Section A-Research paper
ISSN 2063-5346

A Comparative Study of Manikin v/s Conventional Method of Laryngeal Mask Airway Insertion by Novice

First Author: Dr. Anjali Bhure, Professor and H.O.D, Department of Anaesthesiology, NKPSIMS & RC and Lata Mangeshkar Hospital, Nagpur, Maharashtra, India.
Email: anjali_bhure@yahoo.co.in

Second Author: **Dr. Rachana Naitam,** Assistant Professor, Department of Anaesthesiology, NKPSIMS & RC and Lata Mangeshkar Hospital, Nagpur, Maharashtra, India.
Email: rachana.saryam@gmail.com

Third Author: Dr. Sumita Bhargava, Associate Professor, Department of Anaesthesiology, NKPSIMS & RC and Lata Mangeshkar Hospital, Nagpur, Maharashtra, India.
Email: bhargavasumita@yahoo.in

Fourth and corresponding Author: Dr. Ketaki Marodkar, Associate professor, Department of Anaesthesiology, NKPSIMS & RC and Lata Mangeshkar Hospital, Nagpur, Maharashtra, India.
Email: drketaki_didolkar@yahoo.co.in

Fifth Author: Dr. Geeta Sethuraman, Senior Resident, Department of Anaesthesiology, All India Institute of Medical Sciences, New Delhi, India.
Email: geetasthrmn@gmail.com

Sixth Author: Dr. Akansha Upase, Junior Resident, Department of Anaesthesiology, NKPSIMS & RC and Lata Mangeshkar Hospital, Nagpur, Maharashtra, India.
Email: dr.akanshaupase.au@gmail.com

Received Date: 14/07/2022 Revised Date: 18/08/2022 Accepted Date: 23/09/2022

Abstract

Background: "Laryngeal Mask Airway (LMA)" are considered as an effective, safe and easy gadget for airway management as compared to endotracheal intubation in many emergency situations. All health care personnel should be well versed with techniques of airway management to prevent morbidity and mortality due to hypoxia. This study was conducted to assess the skills of novice resident of "laryngeal mask airway" insertion after exposure to manikins in comparison with conventional method of LMA. **Materials and methods:** A total of 12 first year junior resident of anaesthesiology department was enrolled for a randomised controlled interventional trial. These participants were divided into two groups. The control group received training on the patients for 2 weeks while the interventional group received training on the manikin for 1st week and on the patients for 2nd week. As per allocation the participant's performance in the interventional group and control group were evaluated by another expert in terms of number of attempts, time taken for successful insertion, adequate ventilation, and complications, if any. **Results:** The mean no. of attempts in interventional

group on manikin were lesser than that of control groups, but the difference was not found to be statistically significant. The mean no. of attempts in interventional group in operation theatre higher than that of control groups and the difference was found to be statistically significant. The number of complications in manikin group were lesser compared to the OT group and the association was found to be statistically significant. **Conclusion:** Simulation training for learning practical skills of "laryngeal mask airway" insertion has been proven to be beneficial for LMA placement and recommendation of simulation training to improve learning is effective.

Keywords: Laryngeal Masks, Airway Management, Junior Residents, Manikin, Novice.

DOI: 10.48047/ecb/2022.11.9.25

Introduction: In the year 1999, Institute of Medicine revealed that approximately 98000 hospital deaths occur every year due to medical error in the United States [1]. "Simulation based medical education" enables skills, knowledge and attitude to be acquired by Healthcare Professionals in a safe educationally oriented and efficient manner [2]. Earlier LMA was used only in the operation room setting, however it is now being used widely in the emergency setting.

The "laryngeal mask airway (LMA)" can be utilised in a variety of airway management scenarios and is frequently an effective substitute for the more technically difficult operation of intubation. According to one theory, patients having standard surgical operations under general anaesthetic need to be aware of optimal insertion technique in order to use the LMA effectively [3]. However, there is a trend towards using simulators, from low-fidelity to high-fidelity, for training in practical clinical skills [3-5]. Prior to trying the LMA insertion on actual patients, Dierdorf advises practising on a manikin [2].

