Analysis of depth of anesthesia and position of laryngeal mask airway

Arvind Kumar[1], Jay Ram[2], Manish Singh[3*], Abhishek Gautam[4]

[1]Assistant Professor, Department of Anaesthesia, Moti Lal Nehru Medical College, Prayagraj, India

[2]Senior Resident, Department of Anaesthesia, Moti Lal Nehru Medical College, Prayagraj, India

[3]Junior Resident, Department of Anaesthesia, Moti Lal Nehru Medical College, Prayagraj, India

[4]MBBS 2nd Year, GSVM Medical College Kanpur, India

Corresponding author: Dr Manish Singh

Abstract

Introduction: The laryngeal mask airway (LMA) is a widely used device in anesthetic practice. Proper depth of anesthesia is crucial to avoid complications. Entropy is an effective tool to measure anesthesia depth. LMA implantation requires sufficient anesthesia depth. LMA insertion can be challenging, and clinical indicators such as oropharyngeal leak pressure (OPLP) can be used to assess LMA accuracy.

Aims and Objectives: To analyze the depth of anesthesia and position of laryngeal mask airway in pediatric population.

Methods: The study was conducted from April 2022 to March 2023 on 140 patients undergoing surgery in a hospital. Anaesthesia was administered to all patients by a senior medical student or a consultant paediatric anesthesiologist. A single-use LMA was inserted, and cuff pressure was monitored. Sevoflurane was used to administer volatile-based anaesthesia. Patients were randomly assigned to one of four groups for the removal of the LMA using different techniques: Lateral Deep, Lateral Awake, Supine Deep, and Supine Awake. Each group had 35 patients, and the study aimed to avoid bias while reflecting standard practice.

Results: There were statistically considerable variations between the subgroups (P=0.001), and the LMA was successfully released with the fewest difficulties when it was performed in the lateral position under a deep plane of anaesthesia. There was a statistically significant distinction between the parties in terms of the score for 'Clinical Importance' (P=0.001); the highest risk was observed when the LMA was removed from deeply sedated individuals who were lying supine.

Conclusion: The study has concluded that it is best to turn the patient into lateral position before removing the laryngeal mask airway, whether the patient is in deep plane of anaesthesia or the patient is awake.

Keywords: mask, airway, laryngeal, oropharyngeal leak pressure, sevoflurane.

Introduction

Since its development more than 30 years ago, a “laryngeal mask airway (LMA)” has grown into a mainstay of anesthetic clinical practice. It was first used in paediatrics in 1990. Numerous studies have shown the LMA's safety and effectiveness in pediatric anaesthesia, although this patient population has found the manufacturer's suggested LMA removal method to be contentious [1]. In adult anaesthesia, it is a standard suggested practice to leave the patient alone when coming out of general anaesthetic and to take away the LMA once the patient is conscious and competent. follow instructions [2].

A way to gauge the level of anaesthesia is crucial with the development of new anaesthetic procedures such as intravenous anaesthetics, powerful opiate analgesics, and novel volatile agents. Each patient requires a different level of an anaesthetic; thus, it should be tailored to them. Anaesthesia-related complications such as postoperative vomiting and nausea, delayed healing, and cognitive impairment may result from a deeper level of anaesthesia than is necessary [3]. Contrarily, a milder plane of anaesthesia may cause intraoperative consciousness. Tachycardia, hypertension, lacrimation, sweating, and other indications of intraoperative awareness are just approximate estimates of anaesthetic depth. Numerous studies have been conducted in order to develop monitors that can measure the level of anaesthesia [4,5]. The incidence of consciousness during general anaesthetic can be anticipated to decrease with the use of an appropriate assessment technique for depth of anaesthesia, which will also enable anaesthesia that is thought to be mild enough to encourage quick recovery and reduce both human and financial expenses. An effective tool for measuring anaesthetic depth is entropy [6,7]. When determining if a person is conscious while under anaesthetic, entropy exhibits a high level of specificity and sensitivity. EEG & frontal electromyography data are processed by entropy to provide state and response entropies, which are numerical representations of the signals [8]. The RE is based on both “frontal electromyography (FEMG)” and “electroencephalogram (EEG)” recordings, and it shows how the patient reacts to external stimuli and may indicate an early awakening. The SE, a trustworthy parameter determined by EEG, can be used to assess the hypnotic effects of anaesthetic drugs on the brain. The state entropy level is never equal to RE; it is always greater. A sufficient level of anaesthesia is required for the successful implantation of LMA. Inadequate mouth opening doors, coughing, and body movements during the lighter planes of anesthesia can result in LMA rejection and may be linked to breathing retention and bronchospasm [9,10].

