



REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br



SPECIAL ARTICLE

Comparison of three different insertion techniques with LMA-Unique™ in adults: results of a randomized trial



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Received 17 December 2015; accepted 13 July 2016

Available online 9 August 2016

KEYWORDS

Insertion technique;
Laryngeal mask;
Supraglottic airway
device

Abstract

Background: The triple airway maneuver insertion technique allowed faster insertion of the LMA. This study compared three different insertion techniques of the laryngeal mask airway-Unique™.

Methods: One hundred and eighty ASA I–II patients aged 18–65 years were included into the study. Patients were randomly allocated to the standard, rotational and triple airway maneuver (triple) group. In the standard group ($n = 60$), the LMA (Laryngeal Mask Airway) was inserted with digital intraoral manipulation. In the triple group ($n = 60$), the LMA was inserted with triple airway maneuver (mouth opening, head extension and jaw thrust). In the rotational group ($n = 60$), LMA was inserted back-to-front, like a Guedel airway. Successful insertion at first attempt, time for successful insertion, fiber optic assessment, airway morbidity and hemodynamic responses were assessed.

Results: Successful insertion at the first attempt was 88.3% for the standard, 78.3% for the rotational and 88.3% for the triple group. Overall success rate (defined as successful insertion at first and second attempt) was 93% for the standard, 90% for the rotational and 95% for the triple group. Time for successful insertion was significantly shorter in the triple group (mean [range] 8.63 [5–19]s) compared with the standard (11.78 [6–24]s) and rotational group (11.57 [5–31]s). Fiber optic assessment, airway morbidity and hemodynamic responses were similar in all groups.

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PALAVRAS-CHAVE

Técnica de inserção;
Máscara laríngea;
Dispositivo
supraglótico

Conclusions: Rotational and triple airway maneuver insertion techniques are acceptable alternatives. Triple airway maneuver technique shows higher overall success rates and allows shorter insertion time for LMA insertion and should therefore be kept in mind for emergent situations.

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Comparação de três técnicas diferentes de inserção com a máscara laríngea LMA-Unique™ em adultos: resultados de um estudo randômico

Resumo

Justificativa: A técnica de inserção usando a manobra tripla das vias aéreas permitiu a inserção mais rápida da ML. Este estudo comparou três técnicas diferentes de inserção da máscara laríngea Unique™.

Métodos: Foram incluídos no estudo 180 pacientes ASA I-II, entre 18-65 anos. Os pacientes foram aleatoriamente designados para grupos de manobra das vias aéreas padrão, rotacional e tripla. No grupo padrão (n=60), a máscara laríngea (ML) foi inserida com a técnica digital intraoral. No grupo tripla (n=60), a ML foi inserida com a técnica de manobra tripla das vias aéreas (abertura bucal, extensão da cabeça e elevação da mandíbula). No grupo rotacional (n=60), a ML foi inserida com a técnica de inserção de trás para frente, como uma cânula de Guedel. Inserção bem-sucedida na primeira tentativa, tempo de inserção bem-sucedida, avaliação por fibra óptica, morbidade das vias aéreas e respostas hemodinâmicas foram avaliados.

Resultados: O sucesso da inserção na primeira tentativa foi de 88,3% para o grupo padrão, 78,3% para o grupo rotacional e 88,3% para o grupo tripla. A taxa de sucesso global (definida como inserção bem-sucedida na primeira e segunda tentativas) foi de 93% para o grupo padrão, 90% para o grupo rotacional e 95% para o grupo tripla. O tempo de inserção bem-sucedida foi significativamente menor no grupo tripla (média [intervalo] 8,63 [5-19]s), em comparação com o grupo padrão (11,78 [6-24]s) e o grupo rotacional (11,57 [5-31]s). A avaliação por fibra óptica, a morbidade das vias aéreas e as respostas hemodinâmicas foram semelhantes em todos os grupos.

Conclusões: As técnicas de inserção rotacional e de manobra tripla das vias aéreas são alternativas aceitáveis. A técnica de manobra tripla das vias aéreas apresenta taxas mais altas de sucesso global e permite um tempo menor de inserção da ML e, portanto, deve ser considerada em situações de emergência.

