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SCIENTIFIC ARTICLE

Impact of the practising anesthesiologist team member on the laryngeal mask cuff pressures and adverse event rate[☆]

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Abstract

Objective: We have planned to evaluate the laryngeal mask cuff pressures (LMcp) inflated by anesthesia workers of several seniority, without using manometer.

Methods: 180 patients scheduled to have short duration surgery with laryngeal mask were included in the study. Five anesthesia specialists (Group S), 10 residents (Group R) and 6 technicians (Group T) inflated the LM; thereafter LMcp were measured with pressure manometer. Participants have repeated this practice in at least five different cases. LMcp higher than 60 cm H₂O at the initial placement or intraoperative period were adjusted to normal range. Sore throat was questioned postoperatively. Groups were compared in terms of mean LMcp and occupational experience.

Results: At the settlement of LM, LMcp pressures within the normal range were determined in 26 (14.4%) cases. Mean LMcp after LM placement in Group S, R and T were 101.2 ± 14.0, 104.3 ± 20.5 cm H₂O and 105.2 ± 18.4 cm H₂O respectively ($p > 0.05$). Mean LMcp values in all measurement time periods within the groups were above the normal limit (60 cm H₂O). When groups were compared in terms of LMcp, no difference has been found among pressure values. Occupational experience was 14.2 ± 3.9; 3.3 ± 1.1 and 6.6 ± 3.8 years for specialists, residents and technicians respectively and measured pressure values were not different in regard of occupational experience. Seven (3.9%) patients had sore throat at the 24th hour interview.

Conclusion: Considering lower possibility of normal adjustment of LMcp and ineffectiveness of occupational experience to obtain normal pressure values, it is suitable that all anesthesia practitioners should adjust LMcp with manometer.

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PALAVRAS-CHAVE

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Anestesia

Impacto do anestesiologista em treinamento sobre as pressões do manguito de máscara laríngea e incidência de eventos adversos

Resumo

Objetivo: Planejamos avaliar as pressões do manguito de máscara laríngea (PMML) inflado por profissionais da área de anestesiologia com tempos de serviço variados, sem o uso de manômetro.

Métodos: Cento e oitenta pacientes agendados para cirurgia de curta duração com máscara laríngea foram incluídos no estudo. Cinco especialistas em anestesia (Grupo E), 10 residentes (Grupo R) e seis técnicos (Grupo T) inflaram os manguitos das máscaras laríngeas; subsequentemente, as PMML foram medidas com manômetro de pressão. Os participantes repetiram essa prática em pelo menos cinco casos diferentes. As PMML superiores a 60 cm H₂O na colocação inicial ou no intraoperatório foram ajustadas para valores normais. Os pacientes foram questionados sobre a presença de dor de garganta no período pós-operatório. Os grupos foram comparados quanto à média das PMML e experiência profissional.

Resultados: Ao inserirem a ML, as pressões do manguito dentro da faixa normal foram determinadas em 26 (14,4%) casos. As médias das PMML após a inserção da ML pelos grupos E, R e T foram 101,2 ± 14,0, 104,3 ± 20,5 cm e 105,2 ± 18,4 cm H₂O, respectivamente, ($p > 0,05$). A média dos valores das PMML em todos os períodos de mensuração entre os grupos estava acima do limite normal (60 cm H₂O). Quando os grupos foram comparados quanto às PMML, nenhuma diferença foi encontrada entre os valores das pressões. A experiência profissional era de 14,2 ± 3,9; 3,3 ± 1,1 e 6,6 ± 3,8 anos para especialistas, residentes e técnicos, respectivamente, e os valores das pressões mensuradas não foram diferentes em relação à experiência profissional. Sete pacientes (3,9%) apresentaram dor de garganta durante a entrevista realizada na 24^a hora.

Conclusão: Levando-se em consideração uma possibilidade menor de ajuste da pressão do manguito da máscara laríngea (PMML) e da ineficácia da experiência profissional para a obtenção de valores normais das pressões, é adequado que todos os profissionais de anestesia ajustem as PMML com manômetro.