The literature examining the efficacy of various LMA placement training methodologies is scarce, despite the fact that there are many studies contrasting LMAs to other airway management devices [6–11]. We discovered four studies [8, 12–14] that examined LMA training outcomes in vitro (i.e., using a mannequin) but lacked contemporaneous controls during the process of carefully analysing simulation training. None of the aforementioned requirements were met by these studies. We discovered three studies that assessed outcomes in actual patients, however these studies [15–17] did not include contemporaneous controls, thus they only met the first criterion. Last but not least, a study that evaluated LMA placement mannequin training utilising contemporaneous controls examined its results on a cadaver [18]. We couldn't find any studies comparing various "doses" of mannequin training that met both our requirements for using randomised controls and measuring patient proficiency. This essay details such an investigation.

Even in the early weeks of training, anaesthesia residents may be the first to respond to airway emergencies. These residents might not be familiar with the arsenal of airway techniques, even the most basic of which could save a person's life. Hence simulation training for learning practical skills of "laryngeal mask airway" insertion has been chosen for LMA placement. This study is aimed to assess the skills of novice resident of "laryngeal mask airway" insertion after exposure to mannikins.

Materials and Methods

Approval from the institutional ethics committee was obtained. Sample size consisting of 12 1styear junior residents (JR) of Anaesthesiology Department were enrolled in the randomized controlled interventional trial (with written consent). A pre-test was conducted for all the participants and video-assisted Didactic lecture was delivered by an expert, who has served more than 10 years in Anaesthesiology. These participants were divided into two groups.

Randomization was done using computer generated methods. The control group received training on the patients while the interventional group received training on the manikin for 1st week and on the patients for 2nd week. A senior anesthetist assessed the performance of the students with the help of an Assessment form. The assessment form was validated by two experts from the department and was used in the pilot study where the JR II residents were included who did not participate in the study. No attempt was considered successful without the consent of the assessor. Then all the JR I were given single attempt on each day for one complete week as per the allocation on manikin or on the patients. As per the allocation the participants' performance on the real patient in the interventional group and participants performance on the simulator in the control group was evaluated by another expert in terms of number of attempts, time taken for successful insertion, proper ventilation, and complications, if any. Later, a post-test of all the participants was conducted and they were asked to fill up feedback forms. The above method helped to assess whether Manikin training of LMA insertion helped in improving the proficiency of junior residents and also the degree of difficulty involved. The JR I who did not receive training on manikin were offered training on manikin after the completion of study.

Results

On the manikin, the mean number of attempts in the interventional group was lower than in the control group. The difference was not discovered to be statistically significant, though. In comparison to the control group, the interventional group's mean time for insertion on the manikin was shorter. A statistically significant difference was discovered. (Table 1 and Figure 1)

Table 1: Comparison of Interventional group on manikin versus Control group on patients in Operation theatre

Variables	Manikin (Interventional)	OT (Control)	t-test	p value
No. of Attempts	1.3 ± 0.13	1.47 ± 0.19	- 1.808	0.42
Time taken for insertion (in seconds)	31.28 ± 1.28	33.64 ± 3.73	- 1.47	0.03

The mean number of interventions in the operating room was higher in the interventional group than in the control group. It was determined that the difference was statistically significant. In the operating room, the interventional group required less time on average for insertion than the control group. However, it was not determined that the difference was statistically significant. (Table 2 and Figure 1)

Table 2: Comparison of Interventional group versus Control group on patients in Operation theatre

Variables	OT (Interventional)	OT (Control)	t-test	p value
No. of Attempts	1.08 ± 0.09	1 ± 0	2.18	0.0001
Time taken for insertion (in seconds)	19.25 ± 1.13	17.67 ± 2.97	1.213	0.05

