ORIGINAL ARTICLE

# Ease of Laryngeal Mask Airway Insertion in Nigerian Adults: Propofol Alone vs Propofol Combined with Low Dose Suxamethonium

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**ABSTRACT**

**Background:** Inadequate anaesthesia during Laryngeal Mask Airway (LMA) insertion may make correct positioning difficult or even impossible. **Objective:** This prospective study was designed to compare the ease of LMA insertion in patients who received propofol alone and patients who received a combination of propofol with low dose (0.1 mg/kg) suxamethonium. **Methods:** Eighty ASA I and II consenting patients aged 18 to 60 years undergoing elective procedures under general anaesthesia and spontaneous ventilation were recruited and randomly allocated into two groups with each receiving either 5 mls of 0.9% saline (group P) or 0.1 mg/kg suxamethonium, made up to 5 mls (group S), 30 seconds post induction with intravenous (iv) propofol 2.5 mg/kg delivered over 30 seconds. The overall insertion conditions (scored from grade of jaw relaxation, ease of insertion, severity of airway response in terms of coughing, gagging, laryngospasm and patient movement) during first attempt of LMA insertion and the number of attempts made were then accessed. The number of attempts before successful LMA insertion as well as incidence and duration of apnoea post induction were recorded. **Results:** Excellent overall insertion condition occurred in 40% of patients in group S compared to 15% in group P, satisfactory in 30% of patients in group S compared to 35% in group P, and poor in 30% of patients in group S compared to 50% of patients in group P. **Conclusion:** The combination of propofol plus low dose suxamethonium for LMA insertion was found to provide better grades of overall insertion condition. The number of attempts before successful insertion was however comparable.

**Key words:** Laryngeal Mask Airway Insertion, Low dose suxamethonium, Propofol Induction.

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## Introduction

The laryngeal mask airway (LMA) is a novel supraglottic airway device which fills the gap between the facemask and the endotracheal tube. It is designed with a wide bore airway tube and a distal mask equipped with an inflatable cuff which provide a seal around the larynx.[1] It enables the anaesthetist to keep both hands free making it an alternative to the facemask for spontaneously breathing patients during most elective surgical procedures. In some selected cases, minimal positive pressure ventilation could be delivered via the LMA thereby obviating the need for endotracheal intubation.[2] Correct

positioning of the LMA when in situ is a prerequisite for effective device performance and avoidance of gastric insufflation.[3]

Inadequate anaesthesia during LMA insertion is associated with adverse responses such as gagging, coughing, head movement or laryngospasm which makes correct positioning difficult or even impossible.[4]

Various induction agents have been investigated in the search of an ideal technique for smooth LMA insertion. Propofol has been recommended as induction agent of choice because of its greater depressant effect on airway reflexes.[5] Propofol alone however, at the recommended induction dose of 1.5 - 2.5 mg/kg[6] does not always guarantee successful LMA insertion. Different agents have been tried with propofol in order to improve the overall ease and success of LMA insertion and minimise the incidence of side effects. These include intravenous drugs such as midazolam, fentanyl, alfentanil, remifentanil, lidocaine, and inhalational agents such as sevoflurane.[7-12] However each of these agents has its own limitation. Suxamethonium, a depolarizing muscle relaxant, at a low dose (0.1 mg/kg), has been found to suppress laryngeal reflexes by depolarization of motor end plate.[13] It has a rapid onset and offset of action.

It decreases incidence of coughing and gagging without causing full muscle paralysis.[14]

Low dose suxamethonium has no significant effect on spontaneous ventilatory effort and repeated doses does not cause bradycardia.[15] Propofol-low dose suxamethonium combination has yielded better result of success at first attempt and overall insertion condition of the LMA with no significant increase in duration of apnoea.[7]

We conducted this study to determine the efficacy of low dose suxamethonium (0.1 mg/kg) in improving the provider's ease of inserting the LMA in our setting.