Endotracheal intubation has been routinely replaced by the laryngeal mask airway (LMA) during general anaesthesia, or it has been used as a transitional device between the use of a facemask and endotracheal intubation for emergency airway care. Although Brain's blind insertion method is the most popular, stomach insufflation and anaesthetic gas leaks can still happen during LMA insertion [11]. A variety of procedures, including insertion using the aid of a laryngoscope, were documented for reaching the appropriate anatomical location of the LMA. In order to place the LMA across the tongue at a location below the epiglottis with the least amount of resistance by the oral soft tissues, the technique was developed to better control the tongue and displace the epiglottis [12]. Reliable testing for the effectiveness of this approach hasn't been established, with the exception of fibre optic assessment, which relied on the anatomical position of the vocal cords and epiglottis. The usefulness of the fibre optic scoring method has also been questioned in terms of evaluating the airway seal and sufficient breathing of LMA [13]. Alternative assessment techniques are required. It has recently been suggested that clinical indicators such as "oropharyngeal leak pressure (OPLP)" can be used to assess the accuracy of LMA implantation. In order to assess the level of airway protection, OPLP is frequently evaluated during LMA implantation. High OPLPs are preferable since they show whether positive pressure breathing is possible and how likely it is that a supraglottic airway will be placed successfully. However, no research has been done as of yet assessed the effectiveness of OPLP-based laryngoscope-guided LMA placement techniques [14].

Methods

Study design

This is randomized single blinded cross-sectional study which was conducted from April, 2022 to March, 2023 on 140 such patients who were undergoing surgery in our hospital. A senior medical student having a minimum of three months of experience using paediatric anaesthesia experience or a consultant paediatric anesthesiologist administered anaesthesia to all patients. By standardising a number of significant elements of the anaesthesia method, we aimed to avoid bias while still attempting to have our study represent ordinary practice as closely as feasible. Using the anaesthetist's standard approach, a traditional single-use LMA was inserted following induction of anaesthesia with either sevoflurane or propofol. The cuff pressure was monitored with a manometer to make sure it stayed below the 60 cm H_2O recommended maximum by the manufacturer. Sevoflurane was used to administer a volatile-based anaesthetic to each patient. Every individual was assigned at random to one of four groups 5 minutes before the surgery's conclusion for the deletion of the LMA. There are four different withdrawal techniques: (1) Lateral Deep, Removal of Deeply Anaesthetized in the Lateral Position; (2) Lateral Awake, Removal Awake in the Lateral Position; (3) Supine Deep, Remove Deep Anaesthetized in Supine Position; and (4) Supine Awake, Remove Awake in Supine Position. Each group has 35 patients.

Inclusion and exclusion criteria

The study included patients from age 1 to 16 years, Participants in the study had to have American Society of Anaesthesiologists (ASA) health ratings 1 to 2 and have parental informed consent. Patients who had an ASA of 3 or higher, clinically severe congenital heart disease, gastroesophageal reflux disease, or a predicted difficult airway were omitted. Infants younger than one year, people planned to have dental or airway surgery (which could result in an airway following surgery that is bloody), and anyone scheduled to facilitate magnetic resonance imaging was also excluded.

Statistical analysis

The study has used SPSS 25 for effective statistical analysis. MS Excel was used The continuous data has been written in mean ± standard deviation while the discrete data has been presented as frequency and its respective percentage. The study as employed ANOVA as the statistical tool for its analysis. The level of significance was considered to be $P<0.05$.

Ethical approval

Each patient was explained about the process of the study and the consent was obtained from each of them. The study process has been approved by the Ethical Committee of the concerned hospital.

