COMPARATIVE EVALUATION OF FENTANYL VERSUS BUTORPHANOL DURING INDUCTION WITH PROPOFOL ON LMA INSERTION CONDITIONS

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ABSTRACT

BACKGROUND

Airway management skills constitute the cornerstone of anaesthesiology practice. The introduction of LMA by Dr. Archie Brain has revolutionised airway management of modern general anaesthesia. Propofol when used alone as inducing agent is unsatisfactory to overcome problems associated with LMA insertions.

The aim of the present study was to compare the efficacy of fentanyl and butorphanol as adjuvants to propofol for better LMA insertion conditions.

MATERIALS AND METHODS

After obtaining Institutional approval and individual consent, forty patients were randomly selected and divided into two groups of twenty each in this randomised control study. In Group F (Fentanyl 1 microgram per kg) was given and in Group B (Butorphanol 20 microgram per kg) was given. All the patients were induced with propofol 2.5 milligram per kg. Primary outcome parameter was jaw relaxation assessed using Young's criteria and secondary outcome parameter was overall LMA insertion conditions according to modified scheme of Lund and Stovener.

RESULTS

The patient characteristics and demographic data were comparable in the two groups. A statistically significant absolute jaw relaxation was observed in Group B (Butorphanol 20 microgram per kg) 85% patients compared to Group F (Fentanyl 1 microgram per kg) 40% patients. Excellent LMA insertion conditions were observed in 90% patients in Group B and 55% of patients in Group F. Top up doses of propofol required and the apnoea time were significantly less in Group B.

CONCLUSION

Absolute jaw relaxation and excellent LMA insertion conditions with lesser side effects were provided by addition of butorphanol to propofol as compared to fentanyl.

KEYWORDS

Propofol, Fentanyl, Butorphanol, LMA, Insertion Conditions, Jaw Relaxation.

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BACKGROUND

The major responsibility of an Anaesthesiologist is to provide adequate ventilation to the patient. The wide variety of airway armamentarium available today may be broadly classified as infraglottic and supraglottic airway devices, which are employed to protect airway in both elective and emergency situations.¹

The LMA was conceived and designed by Dr. Archie Brain in UK in 1981 and following prolonged research it was released in 1988 for clinical use. Today, it has a clearly established role as an airway device in the elective setting where neither the procedure nor the patient requires endotracheal intubation. It is a good alternative to continued bag and mask ventilation and has proved extremely useful in managing the difficult airway.

Laryngeal Mask Airway (LMA) being a supraglottic device has the advantage of being less stimulating than tracheal

intubation as visualisation of the vocal cords and entry into the larynx is not required.² The LMA insertion technique does not require the use of a Laryngoscope or muscle relaxants. Successful insertion of LMA requires sufficient depth of anaesthesia to relax the jaw and to obtund the airway reflexes to avoid gagging, coughing and laryngospasm. Inadequate depth of anaesthesia may provoke these conditions leading to adverse haemodynamic changes and increased incidence of regurgitation and aspiration. Various induction agents like thiopental and propofol have been studied to achieve excellent LMA insertion conditions.

Propofol is now increasingly being considered as the agent of choice for LMA insertion, because of its depressant effect on laryngeal reflexes compared to other induction agents.^{3,4,5} However, propofol is expensive and if used alone relatively large doses are required which can cause cardiac depression.^{6,7} Hence, a number of adjuvants were studied for facilitating LMA insertion with Propofol like intravenous midazolam, intravenous lignocaine, clonidine, opioids, low-dose succinylcholine.^{8,9,10} Of these, opioids are most commonly studied. The opioids being narcotic drugs need licensing and require distribution records. Fentanyl is a synthetic opioid related to phenyl piperidines. It is a potent analgesic 80 times more potent than morphine. It possesses other properties of opioids namely sedation, respiratory depression, vagal stimulation, nausea and vomiting. Fentanyl

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can blunt or eliminate somatic and autonomic responses to tracheal intubation. Anaesthesia induction is usually achieved by combining loading dose of 2 - 6 microgram/kg of fentanyl along with sedative hypnotic, mostly propofol or thiopental. Studies have been done using different doses of fentanyl as adjuvant to propofol for evaluating LMA insertion conditions. The short-acting and potent opioids like remifentanyl and alfentanil are expensive and are not freely available.