**Materials and Methodology**

This was a prospective single-blind, randomised controlled study conducted in a tertiary health facility in Northwest Nigeria. Following approval from the research ethics committee, patients' informed consent was sought. Eighty consenting American Society of Anesthesiologist risk classification status I or II patients aged between 18 and 60 years were recruited into the study. These patients were scheduled for short elective surgeries (in-patients and day-surgery cases) under general anaesthesia with LMA as airway of choice. Patients with known hypersensitivity to propofol or suxamethonium, family history of plasma cholinesterase deficiency, neuromuscular disorders, family history of malignant hyperthermia, restricted mouth opening (inter-incisor gap < 2.5 cm), cervical spine disease, at risk of aspiration, undergoing oral or nasal surgery, obese with body mass index > 35 kg/m$^2$, taking sedative drugs and with failed LMA insertion were excluded.

A formula used to determine an appropriate sample size for the study showed a minimum of 72 patients were required.[16] Allowing for an estimated 10% non–consent or drop-out rate, the total sample size for the 2 groups was therefore 80 patients.

Patients enrolled for the study were randomly allocated into one of two groups. Eighty pieces of uniformly sized sheets of paper were labelled P or S (40 each), representing groups P (placebo), and group S (suxamethonium) respectively. These papers were folded and shuffled in a large box. Each patient picked one folded sheet of paper from the box and handed it over to the research assistant. The patient's hospital file number was written on

the sheet of paper and sealed in a separate envelope that was only opened after completion of the study. The investigator was blinded to the study drug.

In-patients eligible for the study were routinely reviewed a day before the scheduled surgery on the ward by the investigator and day care patients were evaluated for inclusion in the study on the morning of surgery. On arrival in the operating room, the patient was positioned supine on the operating table and baseline vital signs which include non-invasive Systolic and Diastolic blood pressures (SBP and DBP), Mean Arterial blood pressure (MAP), Pulse rate (PR), Respiratory rate (RR), peripheral arterial oxygen saturation of Haemoglobin ($SpO_2$) and Electrocardiograph were obtained. An intravenous access was secured using an 18G cannula and 0.9% saline infusion was commenced. The LMA classic™ (Teleflex®) was used in all patients of either group. The size of LMA was chosen based on patients' weight as recommended by the manufacturer.

The study drug (suxamethonium 0.1 mg/kg) and placebo (0.9% saline) were prepared in identical 5 ml syringes, by the research assistant according to the patient's group, while the investigator remained blinded. The study drug had the same appearance (colourless) with the placebo, made up to equal volume of 5 mls, and the content of each syringe was not disclosed to the investigator. Initial bolus dose of propofol based on body weight was prepared in a 20 ml syringe. Another preparation was made inside a 10 ml syringe for rescue doses. Lidocaine 1% was added to propofol in 1:10 ratio to minimize injection pain.

Patients were preoxygenated with 100% oxygen at a flow rate of 5 - 6 L/min for 3 - 5 minutes using a Bain circuit with a tight-fitting facemask. The LMA was prepared by pressing the concave part of the mask against a hard surface and its cuff was deflated. The back of the mask was then lubricated using K-Y Jelly. All patients were induced with 2.5 mg/kg intravenous 1% propofol injected continuously over 30 seconds by the research assistant. The adequacy of induction was assessed 30 seconds later (i.e., 60 seconds after the start of propofol injection) by loss of response to verbal command (open your eyes). The amount of propofol injected was noted. This was followed immediately with 0.9% saline in group P or 0.1 mg/kg suxamethonium in group, the investigator remained blinded to the drug used following induction with propofol. Thirty seconds after administration of the placebo or study drug (i.e., 90 seconds after the start of propofol injection); the adequacy of mouth opening was assessed as adequate or inadequate. When mouth opening was adequate, the patient's head was extended and neck was flexed on chest (sniffing position). The LMA was grasped like a pen in the dominant hand, with the tip of the index finger placed at the junction of the tube and mask. It was inserted into the mouth and advanced until resistance was felt. The cuff was then inflated with appropriate volume of air until the LMA tube was seen to rise slightly out of the patient's mouth. The patient was connected to the anaesthesia machine via the Bain circuit. Correct positioning of the LMA was assessed by bilateral equal air entry on auscultation and square wave form on capnograph trace in spontaneously breathing patients or during assisted breaths in patients with apnoea. If correctly placed, the LMA was then secured with adhesive tape. Anaesthesia was maintained on 1 - 2% MAC isoflurane in 50% oxygen in air at a total fresh gas flow rate of 5 - 6 L/min. All insertions of the LMA were

performed by the investigator, who had more than 2 years of experience with LMA use.

