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A Study to Evaluate Intubation Through Intubating Laryngeal Mask Airway Using Conventional Polyvinyl Chloride Endotracheal Tube

KEYWORDS: Intubating laryngeal mask airway, PVC endotracheal tube, Blind intubation"

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ABSTRACT ***Background:*** *A purposely designed wire reinforced silicone tube is available for tracheal intubation through intubating laryngeal mask airway (ILMA). However, this tube is expensive and not always available. Hence, cheaper and readily available alternatives such as conventional polyvinyl chloride (PVC) endotracheal tube should be evaluated for intubation through ILMA.*

Methods: *After informed consent, 50 ASA I-II adults with normal airways undergoing elective surgery under general anaesthesia requiring intubation were allocated to undergo blind tracheal intubation through ILMA with conventional PVC endotracheal tube.*

Results: *The overall success rate for intubation through ILMA was 94% [1st attempt 80%; 2nd attempt 10%; 3rd attempt 4%]. Time taken for successful intubation through ILMA was 18.23 ± 5.46 sec. Haemodynamic parameters remained stable and there was no episode of oxygen desaturation throughout the procedure.*

Conclusion: *Conventional PVC endotracheal tube is a feasible alternative to Fastrach silicone tube for blind tracheal intubation through ILMA.*

Introduction:

Tracheal intubation is the conventional way of securing the airway and has been considered the gold standard in airway management.[1] It is routinely accomplished by laryngoscopy, which involves distortion of the upper airway to visualize the glottis leading to unwanted reflex responses.[2] Further, difficult tracheal intubation remains one of the foremost cause of mortality and morbidity in anaesthesia.[3] The introduction of Laryngeal mask airway (LMA) by Dr. AIJ Brain in 1983 and its clinical availability since 1988 has revolutionized the airway management. But classic LMA is not an ideal intubation aid because of its length and diameter limitations.[4] The intubating laryngeal mask airway (ILMA, LMA-Fastrach) was purposely designed to overcome these limitations and since its introduction in 1997, it has been shown to be useful in management of difficult airway and its role in management algorithms has been established.[5]

The manufacturer of the ILMA recommends a dedicated wire reinforced silicone endotracheal tube for intubation through it.[6] The characteristic features of this tube are its straight alignment, wire reinforcement and a soft, conical Touhy-like tip made of silicone. However, it is expensive and less readily available. It also has a low volume, high pressure cuff making it unsuitable for prolonged use. Further, the wire reinforcement has potential disadvantage of impaired ventilation in event of patient biting and causing distortion of lumen of tube. There have been reports of successful tracheal intubation through ILMA using conventional polyvinyl chloride (PVC) tube which is disposable, cheap, readily available and has a high volume low pressure cuff making it suitable for prolonged ventilation.[7-12]

The present study was designed to evaluate feasibility of conventional PVC tracheal tube as alternative to specially designed ILMA tube. The first time and overall success rate of tracheal intubation through ILMA was taken as the primary outcome measure while time taken for tracheal intubation, haemodynamic changes and postoperative complications were taken as secondary outcome measure.

Methods:

After institutional review board approval and written informed consent, 50 ASA I-II adult patients of either sex, between the age of 18-60 years, scheduled for elective surgery requiring general anaesthesia with endotracheal intubation were recruited in the study. Exclusion criteria were patients with known or predicted difficult airways, interincisor distance < 2.5 cm, loose dentition, upper respiratory tract pathology, morbid obesity and risk of aspiration. All the patients were examined during preoperative visit. They were kept fasting for 6 hours prior to scheduled time of surgery. They were premedicated with oral ranitidine 150 mg and alprazolam 0.01mg kg^{-1} the night before and in the morning 2 hours before surgery along with metoclopramide 10 mg orally in the morning at the same time.

