ORIGINAL ARTICLE

Ease of Proseal Laryngeal Mask Airway Insertion Using Miller Blade; a Comparison with Conventional Digital Technique

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Abstract

The Current study compared the success rate and rate of complications between digital insertion and Miller blade-guided insertion of the laryngeal mask airway ProSeal™ (PLMA) when performed by anesthesia residents in adult patients. A total of 126 anesthetized paralyzed adult patients were included in the study. Patients were allocated randomly to one of two groups, i.e., Digital group (PLMA insertion using the digital insertion technique) or Miller group (PLMA insertion using the Miller blade-laryngoscope). We assessed success rates of insertion at the first attempt, insertion time for an effective airway and postoperative morbidity. The success rate of insertion at the first attempt was higher with the Miller-guided technique than with the digital insertion technique (97% vs 72%, respectively; P <0.05). Insertion time at the first attempt for an effective airway were shorter in the Miller group than in the Digital group (33.5 seconds vs. 21.0 seconds P <0.05). Ease of insertion was significantly better when using miller blade to insert PLMA (p<0.05). Blood staining was more frequent in the Digital group than in the Miller group (P <0.05). When inserting the PLMA in adults, anesthesia residents were more successful using the Miller blade-guided insertion technique than using the digital insertion technique

Key Words

Laryngeal Mask Airway, Proseal, Digital Insertion Technique

Introduction

The Proseal laryngeal mask airway (PLMA) (The Laryngeal Mask Company Ltd., Victoria, Seychelles) is an advanced form of the LMA with a softer and larger cuff to improve sealing and a drain tube to permit venting of the stomach. However, when a larger cuff is used, it is more difficult to save space for inserting the PLMA in the patient's mouth, and the larger cuff is more likely to fold over (1, 2). Use of gum elastic bougie, gastric tube, and stylet have been described to avoid this fold over and to increase success s rate and ease of insertion of PLMA (3-10). Use of Mackintosh laryngoscope has been described to assist variety of laryngeal mask airways including classic laryngeal mask airway, flexible laryngeal mask airway and PLMA (11-15). However we have observed that large cuff size of PLMA hampers the smooth insertion of PLMA alongside the Macintosh blade especially in patients with small mouth opening and decreased submandibular space. We attempted to evaluate the use of miller blade, an important part of armamentarium for difficult airway management (15)to ease insertion of PLMA by anesthesia residents at various levels of junior residency (six months to 3 years) and compared its success rate to digital insertion technique.

Materials and Methods

This study was approved by the Institutional ethical committee. Written informed parental consent was obtained during the preoperative visit. A total of 130 anesthetized paralyzed adult patients were enrolled in the study. Patients were allocated randomly to one of two groups, i.e., group D (PLMA insertion using the digital insertion technique) or group M (PLMA insertion using the Miller blade). All patients were managed by anesthesia residents who were unskilled in using each technique under the supervision of faculty members . We accessed success rates of insertion at the first attempt, number of attempts, oropharyngeal leak pressure and insertion time for an effective airway, and airway morbidity if any. A total of 130 patients (American Society of Anesthesiologists physical status I-II, aged 18 to 75) scheduled for surgery under general anesthesia were

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enrolled. In the operating room, routine monitoring was applied which included the electrocardiogram, pulse oximetry, end tidal carbon dioxide , noninvasive blood pressure. IV propofol 2.5 mg .kg - administered intravenously and a standard anesthesia protocol was followed. Manual mask ventilation was performed using 1 vol% isoflurane in 50% oxygen and 50% nitrous oxide and muscle relaxation was achieved with IV atracurium. The PLMA sizes 3, 4 and 5 were used as per the recommendation of manufacturer based on the weight of the patient. All patients were managed by anesthesia residents who were unskilled with the insertion technique .After a ten-minute explanation for each insertion technique (digital and miller blade) according to the instruction manual (LMA™ airway instruction manual, The Laryngeal Mask Company Ltd, 2005), junior residents in the anesthesiology department (postgraduate year 6 months to 3 years) who were unskilled both in the digital technique and laryngoscope guided technique with any of the available blades, performed PLMA insertion with each technique under the supervision of the faculty member.

