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ORIGINAL ARTICLE

COMPARATIVE STUDY OF EFFICACY OF INTRAVENOUS SUFENTANIL, FENTANYL AND LIGNOCAINE WITH PROPOFOL AS AN INDUCTION AGENT TO FACILITATE THE INSERTION OF LARYNGEAL MASK AIRWAY

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ABSTRACT: BACKGROUND: The aim of this study was to compare the conditions of LMA insertion using i.v. sufentanil, i.v. fentanyl or i.v. lignocaine as premedicants with propofol induction. Also we evaluated the hemodynamic changes, adverse reactions and number of attempts required for LMA insertion. **PATIENTS AND METHODS**: Seventy five ASA1 &2 patients undergoing elective surgery were included in this study. Patients were randomized into three groups to receive either sufentanil 0.4mcg/kg or fentanyl2mcg/kg or lignocaine 1.5mg/kg 2 min before induction of anesthesia. All patients were induced with propofol 2mg/kg. After 60 sec specialist anesthetist inserted appropriate size, deflated LMA. Mean arterial blood pressure, heart rate, respiratory rate and SPO2 were noted till 10 min from the time of LMA insertion. Conditions for LMA insertion i.e. jaw opening, ease of LMA insertion, coughing, gagging, laryngospasm and airway obstruction and patient's movements were assessed. **RESULTS:** There was statistically significant difference in jaw opening between three groups. 1 patient (4%) in group A, 4 patients (16%) in group B, 9 patients (36%) in group C had partial jaw opening. 1patient (4%) in group B and 4 patients (16%) in group C had no jaw opening with the recommended doses. Number of patients with difficulty in LMA insertion were more in lignocaine group 7 (28%) as compared to sufentanil 2 (8%) and fentanyl 2 (8%). There was no significant difference in the incidence of coughing among three groups. There was statistically significant difference with regard to gagging 12% in group C and 4% in group B had partial gagging. There was no statistically significant difference in the incidence of laryngospasm and airway obstruction among the three groups (P= 0. 1592). 6 (24%) patients in group C showed moderate movement as compared to 5 (20%) patients in group B and 0% in group A. 1 (4%) patient in lignocaine group showed vigorous movement. Thus the conditions for LMA insertion were more favorable with drugs like fentanyl and sufentanil. Compared to the above two drugs, lignocaine is a poor agent in suppressing the upper airway reflexes (When given intravenously) causing more patients movement. **CONCLUSION:** Conditions for LMA insertion were more favorable with sufentanil as compared to fentanyl and fentanyl was better than lignocaine. So sufentanil can be the choice of adjuvant with propofol induction for LMA insertion.

KEYWORDS: Anesthesia, i.v. propofol, sufentanil, fentanyl, laryngeal mask airway.

INTRODUCTION: Airway management in an anaesthetized patient is a major concern regarding the morbidity and mortality related to anesthesia. The laryngeal mask airway (LMA) with its variants has proved to be useful device in anesthesia and has revolutionized the management of patients with normal and difficult airway. It has proved to be a useful device in providing general anesthesia without any complications and at times allows intermittent positive pressure ventilation.

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Successful LMA insertion requires suppression of airway reflexes. Once the patient is adequately anaesthetized and laryngeal and pharyngeal reflexes are suppressed, LMA can be inserted blindly without using laryngoscope or use of muscle relaxants. This is the main advantage of LMA to administer general anesthesia.

The first study using LMA was published in 1983,[1] where gynecological laparoscopies were carried out. Premedicants used were either Lorazepam or Papavertum and hyoscine. Anesthesia was induced with thiopentone and alcuronium was the muscle relaxant of choice.

Authors like Yugo Tagarto,[2] Stoneham MD,[3] etc have shown that without the use of neuromuscular blocking agents LMA can be inserted if upper airway reflexes are obtunded with premedicants like Opioids (fentanyl,[4] alfentanil),[5] benzodiazepines (midazolam)[6,7] and local anesthetic (lignocaine) either topically or intravenously.

Propofol induction with or without an opioid has shown to be a better choice as compared to thiopentone for LMA insertion. Various studies have also shown that propofol suppresses airway reflexes more efficiently than thiopentone and has the ability to produce more profound relaxation of the pharyngeal muscles which aids smooth insertion of LMA with reduced incidence of coughing, gagging or laryngospasm.[8, 9]

Drugs like lignocaine either topically or intravenously, fentanyl in a dose of 1-2mcg/kg as premedicants along with propofol induction are used for smooth insertion of LMA.[11] Among the other opioids, alfentanil with midazolam is also used to facilitate LMA insertion.