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Introduction

The Laryngeal Mask Airway (LMA) is a useful airway device for airway management during general anesthesia and for emergency situations. As an alternative airway device the LMA is recommended for use during CPR because it is quicker and easier to insert than a tracheal tube.¹ The standard method of insertion described by Dr. Brain² is relatively easy, but sometimes it is impossible to insert the LMA with the standard method. However ease and time of airway management may be of special importance in emergent situations. Since its inception the LMA has undergone various modifications in type and material, which have made other methods of insertion possible, quicker and easier than the standard method. Intraoral manipulation can put the operator at risk of finger trauma and infection. However it is not possible to avoid intraoral manipulation when the standard technique or the classic LMA is used. Brimacombe and Keller³ showed that insertion of a disposable LMA does not require insertion of the finger into

the patient's mouth. The use of disposable more rigid LMAs is increasing and may be other insertion techniques will be described for these LMAs in the future. We prefer either the triple airway maneuver or rotational technique when we use a disposable LMA in our clinic.⁴ These are the two most favorable techniques among other anesthesiologists too and they do not require intraoral manipulation.^{3,5} There is however no comparison of these two techniques with the standard technique using a disposable LMA in the literature.

In this study we compared three different insertion techniques with the aim to find the easier and faster method for insertion of the disposable LMA.

Methods

After institutional ethics board approval (Dokuz Eylul University Faculty of Medicine, İzmir, Türkiye) and written informed consent, 180 consecutive ASA 1–2 adult patients, aged 18–65 years undergoing routine surgical procedures in which the use of the LMA was applicable, were enrolled

into this study. Patients were excluded if they had a known difficult airway, mouth opening <2.5 cm, body mass index >35 kg m⁻², or were at risk of aspiration. Age, gender, weight, height, Mallampati grades were recorded at pre-anesthetic evaluation.

Routine electrocardiogram, non-invasive blood pressure and pulse oximetry monitoring as well as Bispectral index monitoring (BIS-Vista™ Aspect Medical Systems, Newton, MA, USA) was applied. Midazolam 0.02 mg kg was administered at the beginning of pre-oxygenation. Anesthesia was induced with fentanyl 1–2 µg kg⁻¹ and propofol 2–2.5 mg kg⁻¹. Adequate depth for LMA insertion was judged according to Bispectral index (BIS). Once BIS ≤ 40 was achieved the LMA-Unique™ (LMA-U, Intavent Orthofix, Maidenhead, Berkshire, UK) was inserted. Patients were randomly allocated into one of three groups using computer generated random numbers: standard, rotational and triple airway maneuver (triple) group. In all insertion techniques the cuff of the LMA was deflated and LMA was moistened with saline.

Additional propofol doses of 0.5–1.0 mg kg⁻¹ were administered to maintain BIS value about 40 during insertion attempts. LMA size selection was according to the manufacturer's recommendations based on body weight.

In the standard group (*n* = 60), the LMA was inserted using the standard method described by Brain.² In the triple group (*n* = 60), the technique involved the following steps described by Kuvaki et al.⁴: (a) holding the LMA-U in the middle third of the tube between the index finger and thumb of the dominant hand; (b) performing a 'triple airway maneuver', the combination of head extension, mouth opening and jaw thrust; (c) pressing the LMA directly (front-to-back) against the hard palate and pushing it along the posterior palatopharyngeal curve using the index finger and thumb; (d) when the index finger and thumb reach the mouth, the position of the index finger is adjusted so that it pulls upward on the inferior surface of the tube; (e) pushing the LMA-U into its final position holding the shaft. This group is defined originally as "direct" technique but is defined as "triple" group in this study to emphasize the triple airway maneuver which is not performed in the other two groups in this study.⁴ In the rotational group (*n* = 60), LMA was inserted using the rotational technique without performing a triple airway maneuver. Steps a, d and e are the same; however the LMA-U was inserted back-to-front, like a Guedel airway, and then rotated counterclockwise through 180 as it was pushed into the hypo pharynx.⁶

All device insertions were performed by same investigators who were experienced in LMA use and each insertion technique. After insertion, the cuff was inflated with a manometer to fix intracuff pressure at 60 cm H₂O. The number of attempts of LMA insertion and the time to achieve satisfactory first ventilation were recorded. The time between picking up the LMA and obtaining first effective ventilation (as evidenced by end-tidal carbon dioxide wave form and simultaneous chest movement) was recorded as insertion time. Patients' heart rates, and Mean Arterial Pressures (MAP) were recorded just before insertion of the device and at 1, 3, and 5 min after the insertion. Anesthesia was maintained with O₂, air and sevoflurane. Any adverse events including desaturation (SpO₂ below 92%), airway obstruction, coughing, gagging, laryngospasm

and airway trauma (defined as presence of blood on removal of LMA) were also noted. Two attempts were allowed before insertion was considered a failure. When two attempts with one technique failed, any one of the other two techniques was used as an alternative insertion technique (at the discretion of the anesthesiologist). In case of unsuccessful LMA insertion, tracheal intubation was performed.

