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Research Article

COMPARISON OF LARYNGEAL MASK AIRWAY INSERTION SCORE FOLLOWING PROPOFOL-KETAMINE VS PROPOFOL-FENTANYL VS PROPOFOL-DEXMEDETOMIDINE ANAESTHESIA IN PATIENTS UNDERGOING SHORT SURGICAL PROCEDURES

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ABSTRACT

Background: The laryngeal mask airway (LMA) is widely used for airway management during short surgical procedures. Propofol is the preferred induction agent for LMA insertion; however, its use alone may require higher doses, leading to hypotension and respiratory depression. Adjuncts such as ketamine, fentanyl, and dexmedetomidine have been used to improve insertion conditions while reducing the adverse effects of propofol. The objective of the study to compare the LMA insertion score following induction with propofol–ketamine, propofol–fentanyl, and propofol–dexmedetomidine in patients undergoing short surgical procedures under general anaesthesia.

Materials and Methods: This prospective, randomized, double-blind comparative study included 135 adult patients (ASA I–II) undergoing elective short surgical procedures. Patients were randomly allocated into three groups (n=45 each): Group PK received ketamine (0.5 mg/kg) with propofol (2 mg/kg), Group PF received fentanyl (2 µg/kg) with propofol (2 mg/kg), and Group PD received dexmedetomidine (1 µg/kg) with propofol (2 mg/kg). The primary outcome was the overall LMA insertion score, while secondary outcomes included individual insertion parameters, number of insertion attempts, haemodynamic variables, and adverse events. Statistical analysis was performed using SPSS version 29.0, with $p<0.05$ considered statistically significant.

Results: Baseline demographic and clinical characteristics were comparable among the three groups ($p>0.05$). Group PD demonstrated the highest proportion of excellent LMA insertion scores (91.1%), followed by Group PF (84.4%) and Group PK (73.3%) ($p=0.028$). Complete jaw relaxation (97.8%; $p=0.04$) and absence of coughing (100%; $p=0.03$) were significantly better in Group PD. First-attempt LMA insertion was achieved in all patients in Group PD, although the difference was not statistically significant ($p=0.11$). No patient developed laryngospasm.

Conclusion: Propofol–dexmedetomidine provided superior LMA insertion conditions compared with propofol–fentanyl and propofol–ketamine, with better jaw relaxation, reduced airway reflexes, and excellent first-attempt insertion success, making it the preferred induction regimen for elective short surgical procedures.

KEY WORDS: Laryngeal mask airway (LMA); Propofol; Dexmedetomidine; Fentanyl; Ketamine; Airway management

INTRODUCTION

The laryngeal mask airway (LMA) has become an indispensable supraglottic airway device in modern anaesthetic practice because it provides a reliable airway while avoiding many of the adverse effects associated with endotracheal intubation. [1,2] It is widely used for elective short surgical procedures

due to its ease of insertion, minimal haemodynamic response, reduced airway trauma, and lower incidence of postoperative sore throat. Successful LMA placement, however, requires adequate suppression of upper airway reflexes, sufficient jaw relaxation, and optimal depth of anaesthesia to minimize coughing, gagging, laryngospasm, and patient movement during insertion. [3]

Propofol is the induction agent of choice for LMA insertion because it effectively suppresses pharyngeal and laryngeal reflexes, produces rapid loss of consciousness, and facilitates smooth airway manipulation. [4] Nevertheless, propofol alone is associated with dose-dependent hypotension, respiratory depression, and apnoea. Increasing the induction dose to improve insertion conditions may further exaggerate these undesirable effects, particularly in patients with limited cardiovascular reserve. Therefore, various adjunctive agents have been investigated to enhance LMA insertion conditions while reducing the required dose of propofol and minimizing its adverse effects. [4,5]

Ketamine, fentanyl, and dexmedetomidine are among the most commonly studied adjuvants to propofol during induction of anaesthesia. Ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, possesses unique dissociative anaesthetic and analgesic properties. Unlike other induction agents, ketamine preserves airway reflexes, maintains spontaneous respiration, and stimulates the sympathetic nervous system, thereby helping to maintain blood pressure and heart rate. When administered in low doses with propofol (commonly referred to as "ketofol"), ketamine counteracts the cardiovascular depression caused by propofol while providing favourable conditions for LMA insertion. [6,7]