Sufentanil is 5-10 times more potent than fentanyl. Its use has not been extensively studied for classic LMA insertion, but has been used for inserting an intubating laryngeal mask airway.[12, 13]

Going through various studies, this study was designed to assess and compare the efficacy of various premedicants like sufentanil, fentanyl or lignocaine with propofol induction to suppress airway reflexes and thus facilitate smooth LMA insertion.

AIMS AND OBJECTIVES:

- To compare the conditions for LMA insertion using IV sufentanil, IV fentanyl or IV lignocaine as premedicants with propofol induction.
- To compare the occurrence of adverse responses and number of attempts required during LMA insertion with above-mentioned combination of drugs.

MATERIALS AND METHODS:

After approval by the hospital ethical committee, 75 ASA grade 1 and 2 adult patients between age group 18 to 60 years, with Mallampatti score I and II, undergoing elective surgery requiring less than one-hour duration were included in our study. Patients with suspected difficult intubation, ASA grade 3 and 4 were excluded from the study. Informed consent of the patients was taken.

Routine investigations like Hb% and urine examination were done for all patients. Other investigations like ECG, X-ray chest, blood urea, serum creatinine, random blood sugar were done according to individual patient's requirements. On arrival to the operation theatre, monitors were connected. Baseline HR, SpO_2 and non-invasive blood pressure were recorded. Intravenous access was established using a 20 or 18 gauge venous cannula.

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Patients were preoxygenated for 3 minutes with 100% oxygen. All patients were pre-medicated with 0.2 mg glycopyrolate. Two minutes before induction of anesthesia, patients in group A received intravenous (IV) Sufentanil 0.4mcg/kg, group B received IV Fentanyl 2mcg/kg and group C received IV Lignocaine 1.5 mg/kg.

All patients were induced with injection propofol 2 mg/kg, slowly over a period of 30 seconds. After 60 seconds, specialist anesthetist inserted appropriate size, deflated LMA, which was lubricated with 2% Xylocaine jelly. The rim was inflated with air and positive pressure ventilation was given in order to check cuff leak and air entry on auscultation to the lung fields. Anesthesia was maintained with fresh gas flows of N_2O (50-60%) in O_2, supplemented with volatile anesthetic. At the conclusion of the surgery, LMA was left in situ, until the patient responded to verbal commands. The cuff was then deflated and LMA was removed.

Mean arterial blood pressure, heart rate, respiratory rate and SPO_2 were noted at 0 min (baseline), 1 minute, 2 minutes, 3 minute, 4 minute, 5 minute and at 10 minute after LMA insertion. The readings were taken every 5 minutes thereafter till the completion of the procedure. Readings at 0 minute (baseline) upto the reading at 10 minute were used for statistical analysis.

The conditions for LMA insertion was accessed and graded on a three-point scale using six variables. These included:

- Jaw opening (3 full; 2 partial; 1 nil).
- Ease of LMA insertion (3 easy; 2 difficult; 1 impossible).
- Coughing (3 nil; 2 +; 1 ++).
- Gagging (3 nil; 2+; 1++).
- Laryngospasm and airway obstruction (3 nil; 2 partial; 1 total).
- Patient movements (3 nil; 2 moderate; 1 vigorous).

Patients requiring more than 3 attempts for insertion of LMA were omitted from the study.

The results and observations were analyzed statistically. 3x3 Fisher Exact Test has been used to find the significance of conditions for LMA insertion between the three groups. Repeated measures ANOVA test has been used to find the significance of parameters, like mean arterial blood pressure, heart rate and respiratory rate within each group. A Kruskal Wallis test has been used to find the significance of changes in SpO_2 between the three groups.

OBSERVATIONS AND RESULTS: 75 patients were equally and randomly divided into three groups of 25 each, Group A (Sufentanil), Group B (Fentanyl) and Group C (Lignocaine).

There was no statistically significant difference in the demographic data in terms of age, weight, sex, ASA grading and Mallampatti score. All patients were comparable with regard to these variables.

In this study, jaw opening is found to be full in 24 patients in group A, 20 patients in group B and 12 patients in group C. One patient in group A and 4 patients in group B, showed partial jaw opening. In these patients, after giving more propofol (In increments of 10-20 mg) and starting of inhalational agent (isoflurane), LMA insertion was carried out without difficulty. 9 patients in group C, had partial jaw opening. These patients needed more propofol and deep inhalational anesthesia, after which LMA insertion was carried out without difficulty.

