravenous induction. These findings suggest that incorporating Fentanyl-midazolam pretreatment into routine practice may optimize anaesthesia delivery while minimizing drug usage and hemodynamic disturbances.

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