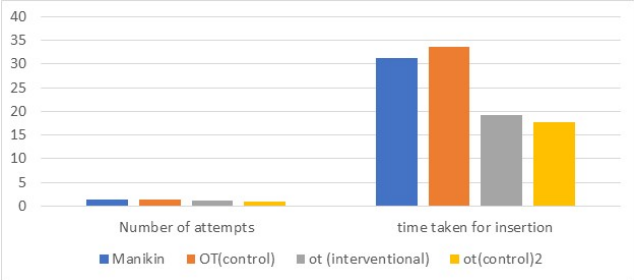

Figure 1: Comparison of Interventional group on manikin versus Control group on patients in Operation theatre

In comparison to the operating theatre group, the mean number of attempts was higher in the manikin group. It was not determined that the difference was statistically significant. In comparison to the operating theatre group, the mean insertion time was longer for the manikin group. It was determined that the difference was statistically significant. (Table 3)

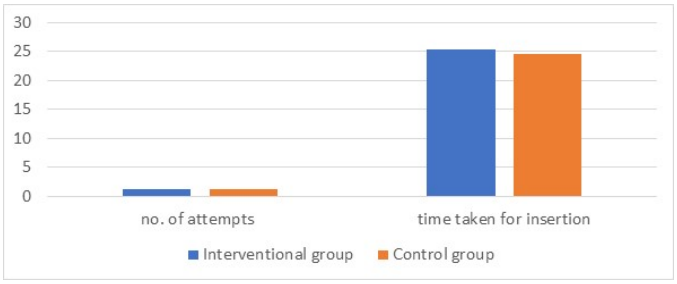

Figure 2: Comparison of Interventional group and Control group in terms of complications

Table 3: Comparison of Interventional group and Control group in terms of number of attempts and time taken for insertion

Variables	Manikin	OT	t-test	p value
No. of Attempts	1.28 ± 0.22	1.23 ± 0.098	0.509	0.1004
Time taken for insertion (in seconds)	25.3 ± 0.96	24.65 ± 3.06	0.494	0.02

In comparison to the OT group, the manikin group experienced less difficulties. It was determined that the connection was statistically significant. Comparison of the number of insertion attempts and time between the interventional group and the control grou. (Table 4 and Figure 2)

Table 4: Comparison of Interventional group and Control group in terms of complications

Complications	Manikin	OT	X^2	p value
Present	3	9	3.27	0.03
Absent	69	63		

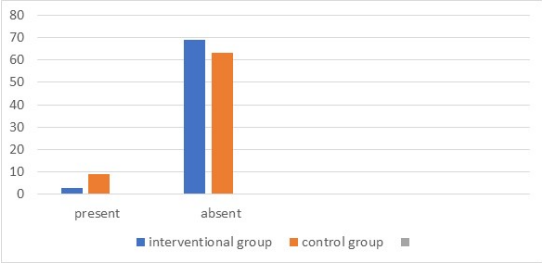

Figure 3: Comparison of Interventional group and Control group in terms of complications

Discussion

Developed by Dr. Archi Brain, a British anesthesiologist, the supraglottic airway device known as the "laryngeal mask airway (LMA)" has been in use since 1988. It was first employed in the operating room for elective ventilation. It is a good substitute for bag-mask ventilation and has the advantages of causing less stomach distention and releasing the provider's hands. In addition, the LMA has more recently been utilised in the emergency environment as a crucial airway device for challenging airway care. LMA is made to cover the supraglottic structures and rest in the patient's hypopharynx, providing for the trachea's relative isolation.

A key factor contributing to morbidity is unsuccessful tracheal intubation attempts [19,20]. Skills in airway management are crucial in both clinical and emergency scenarios. The first healthcare provider's ability to successfully and quickly manage the airway in these circumstances is essential. Nevertheless, even though tracheal intubation is thought to be the best technique for opening and keeping an airway open and secure. It is a challenging skill to master, required for ongoing practise to stay proficient, and has very high failure rates in the hands of inexperienced users [21]. Various alternative airway supraglottic devices have been developed over the past 30 years to reduce failure rates. For medical professionals who are infrequently required to deal with airway management, these devices may be helpful.