Butorphanol being a non-narcotic and non-controlled drug has the advantage of reducing the number of distribution records associated with Schedule II narcotics. Butorphanol is comparatively cheaper drug and is available over the counter. Respiratory depression induced by butorphanol demonstrates a ceiling effect.^{11,12} In addition it was used effectively for conscious sedation. The effect of prior administration of butorphanol in reducing the pain on propofol injection has also been studied.¹³ Prior studies comparing combination of butorphanol to that of fentanyl as adjuncts to propofol and thiopentone for LMA insertion has been done.^{14,15,16,17} In this study, we have assessed the jaw relaxation and overall LMA insertion conditions produced by butorphanol-propofol and have compared with propofol-fentanyl combination.

MATERIALS AND METHODS

Approval from Ethics Committee was obtained prior to the start of study. In a population of patients being posted for surgery a pre-anaesthetic checkup was done. From this, the patients who required general anaesthesia with LMA for maintaining anaesthesia were selected based on inclusion and exclusion criteria and according to the weight and physical characteristics. Patients of both genders between the age 18 to 65 years coming under ASA PS I or II were included.

Patients at risk of aspiration, suffering from pathology of neck or upper respiratory tract with poor pulmonary compliance with recorded allergy to propofol, fentanyl or butorphanol and with mouth opening less than 4 cm were excluded from the study.

The patients selected were invited to take part in the study after explaining the benefits and risks. Informed consent was obtained from those individuals who were willing for the study. The age, weight and airway assessment were done.

The Airway was Assessed According to-

1. Mallampati classification.
2. The Thyromental distance.
3. The mouth opening - It is measured and assessed as less than or equal to 6 cm or greater than 6 cm.

The patients were kept nil per orally for 8 hours. The basal heart rate, systolic and diastolic blood pressure were noted. Randomisation was done using a computer generated random number table into Group F (Those who received fentanyl 1 microgram per kilogram as adjuvant to propofol) and Group B (Those who received butorphanol 20 microgram per kilogram as adjuvant to propofol). According to weight of the patient's appropriate size Classic LMA was kept ready. LMA cuff was checked and deflated. A water based jelly was applied over the cuffed portion as per manufacturer regulations. Monitors included Electrocardiogram, Non-invasive blood pressure and Pulse-oximeter.

All patients were premeditated with midazolam 0.02 mg per kg and glycopyrrolate 0.2 mg intravenously. They were preoxygenated with 100% oxygen for three minutes. Then they were given the assigned drugs over 10 seconds. The patients in Group F received fentanyl 1 microgram per kilogram intravenously and those in Group B received butorphanol 20 microgram per kilogram intravenously. Anaesthesia was induced with Inj. Propofol 2.5 mg per kg intravenously over a period of 15 seconds. Whenever needed, incremental doses of propofol 0.5 mg per kg were given every 30 seconds till loss of consciousness and loss of eye lash reflex was achieved. Sixty seconds later LMA insertion was performed by a blinded observer. Patients were given additional doses of 0.5 mg per kg on every unsuccessful attempt. The jaw relaxation and overall LMA insertion conditions were graded at the first attempt only.

LMA insertion was attempted for a maximum of 3 times. Patients were then kept on spontaneous respiration. Anaesthesia was maintained with 0.75% to 1% Halothane with nitrous oxide 60% and oxygen 40%. Heart rate and non-invasive blood pressure were recorded pre-induction, immediately after induction of anaesthesia and after insertion of LMA. ECG monitoring was done to record any arrhythmias. Continuous pulse oximeter monitoring was done during surgery. Non-invasive blood pressure was monitored every ten minutes. At the completion of surgery, halothane and nitrous oxide were stopped and LMA was removed and 100% oxygen with face mask was continued till recovery.

Following Parameters were Observed during Insertion of LMA -

Jaw Relaxation was Assessed according to Young's Criteria. This was assessed on a Three-Point Scale

1. Absolutely relaxed with no muscle tone.
2. Moderately relaxed with some muscle tone.
3. Poorly relaxed with full muscle tone.

Coughing and Gagging - This was Assessed on a Four-Point Scale

1. No coughing or gagging.
2. Mild coughing, gagging.
3. Moderate coughing, gagging.
4. Severe coughing, gagging.

Laryngospasm was Assessed on Two-Point Scale

1. No laryngospasm.
2. Laryngospasm.

Patient Movements were Assessed on a Three-Point Scale

1. No movement.
2. Mild movement.
3. Severe movement.

The overall LMA insertion condition was assessed according to modified scheme of Lund and Stovener.

Excellent - No coughing or gagging, no patient movement or laryngospasm.