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Introduction

Laryngeal mask (LM) has become one of the cornerstones of airway management after its introduction into clinical practise more than 20 years ago. Originally it had been recommended as an alternative for face mask but upon growing experience but now it has a definite role in routine anesthesia care since then. Today, as an alternative airway device it has a worldwide acceptance and it is assumed that more than 200 million patients had anesthesia with LM.¹

LM has a well defined role in American Society of Anesthesiologists (ASA) difficult airway algorithm and it has even gained a place in prehospital care, in the resuscitation of cardiopulmonary arrest victims.^{2,3}

Health care providers other than anesthesiologists use LM especially for emergency airway care in an increasing trend.⁴⁻⁶ On the other hand, although rare, serious adverse events such as nerve injuries have been reported in the literature associated with pressure neuropraxia while using LM.⁷⁻¹⁰ Pharyngolaryngeal adverse events are more common after LM use, but as recently have been demonstrated, the incidence of them can be reduced by adjusting laryngeal mask cuff pressure (LMcp) appropriately.⁷ It can be expected that pharyngolaryngeal adverse event rate due to LMcp, can be lower when the experience of practitioner increases. However, influence of anesthesiologist's seniority

and experience on LMcp has not been studied before. We have hypothesized that increasing experience in anesthesia practise would achieve correct LMcp determination, and reduce the incidence of one of the common LM associated side effect, sore throat rate. In order to test this hypothesis, we have measured LMcp after inflation of the laryngeal mask cuff (LMc) by anesthesia team workers of varying seniority. Primary outcome variable was initial LMcp; secondary outcome variable was determined as sore throat rate after the operation.

Methods

After approval of the hospital ethics committee and obtaining patients' informed consents, 180 adult patients scheduled for short-duration elective surgeries under general anesthesia were enrolled in the study. All the patients were aged between 18 and 70 years, in the ASA I-III risk group. Exclusion criteria have involved patients with the histories of full stomach, recent upper/lower respiratory tract infection, morbid obesity (BMI > 40 kg/m²), hiatus hernia and gastroesophageal reflux.

Before the administration of the general anesthetic, patients were randomly allocated using a random samples table into three groups according to LM practitioner: anesthesia specialist (Group S, $n = 5$), anesthesia resident (Group

R, $n = 10$), anesthesia technician (Group T, $n = 6$). Each anesthesia team worker has performed at least 5 LM insertion and inflation throughout the study. Participants were not allowed to try a second LM insertion-inflation within the same day.

Upon arrival to the operation theater, routine monitoring (ECG, SpO₂ and non-invasive blood pressure measurement) was applied and anesthesia was induced with the same protocol in all patients: fentanyl 1 $\mu\text{g kg}^{-1}$ and propofol 3 mg kg^{-1} . When the eyelash reflex has been disappeared and the jaw was relaxed, LM placement was attempted. Dorsum of LM was lubricated with a water-based lubricant before insertion. LM size was chosen according to the recommendations of the manufacturer (size 3 for adults 50–70 kg; size 4 for 70–100 kg and size 5 for those above 100 kg). Practitioners were allowed to choose one size bigger/smaller if they decide to do so. Standard LM insertion technique according to manufacturer's instruction manual has been used by all practitioners.¹¹ Ventilation was confirmed with EtCO₂ on monitor and chest wall expansion. If LM was not properly placed on the first trial, then it was re-inserted and number of LM placement trial was recorded. LM Classic was completely deflated and partially inflated before insertion. Initial inflation volume was noted and after the placement, when inflating the LMc, practitioners were not allowed to exceed the suggested maximum volume for each LM size (maximum 20 mL for size 3; 30 mL for size 4 and 40 mL for size 5). Each practitioner decided to end inflating LMc by him/herself according to his personal experience. An anesthesiologist other than the practitioner then measured LMcp with a manometer (VBM Medizintechnik, GmbH, Germany) and recorded. If LMcp was higher than 60 cm H₂O, it was reduced to 60 cm H₂O. Anesthesia was maintained with 1 MAC sevoflurane in 50% oxygen–nitrous oxide mixture, sevoflurane dose was adjusted according to discretion of attending anesthesiologist. LMcp measurement was repeated with 15 min intervals and intracuff pressure was adjusted to 60 cm H₂O if it was higher. LMcp on serial measurements were recorded also. At the end of the operation, LM was removed without suctioning when the patient was awake. Adverse events during extubation such as laryngospasm and bloodstain on removed LM were recorded. Patients were transferred to postoperative care unit, postoperative pain was treated with incremental 0.5 mg kg^{-1} tramadol as needed and those having Aldrete score of 9 or higher were transferred to the ward. Sore throat was defined as constant pain on throat. Presence of postoperative sore throat at the 2nd and 24h was questioned by an anesthesia resident blinded to group assignment. 24h data was obtained with phone interview.

