RESEARCH PAPER

Evaluation Of Two Different Ultrasound Techniques In Detecting Proper Placement Of Laryngeal Mask Airway In Adults – A Prospective Observational Study

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Abstract

Background: Accurate confirmation of laryngeal mask airway (lma) positioning is fundamental for both efficient ventilation and prevention of postoperative airway complications. While fibreoptic bronchoscopy remains the gold standard for detecting proper position of lma, its application might not always be feasible in routine practice. Hence, this research assessed the diagnostic performance of two ultrasound techniques in identifying correct lma placement in adults, using fibreoptic bronchoscopy as the reference.

Methods: A total of 70 patients, adults, asa physical status i-ii, scheduled for elective surgery under general anaesthesia, were recruited in this prospective observational study. Two ultrasonographic techniques, cuff symmetry and arytenoid position, were used to detect lma placement, which was correlated using fob. In addition to detecting the accuracy of lma placement, the time for performing both the ultrasound techniques and the association between postoperative respiratory complaints and positioning of lma were evaluated.

Results: The arytenoid position technique detected proper placement in 57 (81.4%) patients, whereas the cuff symmetry technique identified proper placement in 61 (87.1%) patients. The cuff symmetry technique demonstrated better agreement with fibreoptic bronchoscopy compared to the cuff symmetry technique significantly ($p < 0.05$). The mean time required for ultrasound assessment using the arytenoid position technique was significantly less (22.3 ± 5.4 seconds) when compared to the cuff symmetry technique (34.6 ± 6.8 seconds), $p<0.001$. Postoperative airway morbidity was observed more significantly in patients with malpositioned lma than in patients with proper placement.

Conclusion: Ultrasonography is an effective and non-invasive tool for confirming laryngeal mask airway placement. The cuff symmetry technique showed higher diagnostic accuracy, while the arytenoid position technique was able to detect the lma faster. Proper positioning of lma is required to reduce postoperative airway complications.

Keywords: Laryngeal Mask Airway, Airway Ultrasound, Fibreoptic Bronchoscopy, Arytenoid Position, Cuff Symmetry.

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Introduction:

The laryngeal mask airway (LMA) is a supraglottic airway device, which can be utilized to aid in ventilation during general anaesthesia. Its simplicity of insertion, minimal effects on haemodynamics, and reduced airway trauma are some factors that have caused the continuous increasing trend of LMA utilisation in everyday anaesthetic

practice. However, proper placement of the LMA is important to ensure effective ventilation, prevent air leakage, and minimize airway related problems such as gastric insufflation, hypoxia, and postoperative morbidity [1,3].

Traditionally, clinical indicators such as chest expansion, auscultation, and capnography are employed to verify LMA insertion; nevertheless, these techniques might not always accurately detect a malpositioned LMA. Fibreoptic bronchoscopy is considered the definitive method for determining LMA placement since it allows one to see the opening of the glottis directly under vision. However, its application can be limited by various factors such as cost, necessity for skilled personnel, temporary cessation of ventilation, and the fact that it is not available everywhere [4]. Point of care ultrasonography has recently become a non-invasive modality for airway assessment. Ultrasound delivers instantaneous imaging, is fast, can be done several times, and is available in most operating rooms. It has been shown in some studies that ultrasound examination agrees well with fibreoptic results in confirming LMA placement along with the lung deflation test, which reliably detects malposition without interrupting ventilation [5, 6]. Nevertheless, evidence is scant about the usage of different ultrasonographic techniques to assess LMA positioning in adult patients. Two of the most popular methods among different approaches are the arytenoid position technique and cuff symmetry technique. They are usually used to check whether the LMA has been placed correctly or not but it is not known whether one is better than the other or even whether they are accurate at all. So, the present study was carried out to evaluate two different ultrasonographic techniques in detecting proper placement of the laryngeal mask airway in adults with fibreoptic bronchoscopy as the gold standard reference.

Methodology

This prospective observational study at SRM Medical College Hospital and Research Centre, Chennai, India, was carried out for 12 months from 01/02/2025 to 01/02/2026 after approval was obtained from the Institutional Ethics Committee (SRMIEC-ST0425-2315). The study was registered with the Clinical Trials Registry of India (CTRI/2025/06/088532) before the enrolment of patients. The sample size was calculated based on the primary outcome parameter reported in the study by Song et al., namely the diagnostic accuracy for confirmation of correct laryngeal mask airway placement. Using this parameter as a reference, the required sample size was estimated to be 63 participants. To account for a potential dropout rate of 10%, an additional 7 participants were included. Accordingly, the final sample size was rounded to 70 cases.