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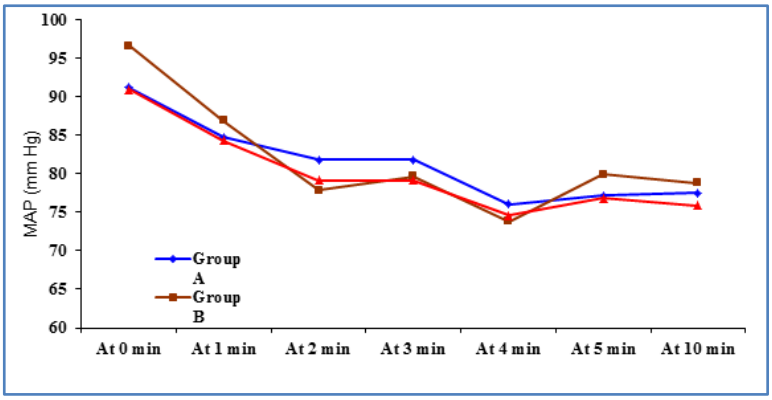
One patient in group B, showed no mouth opening with the recommended dose of fentanyl 2 mcg/kg. This patient needed more propofol, which was given in increments of 20 mg and 30 mg along with deep inhalational anesthesia. LMA was inserted in 2nd attempt in this patient. In 4 patients in group C, mouth opening was not adequate (nil), with the recommended dose of 1.5 mg/kg of lignocaine.

Amongst them in 3 patients, LMA insertion was not possible in first attempt, whereas 1 patient showed mild laryngospasm, vigorous movement with some airway obstruction. However, in all the four patients, after giving some more propofol (40-50 mg) along with deep inhalational anesthesia (oxygen + nitrous oxide + isoflurane), LMA could be inserted in 2nd attempt in 3 patients and in 3rd attempt in the 4th patient. Laryngospasm and airway obstruction was resolved after deepening of anesthesia with the help of narcotics, isoflurane and propofol.

Study period	MAP (mmHg)			p value
	Group A	Group B	Group C	
At 0 minute	91.20±10.68 (70-114)	96.60±12.16 (72-114)	90.92±14.02 (72-120)	0.194
At 1 minute	84.76±9.13 (70-104)	86.84±14.53 (47-108)	84.28±15.63 (50-112)	0.771
At 2 minute	81.84±10.51 (60-102)	77.88±14.21 (48-108)	79.12±15.93 (47-106)	0.583
At 3 minute	81.84±10.51 (60-102)	79.68±14.71 (48-108)	79.12±15.93 (44-96)	0.838
At 4 minute	76.08±8.13 (61-88)	73.84±9.77 (55-100)	74.60±13.94 (50-94)	0.762
At 5 minute	77.12±7.48 (64-90)	79.92±12.11 (48-100)	76.80±12.71 (53-96)	0.548
At 10 minute	77.48±6.09 (68-90)	78.80±9.21 (54-92)	75.84±9.95 (58-90)	0.459
Significance by Repeated Measures ANOVA	F=21.219 p<0.001**	F=22.571 p<0.001**	F=15.059 p<0.001**	-

Table 1: Comparison of changes in Mean Arterial Pressure (mmHg)



Graph 1: Comparison of changes in Mean arterial Pressure (mm Hg)