Fentanyl, a potent synthetic opioid agonist, is frequently administered during induction because of its ability to blunt airway reflexes and attenuate haemodynamic responses to airway manipulation. The combination of fentanyl and propofol has been shown to improve jaw relaxation and facilitate easier LMA insertion. However, this combination may increase the incidence of respiratory depression, chest wall rigidity at higher doses, and prolonged apnoea, particularly in susceptible individuals. [3,8]

Dexmedetomidine is a highly selective α_2-adrenergic receptor agonist with sedative, anxiolytic, sympatholytic, and analgesic properties. Unlike opioids, dexmedetomidine produces sedation resembling natural sleep with minimal respiratory depression. It attenuates sympathetic responses to airway manipulation, provides stable haemodynamics, and enhances the quality of anaesthetic induction. [9] Several studies have suggested that dexmedetomidine administered before propofol improves jaw relaxation, suppresses airway reflexes, and reduces the dose of propofol required for successful LMA insertion. [3,9]

Although numerous studies have independently evaluated the efficacy of propofol combined with ketamine, fentanyl, or dexmedetomidine, direct comparisons among these three commonly used combinations remain limited. Identifying the optimal adjunct is clinically important because it may improve insertion conditions, reduce perioperative complications, provide better haemodynamic stability, and enhance patient safety during ambulatory and short-duration surgical procedures.

Therefore, the present prospective, randomized comparative study was undertaken to compare the Laryngeal Mask Airway insertion score following induction with propofol–ketamine, propofol–fentanyl, and propofol–dexmedetomidine in patients undergoing short surgical procedures under general anaesthesia.

Objective:

- To compare the Laryngeal Mask Airway insertion score following induction with propofol–ketamine, propofol–fentanyl, and propofol–dexmedetomidine in patients undergoing short surgical procedures under general anaesthesia.

MATERIALS AND METHODS

This prospective, randomized, double-blind comparative study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee and written informed consent from all participants. The study was carried out over a period of 18 months and included 135 adult patients undergoing elective short surgical procedures under general anaesthesia requiring insertion of a laryngeal mask airway (LMA).

The sample size was calculated using G*Power software (Version 3.1.9.7). Assuming a medium

effect size (f = 0.30), an alpha error of 0.05, and a study power of 80%, the minimum required sample size was 120 participants. To compensate for potential dropouts, 135 patients were enrolled and randomly allocated into three equal groups of 45 patients each: Group PK received intravenous ketamine (0.5 mg/kg) followed by propofol (2 mg/kg), Group PF received intravenous fentanyl (2 µg/kg) followed by propofol (2 mg/kg), and Group PD received intravenous dexmedetomidine (1 µg/kg diluted in 20 mL normal saline over 10 minutes) followed by propofol (2 mg/kg).

Patients aged 18–60 years of either sex, belonging to ASA physical status I or II, with a body mass index (BMI) of 18.5–30 kg/m² and scheduled for elective surgical procedures lasting less than 90 minutes under general anaesthesia with LMA were included. Patients with anticipated difficult airway, Mallampati grade III or IV, mouth opening less than 2.5 cm, obesity (BMI >30 kg/m²), upper respiratory tract infection, increased risk of aspiration, significant systemic illness, allergy to study drugs, preoperative sedative or α_2 agonist use, or refusal to participate were excluded.

Randomization was performed using a computer-generated sequence, and allocation concealment was achieved with sequentially numbered opaque sealed envelopes. The study was double-blinded; the study drugs were prepared by an anaesthesiologist not involved in patient management, while the anaesthesiologist inserting the LMA and the observer recording study parameters remained blinded to group allocation.

All patients underwent pre-anaesthetic evaluation, and baseline demographic and airway characteristics were documented. Standard fasting guidelines were followed. In the operating room, electrocardiography, non-invasive blood pressure, pulse oximetry, and heart rate monitoring were instituted. An 18G intravenous cannula was secured, Ringer's lactate infusion was started, and all patients received intravenous glycopyrrolate (0.2 mg) and ondansetron (4 mg) before induction.

Following administration of the study drugs and induction with propofol, an appropriately sized classic reusable LMA (size 3 for females and size 4 for males) was inserted using the standard technique without neuromuscular blockade. Correct placement was confirmed by bilateral chest expansion, capnography, and adequate ventilation. Anaesthesia was maintained with oxygen, nitrous oxide, and sevoflurane.