The digital insertion technique (Group Digital) was performed according to the manufacturer's instructions. The posterior aspect of the deflated mask was coated with a water-based lubricant. The PLMA cuff was fully deflated, held like a pen, and inserted while pressing along the palatopharyngeal curve using the index finger. The PLMA was advanced into the hypopharynx until definite resistance was felt. The Miller blade-guided technique (Group Miller) involved the following steps. The PLMA was lubricated on the posterior aspect of the deflated mask with a water-based lubricant. With the patient's head extended, the Miller blade was fully inserted till posterior pharyngeal wall /esophagus was visualized. The tongue was lifted gently with the Miller blade and the PLMA was introduced into a space between the Miller blade and the maxillary incisors while an operator was holding the bite block of the PLMA. The PLMA was advanced into the hypopharynx until definite resistance was felt, and then the Miller blade was removed. All techniques were performed in the sniffing position .

For both techniques, once the PLMA was inserted into the hypopharynx, the cuff was inflated with recommended volume of air and readjusted to maintain a cuff pressure of 60 cm H2O was achieved. An effective airway was defined as bilateral chest movement and auscultation, normal values of partial pressure of end-tidal co2, (35) normal capnograph curve and spo2 (95) . Once in position, gastric tube insertion was attempted. A lubricated 16F gauge gastric tube was inserted and its correct placement confirmed by synchronous injection of air and auscultation during apnea.

After successful insertion of the device and gastric tube, effectiveness of the airway seal (airway leak pressure) was compared. With the cuffs inflated and the fresh gas inflow to the breathing system at 3L/min, the adjustable pressure limiting valve was closed and airway pressure allowed to increase but not permitted to exceed 40cmH2O; pressure at which gas leakage occurs was determined as heard as audible leak from mouth (16).

The following airway maneuvers were allowed: chin lift, jaw thrust, head extension, or flexion of the neck. Fixation was according to the manufacturer's instructions. The number of insertion attempts was also recorded. If the placement failed after two attempts, the insertion was recorded as a failure and the attending anesthesiologist performed the PLMA insertion or tracheal intubation. Insertion time was defined as the time from picking up the Miller blade (Miller group) or the PLMA (Digital group) to confirming successful placement after inflation of the cuff . Times for all individual attempts were added to calculate the insertion time, and data from patients with failed PLMA insertion after two attempts were excluded from calculation). The number of insertion attempts was recorded and the ease of insertion was assessed. Ease of insertion was graded using a subjective five point scoring system:-4 = insertion at first attempt without tactile resistance, 3 = insertion at first attempt with mild tactile resistance,2= insertion at first attempt with moderate tactile resistance, 1= insertion successful at second attempt,0= insertion failed at two attempts. Insertion attempts for inserting gastric tube.

All episodes of hypoxia (SpO2 < 90%), airway reflex activation (coughing, gagging, and/or laryngospasm), or vomiting during PLMA insertion were documented. Data were recorded on standardized data sheets by observers who were blinded to the insertion technique. At the end of surgery, the PLMA was removed when protective upper airway reflexes returned. Anesthesiologists or surgical colleagues blinded to the method of insertion recorded the presence or absence of blood on the laryngeal masks.

Statistical Analysis

The primary aim of the present study was to compare the success rate of first attempts at insertion. Secondary outcomes included insertion time, ease of insertion of PLMA, success rate and ease of insertion of gastric tube, oropharyngeal leak pressures and postoperative complications. Sample size was selected to on the basis of published study (17) In which inexperienced person achieved an 83% success rate for first attempt LMA Proseal insertion in adults using the digital technique and on accepting that an incremental improvement in success rate was 16% in absolute terms. Sixty-one patients were required in each group for a significance level of 95%

Table1. Demographic Profile

	Digital group (*n* = 64)	Miller group (*n* = 62)
Age, yr	44.5 ± 12.8	41 ± 10.7
Sex, M/F	35/29	39/23
Weight, kg	48 ± 12.5	45 ± 13.4
ASA physical status I/II	45/19	47/15
LMA ProSeal size		
3	40 (62.5)	34 (54.85)
4	22 (34.4%)	25 (40.32)
5	2(3.1)	3 (4.83)

