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Original Article

Anaesthesia Section

Assessment of Ease of Insertion of Laryngeal Mask Airway Comparing different Doses of Suxamethonium with Etomidate: A Comparative Randomised Double-blind Controlled Study

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ABSTRACT

Introduction: Laryngeal mask airway (LMA) is used more often in today's anaesthesia practice. Smooth and successful insertion needs proper mouth opening and minimal or no airway reflexes such as gagging, coughing, or laryngospasm. Induction agents like propofol and etomidate are known to blunt the laryngeal reflexes but often patient movement, coughing, and gagging create an unpleasant situation.

Aim: To assess the effects of suxamethonium 0.25 mg/kg, and 0.5 mg/kg, and placebo (normal saline) on the facilitation of laryngeal mask airway insertion along with etomidate as an induction agent in order to achieve haemodynamic stability and fewer complications.

Materials and Methods: This was a double-blind randomised controlled study, which included, a total of 90 adult patients, American Society of Anaesthesiologists (ASA) class I-II, scheduled for minor surgery under general anaesthesia and was conducted from December 2021 to February 2022, at Malla Reddy Medical College for Woman, Hyderabad, Telangana, India. The total participants were randomly allocated into three groups (Normal Saline (NS), S1 and S2). The group NS (placebo) received normal saline, and Group S1 and S2 received injections of suxamethonium 0.25 mg/kg, or 0.5 mg/kg, respectively. Induction of anaesthesia was performed with a bolus dose of etomidate 0.3 mg/kg. Study drugs were administered when the patient had lost consciousness. Laryngeal mask airway size 3 or 4 (as appropriate) was inserted. Relaxation of the jaw, coughing, gagging, laryngospasm, and any patient movements was observed during the insertion of LMA. The overall insertion conditions were graded according to modified scheme of Lund and Stovner. The statistical analysis was carried out by using Chi-square test, Fisher's-Exact test and Bonferroni's t-test.

Results: A total of 89 patients were analysed (group NS: n=29, group S1: n=30, group S2: n=30). Good jaw relaxation (absolutely relaxed with no muscle tone) was noted in 16 patients of group S2, 12 in group S1, and 2 in group NS ($p<0.001$). There was significant difference in coughing and gagging among the three groups ($p=0.041$). However, in the group NS, eight patients had mild movement and six had moderate movement during the insertion of LMA ($p=0.002$). Overall insertion conditions were better in suxamethonium groups ($p=0.0001$).

Conclusion: Etomidate as the sole induction agent for LMA insertion is not ideal. Concurrent use of a low dose of suxamethonium (0.5 mg/kg) might significantly obtund the airway reflexes in response to LMA insertion.

Keywords: Coughing, General anaesthesia, Laryngospasm, Low dose

INTRODUCTION

The Laryngeal Mask Airway (LMA) is a non invasive supralaryngeal device that has allowed a radical change in the management of modern general anaesthesia. Smooth insertion of LMA requires attenuation of airway reflexes to avoid sequelae such as gagging, coughing, or laryngospasm. The most popular induction agent for LMA insertion continues to be propofol, as it best obtunds oropharyngeal reflexes [1,2]. With a standard induction dose (2-3 mg/kg) of propofol, the incidence of poor insertion conditions of LMA is 38-60% [3,4]. Dr. AIJ Brain introduced low-dose neuromuscular blocking drugs and used a small dose of alcuronium (0.2 mg/Kg) before LMA insertion. Korula S et al., in year 2010, described that relaxation was not essential for LMA insertion but the upper airway reflexes must be reduced for insertion to be successful [5]. Later, other studies reported co-induction techniques using various induction agents with low doses of other agents, such as dexmedetomidine with propofol and fentanyl with propofol [6], ketamine with fentanyl and propofol with fentanyl [7,8] neuromuscular blocking agents like atracurium and suxamethonim [9,10] and thiopentone with lidocaine spray vs propofol [11]. In the present study, etomidate was chosen as an induction agent for insertion of LMA, as it is known to have greater cardiovascular stability than the other intravenous induction agents, even in patients with cardiovascular risk factors [12]. In the present study, a combination of etomidate 0.3 mg/kg with different low doses of suxamethonium was used, so as to obtain good LMA insertion conditions, whilst maintaining cardiovascular stability.