The first attempt at LMA insertion was considered as the time of actual insertion of the mask into the mouth. If following loss of response to verbal command (induction endpoint), there was inability to open the mouth, or inadequate mouth opening (jaw not relaxed), or gross movement during mouth opening (jaw partially relaxed), the patient was scored as such and an additional bolus dose of 0.5 mg/kg propofol was given to deepen anaesthesia and a reassessment was done 30 seconds later.

If mouth opening was adequate but correct positioning after insertion was not achieved because of severe airway response, or head or body movement, the LMA was removed (failed first attempt).

Propofol at 0.5 mg/kg bolus was administered to deepen anaesthesia and reinsertion (second attempt) was attempted 30 seconds later. A maximum of three attempts at insertion was allowed for the study. In between insertion attempts, the patients were ventilated via a facemask with 100% oxygen devoid of volatile agents at a flow rate of 5 - 6 L/min. If LMA insertion were to be unsuccessful after three attempts, the patient's airway would have been secured with an appropriate sized endotracheal tube. This was termed as failure of LMA insertion and the patient was excluded from the study.

The investigator assessed the insertion conditions on a three-point scale using six variables as adopted by Sivalingam et al,[17] namely: jaw relaxation (full, partial, nil), ease of LMA insertion (easy, difficult, impossible), coughing (nil, mild, severe), gagging (nil, mild, severe), patient movement (nil, moderate, vigorous) and laryngospasm (nil, partial, total). The three point scale was scored 3, 2 or 1 in order of severity. Jaw relaxation and ease of LMA insertion were defined as the degree of resistance to mouth opening and LMA insertion respectively.[8] Laryngospasm was defined as the presence of inspiratory stridor that subsides with deepening of anaesthesia.[17]

The overall condition for LMA insertion was assessed excellent, satisfactory or poor based on the total score of the component values A total score of 18 was considered excellent overall condition, 16 – 17 as satisfactory and anything below 16 as poor.[18] The overall insertion condition was only assessed during the first attempt at insertion, the number of attempts before successful insertion was recorded. Any incidence of apnoea was noted and treated accordingly; apnoea was defined as cessation in breathing, as evidenced by absence of chest movement, from the end of propofol injection.[19] The duration of apnoea, defined as time from successful LMA insertion till return of spontaneous breathing, was noted. Assisted ventilation was to be given to apnoeic patients (with $SpO_2$ below 90%) through the LMA to maintain $SpO_2$ above 95% and end tidal carbon dioxide concentration between 35 and 45 mmHg till resumption of spontaneous breathing. The study was considered completed when the patient resumed spontaneous breathing and was haemodynamically stable. No further intraoperative anaesthetic management was influenced by the study.

Data obtained was recorded on the preformed data collection form (Appendix 2). Data entry was done by two separate clerical staff and was further crosschecked for consistency.

Data obtained was analysed using Statistical Package for Social Sciences (SPSS) version 21.0. Quantitative variables such as age, weight, height, number of insertion attempts, total propofol requirement per kilogram body

weight and the duration of apnoea was summarized using mean (± standard deviation) and compared using independent t-test. Qualitative variables such as the overall condition of insertion and the incidence of apnoea was summarized using percentages and compared using Chi-squared test or Fisher's exact test where applicable. Level of statistical significance was set at p-value of < 0.05.