Power analysis

The hypothesis of our study was that occupational experience would change initial LMcp. Major outcome variable was initial LMcp. Using the data of a previous study⁷ for LM intracuff pressure (112 \pm 59 cm H₂O), in order to detect 25% difference among the groups, at an alpha error level of 0.05 and a power of 90%, we have calculated that there should be at least 59 patients per group. 60 patients per group were included in the study to overcome any data loss.

Statistical analysis

We analyzed the data with SPSS version 17 (SPSS Inc., Chicago, IL). The normality of the data distribution was assessed with Kolmogorov–Smirnov test. Nominal data were analyzed with the One-Way ANOVA test. Nonparametric data among the groups were analyzed using Kruskal–Wallis and Mann–Whitney *U* test. The pharyngolaryngeal complications were compared among the groups using the chi-square test. *p*-Value less than 0.05 was considered significant.

Results

All patients and anesthesia team workers have completed the study. Demographic data of the patients and durations of operations were similar ($p > 0.05$) and shown in Table 1.

Occupational experience was found to be 4.2 ± 3.9 ; 3.3 ± 1.1 and 6.6 ± 3.8 years for anesthesia specialists, residents and technicians respectively.

Mean initial LMcp were 101.2 ± 14.0 for Group S, 104.3 ± 20.5 for Group R and 105.2 ± 18.4 cm H₂O for Group T. The differences among mean LMcp of groups was not significant ($p > 0.05$).

Mean LMcp values obtained at the initial cuff inflation and the next time intervals have been shown in Tables 2 and 3. There was no statistical difference among LMcp values in the inter-group analysis ($p > 0.05$).

Overall preoperative complication (sore throat, laryngospasm and bloodstain on LM) rate was 13.3% (24 patients). Number of patients having preoperative pharyngolaryngeal adverse events were 6 (10%), 9 (15%) and 9 (15%) within Groups S, R and T respectively. There was no statistically significant difference among the groups with regard to pharyngolaryngeal adverse event rate ($p > 0.05$) (Table 4).

Discussion

We have found that measured mean initial LMcp were higher than suggested values in all groups. Results of the present study have shown that experience of the anesthesia team practitioners does not have an influence on accurate determination of LMcp and related pharyngolaryngeal adverse event incidences. It has also been found that LMcp had a rise trend to exceed normal limits although they were adjusted to normal limits in predetermined time intervals.

Anesthesiologists are a subgroup of health care providers who use LM in their daily routine practise and they are very familiar with the use of it. The other medical personnel such as emergency department physicians, paramedics or nurses who care emergency victims at the ambulance also use LM, LM Fastrach for their patients.^{3–5,12} Rare complications of LM use are especially possible in the setting of emergency airway care of the patients where the primary concern of health care providers is to keep an open airway and continue oxygenation.^{3–5,12}

Hyperinflation of LMc may be harmful because of the exertion of high pressures on pharyngeal and laryngeal structures.¹³ High LMcp can lead to decrease in pharyngeal mucosal capillary perfusion pressure.^{8,14} Ulrich-Pur et al.¹⁴ emphasized that using at maximal cuff volumes according to the manufacturers' guidelines, LM Classic, LM Fastrach and

Table 1 Demographic data and durations of operations in the groups.

	Group S	Group R	Group T	<i>p</i>
Age (year)	48.8 ± 15.8	46.3 ± 15.1	48.5 ± 14.0	0.604
Weight (kg)	72.2 ± 15.6	72.6 ± 16.1	74.5 ± 12.9	0.671
Operation duration (min)	53.7 ± 19.0	54.2 ± 26.6	51.0 ± 18.0	0.678
Sex (F/M)	24/36	19/41	23/37	0.605

Table 2 Measured LMcp at 15 min intervals (cm H₂O), (mean ± SD).