Good - Mild gagging, coughing or mild patient movement with no laryngospasm.

Poor - Moderate gagging, coughing or mild patient movement with no laryngospasm.

Unacceptable - Severe gagging, coughing or severe patient movement or laryngospasm.

Top-up dose of propofol required or not.
 Total dose of propofol required.
 Duration of apnoea.

The data from the study was systematically collected, compiled and statistically analysed to draw relevant conclusions. Data was analysed using computer software, statistical package for social sciences version 10. Primary objective was calculated using Fisher Exact test. The level of significance is 0.05.

RESULTS

There were no significant differences between the two groups with respect to demographic data, anthropometric data and ASA PS status (Table 1).

Jaw Relaxation

In our study, comparison of jaw relaxation between Groups F and B was considered as primary objective. Grade I jaw relaxation was seen in 40% of patients in Group F and 85% of the patients in Group B. P value was 0.004, which was significant (Table 2).

Coughing/Gagging

In our study 10% of the patients in Group B had mild coughing or gagging, while 45% in Group F had mild coughing or gagging. No patients had severe coughing. P value is 0.015, which is significant (Table 3).

Patient Movements

The rate of mild patient movement in Group B was 15% and that of Group F was 50%. There were no severe patient movements during the study. P value is 0.02, which is statistically significant (Table 4).

Laryngospasm

Laryngospasm was observed in 15% of patients who received fentanyl as adjuvant. There was no laryngospasm in B Group. P value is 0.115 and not significant (Table 5).

LMA Insertion Conditions

In Group F 55% patients had excellent LMA insertion conditions, while 90% of the patients had excellent insertion conditions in Group B. P value 0.015, which was significant (Table 6).

Top-Up Dose of Propofol

30% of patients in Group F required top-up dose of propofol; 5% of patients in Group B needed top up. P value was 0.046%, which was significant (Table 7).

Total Dose of Propofol

Mean total dose of propofol required in Group B was 140.6 +/- 18.6 mg and in Group F was 149.7 +/- 29.8 mg. P value was 0.256, which was insignificant.

Duration of Apnoea

The mean duration of apnoea in Group F was 44.5 +/- 16.4 seconds and that in Group B was 31.5 +/- 6.9 seconds. P value is 0.002, which is significant (Table 8).

DISCUSSION

Induction agents like propofol, which reduced pharyngeal and laryngeal reflexes has drastically altered the scenario of airway management with LMA. Although comparatively safe, a higher dose of propofol is required for suppressing airway reflexes. This causes significant cardiac depression. To reduce this depressant effect, many adjuvant drugs have been tried till date of which we compared fentanyl and butorphanol. In our study, comparison of jaw relaxation between Group F and B was considered as primary objective. Grade I jaw relaxation was seen in 40% of patients in Group F and 85% of the patients in Group B. This finding in our study is supported by the study conducted by Gupta A and Kaur S in 2011¹⁸; (93.3% absolute jaw relaxation in propofol butorphanol group vs. 53.33% in propofol fentanyl group).

90% of patients in Group B and 55% of the patients in Group F had no cough or gagging. Decreased gagging in butorphanol group is probably due to the antitussive action and limited skeletal muscle action of butorphanol. This finding is supported by the study conducted by Gupta A and Kaur S et al in 2011. (43.33% coughing in fentanyl group vs 13.33% coughing in butorphanol group) and also in the study conducted by Wong C M et al,¹⁹ in which higher doses of fentanyl were associated with increased incidence of coughing. Increased incidence of gagging in Group F can be due to the administration of bolus dose of intravenous fentanyl. El Baissan M C et al in 2014 suggested the reason of cough during bolus administration of fentanyl may be due to several reasons including inhibition of central sympathetic system leading to vagal predominance, reflex bronchoconstriction after stimulating tracheobronchial tree or histamine release.²⁰

The rate of mild patient movement in Group B was 15% and that of Group F was 50%. There was no severe patient movement during the study. This is also consistent with the study conducted by Gupta A and Kaur S et al in 2011.

In Group F 55% patients had excellent LMA insertion conditions, while 90% of the patients had excellent insertion conditions in Group B. Chari P and Ghai B et al compared the LMA insertion conditions provided by butorphanol 30 microgram per kg and fentanyl 1.5 microgram per kg with thiopentone as induction agent and concluded that butorphanol thiopentone combination provided excellent LMA insertion conditions compared to fentanyl thiopentone group (98% vs. 86% success rate with 92% vs. 71% ease of insertion).