After successful insertion, fiber optic evaluation was performed by an observer who was absent during insertion of LMA. The evaluation was performed by passing a fiber optic endoscope (Fujinon Fiberscope NAP-SL, Fujinon Corporation, Saitama, Japan) through the airway tube to position about 1 cm proximal to the end of the tube. The fiber optic view of the larynx was graded according to the scale: 4 = only vocal cords visible; 3 = cords and posterior epiglottis visible; 2 = cords and anterior epiglottis visible; 1 = vocal cords not seen.⁷

At the end of the procedure the intracuff pressure of LMA was measured and thereafter LMA was removed in a deep plane of anesthesia. On removal of the LMA, the attachment of blood on the surface of the LMA was noted. After the patients started obeying commands, they were shifted to recovery area and evaluated for sore throat quantified on a 10 point Numerical Rating Score (NRS), and again after 24 h. An observer blinded to the insertion technique assessed these data.

The primary outcomes were to determine successful insertion of the LMA-U at the first attempt, insertion time, fiber optic assessment of the airway view comparing three different insertion techniques. Secondary outcomes as airway morbidity and hemodynamic response to insertion were also compared.

Statistical analysis

Sample size calculation was performed based on the assumption that the rotational or triple airway maneuver technique would improve the success rate at the first attempt from 75% to 98%. With α of 0.05 and a power of 80%, 50 patients in each group were required. Due to the probability of lacking data and excluded patients, 60 patients were recruited in each group.

The age, body weight and time to successful LMA insertion, LMA using time were compared using one-way ANOVA. Sex, LMA size, number of attempts at LMA insertion, success rate and incidence of complications were analyzed using chi-squared test. Heart rate, MAP and BIS response to insertion of the device were compared using analysis of variance (ANOVA). A *p*-value <0.05 was considered as significant. Results are expressed as mean ± SD, mean (range), number or percentage (%). Statistical analysis was done using SPSS version 15.0 for windows (Chicago, IL, USA).

Results

The patients' characteristics are summarized in Table 1. Of the 180 patients who were recruited in this study, four patients (6.7%) in the standard group, 6 (10%) in the rotational group and 3 (5%) in the triple group required alternative approaches to insert the LMA (*p* = 0.55). These

Table 1 Characteristics of patients in standard, rotational and triple groups.

	Standard (n = 56)	Rotational (n = 54)	Triple (n = 57)	p-Value
Male/female	23/33	29/25	29/28	0.37
Age; years	40.01 ± 12.19	35.64 ± 13.65	41.52 ± 14.27	0.06
Weight (kg)	71.28 ± 12.22	71.83 ± 12.53	73.12 ± 11.79	0.71
Height (cm)	165.57 ± 10.53	169.07 ± 9.98	168.17 ± 10.84	0.19
Mallampati (I/II)	40/16	48/6	48/9	0.05

Data are number (n) or mean ± SD.

13 patients were excluded from further analysis except the success rates. The groups were similar in age, sex, weight, height, ASA, Mallampati class, type and duration of the surgery ($p > 0.05$). Different sizes of LMA were also comparable amongst the groups ($p = 0.25$).

Successful insertion at the first attempt was not statistically significant between the groups (Table 2). Time for successful insertion was significantly shorter in the triple group (8.63 s) when compared with the standard (11.78 s; $p = 0.0001$) and rotational group (11.57 s; $p = 0.001$). Standard and rotational groups did not differ from each other ($p > 0.05$). No reaction to insertion occurred in any patient.

Results of fiberoptic assessment as well as morbidity were similar between the groups (Table 2). Of the patients who had significant amount of blood on the LMA at removal; five of the eight patients in the standard group, all of the three patients in the rotational group and four of the six patients in the triple group had intranasal Rhino-Dacryocystostomy operation in which presence of blood on airway device is acceptable.

There was no significant difference between groups according to hemodynamic responses ($p > 0.05$).

Table 2 End-points for LMA insertion techniques and postoperative outcomes.