Measurement episode	Group S	Group R	Group T	<i>p</i>
I	101.2 ± 14.0	104.3 ± 20.5	105.2 ± 18.4	0.426
II	83.9 ± 15.8	87.9 ± 15.1	84.5 ± 18.1	0.361
III	80.7 ± 13.9	80.1 ± 15.5	83.8 ± 15.9	0.390
IV	77.5 ± 14.2	78.4 ± 17.4	75.6 ± 12.9	0.669
V	76.5 ± 14.4	71.5 ± 12.3	76.0 ± 17.9	0.375

Table 3 Supramaximal, normal LMcp and overall complication rates within the groups.

Group	LMcp > 120 cm H ₂ O, <i>n</i> (%)	LMcp < 60 cm H ₂ O, <i>n</i> (%)	Complication rate, <i>n</i> (%)
Group S	29 (48.3%)	10 (16.7%),	6 (10.0%)
Group R	29 (48.3%)	9 (15.0%)	9 (15.0%)
Group T	25 (41.7%)	7 (11.7%)	9 (15.0%)
All	83 (46.1%)	26 (14.4%)	24 (13.3%)

Table 4 Rates of intubation attempt, sore throat, laryngospasm and bloodstain on LM according to the groups.

	Intubation attempt 1/2/3 (<i>n</i>)	Sore throat		Laryngospasm (<i>n</i> , %)	Bloodstain on LM (<i>n</i> , %)
		2 h (<i>n</i> , %)	24 h (<i>n</i> , %)		
Group S	56/4/0	2, (3.3%)	2, (3.3%)	2, (3.3%)	0, (0%)
Group R	44/13/3	4, (6.7%)	3, (5%)	0, (0%)	3, (5%)
Group T	50/8/2	7, (11.7%)	2, (3.3%)	0, (0%)	2, (3.3%)

LM ProSeal induced significantly higher pharyngeal pressures compared with all other airway devices such as Combitube, endotracheal tube and the EasyTube. They determined that, using a pharyngeal cuff volume of 40 mL, the Intubating Laryngeal Mask Airway followed by the Laryngeal Mask Airway exerted significantly higher pressures compared with the other devices.¹⁴

Although very rare, it is also possible nerve damages to occur as a result of pressure related trauma to the surrounding tissues.^{9,10,15} Also, hyperinflation of LMc can increase leakage around the LMc.¹⁶ In addition, high LMcp can lead to increased postoperative pharyngolaryngeal morbidity. Overinflation of laryngeal mask especially may lead to postoperative sore throat rate.^{7,17,18} Manufacturer of LM recommends that LMcp should not exceed 60 cm H₂O.^{7,11,17,18}

Seet et al.⁷ has recently demonstrated that intracuff pressure exceeds normal limits when used for anesthesia. As a result of their study they had recommended the routine use of pressure manometers when LM is first placed. Schloss et al.¹⁸ evaluated the incidence of LM hyperinflation and they determined that 53% of subjects had an LM

intracuff pressure exceeds ≥60 cm H₂O. They concluded that significant percentage of patients have an intracuff pressure greater than the generally recommended upper limit of 60 cm H₂O.

However, LMcp adjusted by workers of various experience and team position have not been evaluated in previous studies. Our findings suggest that intracuff pressure occurs as an independent factor of experience.