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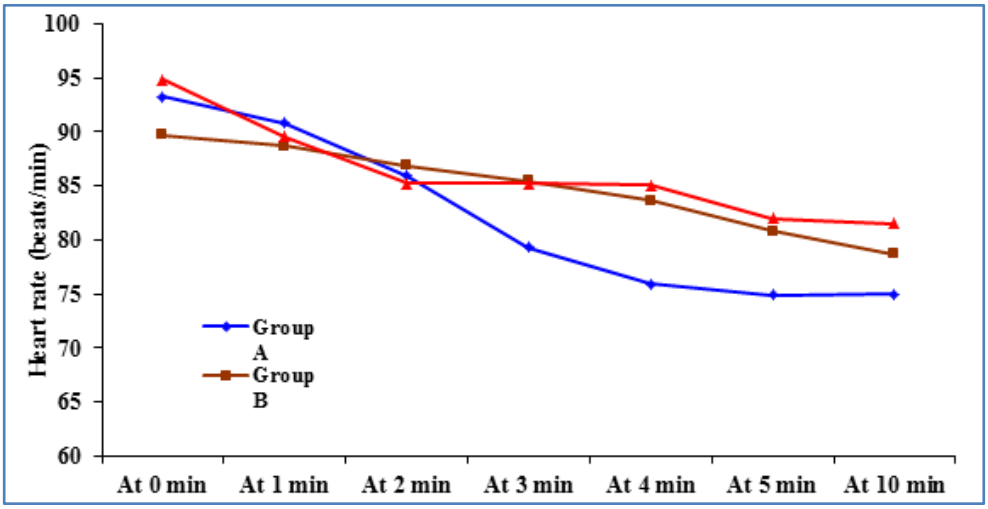
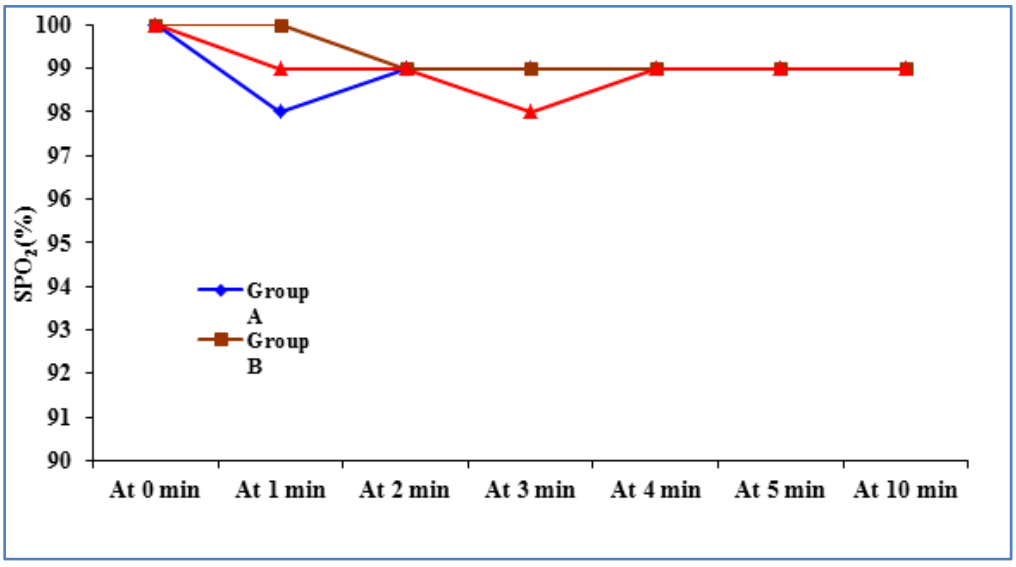
There was no significant difference between the three groups in relation to changes in mean arterial pressure as shown in Graph 1.



Graph 2: Comparison of changes in Heart rate (beats/min)

Changes in heart rate were moderately significant at 3 minute (p=0.037) and strongly significant at 4th minute (p=0.008, p<0.001). Fall in heart rate was more in group A (Sufentanil) which is consistent with its pharmacological effect as shown in Graph 2.



Graph 3: Comparison of changes in SpO_2 (%)

There is only moderately significant change in SpO_2 (%) at 4th minute between the three groups (p=0.041, p>0.001).

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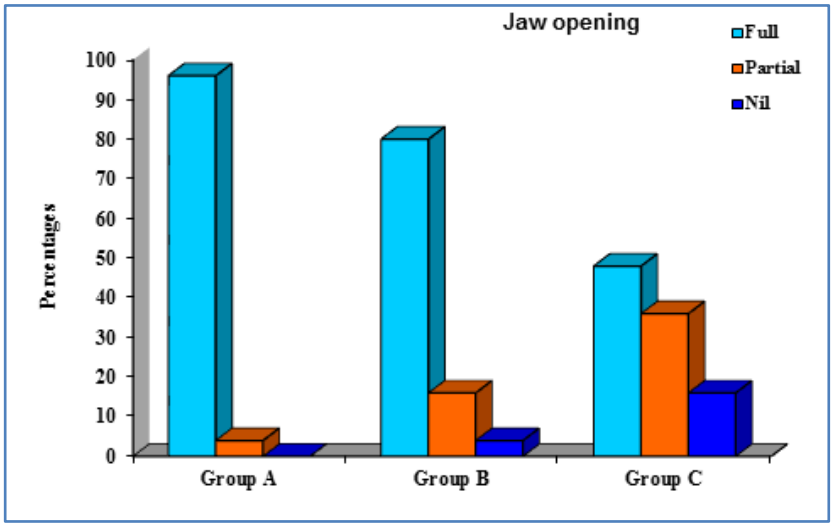
CONDITIONS FOR LARYNGEAL MASK AIRWAY INSERTION:

Grade	Jaw opening			p value
	Group A (n=25)	Group B (n=25)	Group C (n=25)	
Full (3)	24 (96.0%)	20 (80.0%)	12 (48.0%)	0.0006**
Partial (2)	1 (4.0%)	4 (16.0%)	9 (36.0%)	
Nil (1)	-	1 (4.0%)	4 (16.0%)	

Table 2: Comparison of Jaw opening between three groups

3x3 Fisher Exact test



Graph 4: Comparison of Jaw opening between three groups

As shown in table 2, comparison of jaw opening is statistically significant between the three groups (p=0.0006, p< 0.001). 96% of patients in group A had full jaw opening, with 4% showing partial jaw opening. In group B, 80% had full jaw opening, 16% showed partial and 4% showed no jaw opening. While only 48% of patients in group C had full jaw opening, 36% patients had partial and 16% patients had no jaw opening with the recommended doses.

Grade	Ease of LMA insertion			p value
	Group A (n=25)	Group B (n=25)	Group C (n=25)	
Easy	23 (92.0%)	22 (88.0%)	15 (60.0%)	0.0373*
Difficult	2 (8.0%)	2 (8.0%)	7 (28.0%)	
Impossible	-	1 (4.0%)	3 (12.0%)	

Table 3: Comparison of Ease of LMA insertion

3x3 Fisher Exact test

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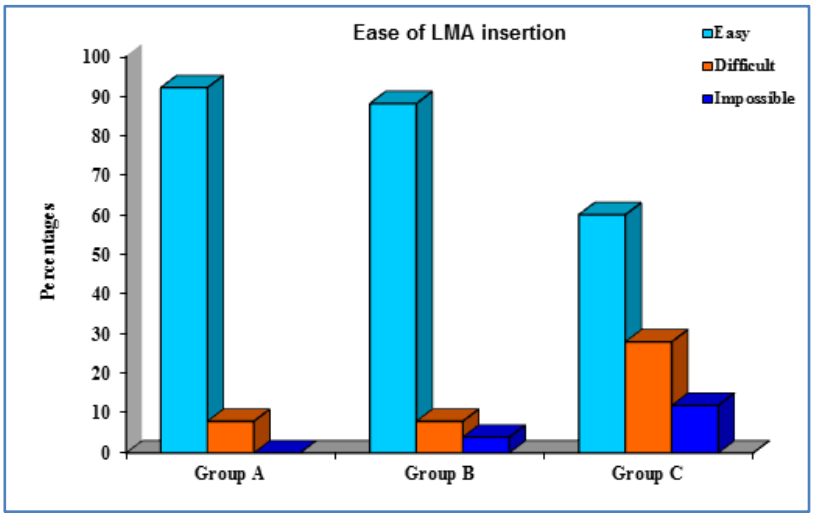


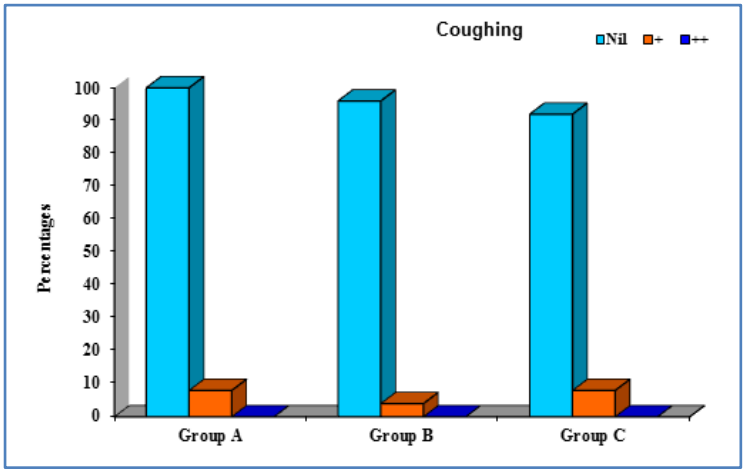
Graph 5: Comparison of Ease of LMA insertion

Comparison of ease of LMA insertion between three groups is moderately significant (p=0.0373). Number of patients with difficult LMA insertion were more in lignocaine group 7 (28%) as compared to sufentanil 2 (8)%) and fentanyl 2 (8%) group as shown in table 3.