	Standard (n = 56)	Rotational (n = 54)	Triple (n = 57)	p-Value
<i>Time to successful insertion (s)^a</i>	11.78 (6–24)	11.57 (5–31)	8.63 (5–19)	0.0001 ^b 0.001 ^c >0.05 ^d
<i>Successful insertion at 1st attempt</i>	53 (88.3)	47 (78.3)	53 (88.3)	0.20
<i>Overall success rate^e</i>	56 (93.3)	54 (90)	57 (95)	0.55
<i>Fiber optic view</i>				
4	27 (48.2)	27 (50)	23 (40.4)	0.52
3	9 (16.1)	14 (25.9)	18 (31.5)	
2	15 (26.8)	10 (18.5)	13 (22.8)	
1	5 (8.9)	3 (5.6)	3 (5.3)	0.68
<i>Blood on mask at removal</i>				
No blood	43 (77)	47 (87)	43 (75)	0.39
Trace amount	5 (9)	4 (7)	8 (14)	
Significant	8 (14)	3 (6)	6 (11)	
<i>Patients experiencing sore throat</i>				
None	53 (95)	49 (91)	52 (91)	0.59
Mild	3 (5)	4 (7)	5 (9)	
Moderate	0	1 (2)	0	
Severe	0	0	0	
Disphonia	0	1 (2)	0	0.32
Disphagia	1 (2)	0	1 (2)	0.45

Data are mean (range) or n (%).

^a Defined as the time between picking up the laryngeal mask airway and obtaining first effective ventilation as evidenced by end-tidal carbon dioxide wave form and simultaneous chest movement.

^b p-Value between standard and triple group.

^c p-Value between rotational and triple group.

^d p-Value between standard and rotational group.

^e Defined as successful insertion at first and second attempt.

For the fiber optic view statistical comparison was made for grade 4 and grade 1 view. For the blood on LMA at the end of surgery statistical comparison was made only for the "no blood" outcome between the groups. For sore throat statistical comparison was made only with the "no sore throat" outcome between the groups.

Desaturation (SpO₂ below 92%), airway obstruction, coughing, gagging or laryngospasm was not seen in any patient.

Discussion

We have shown that in terms of insertion characteristics, airway complications and hemodynamic responses, the triple and rotational techniques may be alternatives to the standard insertion technique. The triple technique makes it possible to insert the LMA faster than with the other two techniques.

A questionnaire about LMA insertion showed that only 30%–34% of anesthesiologists favored the standard technique and 36%–42% of anesthesiologists indicated they were unwilling to use the standard technique of insertion.⁵ Cuff partial inflated insertion technique, rotational technique, and jaw thrust techniques were the most favored alternative insertion techniques among the anesthesiologists participating to that study. According to authors' comment, the reason of seeking different methods is to increase insertion success rate.

First time insertion success with LMA-U has been reported to range from 77% to 100% and overall success rate from 93% to 100%.^{3,8-13} Insertion times for the LMA-U ranges between 14.7 s and 43 s.^{3,12} Success rates for three groups in our study were consistent with these results. Insertion times for all groups in this study were however faster than in the literature.

In the current study the standard technique success rate was 88.3% and increased to 93.3% after two attempts. Brimacombe Berry¹⁴ state that if the standard approach is used correctly the first time success rate should be 95.5% in less than 20 s. In contrast to this study we did not reach this ratio at first time insertion using any of our three techniques. Similarly there are some other studies in which same success rates were not reached either.¹⁵⁻¹⁷ Moreover first time insertion rate using the standard technique in the literature is reported as low as 75%.¹⁸

For rotational technique first time insertion success rate was 78.3% and increasing to 90% after two attempts. When compared with the other groups a second attempt was needed in more patients in the rotational group. In our study with the Softseal™ LMA (SSLM, Portex Ltd, Hythe Kent, UK) we also noticed that second attempt was needed more with the rotational approach than with the direct technique.⁴ In another study first time successful insertion rate was reported as 86%. But in that study neuromuscular blocking drug was used to facilitate the insertion.¹⁶ Inserting the LMA with its lumen facing backward makes it easy to advance over the smooth angle against the posterior pharyngeal wall. According to our experience the other advantage of the technique is not requiring intraoral manipulation or assistance. In children the rotational technique is associated with higher success rates for insertion and lower incidence of complication.¹⁹ Reported lower success rate in adults may be attributed to differences between pediatric and adults airway anatomy and to the bigger size of the airway device in adults.

