Laryngeal mask insertion using thiopental and low dose atracurium: a comparison with propofol

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Purpose: To compare the laryngeal mask airway (LMA) insertion conditions produced by propofol and a thiopental - low dose atracurium combination.

Methods: In a randomized controlled double blind study, 120 premedicated patients were allocated into four groups. After pre-oxygenation, anesthesia was induced as follows: 1 $\mu g \cdot kg^{-1}$ fentanyl, 2.5 $mg \cdot kg^{-1}$ propofol (group I); 1 $\mu g \cdot kg^{-1}$ fentanyl, 5 $mg \cdot kg^{-1}$ thiopental (group II); 1 $\mu g \cdot kg^{-1}$ fentanyl, 5 $mg \cdot kg^{-1}$ thiopental, 0.05 $mg \cdot kg^{-1}$ or 0.1 $mg \cdot kg^{-1}$ atracurium (groups III and IV respectively). The LMA was inserted by a blinded anesthesiologist who also assessed the following insertion conditions on a three point scale; jaw relaxation, biting, gagging, coughing, presence of laryngospasm, adequacy of airway patency, number of attempts at insertion and overall insertion conditions.

Results: There was no difference in insertion conditions between groups I, III and IV. Group II produced the worst overall conditions ($P < 0.05$). There were no differences in hemodynamic changes and apnea times between all four groups.

Conclusion: The combination of fentanyl-thiopental with low dose atracurium (0.05 or 0.1 $mg \cdot kg^{-1}$) provided conditions comparable with those of propofol for LMA insertion.

Objectif : Comparer les conditions d'insertion du masque laryngé (ML) produites par le propofol et une combinaison de thiopental et d'une faible dose d'atracurium.

Méthode : Lors d'une étude contrôlée en double aveugle, 120 patients qui avaient reçu une prémédication ont été répartis en quatre groupes. Après la préoxygénation, l'anesthésie a été induite comme suit : 1 $\mu g \cdot kg^{-1}$ de fentanyl, 2,5 $mg \cdot kg^{-1}$ de propofol (groupe I); 1 $\mu g \cdot kg^{-1}$ de fentanyl, 5 $mg \cdot kg^{-1}$ de thiopental (groupe II); 1 $\mu g \cdot kg^{-1}$ de fentanyl, 5 $mg \cdot kg^{-1}$ de thiopental, 0,05 $mg \cdot kg^{-1}$ ou 0,1 $mg \cdot kg^{-1}$ d'atracurium (groupes III et IV respectivement). Le ML a été inséré par un anesthésiologiste impartial qui a aussi évalué les conditions d'insertion suivantes sur une échelle de trois points : le relâchement de la mâchoire, la morsure, les haut-le-coeur, la toux, la présence de laryngospasme, la qualité de la perméabilité des voies aériennes, le nombre d'essais à l'insertion et les conditions générales de l'insertion.

Résultats : Les conditions d'insertion ont été semblables dans les groupes I, III et IV. C'est dans le groupe II que les conditions ont été les pires ($P < 0,05$). Il n'y avait pas de différence intergroupe pour les changements hémodynamiques et les temps d'apnée.

Conclusion : La combinaison de fentanyl et de thiopental accompagnée d'une faible dose d'atracurium (0,05 ou 0,1 $mg \cdot kg^{-1}$) a permis des conditions d'insertion du ML comparables à celles qui ont été produites avec le propofol.

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THE use of the laryngeal mask airway (LMA) in anesthetic practice has been firmly established. Previous studies have found propofol the induction agent of choice for its insertion. It caused less gagging, coughing and laryngospasm than thiopental.[1,2] However, propofol is expensive and painful on injection. It is associated with a greater degree of ventilatory depression[3] and longer apnea than is thiopental.[4] Propofol also causes greater cardiovascular depression than thiopental during induction of anesthesia.[5] A less expensive and more cardiorespiratory stable alternative to propofol induction would be advantageous. Various combinations of drugs with thiopental have been investigated. These include lidocaine (topical and intravenous)[6] and co-induction with midazolam.[7] However, topical lidocaine can be unpleasant to taste and may produce upper airway obstruction.[8] Recovery from anesthesia can be delayed with midazolam co-induction.[9]

The aim of our study was to determine whether the use of thiopental in combination with low dose atracurium provided LMA insertion conditions comparable with those after propofol.