In the operation theater, intravenous infusion was started with ringer lactate and standard monitors [HR, ECG, SpO_2, NIBP] were applied. Induction was performed with intravenous glycopyrrolate 0.2 mg, propofol 2 mg kg^{-1}, fentanyl 2 µg kg^{-1} followed by vecuronium 0.1 mg kg^{-1} for neuromuscular blockade. When the patient was fully relaxed with head in neutral position, appropriate sized, fully deflated and well lubricated ILMA was inserted and its cuff inflated as per manufacturer's instruction manual.[13] Correct placement and ventilation with ILMA was judged by chest expansion, auscultation of breath sounds, square wave capnography and no oropharyngeal leak at peak airway pressures of ≥20 cm H_2O. Various adjustment manoeuvers like extension of ILMA handle, optimization manoeuver, up-down manoeuver, head-neck manoeuver, rotation in sagittal plane or lifting away from posterior pharyngeal wall (Chandy manoeuver) were allowed to ensure appropriate positioning and ventilation. If ventilation continued to be a problem even after attempting adjusting manoeuvers,

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patient was excluded from the study and intubation done using conventional laryngoscopy. The PVC endotracheal tube was softened by immersion in sterile water bath heated to 40° C for I min. The well lubricated, softened PVC endotracheal tube, size 7.0, 7.5 or 8.0 mm ID as judged appropriate for the patient, was then passed into the ILMA till 15 cm depth (the distance to epiglottic elevating bar) with its inherent curve facing forward. It was then gently advanced into the trachea without applying undue force and its cuff was inflated and breathing circuit attached. Correct tube placement was confirmed by square wave capnography and auscultation of bilateral breath sounds. The ILMA was then deflated and removed as per manufacturer's guidelines[13] using the designated stabilizing rod to maintain the tube in place which was then reconnected to breathing circuit. If the tube faced resistance, a sequence of adjusting maneuvers were attempted based on the level at which resistance was felt. If resistance was felt at 0-1.5 cm, "smaller ILMA" was used; if at 2 cm, the "up-down manoeuver" or "rotating the tube bevel" was done; if at 3 cm, "larger ILMA" was used; if at 4-5 cm, "smaller ILMA" was used. Time taken for intubation was defined as the time from disconnection of breathing circuit from ILMA to successful tracheal intubation as confirmed by capnography and presence of bilateral breath sounds. A maximum of 3 attempts were allowed for tracheal intubation through ILMA. An attempt was considered if the tube faced resistance followed by adjusting maneuver or esophageal intubation occurred. Tracheal intubation through ILMA was considered as failure if it could not be accomplished within 3 attempts and the patient was intubated using direct laryngoscopy. After intubation, anaesthesia was maintained with end tidal isoflurane 0.5-1% and 66% N_2O in oxygen.

Haemodynamic parameters [HR, systolic blood pressure (SBP), diastolic blood pressure (DBP)] and SpO_2 were monitored at various time intervals as: baseline, after induction, after ILMA placement, 0 min, 5 min, 10 min and 15 min after successful tracheal intubation. Any event of hypoxia (SpO2 <90%), mucosal trauma (blood detected on the ILMA when it was removed from patient's mouth after completion of intubation), and occurrence of hoarseness and/or sore throat postoperatively were noted.

Results:

The demographic profile of the study group is presented in table 1. ILMA placement and ventilation through it was successful in all 50 patients. Tracheal intubation through ILMA was successful in 47 (94%) patients [40 (80%) in 1st, 5(10%) in 2nd and 2(4%) in 3rd attempt], while it could not be accomplished in 3(6%) patients.(Table 2) These were considered as failure and patients intubated with direct laryngoscopy. Esophageal intubation occurred in 3(6%) patients. Adjusting manoeuvers used were up-down manoeuver in 9 (18%), rotating the tube bevel in 3(6%) and changing to smaller size ILMA in 1(2%) patient. The mean time for successful tracheal intubation through ILMA was 18.23 ± 5.46 sec. (Table 2) There was no episode of desaturation (SpO_2 < 90 %) and change in haemodynamic parameters was both clinically and statistically insignificant.(Figure 1) Mucosal trauma as detected by blood on ILMA was found in 5 (10%) patients. Sore throat was observed in 8 (16%) patients.(Table 2)

Discussion:

A purposely designed straight, soft, wire reinforced silicone tube with distal conical Tuohy like tip is recommended by manufacturer for insertion through ILMA. The ILMA guides this tube towards the plane of glottis without distortion of anatomy with reported success rate of 89 - 99.3%[14-16] Blind tracheal intubation through ILMA using conventional PVC endotracheal tube (PVCT) has shown varying success rates. Sharma et al reported overall success rate of 96% and first attempt success rate of 90% with PVCT.[7] Shah et al reported 82.14 % first attempt and 93.33 % overall success rate with PVCT.[8] Kundra et al demonstrated 86% first attempt and 96% overall success rate with PVCT.[9] The results are comparable to our study. Kanazi et al reported 57% overall success rate with PVCT due to impingement of tip of ETT on the tubercle of epiglottis.[10] Lu et al reported 96.7% overall success rate (75% first attempt) with Sheridan PVCT.[11] Our higher first attempt success rate compared to previous studies may be attributed to appropriate ILMA placement and softening of tube by prewarming.