Data are presented as either mean (standard deviation), or as number of patients (%). ASA = American Society of Anesthesiologists. LMA Proseal = Proseal laryngeal mask airway

Table 3. Complications

	Digital group (N=64)	*Miller group (N=62)*
Airway Trauma	8	5
Gastric Secretions On PLMA	1	2
Blood On PLMA		
No	40 (64.6%)	57 (91.93%)*
Mild	18 (26.56%)	4(6.46%)*
Moderate	5 (7.81%)	1(1.61%)
Significant	1 (1.56%)	0 (0%)
SORE THROAT		
After 1 hour	8	7
After 24 hours	7	5
DYSPHAGIA		
After 1 hour	8	6
After 24 hours	7	7
DYSPHONIA		
After 1 hour	3	4
After 24 hours	3	2

*Data are number of patients (%) or mean (standard deviation). *P < 0.05 vs digital group*

with a power of 80%. Therefore, sixty five patients per group were enrolled to compensate for possible dropouts.

Table 2. Insertion Data

	Digital group (*n* = 64)	Miller group (*n* = 62)
Insertion attempt		
1	47(73.43%)	59 (95.16%)*
2	15(23.43%)	3(4.84%)*
Fail	2(3.12%)	0 (0%)
Ease of insertion of plma		
4	30	54*
3	9	3
2	8	2
1	15	3
0	2	0
Attempts to insert gastric tube		
1st attempt	45	55
2nd attempt	13	5*
Failed	6	2
Insertion time (sec)		
At first attempt	33.5(8.9)	21 (5.5)*
Overall insertion time	39.0 (9.8)	34.9 (7.6)
Oropharyngeal seal pressures	32± 5	31± 3

*Data are number of patients (%) or mean (standard deviation). *P < 0.05 vs. digital group*

Data were presented as the number of patients or the mean ± standard deviation (*Table 1*), and were compared between groups using Fisher's exact test, the x^2 test, the Mann-Whitney U test, or Student's t test, as appropriate. P<0.05 was considered to be statistically significant.

Results

One hundred and thirty patients were enrolled. One patient declined to participate; one patient had cardiac arrhythmia during insertion attempts. In two patients there were excessive secretion and regurgitation during insertion attempts and trachea was intubated with tracheal tube. One hundred and twenty six patients completed the study. Demographic data are summarized in *table 1*. The two groups were comparable in terms of age, weight, height, sex, and size of PLMA. Comparison data for the digital insertion and Miller blade-guided techniques are presented in Table 2. The success rate of insertion at the first attempt was higher with the Miller-guided technique than with the digital insertion technique (97% vs 72%, respectively; P <0.05). Insertion time at the first attempt for an effective airway were shorter in the Miller group than in the Digital group (33.5 seconds vs. 21.0 seconds P <0.05) (*Table 2*). Ease of insertion was significantly better when using miller blade to insert PLMA (p<0.05) . Gastric tube insertion failed in 6 patients in digital group and 3 patients in miller group (p>0.05) .Number of attempts to insert gastric tube were more in group miller and slight withdrawal of PLMA was successful in inserting gastric tube in 13 of the patients in second attempt in Miller group and 5 patients in digital group(p<0.05). Blood staining was more frequent in the Digital group than in the Miller group (P <0.05) although it was primarily mild to in nature .airway trauma , gastric secretions on the PLMA , dysphagia, dysphonia and sore throat were comparable (*table 3*).

Dscussion

PLMA insertion in adult patients using the Miller blade-guided technique, had greater success at the first attempt with insertion in shorter time. There was a more ease of inserting of PLMA and gastric tube in Miller group. Incidence of postoperative blood staining was also lower when PLMA was inserted using miller technique than using the digital technique.

The main cause of difficult and failed insertions with the digital technique is impaction of the PLMA at the back of the mouth and glottic inlet.(1,2) Insertion can also occasionally fail due to the tongue buckling up at the back of the mouth. The manufacturer recommends inserting the PLMA with digital manipulation or with an introducer. However, insertion with these techniques can sometimes be difficult and several techniques have been introduced to improve the insertion success rate. Use of an Eschmann® Tracheal Tube Introducer , gastric tube and suction catheter have been described to increase success rate of PLMA However, these techniques require addition instrument and digital assistance to assist insertion of PLMA and are blind (3-9) .Although direct laryngoscopy has been used using mackintosh blade to insert PLMA(3-5), Miller blade has not been evaluated for insertion of plma under vision in adult patients , although it use has been described in pediatric patients to insert classic laryngeal mask airway (14).