The primary objective was to find out, whether suxamethonium was useful along with etomidate to facilitate LMA insertion and compare the two different doses,0.25 mg/kg and 0.5 mg/kg of suxamethonium to obtain effective LMA insertion conditions. The secondary outcome was adverse events, if any.

MATERIALS AND METHODS

A double-blind randomised controlled study was conducted from December 2021 to February 2022 at Malla Reddy Medical College for Woman, Hyderabad, Telangana, India. After obtaining Ethical Committee approval (MRIMS/2021/IEC167) and written informed consent, a total of 90 American Society of Anaesthesiologists (ASA) class I and II [13] were studied.

Inclusion criteria: A total of 90 American Society of Anaesthesiologists (ASA) class I and II patients of either sex, aged 20-60 years scheduled for various elective minor surgeries under general anaesthesia were included in the study.

Exclusion criteria: Patients scheduled for emergency surgeries on anti-hypertensive medication or with a head injury, cardiac

conduction defects, or on anti-arrhythmic drugs, were excluded from the study.

Sample size calculation: It was done based on the study by George LR et al., [4]. A sample size of 25 in each group would be required to show a difference in the LMA insertion conditions (82.1% versus 84.9%). This was calculated assuming a 1% significance level, a value of 0.05 (2-sided), and 80% power. Considering a probable dropout rate of 10%, 30 patients were enrolled in each of the three groups. A computer block randomisation was used to divide the study population into three groups of 30 each. Group NS (placebo) received normal saline, group S1 received suxamethonium 0.25 mg/kg, and group S2 received suxamethonium 0.5 mg/kg.

Study Procedure

Upon arrival in the operating room electrocardiogram, pulse oximetry, and automated non invasive blood pressure monitors were connected and baseline values were noted. Peripheral intravenous access was secured using either an 18 or 20-gauge venous cannula. All patients were pre-oxygenated for 3 minutes with 100% oxygen. Fentanyl 2 µg/kg and Midazolam 1-2 mg were given intravenously. Induction of anaesthesia was performed with a bolus dose of etomidate 0.3 mg/kg. Study drugs were administered after confirmation that the patient had lost consciousness. The drugs were loaded in a 2 mL syringe- for group NS only normal saline, for group S1 suxamethonium 0.25 mg/kg, and for group S2 suxamethonium 0.5 mg/kg were diluted with normal saline to make it 2 mL. An appropriate size of LMA was inserted by an anaesthesiologist who was blinded to the drug administration. The same blinded anaesthesiologist administered the study drugs and LMA, and also assessed the insertion conditions. If jaw relaxation was found to be inadequate or the patient had a cough, a bolus dose of propofol 20 mg upto 0.5 mg/kg was given to deepen the plane of anaesthesia to facilitate the LMA insertion [14].

Heart rate (HR) and mean arterial blood pressure (MAP) were recorded at the end of pre-oxygenation, 30 seconds post-induction, and 60 seconds post-LMA insertion. Inhalational anaesthetic agents were not delivered to the patients until the variables are measured. Anaesthesia was then maintained with oxygen, nitrous oxide, sevoflurane, and fentanyl.

Jaw relaxation, coughing and gagging, and laryngospasm was graded according to the classification given by Young HAS et al., [15], and body movement (head or limbs) was graded on a four-point scale according to Nimmo SM et al., [16]. Overall insertion conditions were graded according to a system modified by Lund I and Stovner J [17] [Table/Fig-1].