On the other hand, anesthesia residents, specialists and intensive care physicians have been demonstrated that they adjust endotracheal tube cuff pressures improperly in the previous studies.^{19–22} Galinski et al.¹⁹ have studied the incidence of excessive intracuff pressure in the out-of-hospital setting and they found out that most of cuff pressures were exceeding the normal limits requiring correction. They have recommended frequent measurement and adjustment of cuff pressure as necessary. In a simulation model, Hoffman et al.²⁰ had determined that physicians working on the emergency service of a university were causing to excess pressures, higher than 120 cm H₂O and, concluded, similarly to our study, over-inflation did not had a relationship with

occupational expertise. Endotracheal tube cuff pressure without proper adjustment may exceed recommended limits, which can place the patients unwanted risks.²¹ Ganner²¹ concluded that cuff pressures are too high using the minimal occlusion technique and the cuffs are prone to leaking. Fernandez et al.²² compared the accuracy of this method with instrumental intracuff pressure measurement in tracheal model tests by 20 members of our ICU team and they conclude that precise intracuff pressure measurement is mandatory to prevent complications of over- or underinflation. Morris et al.²³ determine the incidence of endotracheal and tracheotomy tubes cuff overinflation and they concluded that despite increasing awareness among intensivists and respiratory therapists, the incidence of tracheal tube overinflation remains high, with both endotracheal and tracheotomy tubes.

Similarly that Parwani et al.²⁴ determine the ability of paramedics to inflate endotracheal tube cuffs within safe pressure limits as well as to estimate the pressure of previously inflated endotracheal tube cuffs by palpation of the pilot balloon. They concluded that, participants were unable to inflate endotracheal tube cuff to safe pressures and were unable to identify endotracheal tube cuffs with excessive intracuff pressure by palpation. They emphasized that clinicians should consider using devices such as manometers to facilitate safe inflation and accurate measurement of endotracheal tube cuff pressure.²⁴

In this study, our results were in concordance with those of previous studies so that users might achieve incorrect LMcp during their practice. In addition, we determined that anesthesia team members of various occupational expertise were not different from each other in terms of normal LMcp determination since only 14.4% of the cases had LMcp lower than 60 cm H₂O.

LMcp can increase to high pressure values due to diffusion of N₂O into the cuff even if it was accurately inflated at the first attempt or adjusted to normal limits at the beginning of anesthesia practise. During general anesthesia with LM, a significant increase in cuff pressure due to diffusion of nitrous oxide through the cuff wall occurs.^{7,25-27} In previous studies, Ouellette²⁵ demonstrated that there was a gradual increase in the cuff pressure well over a 3-hour period during nitrous oxide and oxygen anesthesia. Maino et al.²⁶ investigated LMcp changes during nitrous oxide exposure and they demonstrated that LMcp increases within 5 min of nitrous oxide exposure were >250% in the LM-Classic. Similarly van Zundert et al.²⁷ studied cuff-pressure changes in the LM-Classic and they demonstrated that during nitrous oxide anesthesia, cuff pressure increases. They concluded that cuff pressures should be monitored during nitrous oxide anesthesia because of less postoperative sore throat when LM-Classic is used.

Burgard et al.²⁸ studied the effect of LMcp on the incidence of postoperative sore throat. They determined that significant increase in cuff pressure is seen during the first 60 min. And they concluded that postoperative sore throat can be reduced when cuff pressure is continuously monitored and kept on low-pressure values.

Results of our study have also demonstrated that LMcp continue to increase and exceed normal limits even if it was adjusted to normal range at the first placement. The reason of this observation is intraoperative N₂O use. Thus, we

further extend the earlier recommendation of Seet et al.⁷ and advise periodic measurements of LMcp intraoperatively.

The sore throat incidence found in our study is similar with the previous study of Seet et al.⁷ This result can be attributed to serial LMcp adjustments when it exceeds 60 cm H₂O.

There are certain limitations of this study. One of the limitations is the fact that all the participants in the study knew the study subject, but it is impossible to conduct such a study in double-blind fashion. All the participants learned what was the LMcp value when they inflate the LM. Although it can be speculated that this knowledge could effect the next LM inflation of the same practitioner, all participants were allowed only one trial in the same day. When we investigate the results, we have observed that each group had similar values at all measurement intervals, thus such an affect did not occur as expected.

In conclusion, we have found that optimal LMcp cannot be properly determined without use of pressure manometers and this skill is independent from practitioner's expertise. As these manometers are cheap and easy to use, we recommend routine use of them both at the initial placement of LM and during the surgery for LMcp adjustment for their contribution to decrease adverse laryngopharyngeal adverse event rate.

Conflicts of interest

The authors declare no conflicts of interest.

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