Adult patients aged 18-65 years, classified as I or II physical status according to the American Society of Anesthesiologists (ASA), and admitted for elective surgery under general anaesthesia with laryngeal mask airway (LMA) usage, were included in the study. Patients with pregnancy, upper respiratory tract infection, previous neck surgery or airway stenosis, goitre or hyperthyroidism, and gastroesophageal reflux disease were not considered for the study.

Upon arrival in the operating room, standard monitoring including electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography was instituted, and baseline vital parameters were recorded. Premedication was administered with intravenous glycopyrrolate 0.005–0.01 mg/kg, ondansetron 0.1 mg/kg, and midazolam 0.02–0.05 mg/kg.

All patients were preoxygenated with 100% oxygen for three minutes. Anaesthesia was induced with intravenous propofol 2–3 mg/kg and fentanyl 2 µg/kg. Neuromuscular blockade was achieved using atracurium 0.5 mg/kg to facilitate smooth LMA insertion and to prevent coughing or movement during ultrasound and fibreoptic evaluation.

A pre-insertion ultrasound examination was performed using a high-frequency linear probe (8–13 MHz) (Fig.1) placed over the anterior neck. Transverse scanning was initiated at the level of the hyoid bone and continued caudally to identify the vocal cords and arytenoid cartilages. The glottic view was documented, and a reference image was stored for comparison with post-insertion findings (Fig.2)

(A)

(B)

Figure 1: Image showing the high frequency linear probe (A) and (B) The linear probe is being placed over the anterior neck to identify the anatomical structures.

Figure 2: Ultrasound Anatomy of the Hyoid Bone and Larynx in Midline Transverse View (A midline transverse ultrasound image of the anterior neck showing the hyoid bone which is visualized as an inverted U-shaped hyperechoic curvilinear structure with characteristic posterior acoustic shadowing, serving as an important landmark for upper airway identification)

An appropriately sized classical LMA (size 3 for 30–50 kg, size 4 for 50–70 kg, and size 5 for >70 kg) was inserted by an experienced anaesthesiologist using the standard index finger technique. The cuff was inflated to achieve an intracuff pressure of approximately 60 cm H_2O. Placement of the LMA was initially confirmed clinically by adequate chest expansion, absence of audible leak at airway pressure of 20 cm H_2O, and presence of a square wave capnograph tracing. A maximum of three attempts was permitted.

Two ultrasonographic techniques were used to evaluate LMA positioning: the arytenoid position technique and the cuff symmetry technique.

In the arytenoid position technique, the degree of arytenoid cartilage displacement was assessed in the transverse plane and graded from 0 to 3. Grade 0 indicated symmetrical arytenoids (optimal placement), while Grades 1–3 indicated increasing degrees of asymmetrical elevation, suggestive of malposition.

Figure 3: Ultrasonographic Grading of Arytenoid Cartilage Elevation
(Ultrasound image demonstrating asymmetrical arytenoid elevation for assessment of LMA position).

In the cuff symmetry technique, LMA position was evaluated in both transverse and parasagittal planes (Fig.4). Each plane was scored as 0 (normal) or 1 (abnormal), and the total score ranged from 0 to 2. Based on this, Grade I (score 0) and Grade II (score 1)

were categorized as acceptable placement, whereas Grade III (score 2) was considered unacceptable placement.

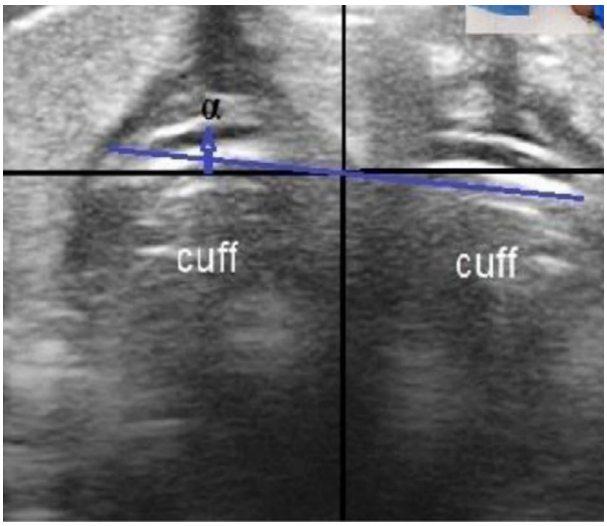

Figure 4: Ultrasound image of Acceptable Laryngeal Mask Airway Placement using cuff symmetry technique (ultrasound image taken in the transverse plane showing a smooth, well-defined cuff tip with symmetrical acoustic shadowing)

The time taken for each technique was recorded from probe placement to identification of the relevant anatomical landmarks.