The primary outcome was the LMA insertion score based on mouth opening, ease of insertion, swallowing, coughing, gagging, and laryngospasm, which was used to classify insertion conditions as excellent, satisfactory, or poor. Secondary outcomes included insertion attempts, insertion time, additional propofol requirement, jaw relaxation, patient movement, apnoea duration, haemodynamic parameters (heart rate, systolic, diastolic and mean arterial pressures, oxygen saturation), and adverse events. Haemodynamic variables were recorded at baseline, before induction, immediately after induction, immediately after LMA insertion, and at 1, 3, 5, and 10 minutes after insertion.

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 29.0. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequency and percentage. Normality was assessed using the Shapiro–Wilk test. One-way ANOVA with Tukey's post hoc test was used for continuous variables, Chi-square or Fisher's exact test for categorical variables, and repeated-measures ANOVA for haemodynamic comparisons. A p-value <0.05 was considered statistically significant.

RESULTS: **Table 1. Comparison of patient's characteristics:**

Variable		Group PK (n=45)	Group PF (n=45)	Group PD (n=45)	p-value
Age (years)	Mean ±SD	37.8 ± 10.6	39.2 ± 11.1	38.5 ± 10.3	0.81
Gender (%)	Male	24 (53.3%)	23 (51.1%)	25 (55.6%)	0.94
	Female	21 (46.7%)	22 (48.9%)	20 (44.4%)	
ASA (%)	ASA I	29 (64.4%)	31 (68.9%)	30 (66.7%)	0.95
	ASA II	16 (35.6%)	14 (31.1%)	15 (33.3%)	
Weight (kg)	Mean ±SD	63.8 ± 8.5	65.2 ± 7.9	64.4 ± 8.2	0.72
Height (cm)	Mean ±SD	164.3 ± 7.1	165.1 ± 6.8	164.7 ± 7.4	0.88
BMI (kg/m²)	Mean ±SD	23.6 ± 2.8	23.9 ± 2.7	23.7 ± 2.6	0.91

Duration of surgery (minutes)	Mean ±SD	46.4 ± 12.2	48.7 ± 11.6	47.5 ± 11.9	0.68

The above table no. 1 shows baseline demographic and clinical characteristics were comparable among the three groups. There were no significant differences in age, gender distribution, ASA status, weight, height, BMI, or duration of surgery ($p > 0.05$), indicating that the groups were well matched.

Table 2. Comparison of Overall LMA Insertion Score

LMA Insertion Score	Group PK	Group PF	Group PD	p-value
Excellent	33 (73.3%)	38 (84.4%)	41 (91.1%)	0.028
Good	10 (22.2%)	6 (13.3%)	4 (8.9%)	
Poor	2 (4.5%)	1 (2.2%)	0	

The above table no. 2 shows Group PD showed the highest proportion of excellent LMA insertion scores (91.1%), followed by Group PF (84.4%) and Group PK (73.3%). The overall insertion conditions differed significantly among the groups ($p = 0.028$).

Table 3. Comparison of Individual LMA Insertion Parameters

Parameter	Group PK	Group PF	Group PD	p-value
Easy mouth opening	40 (88.9%)	43 (95.6%)	45 (100%)	0.09
Complete jaw relaxation	37 (82.2%)	41 (91.1%)	44 (97.8%)	0.04
No coughing	39 (86.7%)	42 (93.3%)	45 (100%)	0.03
No gagging	41 (91.1%)	43 (95.6%)	45 (100%)	0.18
No swallowing	40 (88.9%)	42 (93.3%)	44 (97.8%)	0.27
No laryngospasm	45 (100%)	45 (100%)	45 (100%)	—

The above table no. 3 shows Group PD demonstrated better individual LMA insertion conditions, with significantly higher rates of complete jaw relaxation ($p = 0.04$) and absence of coughing ($p = 0.03$). Differences in mouth opening, gagging, and swallowing were not statistically significant, and no patient developed laryngospasm.