The LMA has consistently been an effective tool for securing the airway in emergency settings. For LMA to be effective for ventilation, it must be simple for beginners to operate and offer dependable airway patency and seal pressure. There are several simulated manikins available, with prices ranging from a few hundred to several thousand dollars. Animal and cadaver airway models both have high learner satisfaction rates and have been shown in modest trials to improve patient-level results. This method is typically regarded as risk-free for the animals and significantly increases realism without endangering human patients. This technique can also be used to teach medical professionals how to intubate patients with normal airways, although it is less effective when managing problematic airways. Numerous types of airway trainers can be used in conjunction with technologically based tactics to enhance the learning process.

In our study, it was observed that the trainees from the interventional group (mannikin) experienced better ease of insertion, lower insertion time and higher success rate when compared to the control group. Also, the postoperative events like sore throat, post operative nausea and vomiting, blood staining on device, lip damage where lower among the trainees in Interventional group. Similar studies were done by B.W. Howes et al. And Timmermann et al where they reported “90% first time insertion success rate with no failures” and “100% participants achieved ventilation with LMA Supreme in less time and more efficiently”. The purpose of this study was to investigate whether manikin training helped in improving the skill of 1st year Junior Residents of “Laryngeal Mask Airway” insertion during their regular clinical practice on real patients and also the degree of difficulty involved.

With repetitive practice and feedbacks given by the participants, there was an improving trend of performance seen in the novice due to more opportunity to practice their skills. The overall attempts taken by the trainees who practiced on mannikin before placing LMA in real patients where reduced due to acquired skills by practice. The feedbacks given by trainees suggested that they were more comfortable in using LMA on real patients after their mannikin training programme, helping them to improve their skills and preparing for real life situations with less complications as observed in our study.

The sample was dominated by studies done in a simulated setting [22,23]. Manikin simulations are useful techniques to help with the development of clinical skills and decision-making because they may replicate realistic scenarios of life-or-death circumstances without endangering the wellness of the patients [24, 25]. "They have been utilised extensively in research pertaining to airway management. According to a study (35) done in a paediatric resuscitation environment, the insertion time was 5.98 seconds (p0.001), which is significantly different from the values indicated above". This discrepancy may be caused by the employment of these devices by various groups of people in various manikins and environments.

"By employing videotapes, mannequin practise, and a demonstration on an anaesthetized patient, 11 naval medical trainees were studied by Davies et al. (25). In terms of LMA insertion, they reported 100% success in their participants for the initial patient, 82% success for the second patient, over 90% success moving forward, and an overall success rate of 94%. They have better first-patient success rates than in our study. Additionally, Higginson et al [26] contrasted five LMA insertions on a mannequin with the same mannequin training plus extra in vivo patient instruction. In their "mannequin training only group," they discovered a 75% first-time LMA insertion success rate in vivo".

To imitate the limited operating room training that most people who aren't anaesthetists receive, Coulson et al used manikin-only instruction. The authors believe that having operating room training would have increased insertion success rates. Following operating room training versus manikin-only training, Rumball and McDonald [27] discovered that the success rate of pre-hospital cardiopulmonary resuscitation by emergency medical assistants was higher. However, Roberts and colleagues [28] showed that there was no difference in success rate between training with a manikin alone versus training with a real patient in an operating room trial.

Directed learning is made possible by simulation in a setting that is secure for both the learner and the patient. With routine airway control and adjustments, manikins can increase learner comfort. The learning objectives of each simulation scenario can be changed. Each scenario type can be customised for various learner levels and academic fields. In order to help a learner who is having difficulty with an objective, the facilitator can halt the scenario, give timely feedback, and then resume the simulation. This will give the learner another chance to do better. The ability to simulate a challenging or unusual clinical presentation, the ability for the trainee or team to repeat the experience with feedback, and the opportunity for trainees to experience and practise managing a rare event—particularly if they haven't dealt with one before during training—are all significant benefits of simulation training.

