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Pharyngolaryngeal, Neck, and Jaw Discomfort after Anesthesia with the Face Mask and Laryngeal Mask Airway at High and Low Cuff Volumes in Males and Females

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Background: **There is controversy over (1) the relative incidence of sore throat between the face mask (FM) and laryngeal mask airway (LMA), (2) the efficacy of LMA intracuff pressure reduction as a mechanism for minimizing sore throat, and (3) the relative incidence of sore throat with the LMA between males and females. In a randomized double-blind study, the authors compared laryngopharyngeal, neck, and jaw discomfort with the FM and LMA at high and low cuff volumes in males and females.**

Methods: **Three hundred adult patients were randomly assigned to three equal-sized groups for airway management: (1) the FM, (2) the LMA with a fully inflated cuff (LMA-High), or (3) the LMA with a semi-inflated cuff (LMA-Low). Anesthesia was administered with propofol, nitrous oxide, oxygen, and isoflurane. In the FM group, a Guedel-type oropharyngeal airway and jaw thrust were used only if necessary. In the LMA groups, cuff inflation was achieved with either 15 or 30 ml for the size 4 (females) and 20 or 40 ml for the size 5 (males). The LMA was removed when the patient was awake. Patients were questioned 18–24 h postoperatively about surgical pain, sore throat, sore neck, sore jaw, dysphonia, and dysphagia, and about whether they were satisfied with their anesthetic.**

Results: **The incidence of sore throat was lower in the FM (8%) than the LMA-High (42%) and LMA-Low (20%) groups (both: $P \leq 0.02$). The incidence of sore neck was higher for the FM (14%) than the LMA-High group (6%; $P = 0.05$) but similar to the LMA-Low group (8%). The incidence of sore jaw was higher in the FM (11%) than the LMA-High (3%) and LMA-Low (3%) groups (both: $P = 0.02$). There were no differences among groups for surgical pain or dysphonia. The incidence of dysphagia was lower in the FM (1%) than the LMA-High group (11%; $P = 0.003$), but similar to the LMA-Low group (1%). The incidence of sore throat and dysphagia was lower in the LMA-Low group than the LMA-High group for both males and females (all: $P \leq 0.04$). There were no differences in discomfort levels between males and females in any group. Two patients from the FM group and one from the LMA-High group were not satisfied with their anesthetic. These complaints were unrelated to postoperative morbidity.**

Conclusion: **The LMA causes more sore throat and dysphagia but less jaw pain than the FM. Sore throat and dysphagia are more common with the LMA if the initial cuff volume is high. There are no differences in discomfort levels between males and females. However, these discomforts do not influence patient satisfaction after LMA or FM anesthesia. (Key words: Airway management; complications; cuff pressure; dysphagia; dysphonia; sore throat.)**

PHARYNGOLARYNGEAL complications are common after general anesthesia,[1] and there is evidence that the pattern, severity, and incidence of complications varies with the type of airway device used.[2,3] When comparing the laryngeal mask airway (LMA) with the endotracheal tube, Rieger *et al.*[2] found that the incidence of dysphonia was higher with the endotracheal tube, and dysphagia was higher with the LMA. When comparing the LMA with the cuffed oropharyngeal airway, Brimacombe *et al.*[3] found that the incidence of sore throat and jaw pain was higher for the cuffed oropharyngeal airway. Alexander and Leach[4] suggested that the incidence of sore throat was similar for the LMA and face mask (FM), but Dingley and Whitehead[5] reported a higher incidence with the LMA. In addition, there are conflicting data

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about the influence of *in vivo* intracuff pressure on the incidence of sore throat with the LMA. Burgard *et al.*[6] showed that lowering intracuff pressure reduces the incidence of sore throat, but Rieger *et al.*[7] showed that it has no effect. Nott *et al.*[8] showed that lowering intracuff pressure reduced the incidence of sore throat for females but not for males. Nott *et al.* also noted that sore throat occurred more often in women.[8] In the current study we compared laryngopharyngeal, neck, and jaw discomfort for the FM and LMA at high and low cuff volumes in males and females.