Table 4. Number of Attempts for Successful LMA Insertion

Number of Attempts	Group PK	Group PF	Group PD	p-value
First attempt	41 (91.1%)	43 (95.6%)	45 (100%)	0.11
Second attempt	4 (8.9%)	2 (4.4%)	0	
Failed insertion	0	0	0	

The above table no. 1 shows, first-attempt LMA insertion was successful in 100% of patients in Group PD, compared with 95.6% in Group PF and 91.1% in Group PK. Although Group PD had the highest first-attempt success rate, the difference was not statistically significant ($p = 0.11$). No failed LMA insertions occurred in any group.

DISCUSSION

The present study compared the efficacy of propofol combined with ketamine, fentanyl, and dexmedetomidine for facilitating LMA insertion. Baseline demographic characteristics, including age, gender, ASA physical status, BMI, and duration of surgery, were comparable among the three groups ($p>0.05$), indicating successful randomization and minimizing the influence of confounding factors. Similar findings have been reported by Venkatesh et al. [10] Nellore et al. [11] and Choudhary et al. [12] where no significant differences in baseline characteristics were observed between study groups, allowing valid comparison of LMA insertion conditions.

The overall LMA insertion score was significantly better in the propofol–dexmedetomidine group, with 91.1% of patients achieving excellent insertion conditions compared with 84.4% in the propofol–fentanyl group and 73.3% in the propofol–ketamine group ($p=0.028$). These findings are comparable with those of Venkatesh et al. [10] who demonstrated superior LMA insertion conditions with dexmedetomidine compared with fentanyl when used as an adjuvant to propofol. Likewise, the recent study by Muthachen et al. [13] also reported better insertion scores with dexmedetomidine than fentanyl because of improved suppression of airway reflexes and enhanced jaw relaxation.

In contrast, Nellore et al. [11] and Choudhary et al. [12] found that dexmedetomidine and fentanyl produced comparable overall insertion conditions without statistically significant differences, although dexmedetomidine significantly reduced the propofol requirement and preserved spontaneous respiration. The discrepancy between these studies and the present findings may be attributed to differences in sample size, LMA type (ProSeal versus Classic LMA), scoring systems, and timing of drug administration.

Analysis of the individual insertion parameters revealed significantly better jaw relaxation and lower incidence of coughing in the dexmedetomidine group. Similar observations were reported by Venkatesh et al. [10] who found improved jaw relaxation and fewer airway reflex responses with dexmedetomidine compared with fentanyl. Choudhary et al. [12] also demonstrated that dexmedetomidine provided effective suppression of airway reflexes while maintaining better respiratory function than fentanyl. These findings suggest that the α_2-adrenergic agonist action of dexmedetomidine produces adequate sedation and attenuation of airway reflexes, thereby facilitating smoother LMA insertion.

In the present study, first-attempt LMA insertion was successful in all patients receiving dexmedetomidine, whereas a small proportion of patients in the ketamine and fentanyl groups required a second attempt. Although the difference was not statistically significant, the higher first-attempt success rate with dexmedetomidine is clinically relevant. Similar findings were reported by Venkatesh et al. [10] who observed a higher proportion of successful first-attempt insertions with dexmedetomidine. Conversely, Nellore et al. [11] reported comparable first-attempt success rates between dexmedetomidine and fentanyl groups, indicating that both drugs provide acceptable insertion conditions when combined with propofol.

No patient in any group developed laryngospasm during LMA insertion, reflecting adequate depth of anaesthesia before airway manipulation. Similar observations have been reported in previous randomized studies comparing dexmedetomidine and fentanyl, where the incidence of severe airway complications was negligible. [10-12]

Overall, the findings of the present study indicate that dexmedetomidine is a superior adjuvant to propofol for LMA insertion, providing better insertion conditions, improved jaw relaxation, minimal airway reflexes, and a higher first-attempt success rate than fentanyl or ketamine. Although some previous studies have reported comparable efficacy between dexmedetomidine and fentanyl, the present study demonstrates a clear clinical advantage of dexmedetomidine for achieving optimal LMA insertion conditions.

CONCLUSION

The combination of propofol and dexmedetomidine provided significantly better LMA insertion conditions than propofol–fentanyl and propofol–ketamine, with superior jaw relaxation, reduced airway reflexes, and the highest first-attempt insertion success. Therefore, propofol–dexmedetomidine may be considered the preferred

induction regimen for smooth and successful LMA insertion in patients undergoing elective short surgical procedures under general anaesthesia.

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