Fibreoptic bronchoscopy (FOB) was performed in all patients as the gold standard for confirmation of LMA placement. The fibreoptic view was graded using a four-point scale, where Grades 1 and 2 were considered indicative of proper placement, and Grades 3 and 4 were considered as malpositioned. Additionally, the degree of LMA rotation was measured and graded from 0 to 3 based on angular deviation from the laryngeal midline, with higher grades indicating greater malalignment.

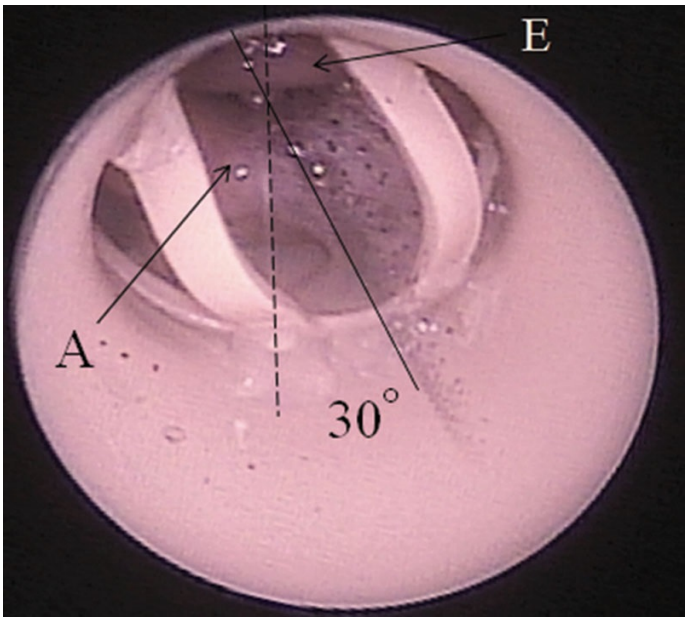

Figure 5: Fibreoptic Assessment of Laryngeal Mask Airway Rotation

(Fibreoptic bronchoscopic view demonstrating assessment of laryngeal mask airway (LMA) rotation. The rotational angle is measured between the central axis of the LMA grille (solid line) and the vertical axis of the laryngeal inlet (dotted line). Key anatomical landmarks, including the epiglottis (E), aryepiglottic fold (A), and glottic opening, are visible through the LMA aperture)

Ultrasound findings from both techniques were compared with fibreoptic bronchoscopy (FOB) grading to evaluate diagnostic accuracy and agreement. Statistical analysis was performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation, while categorical data were presented as frequencies and percentages. The association between ultrasound findings and FOB results was analysed using the Chi-square test, with statistical significance defined at $p < 0.05$. Furthermore, postoperative airway morbidity, including sore throat and hoarseness of voice, was assessed in the recovery period. The association between malposition and increased postoperative complications was analysed to evaluate clinical significance.

RESULTS:

A total of 70 patients were included in the study. The mean age of the study population was 41.2 ± 12.6 years. Among them, 38 (54.3%) were males and 32 (45.7%) were females. The majority of patients belonged to ASA physical status I (62.9%), while 37.1% were ASA physical status II

Demographics	n(%)/Mean±SD
Age (years)	41.2 ± 12.6

Gender	Male	38(54.3%)
	Female	32(45.7%)
ASA Physical Status	ASA I	44 (62.9%)
	ASA II	26 (37.1%)

Table 1: Demographic Characteristics of Patients

The incidence of proper LMA placement assessed by fibreoptic bronchoscopy (FOB), considered the reference standard, was 63 (90.0%). Among the ultrasonographic techniques, the arytenoid position technique detected proper placement in 57 (81.4%) patients, whereas the cuff symmetry technique identified proper placement in 61 (87.1%) patients. The cuff symmetry technique demonstrated significantly better agreement with fibreoptic bronchoscopy compared to the arytenoid position technique ($p < 0.05$)

Method	**Proper Placement n (%)**	**Agreement with FOB**	**p-value**
Arytenoid Position USG	57 (81.4%)	moderate	**0.041 ***
Cuff Symmetry USG	61(87.1%)	high	**0.032 ***
Fibreoptic Bronchoscopy (Reference)	63 (90.0%)		

Table 2: Comparison of LMA Position Detection by Different Methods

The mean time required for ultrasound assessment using the arytenoid position technique (34.6 ± 6.8 seconds), whereas the cuff symmetry technique required significantly less time (22.3 ± 5.4 seconds) . The difference in time taken between the two techniques was statistically significant ($p < 0.001$), indicating that the arytenoid position technique was faster to perform.