Results

Table 1 shows the baseline characteristics of patients. There are 45 females and 95 males in total. The patients were divided into four groups lateral awake, lateral deep, supine deep, supine awake each with 35 patients. The overall baseline characteristics are similar in all groups.

Table 1: Demographic and baseline characteristics of patients in this study

Characteristics	**Lateral awake (n=35)**	**Lateral deep (n=35)**	**Supine deep (n=35)**	**Supine awake (n=35)**
Age (years) mean	7.1	8.3	8.1	7.7
Sex, n				
Female	15	12	10	8
Male	20	23	25	27
BMI (kg m-3) mean	19	19.1	17.9	19.5
Surgical speciality, n				
Paediatric surgery	20	18	21	16
Plastic surgery	4	2	6	7
Opthalmic surgery	5	7	3	7
Orthopaedic surgery	6	8	5	5
Pre medication				
Midazolam	5	4	3	6
None	30	31	32	29
Length of LMA , n				
1.4	0	1	0	0
2.1	20	10	15	14
2.5	7	10	8	10
3	8	11	10	8
4	0	3	2	3

The main outcome metric is described in Table 2 at the number of patients with one or more documented airway difficulties for every group in addition to the overall amount of complications. When a partial upper airway obstruction developed, the accompanying anesthesiologist or nurse detected it right away and took care of it. Over the span of the trial, no patients were ever turned into the medial to supine positions, however, seven initially supine patients were additionally shifted to the lateral position to assist with airway management during recovery. When the LMA was removed, no patients developed laryngospasm, and there were only four instances of desaturation below 90%. After the LMA was removed, an airway obstruction associated with stridor was caused Along with access to an oropharyngeal airway, manual breathing support was required for a single individual in the supine deep group who briefly desaturated to 66%. Another individual was desaturated to 88% while lying supine and awake after biting on a partially disconnected LMA. (Table 3).

Table 2: The proportion of patients who experienced airway issues after removing their laryngeal mask in each group.

Complication	**Lateral awake (n=35)**	**Lateral deep (n=35)**	**Supine deep (n=35)**	**Supine awake (n=35)**	**Total**
Laryngospasm	0	0	0	0	0
Desaturation <90%	0	0	2	2	4
Retching/vomiting	0	2	2	2	6
Biting stem of LMA	0	7	0	7	14
Stridor/ partial airway obstruction	2	9	17	2	20
High secretions	13	0	0	15	8
Patients with one or more number of complications	6	2	12	8	28

The study of the overall rate of complications (Figure 1) and the secondary outcome, the average "Clinical Importance" rating (Figure 2) assigned to the problems that took place in each group, revealed incredibly substantial disparities across the four groups. Analysis of these groups' scores showed very significant variations (P 0.001), with the supine deep group experiencing more clinically severe difficulties.