Methods

Three hundred patients (American Society of Anesthesiologists physical status 1-3, aged 18-80 yr) scheduled to undergo general anesthesia with the LMA were randomly assigned, by opening a sealed envelope, to one of three equal sized groups for airway management. Group A was treated with the FM. Group B was treated with the LMA and the cuff fully inflated after insertion (LMA-High). Group C was treated with the LMA and the cuff semi-inflated after insertion (LMA-Low). Patients were excluded if they required surgery to the head and neck or in the prone position, or if they had jaw, neck, mouth, or upper respiratory tract symptoms in the previous 10 days. Ethical committee approval and written informed consent was obtained. Airway management was performed by 25 anesthesiologists with at least 6 months of clinical experience with the FM and LMA (> 100 uses each device).

A standard anesthesia protocol was followed and routine monitoring applied. Intravenous sedation (midazolam 0.02-0.03 mg/kg and fentanyl 0.5-1.0 μg/kg) was given, an FM was applied, and oxygen was administered. Two minutes later, anesthesia was induced with propofol 2-3 mg/kg and maintained with oxygen 33% in N_2O and 0.5-2% isoflurane *via* a circle anesthesia breathing system with a fresh gas flow of 3 l/min. In the FM group, after induction of anesthesia, the chin was lifted and manual ventilation commenced until spontaneous breathing resumed. If an effective airway was not obtained, (1) a Guedel-type oropharyngeal airway was inserted (size 3-5, as considered clinically appropriate), (2) jaw thrust was applied, and (3) an LMA was inserted. An effective airway was judged by normal thoracoabdominal movement and a square wave capnograph trace. In the LMA groups, after induction of anesthesia, the chin was lifted and patients were manually ventilated with an FM without the use of a Guedel-type oral airway or jaw thrust for approximately 1 min before LMA insertion. If FM ventilation was ineffective, the LMA was inserted earlier. The LMA was inserted and fixed according to the manufacturer's instructions.[9] Before insertion, the LMA cuff was deflated until no more air could be evacuated and a clear, water-based lubricant (K-Y Lubricating Jelly; Johnson and Johnson, Maidenhead, United Kingdom) was applied to the dorsal surface. A size 4 LMA was used for females, and a size 5 LMA was used for males.[10] The cuff was inflated with the randomized volume of air (size 4: 15 or 30 ml; size 5: 20 or 40 ml) using a 20-ml syringe and connected to the circle anesthesia breathing system. If the insertion attempt failed or the airway was ineffective, the LMA was reinserted. A maximum of two attempts was allowed. A failed attempt was defined as removal of the LMA from the mouth. If the LMA failed after two attempts, the FM was used. Once the LMA was successfully inserted, manual ventilation was continued until spontaneous breathing resumed. A heat and moisture exchanger was attached to the proximal end of the FM and LMA. A 5-cm-long translucent polyvinylchloride bite block[11] was used with the LMA. Intraoperative analgesia was achieved with morphine (1-2-mg increments as needed).

At the end of surgery, anesthesia was discontinued and the patient transferred to the postanesthesia care unit (PACU). Patients in the FM group were recovered in the lateral position, and patients in the LMA groups were recovered in the supine position. In recovery, supplementary oxygen was given at 4 l/min to the FM group *via* a Hudson mask and to the LMA groups *via* a T-bag[12] that was attached proximal to the heat and moisture exchanger. Patients were treated in the PACU by nurses who had undergone standard training in LMA removal[13] and had experience of at least 100 LMA removals. The LMA was removed when the patient was able to open their mouth on command. Any blood on the LMA was documented. The oral cavity of all patients was assessed for trauma to the lips, tongue, and teeth by the PACU nurse before discharge to the ward. Pharyngeal suction was not performed. Postoperative analgesia in the PACU was achieved with intravenous morphine in 1-2-mg increments. Postoperative analgesia on the ward was achieved with intramuscular morphine and/or oral paracetamol.