**Results**

Eighty (80) patients were evaluated in two groups and none of them was excluded from the final analysis. The patients' demographics and clinical characteristics were not significantly different statistically in the two groups (see Table 1)

Table 2 shows the insertion condition grades during the first attempt at LMA insertion in the two groups. The grades of jaw relaxation were comparable between the two groups (p = 0.252). Jaw relaxation was full in 23 (57.5%) patients in group P and 30 (75.0%) patients in group S, partial in 15 (37.5%) patients and 9 (22.5%) patients respectively in group P and group S. Two (5.0%) and 1 (2.5%) patients in group P and S had no jaw relaxation respectively.

Insertion of the LMA was easy in 36 (90.0%) and 38 (95.0%) patient in group P and S respectively, difficult in 4 (10.0%) and 2 (5.0%) patients in group P and S respectively. There was no patient in both groups who had impossible insertion. The ease of LMA insertion grading was comparable between the two groups (p = 0.593).

Coughing occurred after LMA insertion at first attempt in 12 (30.0%) patients in group P and it was mild in 9 (22.5%) patients and severe in 3 (7.5%) patients. Only 2 (5.0%) patients in group S had cough after LMA insertion and it was mild in 1 (2.5%) patient and severe in 1(2.5%) patient. The difference in the incidence of cough between the two groups was observed to be statistically significant (p = 0.011).

Gagging occurred in 10 (25.0%) patients in group P and it was mild in 3 (7.5%) patients and severe in 7 (17.5%) patients. Only 2 (5.0%) patients assessed in group S gagged after LMA insertion and it was mild in 1 (2.5%) patient and severe in 1 (2.5%) patient. The difference was not statistically significant (p = 0.038).

Head or body movement occurred in 27 (67.5%) patients in group P and it was moderate in 6 (15.0%) patients and vigorous in 21 (52.5%) patients. In group S, 18 (45.0%) patients moved post insertion and it was moderate in 8 (20.0%) patients and vigorous in 10 (25.0%) patients. The difference was statistically significant (p = 0.030).

None of the patients in either group had a total laryngospasm. Only 1 (2.5%) patient in group P had a partial laryngospasm while no patient in group S had laryngospasm. The difference was not statistically significant (p = 0.314).

**Table 1: Patients' Demographic data and Clinical Characteristics**

| | Group P ( n = 40) | Group S ( n = 40) | p – value |
|---|---|---|---|
| Age (years) | 38.40 ± 14.01 | 35.55 ± 14.01 | 0.319 |
| Weight | 60.50 ± 6.87 | 61.90 ± 6.83 | 0.364 |
| BMI (kg/m$^2$) | 22.00 ± 1.50 | 22.08 ± 2.29 | 0.863 |
| Gender (Male:Female) | 18:22 | 26:14 | 0.072 |
| ASA (I:II) | 34:6 | 31:9 | 0.39 |
| Interincisor gap (cm) | 7.13 ± 0.82 | 6.75 ± 1.08 | 0.085 |

**Table 2: Insertion Conditions during first attempt at LMA Insertion**

| Insertion Condition | Group P | Group S | $X^2$ value | p value |
|---|---|---|---|---|
| Jaw Relaxation | **(n = 40)** | **n = 40** | | |
| Full | 23 (57.5%) | 30 (75.0%) | | |
| Partial | 15 (37.5%) | 9 (22.5%) | 2.758 | 0.252 |
| Nil | 2 (5.0%) | 1 (2.5%) | | |
| Ease of LMA Insertion | **(n = 40)** | **(n = 40)** | | |
| Easy | 36 (90.0%) | 38 (95.0%) | | |
| Difficult | 4 (10.0%) | 2 (5.0%) | 1.046 | 0.593 |
| Impossible | 0 (0.0%) | 0 (0.0%) | | |
| Coughing | **(n = 40)** | **(n = 40)** | | |
| Nil | 28 (70.0%) | 38 (95.0%) | | |
| Mild | 9 (22.5%) | 1 (2.5%) | 9.067 | 0.011* |
| Severe | 3 (7.5%) | 1 (2.5%) | | |
| Gagging | **(n = 40)** | **(n = 40)** | | |
| Nil | 30 (75.0%) | 38 (95.0%) | | |
| Mild | 3 (7.5%) | 1 (2.5%) | 6.532 | 0.038* |
| Severe | 7 (17.5%) | 1 (2.5%) | | |
| Head or Body Movement | **(n = 40)** | **(n = 40)** | | |
| Nil | 13 (32.5%) | 22 (55.0%) | | |
| Moderate | 6 (15.0%) | 8 (20.0%) | 6.982 | 0.030* |
| Vigorous | 21 (52.5%) | 10 (25.0%) | | |
| Laryngospasm | **(n = 40)** | **(n = 40)** | | |
| Nil | 39 (97.5%) | 40 (100%) | | |
| Partial | 1 (2.5%) | 0 (0%) | 1.014 | 0.314 |
| Total | 0 (0%) | 0 (0%) | | |