Grade	Coughing			p value
	Group A (n=25)	Group B (n=25)	Group C (n=25)	
Nil	25 (100.0%)	24 (96.0%)	23 (92.0%)	0.2133
+	0	1 (4.0%)	2 (8.0%)	
++	0	0	0	

Table 4: Comparison of Coughing

3x3 Fisher Exact test



Graph 6: Comparison of Coughing

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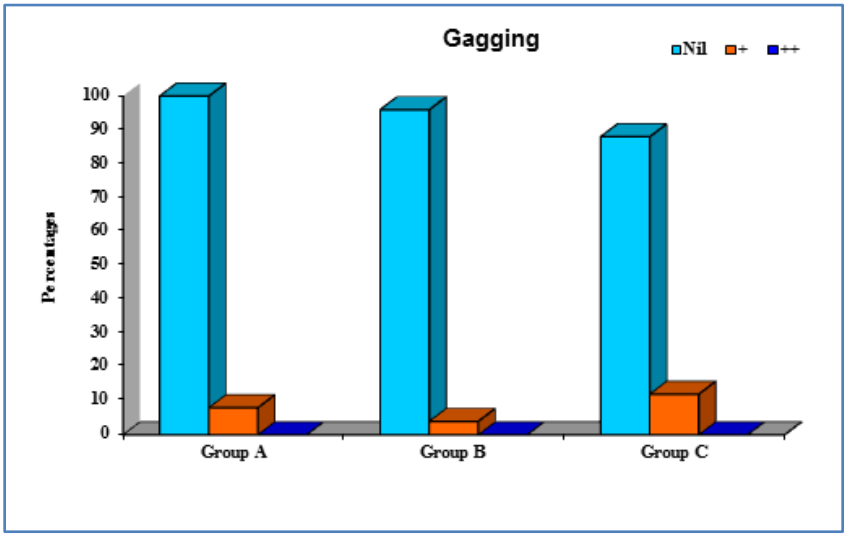
Observation from table 4 shows that comparison of coughing between the three groups are statistically not significant (p=0.2133).

Grade	Gagging			p value
	Group A (n=25)	Group B (n=25)	Group C (n=25)	
Nil	25 (100.0%)	24 (96.0%)	22 (88.0%)	0.0785+
+	0	1 (4.0%)	3 (12.0%)	
++	0	0	0	

Table 5: Comparison of Gagging

3x3 Fisher Exact test



Graph 7: Comparison of Gagging

Comparison of gagging between three groups as shown in table 5, had some statistical significance (p=0.0785). 12% in group C and 4% in group B showed partial gagging.

Grade	Laryngospasm and Airway obstruction			p value
	Group A (n=25)	Group B (n=25)	Group C (n=25)	
Nil	24 (96.0%)	23 (92.0%)	21 (84.0%)	0.1592
Partial	1 (4.0%)	2 (8.0%)	3 (12.0%)	
Total	**0**	**0**	**1 (4.0%)**	

Table 6: Comparison of Laryngospasm and Airway obstruction

3x3 Fisher Exact test

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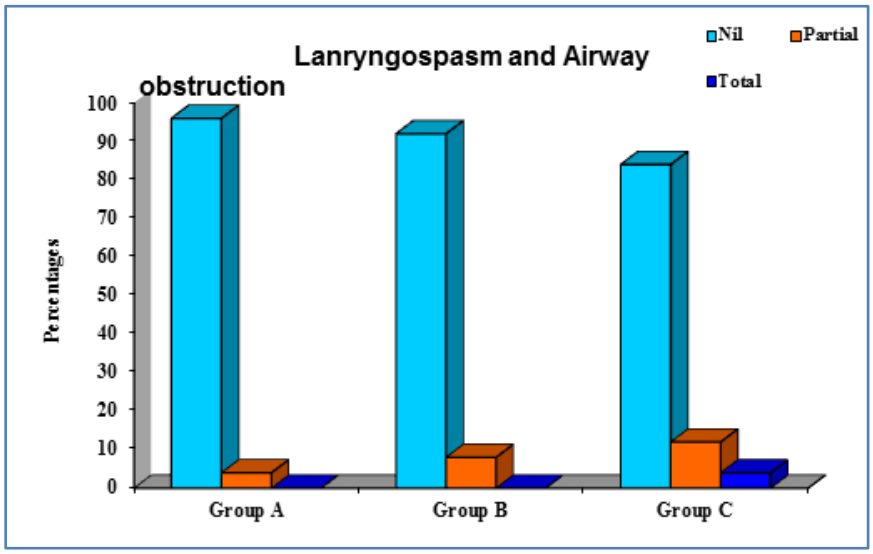