Methods

Institutional ethics committee approval was obtained for the prospective double blind study. After obtaining informed consent, 120 ASA I and II patients undergoing elective surgery whereby the use of LMA was appropriate, were enrolled into the study. Patients who had a potentially difficult airway, history of asthma or were at risk of regurgitation were excluded.

All patients received 7.5 mg midazolam *po* one hour prior to induction. The patients were randomly allocated into four groups. After preoxygenation, all patients received 1 $\mu g \cdot kg^{-1}$ fentanyl *iv*. Two minutes later, for the control group (group I), anesthesia was induced with 2.5 $mg \cdot kg^{-1}$ propofol *iv* (with 0.5 $mg \cdot kg^{-1}$ lidocaine given over 30 sec). In the study groups, a 2 ml test solution was given one minute after fentanyl. This consisted of saline, 0.05 $mg \cdot kg^{-1}$ atracurium or 0.1 $mg \cdot kg^{-1}$ atracurium for groups II, III and IV respectively. Anesthesia was induced with 5 $mg \cdot kg^{-1}$ thiopental (given over 30 sec) one minute later. The LMA was then inserted one minute after loss of eyelash reflex by one of the authors, blinded to the induction method and using the technique described by Brain.[10] (Each of the authors had at least one year's experience with insertion of LMAs) The overall ease of LMA insertion was assessed by the inserting anesthesiologist as easy, difficult or impossible. Specific conditions during the insertion were also assessed on a three point scale. These include degree of jaw relaxation, biting, gagging, coughing, presence of laryngospasm, (absent, mild or severe) number of attempts required for insertion and overall airway patency. The last was judged clinically by chest expansion and normal chest compliance on manual ventilation and graded as patent, partially obstructed or completely obstructed. Automated hemodynamic variables and pulse oximeter readings were recorded before and every minute for five minutes after induction (Narkomed 4; North American Drager) The apnea time, i.e. the time from insertion of LMA until return of first spontaneous breath, was also noted. Surgery was only allowed to commence after return of spontaneous respiration. If the LMA could not be inserted after two attempts or if the insertion conditions were deemed impossible, succinylcholine was given as rescue therapy and a failed insertion was recorded.

After LMA insertion, anesthesia was maintained with nitrous oxide 66% in oxygen and isoflurane 1-2%. The lungs were ventilated as necessary.

The data were analysed using Kruskal-Willis (demographic data), chi squared with Bonferroni correction (insertion conditions) and repeated measure ANOVA (hemodynamic data). The statistical package SPSS for Windows Release 8.0 was used for the calculations. All results were presented as mean ± standard deviation (SD). A value of $P < 0.05$ was taken as significant.

Results

There were no demographic differences among the four groups with respect to age, sex, height or weight (Table I). Hemodynamic variables (heart rate and blood pressure) were comparable for all four groups throughout the study.

TABLE I Demographic Data

	Propofol Group I (30)	*Saline Group II (30)*	*Atracurium 0.05 mg·kg–1 Group III (30)*	*Atracurium 0.1 mg·kg^{-1} Group IV (30)*
Age	38.6 ± 9.5	31.6 ± 10.4	32.9 ± 13.9	34.5 ± 11.6
Sex M : F	20 : 10	18 : 12	19 : 11	19 : 11
Height (cm)	165 ± 6.8	165 ± 7.4	166 ± 7.0	163 ± 7.0
Weight (kg)	65.0 ± 11.5	63.4 ± 11.5	66.2 ± 14.8	63.0 ± 10.9