Six (15.0%) patients in group P and 16 (40.0%) in group S had an excellent overall insertion condition. Satisfactory overall condition of insertion was observed in 14 (35.0%) patients in group P and in 12 (30.0%) in group S. Poor overall insertion condition was demonstrated in 20 (50.0%) patients in group P and in 12 (30.0%) patients in group S. This difference in proportions was found to be statistically significant (p = 0.035) (Table 4)

All patients had successful LMA insertions within one or two attempts, the LMA insertion was successful at first attempt in 28 (70.0%) patients and 33 (82.5%) patients in group P and group S respectively. A second attempt was required in 12 patients (30.0%) and 7 patients (17.5%) in group P and group S respectively. The difference was not statistically significant (p = 0.321).

**Table 3: Overall Condition for LMA insertion**

| | Group P (n = 40) | Group S (n = 40) | p-value |
|---|---|---|---|
| Excellent | 6 (15.0%) | 16 (40.0%) | |
| Satisfactory | 14 (35.0%) | 12 (30.0%) | 0.035 |
| Poor | 20 (50.0%) | 12 (30.0%) | |

**Table 4: Number of Attempt(S) at Successful LMA Insertion**

| No of Attempt(s) | Group P (n = 40) | Group S (n = 40) | $X^2$-value | p-value |
|---|---|---|---|---|
| 1 | 28 (70.0%) | 33 (82.5%) | | |
| 2 | 12 (30.0%) | 7 (17.5%) | 2.27 | 0.321 |
| 3 | 0 (0.0%) | 0 (0.0%) | | |
| Failed Insertion | 0 (0.0%) | 0 (0.0%) | | |

Apnoea was observed in 20 patients (50.0%) in group P and in 23 patients (57.5%) in group S. The difference was not statistically significant (p = 0.501). The mean duration of apnoea was

1.04 minutes in group P and 0.65 minutes in group S, the difference was also not statistically significant (p = 0.107).

All patients either had a size 3 or 4 LMA with the latter being the most used in both groups. No other size was used. The ratio of patients who had LMA size 3 to those who had LMA size 4 in group P (8:32) was comparable to those in group S (11:29) (p = 0.431).

**Discussion**

Findings from this study showed that following propofol induction, low dose suxamethonium (0.1 mg/kg) significantly improved grades of overall laryngeal mask airway (LMA) insertion condition when compared to a saline placebo, the number of attempts before successful insertion were however comparable in the two study groups.

This reaffirms observations by other authors that low dose suxamethonium increase tolerance to LMA insertion without causing full muscle paralysis. Jain and Parikh[20] found the incidence of excellent to satisfactory overall insertion condition to be 88% with propofol and suxamethonium while that of the propofol-only group was 52%, p < 0.05.

The higher incidence (88%) observed in their suxamethonium group, compared to that (70%) in this study, this could be due to the higher dose of suxamethonium (0.25 mg/kg) they used. Salem[7] similarly reported excellent overall insertion conditions in 50% of patients in the propofol plus suxamethonium group, which was significantly higher than the 20% in the propofol-only group; p < 0.05, the slightly lower incidences in our study (40% and 15% respectively) may be because we included female patients in our study unlike the male-only population in Salem's study.