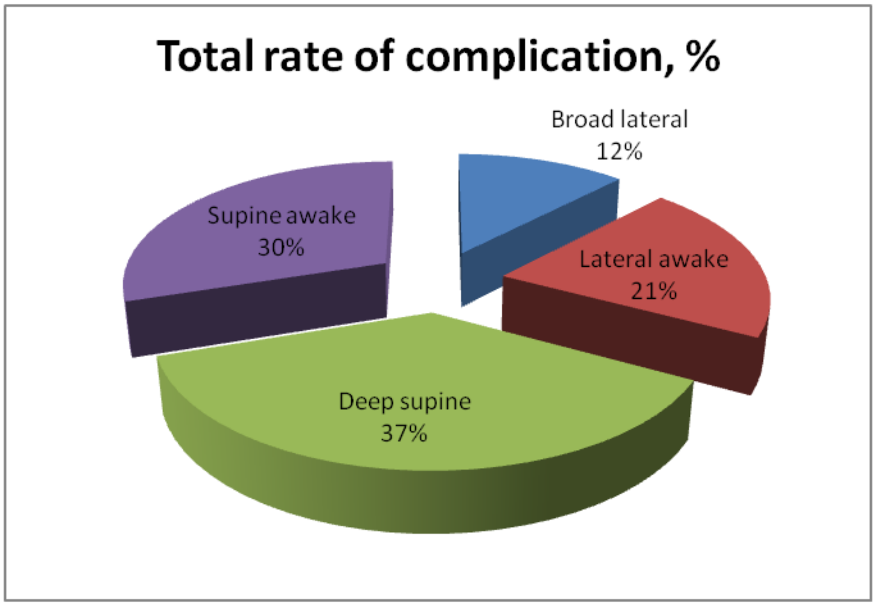

Figure 1: Rate of complications in each position

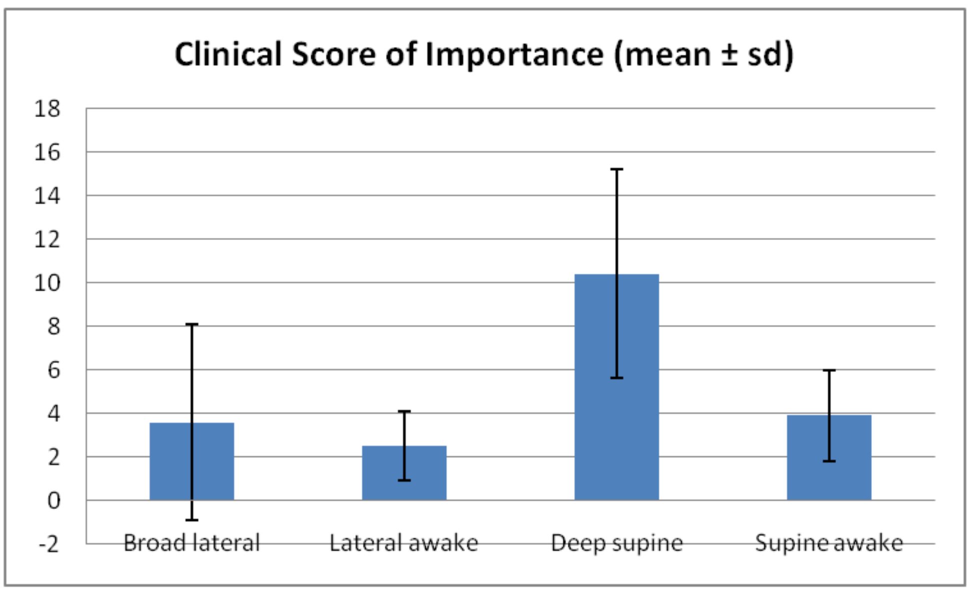

Figure 2: Clinical score of Importance for each position

Discussion

In order to increase the success rate of installation, numerous approaches are explained because inserting a laryngeal mask airway in a child is not always simple. Determining the best insertion technique is crucial since prolonged failure insertion and repeated attempts are linked to severe respiratory events including trauma in infants. in addition to recent discoveries about the cuff pressure and level of anaesthesia in the insertion of the laryngeal mask airway [15]. To enhance its functionality, Children's laryngeal mask airways have undergone several modifications, among them the ProSeal laryngeal mask airway. According to reports, when utilized to insert a conventional laryngeal mask airway for children, the rotating technique with a slightly deflated cuff had the best insertion rate and the fewest challenges [16]. The cuff for the laryngeal mask airway is associated with considerable hyperinflation & increased leakage in clinical goals for cuff inflation. It is exceedingly challenging to make conclusions about obtaining depth during laryngeal mask airway implantation, the dose of intravenous anaesthetic agents with the end-tidal level of volatile anaesthetics should be given to children [17]. Children who use the ProSeal laryngeal mask airway have very high insertion success rates on the first try. For inserting a traditional laryngeal mask airway for youngsters, the rotational method may be the initial option. When children are using a laryngeal mask airway, routine cuff pressure control is required. The laryngeal mask airway for children is modified by the ProSeal device, which is promising and increases insertion success [18].

When it comes to removing a laryngeal mask airway (LMA) for children, clinicians' clinical practices vary greatly. Many of the airway issues that arise after recovery are related to the child's position and the level of anaesthetic, and they may be preventable. We wanted to know if removing the LMA from the lateral position lessens the likelihood of airway difficulties, whether they occur while awake or during an extended plane of anaesthesia. According to the findings of the current study, lateral positioning of kids during LMA removal offers the safest circumstances if the LMA is being removed during a deep plane with anaesthesia. Foundation for Sheffield Children's NHS [19].