The difficulties with conventional PVC tubes are due to their curvature, stiffness and lateral opening bevel. This makes the PVCT to emerge at more obtuse angle from distal aperture of ILMA as compared to ILMA tube. This non alignment of axes of the trachea and tube results in increased incidence of failed intubation and trauma. Insertion of PVCT with reverse orientation has been shown to increase the first time success rate by decreasing the emergence angle compared to normal orientation.[11,12] Softening of the PVC tube by prewarming and avoiding force during tracheal intubation decreases the incidence of trauma. Inappropriate positioning of ILMA in relation to glottis can also cause increased number of attempts and higher failure rate. Lu et al[11] in their study reported inappropriate ILMA positioning as the cause of failure in 54.5% of patients. In our study, good mask glottis alignment was assured before tracheal intubation was attempted. This was done by attempting various adjusting manoeuvers to produce appropriate ILMA position as confirmed by chest expansion, auscultation of breath sounds, square wave capnography and no oropharyngeal leak with peak airway pressures ≥20 cm H_2O. This might account for higher success rate than other investigators.[10]

Sharma et al[7] reported mean tracheal insertion time of 14.71 ± 6.21 sec , Shah et al[8] recorded it as 22.42 ± 8.5 sec, Kundra et al[9] as 11.8 sec and Joo et al[17] as 23 sec. The difference in times as compared to our study can be due to difference in adjusting maneuvers and technique of insertion of PVCT.

Lu et al[18] reported no significant hemodynamic changes in ankylosing spondylitis patients intubated with PVCT through ILMA. This is comparable to our study as the haemodynamic changes were neither clinically nor statistically significant.

There are certain limitations to our study. Firstly, it is a feasibility study and comparison with the silicone wire reinforced ILMA tube has not been done. Secondly, study group consisted of patients with normal airways and results might not apply to patients with difficult airways.

Conclusion:

Blind tracheal intubation through ILMA with conventional PVC tube is a feasible alternative to wire reinforced silicone ILMA tube.

Table 1:
Demographic data of the study group

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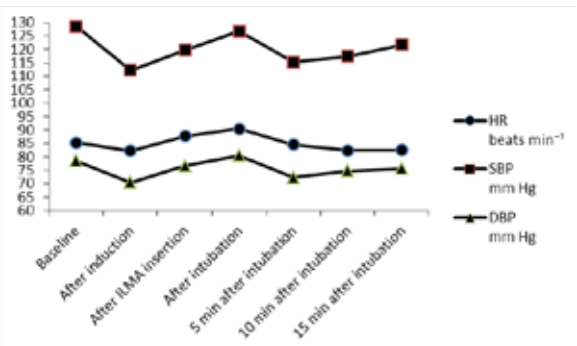
Demographic profile parameter	Measured Value n = 50
Age, yr	37.64 ± 11.47
Sex, M/F, n (%)	28/22 (56/44)
Weight, kg	58.86 ± 8.99
Height, cm	163.24 ± 8.81
BMI, kg m^{-2}	22.04 ± 2.67
ASA, I/II, n (%)	39/11 (78/22)

Data are expressed as mean ± SD or number of patients (%) BMI: Body mass index

Table 2:
Number of attempts, time of insertion and complications

Variable			Measured Value n=50
Number of Attempts, n (%)	One		40 (80%)
	Two		5 (10%)
	Three		2 (4%)
	Failure		3 (6%)
Time of insertion, sec			18.23 ± 5.46
Complications		Mucosal Trauma	5 (10%)
Sore throat		8 (16%)	

Figure 1:
Heart Rate (HR), Systolic BP (SBP) and Diastolic BP (DBP) at specified times



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