Although one could argue to the use of commonly used Macintosh blade for the purpose, we found that in a pilot study, it provided very limited space to insert PLMA as its large flange impeded insertion in many cases with a rough insertion in many cases even when cuff is fully deflated The blade of the Macintosh laryngoscope is much thicker than the Miller blade. In two studies evaluating various straight blades to curved blades , it has been found that laryngoscopic views obtained with the straight blades like Miller blades and Belscope were similar, and better than with the other types of curved laryngoscope blades . Straight blades provide a significantly greater field of view between the posterior end of the blade and the upper teeth than other types of blades. Further in case of prominent upper incisors, geometry may change somewhat, and straight blades make a Miller blade are more favorable than a curved blade like Macintosh blade. In addition, the Macintosh laryngoscopic blade allows only the right half of the oral space for insertion due to displacement of the tongue to the left side of the blade. Thus, it might be less effective than the Miller blade in preserving oral space (18-19). The Miller blade-guided technique provided sufficient oral space by displacing the tongue towards floor of mouth, guiding the distal cuff of the PLMA directly into the hypopharynx without oropharyngeal impaction, and prevented the cuff from folding over, which can reduce mucosal injury and success rate of insertion of gastric tube in first attempt without much manipulation . In addition, there is no need for the operator to place the index finger into the patient's oral space to provide more room for insertion. In previous studies using mackintosh laryngoscope to assist insertion of laryngeal mask airway in adults it has been found it to be simpler and easier method with significantly higher first insertion success rate, more ideal placement position of laryngeal mask airway as evaluate on fiberoptic assessment and lesser sore throat when compared to digital technique .In all these studies these laryngeal mask airway were prototypes of classic laryngeal mask airway were easier to insert with the aid of mack intosh blade due to small size of their cuff , a contrast to large bulkier cuff of PLMA (5-10). Brimacombe J *et al*, Hohlrieder M *et al* and Howath A *et al* have demonstrated significantly high success rate to insert PLMA using mack intosh laryngoscope to insert PLMA by both experienced anesthesiologists and inexperienced anesthesia residents (3-5). However in all these studies ,Macintosh blade was used along with preloading of PLMA over gum elastic bougie .In contrast, we did not loaded our PLMA with gum elastic bougie and wanted to evaluate emergency scenario faced commonly by the residents where in attempt using miller blade may fail to achieve successful tracheal intubation and may aid in insertion of PLMA.In previous studies of LMA Proseal insertion in children, experienced personnel have achieved success rates ranging from 84-94% on their first attempt (19-20). In an another study by Hwang J *et al* used McIvor blade to assist insertion of the LMA Proseal in children, by inexperienced personnel achieved 97% success rate on their first attempt when using McIvor blade in contrast to 78% success rate on their first attempt when using the digital technique (21). However McIvor blade is not a Part of routine armamentarium for difficult airway management, nor is it a part of difficult airway cart (15). Further its use will not make anesthesia residents to learn any addition skills of intubation which

are feasible with miller blade. Alternative laryngoscope blades like miller blade have been strongly recommended in adult patients in difficult airway algorithm. In our study we failed to find any significant differences in the oropharyngeal leak pressures which were comparable. This may be due to increased incidence of misplacement, albeit with feasible ventilation in both the groups despite increased success rate in Miller group. Study has some limitations. First, study was open labeled and it did not evaluate the position of the PLMA directly using a fiberoptic bronchoscope and correct placement was confirmed only by clinical assessment.

Conclusion

This result supports the superiority of the Miller blade-guided technique over the digital technique when performed by anesthesia residents in adults with higher success rate at first attempt and the reduction of oropharyngeal mucosal injury compared to the digital insertion technique for PLMA. However, the efficacy of experienced personnel performing the miller blade-guided insertion technique is unclear. Further evaluations is required with insertion success rate of insertion of PLMA preloaded with gum elastic bougie or gastric tube with the aid of miller blade.

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