The manikins utilised appear to execute effectively for the tasks, and manikins enable optimal study conditions. Manikin studies' findings can serve as a crucial planning aid for clinical trials, even if they may not exactly mirror actual clinical trials. Findings from the current study's usage of low fidelity manikins seem to support the idea that there is no additional benefit to practising with manikins after the initial brief session. In a comprehensive assessment of medical simulators, repetitive practise and providing feedback

were identified as the two most crucial elements for effective learning [29], and participants in good practise were monitored during the intervention training.

Conclusions

Complications observed between 2 groups was statistically significant with lesser complications observed in group who had prior manikin training before LMA placement. Hence, simulation training for learning practical skills of "laryngeal mask airway" insertion has been proven to be beneficial for LMA placement and recommendation of simulation training to improve learning is effective.

Declarations

Funding

This research received no external Funding.

Author contributions

Conceptualization, A.B, S.B., R.N.; Validation, A.B., K.M.; Data Collection, R.N., G.S., A.U.; Writing - Original Draft Preparation, A.B., R.N., A.U.; Writing - Review & Editing, A.B., S.B., K.M.; Supervision, A.B.

Conflict of interest

The authors declare no conflict of interest.

Data availability

Data supporting the result of this study shall, upon appropriate request, be available from the corresponding author.

Ethics approval

Institutional ethic commission, NKPSIMS & RC and LMH, Nagpur (IEC/1/2021) dated 30/12/2021, approved the study.

References

1. Kohn LT, Corrigan JM, Donaldson MS editors, To ERR is Human: Building a Safer Health System. Washington: National Academics Press (US):2000
2. Gaba D, DeAnda A, A Comprehensive anaesthesia simulation environment: Re- creating the operating room for research and training Anaesthesiology 1988; 69:387-94
3. Maran NJ, Glavin RJ: Low- to high-fidelity simulation - A continuum of medical education? Medical Education 2003, 37:22-28.
4. du Boulay C, Medway C: The clinical skills resource: a review of current practice. Medical Education 1999, 33:185-191.
5. Kneebone R, Nestel D, Wetzel C, Black S, Jacklin R, Aggarwal R, Yadollahi F, Wolfe J, Vincent C, Darzi A: The human face of simulation: Patientfocused simulation training. Academic Medicine 2006, 81:919-924. Dierdorf SF: Education in the use of the laryngeal mask airway. International Anesthesiology Clinics 1998, 36:19-29.
6. Garcia-Guasch R, Ferra M, Benito P, Oltra J, Roca J: Ease of ventilation through the cuffed oropharyngeal airway (COPA), the laryngeal mask airway and the face mask in a cardiopulmonary resuscitation training manikin. Resuscitation 2001, 50:173-177.
7. Pennant JH, Walker MB: Comparison of the endotracheal tube and laryngeal mask in airway management by paramedical personnel. Anesthesia & Analgesia 1992, 74:531-534.