30% of patients in Group F required top-up dose of propofol and 5% of patients in Group B needed topup. This finding is consistent with the study conducted by Gupta A and Kaur S.

In our study the mean total dose of propofol required in the group, which received propofol with butorphanol was 140.6 +/- 18.6 mg and that in the group which received propofol with fentanyl was 149.7 +/- 29.8 mg. The p value was 0.256. The value is insignificant. Gupta A and Kaur S in 2011 compared the mean total dose of propofol required for LMA insertion in 90 patients who were given Propofol and Fentanyl, Propofol with Butorphanol and Propofol with Ketamine. The mean total dose of propofol required was 140.08 +/- 18.97 mg in the group which received butorphanol and it was 156.22 +/- 17.18 mg in the group which received Fentanyl. P value was significant in their study.

The mean duration of apnoea in Group F was 44.5 +/- 16.4 seconds and that in Group B was 31.5 +/- 6.9 seconds. This difference is due to differential action of butorphanol on mu, kappa and delta opioid receptors. This is consistent with the study conducted by Cheam E W S and Chui P T,²¹ which found that fentanyl prolongs duration of apnoea when used along with propofol for LMA insertion.

From this randomised, controlled trial comparing LMA insertion conditions provided by fentanyl versus butorphanol with propofol as induction agent, it can be concluded as follows -

1. Addition of butorphanol to propofol can provide better jaw relaxation and excellent LMA insertion conditions.
2. Lower top-up dose of propofol is needed in butorphanol group.
3. Lower duration of apnoea will be produced by butorphanol.

Hence, butorphanol can be considered superior to fentanyl as an adjuvant to propofol for insertion of LMA.

	Group B (n = 20)	Group F (n = 20)	P value
Age (Years) Mean +/- S.D.	34.5 +/- 7.5	32.6 +/- 6.8	0.409
Sex Male/Female	6/14	6/14	0.634
Weight (kg) Mean +/- S.D.	55.8 +/- 7.5	55.6 +/- 6.3	0.946
ASAPS I/II	16/4	17/3	0.500

Table 1. Demographic Data

Comparison of Jaw Relaxation Based on Group					
Jaw Relaxation	Group F		Group B		P value
	Count	%	Count	%	
Grade I	8	40	17	85	0.004
Grade II	12	60	3	15	
Table 2. Jaw Relaxation					

Table 2. Jaw Relaxation

Comparison of Coughing, Gagging Based on Group					
Coughing and Gagging	Group F		Group B		P value
	Count	%	Count	%	
Grade I	11	55	18	90	0.015
Grade II	9	45	2	10	
Table 3. Coughing and Gagging					

Table 3. Coughing and Gagging

Comparison of Patient Movements Based on Group					
Movements	Group F		Group B		P value
	Count	%	Count	%	
Grade I	10	50	17	85	0.02
Grade II	10	50	3	15	
Table 4. Patient Movement					

Table 4. Patient Movement

Comparison of Laryngospasm based on Group					
Laryngospasm	Group F		Group B		P value
	Count	%	Count	%	
Grade I	17	85	20	100	0.115
Grade II	3	15	0	0	
Table 5. Laryngospasm					

Table 5. Laryngospasm

Comparison of Overall LMA Insertion Conditions based on Group					
LMA Insertion Condition	Group F		Group B		P value
	Count	%	Count	%	
Excellent	11	55	18	90	0.015
Good	9	45	2	10	

Table 6. Overall LMA Insertion Conditions

Comparison of Top-Up Dose of Propofol based on Group					
Top-Up	Group F		Group B		P value
	Count	%	Count	%	
Yes	6	30	1	5	0.046
No	14	70	19	95	

Table 7. Top-Up Dose of Propofol

Comparison of Duration of Apnoea based on Group					
Type	Mean	SD	N	T	P value
Group F	44.5	16.4	20	3.28**	0.002
Group B	31.5	6.9	20		

Table 8. Duration of Apnoea

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CONCLUSION

From this randomised controlled trial comparing LMA insertion conditions provided by fentanyl versus butorphanol with propofol as induction agent, it can be concluded as follows:

1. Addition of butorphanol to propofol can provide better jaw relaxation and excellent LMA insertion conditions.
2. Lower top-up dose of propofol is needed in butorphanol group.
3. Lower duration of apnoea will be produced by butorphanol.

Hence, butorphanol can be considered superior to fentanyl as an adjuvant to propofol for insertion of LMA.

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