For triple technique the first time success rate was similar to the standard technique. In second attempt the success rate rose to 95%, this difference was not statically significant

among the groups. However time for successful insertion was significantly shorter in the triple group than the others. A difference of 3 s may not be meaningful in routine practice, but it can be valuable in emergent situations of airway management.

In our previous study with the SSLM first time insertion success rate was 98% and insertion time was 20 s (8–56 s) when the triple technique was used.⁴ First time insertion success rate was higher and mean insertion time was longer than in the present study. Since many years we prefer either the triple or rotational technique when we have to use a disposable LMA in our clinic. Our experience with these techniques is getting more each day, which may be a reason of even faster times than in our previous study.⁴ Another reason for this finding may due to differences in the design and/or material of the LMAs. The wider and stiffer airway tube and softer cuff of SSLM may be related with higher insertion success rates with triple airway maneuver insertion technique. In the literature there are some studies which compared LMA-U and SSLM according to the standard insertion technique, and resulted with higher first time success rates in the LMA-U group. In those studies insertion time of SSLM was longer than insertion time of LMA-U.^{9,20}

It has been recognized that lung ventilation is often adequate and clinical signs of improper placement are rarely observed even when the LMA is not in the optimal position. This was also the case in our study and ventilation through the LMA was always adequate in all groups regardless of the fiber optic view. According to Brimacombe and Berry²¹ studied different insertion techniques with the classic LMA and had an incidence of epiglottic down folding of 3.3% with the standard method and 7% with the rotational method. Goyal et al. have reported²² the thumb insertion technique was as effective as index finger insertion technique with respect to ease of insertion and insertion success. Contrarily, Krishna et al.²³ were showed the LMA Classic™ can be inserted successfully without the need to insert index finger into patient's mouth, though the first attempt success rate is higher with the standard technique. In our previous study with SSLM we had an epiglottic down folding rate of 2% in the triple group whereas this was 6% in the rotational group.⁴ In this study this was 5% both for rotational and triple groups. Epiglottic down folding was determined in more patients with the standard technique. Aoyama et al.²⁴ found similar results according to down folding with the standard technique however lower incidence with the triple technique. They concluded that the triple airway maneuver widened the pharyngeal space and decreased the incidence of down folding of the epiglottis. In the above mentioned study, neuromuscular blocking agent was used for facilitating insertion. So the neuromuscular blocking drug may have influenced the placement of the LMA. Different results with same insertion techniques may be explained with the investigators experience or use of neuromuscular block or with the difference in the LMA types.

A successful insertion of LMA depends not only on the insertion technique but also on the depth of anesthesia which is sufficient to obtund airway reflexes, movement and hemodynamic responses. For this reasons we used BIS for monitoring and standardize depth of anesthesia. Our preliminary study revealed that a target BIS level between 40 and 60 which recommended for general anesthesia²⁵ led to high

incidence of patient movement in response to LMA insertion. Therefore we decided to keep BIS at a level of ≤ 40 at the time of insertion. None of the patients showed airway reaction to insertion. According to our results, inserting LMA with different techniques did not produce any significant difference in hemodynamic responses.

Prevention strategies for sore throat in our study were moistening LMA with saline, allowing only two attempts and monitoring the cuff pressure. In a recent study it is suggested that measuring intracuff pressure after insertion of LMA reduced laryngopharyngeal complications by 70%. In that study the authors recommend to measure LMA cuff pressure routinely using manometer and deflating the pressure to less than 60 cm H₂O.²⁶

In all patients who were excluded from the study LMAs were inserted successfully using any of the alternative techniques. There was not any intubation requirement. This is confirming that if one technique fails, another technique may be successful for the insertion of LMA. Therefore anesthesia providers should be able to master at least two alternative insertion techniques of LMA.

There are some limitations in our study. First, the LMAs were inserted by two experienced anesthesiologists. May be experience in airway management, may have affected the results. Second, blinding was not possible during insertion of the LMA and so the insertion technique, measurement of insertion time and number of attempts. Third, because of ethical reasons we did not abandon analgesic use and so intra and postoperative analgesic usages were not questioned.

Conclusion

We suggest that the rotational technique and triple airway maneuver techniques are acceptable alternatives to the standard technique for inserting LMA in adults. Considering possibility of infection and trauma to the operator, rotational and triple airway maneuver techniques are advantageous because these techniques do not require intraoral manipulation. However triple airway maneuver technique shows higher overall success rates and allows shorter insertion time for LMA insertion and should therefore be kept in mind for emergent airway management.

Conflicts of interest

The authors declare no conflicts of interest.

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