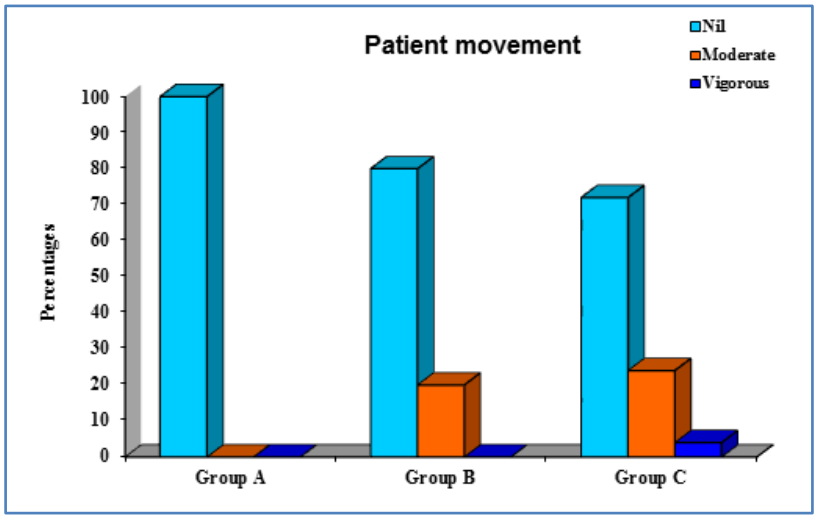
Graph 8: Comparison of Laryngospasm and Airway obstruction

Observation from Table 6 shows that incidence of laryngospasm and airway obstruction was not statistically significant between the three groups (p=0.1592)

Grade	Patient movement			p value
	Group A (n=25)	Group B (n=25)	Group C (n=25)	
Nil	25 (100.0%)	20 (80.0%)	18 (72.0%)	0.0176*
Moderate	0	5 (20.0%)	6 (24.0%)	
Vigorous	0	0	1 (4.0%)	

TABLE 7: Comparison of patient movement

3x3 Fisher Exact test



Graph 9: Comparison of Patient movement

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Comparison of patient movement in table 7 shows moderate significance between the three groups (p=0.176). 6 (24%) patients in group C showed moderate movement as compared to 5 (20%) patients in group B and 0% in sufentanil group. 1 (4%) patient in lignocaine group showed vigorous movement.

DISCUSSION: Adequate jaw relaxation and suppression of upper airway reflexes are required for smooth insertion and correct positioning of the LMA. Compared with thiopentone, propofol is more potent in suppressing pharyngeal and laryngeal reflexes and is the induction agent of choice for insertion of LMA.[8,9] However, when propofol is used alone, LMA insertion can still lead to undesirable effects like coughing, gagging, movement and laryngospasm. Hence, various drugs like opioids, benzodiazepines or local anesthetics need to be supplemented to propofol for suppressing laryngeal and pharyngeal reflexes more efficiently and thus facilitate smooth insertion of LMA.

Opioids like fentanyl[4], alfentanil[5], benzodiazepines like midazolam[6,7] and local anesthetic lignocaine[10] either intravenously or topically has been used to facilitate LMA insertion along with propofol.

In our study, intravenous sufentanil, fentanyl or lignocaine was used to facilitate LMA insertion with propofol as an induction agent. Total number of patients were 75, divided into three groups of 25 each. All patients received injection glycopyrolate 0.2 mg IV prior to induction of anesthesia.

Propofol has been found to provide more satisfactory conditions for LMA insertion as compared to thiopentone.[9] Thiopentone has been found to be associated with increased incidence of gagging and coughing.[8,9] These findings are consistent with studies by various authors. Hence in our study, we used propofol as an induction agent.

Patrick Scanlon[9] has shown that there was less head movement, gagging or laryngospasm and relaxation of jaw was adequate with propofol. This is due to the fact that propofol suppresses airway reflexes more efficiently and relaxes jaw more adequately than thiopentone. Our study also shows similar results.

Stoneham M. D. et al[3] had studied effects of lignocaine 1.5 mg/kg given intravenously before propofol. They found LMA insertion conditions to be satisfactory. However, in their study almost all patients moved or grimaced in some way after LMA insertion. In our study also only 60% of the patients receiving lignocaine showed easy insertion. Rest of the patients showed some movement, inadequate jaw relaxation, hence more propofol was given along with deep inhalational anesthesia (p=0.0373).

In a similar study by Cook T. M.[14] et al who used lignocaine 0.5 mg/kg IV, 1.5 mg IV and topical lignocaine showed that patients receiving IV lignocaine showed more incidence of gagging, laryngospasm and coughing as compared to those receiving topical lignocaine. In our study, also 2 patients receiving IV lignocaine showed moderate coughing and 3 patients showed little gagging. Partial laryngospasm was found in 3 patients. However, all these problems were resolved after giving more propofol and deepening of anesthesia with inhalational agent (Isoflurane).