STATISTICAL ANALYSIS

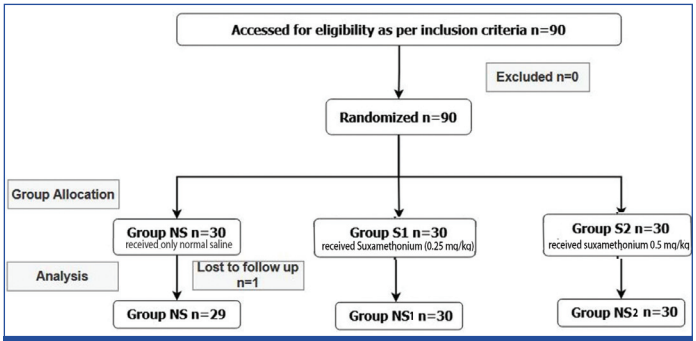
Data were analysed using Statistical Package for Social Sciences (SPSS) software (version 19.0 for Windows; SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test was used to analyze the normality of the distribution of continuous variables. Differences in continuous variables were analysed using a one-way analysis of variance. Categorical variables were analysed using the Chi-square test or Fisher's-Exact test, as deemed appropriate. Bonferroni's t-test and Chi-square test were used to compare the three groups. Insertion conditions were assessed by Fisher's-Exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 89 patients could be included in the final analysis as shown in the CONSORT flow diagram for the study [Table/Fig-2]. Demographically, all three groups are comparable with respect to age, sex, and weight with a p-value of 0.820, 0.971, and 0.935 respectively [Table/Fig-3]. The data were analysed using the one-way ANOVA (Analysis of Variance) test [Table/Fig-3].

Jaw relaxation- Young HAS et al [15]	Coughing and gagging- Young HAS et al., [15]	Laryngospasm- Young HAS et al., [15]	Patient movement- Nimmo SM et al., [16]	Overall insertion conditions- modified scheme of Lund I and Stovner J [17]
Good: relaxed with no muscle tone	None	None	None	Excellent: insertion easy, no gagging, coughing, movement, or laryngospasm
Incomplete: Moderately relaxed with some muscle tone	Mild: One or two coughs	Partial: use of accessory muscles of respiration	Mild: transient or minimal	Good: insertion resulting in mild to moderate coughing, gagging, movement with no Laryngospasm
Poor: Poorly relaxed with full muscle tone	Moderate: Three or more coughs	Complete: paradoxical chest and abdominal movements, ventilation not possible	Moderate: lasted more than a few seconds but resolved within 20 sec	Poor: insertion possible but resulting in moderate to severe coughing, gagging, patient movement with no laryngospasm
	Severe: bucking		Severe: sustained or needed propofol to allow LMA insertion	Unacceptable: severe coughing gagging, movement, or laryngospasm

[Table/Fig-1]: Assessment of laryngeal mask airway insertion conditions [15-17].



[Table/Fig-2]: CONSORT flow diagram.

Variables	Group NS (placebo)	Suxamethonium		p-value (One way ANOVA test)
		Group S1 (0.25 mg/kg)	Group S2 (0.5 mg/kg)	
Age (years) mean±SD	36.70±9.570	34.65±10.494	35.47±0.752	0.820
Weight (kg) mean±SD	54.40±8.268	55.05±7.466	54.65±8.428	0.971
Sex				
Male	9 (45%)	9 (45%)	9 (45%)	0.935
Female	11 (55%)	11 (55%)	11 (55%)	

[Table/Fig-3]: Demographic Variables of all subjects.

Haemodynamic parameters of heart rate, and mean arterial pressure were recorded at pre-oxygenation, 30 sec post-induction, and one-minute post-LMA insertion. All the three groups were noted with similar changes in these parameters, which were statistically insignificant. The change across time as analysed using the one-way ANOVA test and Pearson's Chi-square test is presented in [Table/Fig-4,5].

A significantly better jaw relaxation was noted in Group S2 than in Groups S1 and NS (p-value=0.0001). It was also noted that jaw relaxation was incomplete, ~60% in the NS (placebo) group and ~40% in Group S1. There was statistically significant difference (p-value 0.041) between the three groups for coughing and gagging; although clinically the incidence of mild cough was more in the placebo group. No coughing was seen in group S2 in response to LMA insertion. The patient movement was significantly more in the placebo group NS (p-value=0.002) compared in Groups S1 and S2.