Studies have demonstrated that female subjects have enhanced cough reflex thus predisposing them to poor insertion conditions.[21,22]

In contrast, Tan and Wang[8] observed none of the 15 patients (0%) in their study who had placebo following propofol induction for LMA insertion had an optimal insertion condition, the initial dose of propofol used and the patients' age group in their study were similar to those in this study though their patients were Asians. Their low incidence may be due to interracial difference in anaesthetic requirement. Pattanayak*etal*[23] identified a lower anaesthetic requirement in blacks compared to Caucasians. Moreover, their sample size was small (only 15 patients compared to 40 studied in the propofol-only group in this study). In a study from South-west Nigeria, Desalu *et al* [24] reported a higher incidence (93.3%) of excellent to satisfactory conditions of LMA insertion with propofol alone. Their higher propofol induction doses (initial and the top-up) might have put their patients at a better plane of anaesthesia before attempt of LMA insertion, even though they were children and their induction dose is higher than that of adults.[6]

In this study, jaw relaxation and ease of insertion of LMA were found to be better in patients that received low dose suxamethonium following propofol, with 75% having full jaw relaxation on first attempt compared to the placebo group (57.5%), these were comparable. Cough and body movements were significantly reduced following LMA insertion in the suxamethonium group compared to the propofol only group. These enhanced

insertion conditions on first attempt in patients that received low dose suxamethonium. These findings are similar to a previous study where 80% of patients that had low dose suxamethonium after propofol for LMA insertion had good jaw relaxation.[20] Their dose of suxamethonium (0.25mg/kg) was however higher than what was used in this present study

Previous studies[17,20] have reported that the administration of suxamethonium (0.1 mg/kg) following propofol induction increased the incidence of successful LMA insertion at first attempt, thus reducing the need for further attempts at insertion. The result from this study also showed a higher incidence of successful LMA insertion at first attempt in the suxamethonium group (82.5%) compared to the placebo group (70%). However, the difference in the number of attempts before successful LMA insertion in the two groups was not significant, p = 0.321. This was probably because the most common response to LMA insertion in both study groups was patients' head or body movement which settles with inhalational agent or with additional dose of propofol with the LMA well in place and not requiring a second attempt. Aghamohammadi *et al*[25] in their study however reported the rate of successful LMA insertion at first attempt to be significantly higher in suxamethonium group (90%) compared to the placebo group (46.6%) following propofol induction; p = 0.001. This difference could have resulted from the different insertion techniques used. They inserted the LMA with the cuff partially inflated, as opposed to the full deflation before insertion in this study.

The need for a second or third attempt before successful LMA insertion in this study was noted to be lower in the suxamethonium group compared to the placebo group. This was consistent with the report of previous studies.[7,17]

Duration of action of suxamethonium is dose dependent; reducing the dose allows a more rapid return of spontaneous ventilation and airway reflexes.[26] In this study, a higher incidence of apnoea occurred in the suxamethonium group compared to placebo group, though the difference was not significant; p = 0.501. However, the mean duration of apnoea was shorter in suxamethonium group compared to placebo group, but the difference was also not significant, p = 0.107. Similarly, Ho and Chui[17] did not find any significant difference in the duration of apnoea between the suxamethonium and placebo groups; p = 0.46.

The incidence of apnoea recorded by Jain and Parikh[20] in their propofol plus suxamethonium group (84%) and the propofol-only group (80%) are higher than those (57.5%, 50% respectively) obtained in this study. This is likely due to the higher suxamethonium dose (0.25mg/kg) used in their study.

**Conclusion**

The results from this study showed that suxamethonium (0.1 mg/kg) when given following propofol induction improved grades of overall LMA insertion condition.The numbers of attempts before successful LMA insertion were comparable using propofol combined with suxamethonium (0.1 mg/kg) or propofol alone.The incidence of apnoea is similar with the two study groups and its duration is within a clinically acceptable limit.

**Recommendation**

Suxamethonium is a readily available drug and its enhancement of insertion conditions

while using LMA makes it desirable and it is recommended for use

**Limitations**

Objective assessment tool of anaesthesia depth such as the bispectral index was not used, nor was the effect-site concentration of propofol estimated using a target controlled infusion system.

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