Pramod Bapat et al[7] had studied LMA insertion using fentanyl-propofol and thiopentone-lignocaine combination. They found that incidence of gagging, limb movement and laryngospasm was higher in the lignocaine-thiopentone group. Our study findings are also consistent with these findings.

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Our study results are consistent with all these above mentioned studies. In our study, although LMA insertion could be achieved with lignocaine, comparatively more number of patients than with either sufentanil or fentanyl group had shown movements and difficulty in inserting LMA. Fentanyl is a potent opioid. It has been shown to suppress pressor response during intubation as well as to suppress upper airway reflexes during LMA insertion.[15]

Cheam E. W. S[4] had studied fentanyl in a dose of 1 mcg/kg along with propofol 2 mg/kg. They found LMA insertion conditions to be satisfactory. Other studies also have shown fentanyl and propofol to be a better combination for facilitating LMA insertion. Hence, in our study, we chose fentanyl-propofol combination as one of the study groups and our study results are almost consistent with these findings.

Kodaka M et al[16] in their study found that fentanyl in a dose of 0.5mcg/kg is sufficient to decrease predicted EC_{50} LMA (effective concentration for 50% of the attempts to secure LMA insertion) However, with this dose of fentanyl, EC_{95} LMA (response to insertion in 95% of patients) cannot be correlated. In such situation, fentanyl in a dose of 1.5-2 mcg/kg decreases propofol requirement for LMA insertion. Out study results are also similar to these findings.

Yugo Tagito et al[2] had studied three groups. One group received cumulative dose of Fentanyl 200 mcg given in the form of two doses of 50 mcg and one dose of 100 mcg after 6 minutes, 2nd group received a bolus does of 200 μg, 3rd group received propofol alone. Before administration of fentanyl, laryngeal stimulation caused spasmodic panting, cough reflex, apnea and laryngospasm. Increasing the doses of fentanyl reduced the incidence of all these responses. From this study, it is concluded that fentanyl suppresses airway reflexes in a dose related manner. Hence in our study, we selected fentanyl in a dose of 2 mcg/kg.

In a study by Wong CM,[17] fentanyl 1 mcg/kg along with propofol 2.5 mg/kg provided optimal conditions in only 65% of cases. This proves that fentanyl 2 mcg/kg, which was used in our study, is more appropriate dose for providing satisfactory conditions for LMA insertion. In our study, 88% of the patients showed easy insertion of LMA in first attempt, which is consistent with the results of the study, done by Sarma V. J.[11] where LMA could be correctly cited in 88% in first attempt and in 98% in the 2nd attempt using fentanyl.

Sufentanil is also a potent opioid analgesic. It has been used to suppress pressor response during tracheal intubation in patients undergoing cardiovascular procedures.[18] Sufentanil has been used along with intubating LMA in difficult airway situations. But its use to facilitate insertion of classic LMA has not been extensively studied.

Jerome Flappier et al[12] had used sufentanil 0.2 mcg/kg along with atracurium 0.4-0.6 mg/kg and propofol 2.5-3 mg/kg in a morbidly obese patient. Tracheal intubation with the help of intubating LMA was carried out satisfactorily in that patient. In our study, we used sufentanil in a dose of 0.4mcg/kg. In a case report by Maltby J. R.[13] sufentanil 5 mcg was used along with 450 mg of thiopentone and succinylcholine 100 mg in a 75 kg patient with an inter incisor opening of 18 mm. A 6 mm cuffed tracheal tube was passed after insertion of LMA into the trachea with the help of fibreoptic bronchoscope. With sufentanil and propofol combination we have few references to quote.[19]

In our study, sufentanil has been found to provide more satisfactory conditions for LMA insertion as compared to fentanyl and lignocaine. 92% of patients in Group A (Sufentanil) showed easy insertion of LMA, as compared to 88% in group B (Fentanyl) and 60% in group C (Lignocaine).

In our study, the dose of sufentanil is on the higher side (0.4 mcg/kg) as compared to equipotent dose of fentanyl (2 mcg/kg) and sufentanil is 5-10 times more potent than fentanyl. Our study shows that using propofol as an induction agent, conditions for LMA insertion were more favorable with sufentanil as compared to fentanyl. Similarly fentanyl was found to provide better conditions for LMA insertion than intravenous lignocaine. So, in conclusion, sufentanil can be the choice of adjuvant to propofol induction to facilitate LMA insertion.

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