In order to select the proper insertion depth when using a flexible laryngeal mask airway (FLMA), this study set out to elucidate the relationships between insertion depth among patient age, body weight, height, and other variables. When it is difficult to detect opposition during FLMA insertion, also assessed an insertion strategy that makes advantage of the shift in intracuff pressure to position the FLMA properly. Following the onset of general anaesthesia, a decrease in intracuff pressure, as determined by a manometer, was used to guide FLMA insertion [20].

A fibre optic bronchoscope was used to evaluate the FLMA location. At the conclusion of each surgical procedure, the total FLMA insertion depth was assessed. Then, utilizing age, height, weight, the length of the nasal tragus, and the length of the sternum, a model of multiple linear regression was established. Height and weight can be used to determine the FLMA insertion depth. In situations when resistance is challenging to detect, an effective alternate insertion technique is constant tracking of intracuff pressure throughout FLMA insertion [21].

The “laryngeal mask airway (LMA)” must frequently be repositioned in youngsters due to the LMA's frequent displacement within the hypopharynx. The arytenoids shift ventrally when the LMA's tip is inserted into the oesophagal entrance. Ultrasound (US) can be used to identify asymmetric elevation in arytenoid cartilage when the LMA rotates and deviated due to the ventral motion of the arytenoids. In the study, the goal was to assess the incidence of LMA malposition observed in the US in pediatric patients. Comparing the incidence of LMA malposition in “fibre optic bronchoscopy (FOB)” versus ultrasound (US) was the study's main objective. The additional consisted of assessing the link between LMA malposition detected by US and that detected by FOB as well as the diagnostic effectiveness using US to identify LMA malposition. US shows promise as an accurate technique for recognizing a rotated LMA, but not being able to detect an LMA's poor depth [22].

In general anaesthesia, laryngeal mask tubes are becoming more common as supraglottic devices. While a supraglottic airway device is being implanted, ultrasound can deliver a dynamic image. In the current investigation, simultaneous ultra-sonographic imaging was used to determine the frequency of incorrect laryngeal mask replacement and positioning in kids. It is safe and efficient to utilize ultrasonography to check and reposition the laryngeal mask airway [23].

Conclusion

The study has concluded that it is best to turn the patient into lateral position before removing the laryngeal mask airway, whether the patient is in deep plane of anaesthesia or the patient is awake. When the LMA have to be removed while the individual in need is supine and profoundly sedated, airway obstacles need to be prepared and properly addressed. having undergone the fact that our study was a single-centre randomly assigned trial conducted at a tertiary children's hospital, we acknowledge it has exterior reality because we studied a sample of

ISSN:0975-3583,0976-2833 VOL14,ISSUE05,2023

children who could be found in any population of children undergoing day-case surgery and chose a study design that allowed our findings to be transferable to other settings. We acknowledge that our study design has limitations. The sample size was determined based on the results of an observational investigation, which served as a pilot study due to the lack of directly applicable published data. Nevertheless, our sample sizes were comparable to those employed in a number of previous studies of a similar character. The anaesthetic technique was not completely standardized, which could have resulted in bias, although we did not observe a great deal of variation in our groups.

References

1. Van Zundert TCRV, Brimacombe JR, Ferson DZ, et al. Archie Brain: celebrating 30 years of development in laryngeal mask airways. Anaesthesia 2012; 67:1375–1385.
2. Mason DG, Bingham RM. The laryngeal mask airway in children. Anaesthesia 1990; 45:760–763.
3. Johnston DF, Wrigley SR, Robb PJ, Jones HE. The laryngeal mask airway in paediatric anaesthesia. Anaesthesia 1990; 45:924–927.
4. McGinn G, Haynes SR, Morton NS. An evaluation of the laryngeal mask airway during routine paediatric anaesthesia. Pediatr Anesth 1993; 3:23– 28.
5. Lopez-Gil M, Brimacombe J, Alvarez M. Safety and efficacy of the laryngeal mask airway. A prospective survey of 1400 children. Anaesthesia 1996; 51:969–972.
6. Singh, S., Bansal, S., Kumar, G., Gupta, I., & Thakur, J. R. (2017). Entropy as an Indicator to Measure Depth of Anaesthesia for Laryngeal Mask Airway (LMA) Insertion during Sevoflurane and Propofol Anaesthesia. *Journal of Clinical and Diagnostic Research: JCDR*, *11*(7), UC01
7. Seet E, Rajeev S, Firoz T, Yousaf F, Wong J, Wong DT, et al. Safety and efficacy of laryngeal mask airway supreme versus laryngeal mask airway ProSeal: a randomized controlled trial. Eur J Anaesthesiol. 2010;27:602–7.
8. Francksen H, Bein B, Cavus E, Renner J, Scholz J, Steinfath M, et al. Comparison of LMA unique, Ambu laryngeal mask and soft seal laryngeal mask during routine surgical procedures. Eur J Anaesthesiol. 2007;24:134–40.