Technique	**Time (seconds) Mean ± SD**	**p-value**
Arytenoid Position	22.3 ± 5.4	**<0.001***
Cuff Symmetry	34.6 ± 6.8	

Table 3: Time Taken for Ultrasound Techniques

Postoperative airway morbidity was significantly more in patients with malpositioned LMA than in patients with proper placement. The incidence of sore throat (57. 1%) and hoarseness (42.9%) was significantly higher in malpositioned LMA patients and also showed statistical significance ($p < 0. 01$).

Complication	**Proper Placement (n=63) n (%)**	**Malposition (n=7) n (%)**	**p-value**
Sore throat	6 (9.5%)	4 (57.1%)	**0.003 ***
Hoarseness	4 (6.3%)	3 (42.9%)	**0.007 ***

Table 4: Postoperative Airway Morbidity According to LMA Position

Discussion

This prospective study was conducted to compare two ultrasonographic approaches to identify laryngeal mask airway (LMA) misplacement with the aid of fibreoptic bronchoscopy in adult patients as the standard of reference.

Patient demographics in the study were similar to those in earlier ultrasound, assisted airway studies. Most patients were in the physical status of American Society of Anesthesiologists (ASA) I-II and had elective surgical procedures. Malik et al. reported a patient population of adult ASA III patients undergoing elective surgery for ultrasound confirmation of LMA placement [7], and Atar et al. conducted a study on ultrasonographic assessment of LMA position in patients with a similar age range and ASA class [8]. This likeness increases the external validity and generalizability of the current findings.

The current study revealed that the cuff symmetry ultrasound method had a closer match with fibreoptic bronchoscopy than the arytenoid position method, thus, it had higher accuracy of LMA correct placement. Researches validating ultrasound as a reliable method for confirming supraglottic airway device position have also supported these studies. Wang et al. reported that ultrasound provides real-time visualization of laryngeal structures and correlates well with fibreoptic findings [10]. Similarly, Song et al. demonstrated strong agreement between ultrasonographic evaluation and fibreoptic grading in detecting LMA malposition [6]. Malik et al. also published that the accuracy of ultrasound in detecting optimal LMA placement that had been confirmed by fibreoptic bronchoscopy reaches about 80, 90% [7]. This agrees with the fact that ultrasound can be a dependable method for LMA placement confirmation and a good clinical tool when a fibreoptic bronchoscope is not at hand.

The arytenoid position technique took lesser time than the cuff symmetry procedure. Previous Literature reveals that ultrasonography as a bedside tool is fast

and can be used for airway evaluation and device confirmation in perioperative settings [11, 12]. On the other hand, it has been suggested that when detailed visualization of the laryngeal structures is employed, there is a compromise between speed and diagnostic accuracy because these techniques require more expertise and are, thus, more time, consuming [13]. The fact that the arytenoid position technique resulted in a shorter examination time may be explained by the fact that the visualisation of the arytenoids is simpler whereas the contour of the cuff is difficult to identify and hence time consuming. A learning curve for advanced airway ultrasound techniques has also been documented [11]. So, whereas arytenoid position can be seen as a quick screening tool, cuff symmetry visualization actually gives more detailed information about the anatomy and position of laryngeal mask airway and shows better accuracy.

Our findings in this study that patients with malpositioned LMA have significantly higher rates of postoperative sore throat and hoarseness agree with the previous studies which demonstrated that postoperative airway complications resulted from mucosal pressure and device misplacement [14]. A misplaced LMA may cause the pharyngeal mucosa to be excessively pressed by the cuff, which can result in tissue irritation, swelling, and airway morbidity. The implication of the results, therefore, is that accurate positioning of the LMA is of great importance in order to minimize the risk of postoperative complications.

Conclusion:

Ultrasonography is a safe and non-invasive method for confirming laryngeal mask airway placement in adults. The cuff symmetry technique showed greater accuracy, while the arytenoid position technique allowed quicker identification. LMA malposition had a higher association with postoperative airway complications, emphasizing the importance of proper positioning of the supraglottic airway device.

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