TABLE II Patient response to Laryngeal Mask Insertion

		Propofol Group I (30)	*Saline Group II (30)*	*Atracurium 0.05 mg·kg^{-1} Group III (30)*	*Atracurium 0.1 0.1 mg·kg^{-1} Group IV (30)*	*P < 0.05*
Jaw relaxation	*Good*	80% (24)	50% (15)	63.3% (19)	93.3% (28)*	II *vs* IV
	Acceptable	20% (6)	40% (12)	33.3% (10)	6.7% (2)	
	Impossible	0	10% (3)	3.3% (1)	0	
Biting	*None*	93.3% (28)	66.7% (20)*	83.3% (25)	100% (30)	II *vs* IV
	Mild	6.7% (2)	23.3% (7)	13.3% (4)	0	
	Severe	0	10% (3)	3.3% (1)	0	
Cough	*None*	100% (30)*	80% (24)	90% (27)	86.7% (26)	N.S.
	Mild	0	13.3% (4)	10% (3)	13.3% (4)	
	Severe	0	6.7% (2)	0	0	
Gagging	*None*	83.3 % (25)	70% (21)	80% (24)	86.7% (26)	NS
	Mild	13.3% (4)	23.3% (7)	20% (6)	13.3 % (4)	
	Severe	3.3% (1)	6.7% (2)	0	0	
Laryngospasm	*Absent*	86.7% (26)	76.7% (23)	83.3% (25)	100% (30)*	NS.
	Present	13.3% (4)	23.3% (7)	16.7% (5)	0	
Attempts	*Once*	90% (27)	73.3% (22)	80% (24)	93.3% (28)	NS.
	Twice	10% (3)	20% (6)	10% (3)	6.7% (2)	
	Impossible	0	6.7% (2)	10% (3)	0	
Desaturation	*Present*	0	0	0	0	NS.
Airway patency	*Good*	96.7% (29)	60% (18)*	90% (27)	96.7% (29)	II *vs* I, IV
	Partial	3.3% (1)	20% (6)	3.3% (1)	3.3% (1)	
	Poor	0	20% (6)	6.7% (2)	0	
Ease of Insertion	*Easy*	100% (30)	36.7% (11)*	76.7% (23)	93.3% (28)	II *vs* I, IV
	Difficult	0	43.4% (13)	13.3% (4)	6.7% (2)	
	Impossible	0	20% (6)	10% (3)	0	

Values: % (number)

There was no difference in overall insertion condition between group I (propofol; control group), III (0.05 mg·kg^{-1} atracurium) and IV (0.1 mg·kg^{-1} atracurium) in terms of difficulty in mouth opening, incidence of gagging, biting, coughing, laryngospasm, number of insertion attempts, ease of insertion, airway patency and desaturation to < 90% (Table II). In group III, there was a 10% failure rate for LMA insertion but none in groups I and IV. However, these did not reach statistical significance ($P < 0.17$).

As expected, group II produced the most unsatisfactory conditions in comparison with groups I, III and IV. The LMA could not be inserted in nine patients in the study (six in group II and three in group III). All were given succinylcholine as rescue therapy. No patients became desaturated during the study (SpO_2 < 90%).

The time to return of spontaneous respiration was comparable for all groups: 3.6 ± 2.2 min [range 1-10 min], 2.4 ± 2.4 min [1-13], 2.3 ± 2.5 min [0-9] and 3.1 ± 2.5 min [0-10] for groups I, II, II and IV respectively.

Discussion

The insertion of an LMA requires suppression of upper airway reflexes to prevent coughing, gagging or laryngospasm. McKeating found that propofol (2.5 mg·kg^{-1}) was superior to thiopental (4 or 5 mg·kg^{-1}) in decreasing the jaw tone and in depressing pharyngeal and laryngeal activity. Laryngoscopy could be performed with propofol as the sole agent in all 38 patients. This was possible in only 66% of patients given thiopental.[11] Previous studies have found that thiopental as a sole induction agent was unsatisfactory for LMA insertion.[1]

Alternative induction techniques, including co-induction, have been reported for LMA insertion. These produced variable results. Lidocaine has been shown to suppress cough[12] and obtund hemodynamic responses to tracheal intubation.[13] Seaval found that by spraying 40 mg topical lidocaine into the posterior pharyngeal wall three minutes before the induction of anesthesia with thiopental, the conditions for insertion of LMA were equal to those following an equipotent dose of propofol. There was also greater hemodynamic sta-

bility and shorter apneic time.[4] Bapat found that the insertion conditions provided by fentanyl-midazolam-thiopental were comparable to those of propofol providing excellent conditions in 96% of patients (*vs* 92% in propofol group.[14]