Heart rate analysis	Group NS Mean±(SD)	Group S1 Mean±(SD)	Group S2 Mean±(SD)	p-value (One way ANOVA test)
Pre-oxygenation (mmHg)	80.90±(13.841)	79.55±(9.191)	78.20±(10.061)	0.749
30 sec post induction (mmHg)	83.50±(14.099)	80.50±(11.128)	80.00±(13.727)	0.682
60 sec post LMA insertion (mmHg)	82.41±(9.076)	78.70±(10.692)	77.90±(10.498)	0.372

[Table/Fig-4]: Heart rate at various intervals.

Mean arterial pressures (mm of Hg)	Group NS Mean±(SD)	Group S1 Mean±(SD)	Group S2 Mean±(SD)	p-value (One way ANOVA test)
Pre-oxygenation	83.55±(13.709)	87.85±(14.561)	92.20±(11.579)	0.132
30 sec post induction	82.85±(11.579)	87.10±(15.967)	92.05±(13.121)	0.076
60 sec post LMA insertion	83.53±(16.071)	86.35±(14.529)	89.45±(11.009)	0.438

[Table/Fig-5]: Mean arterial pressures of all study participants.

Partial laryngospasm occurred in only 5 patients (17.2%) in the placebo group with p-value=0.004. No other patients in both Groups S1 and S2 had laryngospasm. Overall insertion conditions were significantly better in suxamethonium groups. Overall insertion conditions showed better results in Group S2 than in Group S1. Approximately, half the patients in the NS (placebo) group had excellent (10%) or good (40%) insertion conditions with a moderate patient response [Table/Fig-6].

Variables	Group NS (placebo)	Suxamethonium Group S1 (0.25 mg/kg)	Suxamethonium Group S2 (0.5 mg/kg)	p-value (Pearson's Chi-square test)
Jaw relaxation, n (%)				
Good	3 (10%)	18 (60%)	24 (80%)	**0.0001**
Incomplete	17 (60%)	12 (40%)	6 (20%)	
Poor	9 (30%)	0	0	
Gagging, cough, n (%)				
None	17 (60%)	25 (83.3%)	29 (96.6%)	**0.041**
Mild	7 (25%)	2 (6.6%)	1 (3.3%)	
Moderate	5 (15%)	3 (10%)	0	
Severe	0	0	0	
Patient movement, n (%)				
None	9 (30%)	24 (80%)	26 (86.6%)	**0.002**
Mild	12 (41%)	3 (10%)	4 (13.4%)	
Moderate	8 (29%)	3 (10%)	0	
Severe	0	0	0	
Laryngospasm, n (%)				
None	24 (82.7%)	30 (100%)	30 (100%)	**0.004**
Partial	5 (17.3%)	0	0	
Severe	0	0	0	
Overall insertion condition, n (%)				
Excellent	3 (10%)	17 (56.6%)	26 (86.6%)	**0.0001**
Good	12 (41%)	10 (33.3%)	4 (13.4%)	
Poor	10 (34.5%)	3 (10%)	0	
Unacceptable	4 (14.5%)	0	0	

[Table/Fig-6]: Analysis of results among the treatment groups for LMA insertion.

DISCUSSION

The laryngeal mask airway enables anaesthesiologists to keep both their hands free and obviates the need for tracheal intubation in some surgeries. However, the adverse response to the insertion of a laryngeal mask airway (such as gagging, coughing, and laryngospasm) may make correct positioning difficult or even impossible. Moreover, the popularity of a drug for LMA insertion does not preclude the uncertainty in the exact choice of the induction drug(s), the nature, doses, mode of administration, the optimal and guaranteed insertion procedure, the efficacy of the induction technique(s) used, and the recovery/respiratory onset after surgery.