8. Weksler N, Tarnopolski A, Klein M, Schily M, Rozentsveig V, Shapira AR, Gurman GM: Insertion of the endotracheal tube, laryngeal mask airway and oesophageal-tracheal Combitube. A 6-month comparative prospective study of acquisition and retention skills by medical students. European Journal of Anaesthesiology 2005, 22:337-340.
9. Reinhart DJ, Simmons G: Comparison of placement of the laryngeal mask airway with endotracheal tube by paramedics and respiratory therapists. Annals of Emergency Medicine 1994, 24:261-263.
10. Cook TM, Porter MV: Randomized comparison of the classic Laryngeal Mask Airway™ with the Airway Management Device™ during anaesthesia. British Journal of Anaesthesia 2003, 91:672-677.
11. Timmermann A, Russo S, Crozier TA, Eich C, Mundt B, Albrecht B, Graf BM: Novices ventilate and intubate quicker and safer via intubating laryngeal mask than by conventional bag-mask ventilation and laryngoscopy. Anesthesiology 2007, 107:570-576
12. . Ander DS, Hanson A, Pitts S: Assessing resident skills in the use of rescue airway devices. Annals of Emergency Medicine 2004, 44:314-319.
13. Tiah L, Wong E, Chen MFJ, Sadarangani SP: Should there be a change in the teaching of airway management in the medical school curriculum? Resuscitation 2005, 64:87-91.
14. Vertongen VM, Ramsay MP, Herbison P: Skills retention for insertion of the Combitube and laryngeal mask airway. Emergency Medicine 2003, 15:459-464
15. Davies PR, Tighe SQ, Greenslade GL, Evans GH: Laryngeal mask airway and tracheal tube insertion by unskilled personnel. Lancet 1990, 336:977-979.
16. Murray JM, Vermeulen MJ, Morrison LJ, Waite T: Evaluation of prehospital insertion of the laryngeal mask airway by primary care paramedics with only classroom mannequin training. Canadian Journal of Emergency Medicine 2002, 4:338-343.
17. Frascone RJ, Pippert G, Heegaard W, Molinari P, Dries D: Successful training of HEMS personel in laryngeal mask airway and intubating laryngeal mask airway placement. Air Medical Journal 2008, 27:185-187.
18. Morse Z, Sano K, Kageyama I, Kanri T: The relationship of placement accuracy and insertion times for the laryngeal mask airway to the training of inexperienced dental students. Anesthesia Progress 2002, 49:9-13.
19. Mort TC. Emergency tracheal intubation: complications associated with repeated laryngoscopic attempts. Anesth Analg 2004; 99:607–613.
20. Nasim S, Maharaj CH, Butt I, Malik MA, O' Donnell J, Higgins BD, et al. Comparison of the Airtraq and Truview laryngoscopes to the Macintosh laryngoscope for use by Advanced Paramedics in easy and simulated difficult intubation in manikins. BMC Emerg Med 2009; 9:2.
21. Nolan JP, Deakin CD, Soar J, Bo¨ttiger BW, Smith G. European Resuscitation Council guidelines for resuscitation 2005. Section 4. Adult advanced life support. Resuscitation 2005; 67:S39–S86.
22. Schunk D, Ritzka M, Graf B, Trabold B. A comparison of three supraglottic airway devices used by healthcare professionals during paediatric resuscitation simulation. Emerg Med J. 2013.
23. Tritsch L, Boet S, Pottecher J, Joshi GP, Diemunsch P. Intubating laryngeal mask airway placement by nonphysician healthcare providers in management outof-hospital cardiac arrests: a case series. Resuscitation [Internet]. 2014;85(3):320- 5.
24. Ott T, Tschöpe K, Toenges G, Buggenhagen H, Engelhard K, Kriege M. Does the revised intubating laryngeal tube (ILTS-D2) perform better than the intubating laryngeal mask (Fastrach)? – a randomised simulation research study. BMC Anesthesiol. 2020;20:1-7.

25. Ott T, Tschöpe K, Toenges G, Buggenhagen H, Engelhard K, Kriege M. Does the revised intubating laryngeal tube (ILTS-D2) perform better than the intubating laryngeal mask (Fastrach)? – a randomised simulation research study. BMC Anesthesiol. 2020;20:1-7.
26. Higginson R, Parry A, Williams M. Airway management in the hospital environment. Br J Nurs [Internet]. 2016;25(2):94-100.
27. Rumball CJ, McDonald D. The PTL, combitube, laryngeal mask, and oral airway: A randomized prehospital comparative study of ventilatory device effectiveness and cost-effectiveness in 470 cases of cardiorespiratory arrest. Prehospital Emergency Care 1997; 1:1-10.
28. Roberts I, Allsop P, Dickinson M, Curry P, Eastwick-Field P, Eyre G. Airway management training using the laryngeal mask airway: a comparison of two different training programs. Resuscitation 1997; 33:211-214.
29. Issenberg SB, McGaghie WC, Petrusa ER, Gordon DL, Scalese RJ: Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. Medical Teacher 2005, 27:10-28.
30. Byrne AJ, Pugsley L, Hashem MA: Review of comparative studies of clinical skills training. Medical Teacher 2008, 30:764-767.