Driver *et al.* compared co-induction with midazolam-alfentanil-thiopental and midazolam-alfentanil-propofol for LMA insertion. They found jaw relaxation and ease of insertion were similar between the two groups but the group receiving propofol had fewer undesired responses requiring additional boluses. They concluded that propofol was superior to thiopental for LMA insertion during co-induction.[7] The apparent difference in results between Bapat and Driver's studies could have arisen from the different doses of induction agent used; 2.5 $mg \cdot kg^{-1}$ propofol, 5 $mg \cdot kg^{-1}$ thiopental and 1.25 $mg \cdot kg^{-1}$ propofol, 2.5 $mg \cdot kg^{-1}$ thiopental respectively. Driver also used alfentanil for LMA insertion, which was more effective in suppressing airway reflexes than the fentanyl used by Bapat.[15]

Cook found that 0.5 $mg \cdot kg^{-1}$ lidocaine *iv* did not improve LMA insertion conditions after thiopental induction.[6] However, Stoneham found that at a higher dose (1.5 $mg \cdot kg^{-1}$), lidocaine did improve insertion conditions after propofol.[16] We gave 0.5 $mg \cdot kg^{-1}$ lidocaine *iv* with propofol to reduce pain on injection. This small dose might have modified and improved insertion conditions after propofol induction.

The use of low dose neuromuscular blocking drugs is not new. It has been used in the priming technique, modification of electroconvulsive therapy and in the treatment of laryngospasm. Brain first described using a small dose of alcuronium (0.2 $mg \cdot kg^{-1}$) with thiopental induction before LMA insertion. He recognized that relaxation was not essential to LMA insertion.[17] However, the upper airway reflexes must be reduced or even abolished for insertion to be successful and Brain recommended the use of propofol.[18] Chui and Cheam recently reported that low dose mivacurium facilitated insertion of LMA after propofol induction. There was a lower incidence of swallowing, coughing, movement, laryngospasm and post operative sore throat. Although the 88% of patients were graded as having easy LMA insertion following mivacurium compared with 50% for those who had propofol alone, the incidence of correct placement was comparable. They did not determine if mivacurium was effective for LMA insertion if thiopental had been used as the induction agent instead of propofol.[19]

D'Honneur found that priming doses of atracurium (0.05 and 0.075 $mg \cdot kg^{-1}$) depressed swallowing.[20] We suggest that the combination of low dose atracurium depressed the pharyngeal and laryngeal reflexes sufficiently to allow successful LMA insertion. The priming dose is usually 15-20% of the intubating dose.[21] Naguib found that the optimal priming dose for atracurium was 0.05 $mg \cdot kg^{-1}$ (range of 0.04 to 0.09 $mg \cdot kg^{-1}$)[22] and the optimal priming interval was three minutes (range two to five minutes).[23] In our study, we used 10% (0.05 $mg \cdot kg^{-1}$) and 20% (0.1 $mg \cdot kg^{-1}$) of the usual intubating dose of atracurium (0.5 $mg \cdot kg^{-1}$). The LMA was inserted about three minutes after atracurium was given, taking into account the time taken for administering the induction agent (30 sec) and loss of eyelash reflex (20-30sec). We used a higher priming dose than Naguib because we wanted to determine if a higher dose of atracurium could produce better insertion conditions.

Yaddanapudi, in a small study reported a low rate of failure during LMA insertion using thiopental induction followed by 1.5 $mg \cdot kg^{-1}$ succinylcholine.[24] Brimacombe, in a follow-up study, compared LMA insertion with fentanyl-propofol induction and fentanyl-thiopental-succinylcholine induction. He found no difference in the ease of insertion. He concluded that there was no advantage in using a neuromuscular blocking agent provided an adequate dose of induction agent was used.[25] While full paralysis may have no advantage over propofol induction, the use of a low dose neuromuscular blocker allowed for rapid return of spontaneous (within 3.1 min in our study).

Unlike previous studies, we were unable to find any difference in the hemodynamics during induction between propofol and thiopental. This may be due to the young age of our patients and the slower speed of injection of propofol.

A priming dose of neuromuscular blocking drug can be associated with many unpleasant symptoms like diplopia, weakness, hypoventilation[26] and aspiration of gastric contents.[27] In the elderly patients (65-73 yr), priming with vecuronium was found to produce greater decreases in oxygen saturation and pulmonary function than in younger adults (25-35 yr).[28] These possible complications should be considered when low dose atracurium is used during LMA insertion.

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