Numerous pharmacological agents and combinations have been introduced to decrease the haemodynamic instability throughout anaesthesia. Etomidate is one of the Intravenous (i.v.)anaesthetics which are used alone or in combination with other anaesthetics for induction; it also has been used for anaesthesia maintenance in different contexts. However, it is mostly used in cardiac patients in whom the risk of cardiovascular instability following the administration of other i.v. anaesthetics such as propofol or thiopental cannot be underestimated. Etomidate is of rapid onset and emergence from anaesthesia and it is not associated with histamine release. In addition, it has sedative and hypnotic characteristics with no analgesic effects. The haemodynamic stability seen with etomidate may be partly caused by its unique lack of effect on both the sympathetic nervous system and baroreceptor function. Thus, it can be deliberated that the conditions and doses of the combination drugs chosen provide a viable and effective alternative for laryngeal mask airway insertion.

In 2004, a study was conducted by Liou CM et al., [18] using etomidate alone, and etomidate with fentanyl or suxamethonium, to assess improvement in the success rate of LMA insertion. They concluded that etomidate alone was far from perfect and succinylcholine with etomidate might provide better results in terms of shortened time for the LMA insertion, jaw relaxation, and the success rate of LMA insertion than that of fentanyl. In the present study, 60% of patients in the placebo group (etomidate alone) had incomplete jaw relaxation, and although statistically insignificant many had mild cough (15%). In the placebo group, patient movement (p-value=0.002), laryngospasm (p-value=0.004), and overall insertion condition (p-value=0.0001) were statistically significant.

George LR et al., compared different doses of suxamethonium and concluded that 0.25 mg/kg of suxamethonium facilitates the insertion of the LMA [4]. But the present study found that 0.25 mg/kg of suxamethonium (group S1) had an incomplete jaw relaxation in 40% of the patients, 20% had mild to moderate movement during LMA insertion, and overall insertion condition was poor in 10% of the patients. In the same year, Liao AH et al., [14] analysed data from 10 Randomised Clinical Trials (RCTs) comprising 625 participants. They concluded that low-dose suxamethonium (0.3 to 1 mg/kg) reduced the LMA insertion failure rate and its related coughing and gagging when compared with the mini dose (0.3 mg/kg). The low doses of suxamethonium only offered significant protection against coughing and gagging and did not provide significant improvement in mouth opening. Postoperative myalgia did not increase with the overall use, mini dose, or low dose of suxamethonium. No studies reported any severe complications such as malignant hyperthermia. The present study study used etomidate as an induction agent to observe, whether, this can be used as an induction agent of choice in emergency procedures in the elderly and patients with cardiovascular instability.

To summarise, a significant difference was observed in the incidence of patient response (coughing, gagging, patient movement) during

LMA insertion in the NS (placebo) group versus the other two treatment groups. Jaw relaxation was found to be better in patients who received 0.5 mg/kg suxamethonium compared to the other two groups. The incidence of laryngospasm was highest in the NS (placebo) group when compared to the other groups. In the two groups, who received suxamethonium, the LMA insertion conditions were found to be better when compared to the saline group, but the overall optimal insertion conditions with fewer adverse events were observed in patients who received suxamethonium at a dose of 0.5 mg/kg.

Limitation(s)

The patients were not followed up for the known side effects of suxamethonium like myalgia, sore throat, hyperkalemia, and any other complications postoperatively. The type of LMA used in the study was not defined, so unable to compare the insertion conditions with different generations of LMAs.

CONCLUSION(S)

Etomidate as the sole induction agent for LMA insertion is far from perfect. A low dose of suxamethonium when combined with etomidate, provides better conditions for LMA insertion than etomidate alone. Suxamethonium at a dose of 0.5 mg/kg produces better insertion conditions for the laryngeal mask airway than suxamethonium at 0.25 mg/kg given intravenously. Further prospective studies with larger sample size and different induction agents are required, to fully evaluate the dose-dependent effects of suxamethonium, for the safe insertion of LMA.

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