9. Brimacombe J, Keller C. Comparison of the flexible and standard laryngeal mask airways. Can J Anaesth 1999;46:558–63.
10. Brimacombe J, Keller C. Comparison of the flexible and standard laryngeal mask airways. Can J Anaesth 1999;46:558–63.
11. Turner MW, Masou P. The reinforced LMA—what is needed is less flexibility. Anaesthesia 1999;54:603
12. Ghai B, Ram J, Makkar JK, Wig J. Fiber-optic assessment of LMA position in children: a randomized crossover comparison of two techniques. Paediatr Anaesth 2011;21: 1142–7.
13. Kahrilas PJ, Dodds WJ, Dent J, Haeberle B, Hogan WJ, Arndorfer RC. Effect of sleep, spontaneous gastroesophageal reflux, and a meal on upper esophageal sphincter pressure in normal human volunteers. Gastroenterology 1987;92:466–71.
14. Shimbori H, Ono K, Miwa T, Morimura N, Noguchi M, Hiroki K. Comparison of the LMA-ProSeal and LMA-Classic in children. Br J Anaesth 2004;93:528–31
15. Ghai B, Ram J, Makkar JK, Wig J. Fiber-optic assessment of LMA position in children: a randomized crossover comparison of two techniques. Paediatr Anaesth 2011;21:1142–7
16. Mizushima A, Wardall GJ, Simpson DL. The laryngeal mask airway in infants. Anaesthesia 1992;47:849–51
17. Gupta D, Srirajakalidindi A, Habli N, Haber H. Ultrasound confirmation of laryngeal mask airway placement correlates with fiberoptic laryngoscope findings. Middle East J Anaesthesiol 2011;21:283–7
18. Brimacombe J, Berry A. Insertion of the laryngeal mask airway– a prospective study of four techniques. Anaesth Intensive Care 1993;21:89–92
19. Ghai B, Wig J. Comparison of different techniques of laryngeal mask placement in children. Curr Opin Anaesthesiol. 2009 Jun;22(3):400-4. doi: 10.1097/aco.0b013e3283294d06. PMID: 19434792.
20. Thomas-Kattappurathu, George & Kasisomayajula, Ananth & Short, Judith. (2015). Best position and depth of anaesthesia for laryngeal mask airway removal in children: A randomised controlled trial. European journal of anaesthesiology. 32. 10.1097/EJA.0000000000000286.
21. Lee JH, Oh HW, Song IK, Kim JT, Kim CS, Kim HS. Determination of insertion depth of flexible laryngeal mask airway in pediatric population-A prospective observational

study. J Clin Anesth. 2017 Feb;36:76-79. doi: 10.1016/j.jclinane.2016.10.012. Epub 2016 Nov 29. PMID: 28183579.

22. Kim J, Kim JY, Kim WO, Kil HK. An ultrasound evaluation of laryngeal mask airway position in pediatric patients: an observational study. Anesth Analg. 2015 Feb;120(2):427-32. doi: 10.1213/ANE.0000000000000551. PMID: 25545750.
23. Arican, S., Pekcan, S., Hacibeyoglu, G., Yusifov, M., Yuce, S., & Uzun, S. T. (2021). The place of ultrasonography in confirming the position of the laryngeal mask airway in pediatric patients: An observational study. *Brazilian Journal of Anesthesiology (English Edition)*, *71*(5), 523-529. https://doi.org/10.1016/j.bjane.2020.12.014.