Ease of airway management was graded as easy (LMA, one attempt, no tactile resistance; FM, chin lift only), some difficulty (LMA, one attempt, some tactile resistance; FM, chin lift plus oral airway required), and diffi-

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cult (LMA, two attempts; FM, chin lift plus oral airway plus jaw thrust required). Airway management failed if LMA insertion was unsuccessful after two attempts and if FM ventilation failed with the combination of chin lift, a Guedel-type oropharyngeal airway, and jaw thrust. Airway management failures were excluded from the analysis and the cases repeated. The following intraoperative data were collected: dose of anesthesia drugs, minimum alveolar concentration (measured at the start, during, and at the end of surgery), dose of morphine, anesthesia time (injection of propofol until volatile agent switched off), and use of local anesthesia. The following data were collected in the PACU: LMA removal time (volatile agent switched off to LMA removal), blood detected on LMA, lip/teeth/tongue trauma, and dose of morphine. Any other airway problems were noted. Patients underwent a structured interview 18–24 h postoperatively. At the interview, patients were asked if they had any of the following symptoms: surgical pain (pain from the surgical site), sore throat (constant pain, independent of swallowing), sore neck, sore jaw, dysphonia (difficulty speaking and pain on speaking), and dysphagia (difficulty or pain provoked by swallowing). Any symptoms were graded as mild, moderate, or severe. Patients were also asked if they were satisfied with the anesthetic and if they would be happy to have the same anesthetic again. Intraoperative data were collected by the anesthesiologist (unblinded), and postoperative data were collected by two trained data collectors (blinded). Patients were unaware of the airway device used.

Sample size was based on data from previous pharyngeal morbidity studies (reporting a 10% incidence of sore throat with the FM[4] and 15% with the LMA at low cuff volumes[3]) for a type I error of 0.05 and a power of 0.95. Statistical analysis was performed with paired t test (parametric data) and Kruskal-Wallis, Mann–Whitney rank sum, and chi-square tests (nonparametric data). Significance was considered as $P < 0.05$.

Table 1. Demographic, Surgical, and Anesthetic Characteristics for the Face Mask (FM), the Laryngeal Mask Airway High-volume (LMA-High) and the Laryngeal Mask Airway Low-volume (LMA-Low) Groups

	FM	LMA-High	LMA-Low
N	100	100	100
Age (yr)	37 ± 13	42 ± 15	40 ± 14
Height (cm)	170 ± 10	170 ± 10	172 ± 9
Weight (kg)	69 ± 13	73 ± 18	72 ± 14
Male:Female	39:61	49:51	52:48
Smoker (n)	27	18	24
Premedication (n)	5	4	3
Procedures (n)			
General	13	15	16
Gynecologic	47	38	29
Urologic	5	17	17
Orthopedic	35	30	38
Anesthesia drugs			
Propofol (mg)	162 ± 48*	192 ± 45	200 ± 58
Fentanyl (mcg)	79 ± 27*	86 ± 23	88 ± 21
Midazolam (mg)	1.6 ± 1.2	1.8 ± 1.1	1.8 ± 0.9
Morphine (mg)	1.5 ± 3.3	1.7 ± 3.3	1.7 ± 3.2
MAC	1.4 ± 0.6	1.3 ± 0.3	1.3 ± 0.3
Local infiltration (n)	21	32	34
Airway management grade*† (n)			
Easy	59	77	74
Some difficulty	29	14	18
Difficult	12	9	8
Cough or gagging at insertion	2‡	3	4
Cough or gagging at emergence	0	2	1
Anesthesia time (min)	29 ± 17	32 ± 21	35 ± 27
Emergence time (min)		12 ± 10	12 ± 8
Blood detected (n)		8	8
Morphine in recovery* (mg)	2.3 ± 2.3	1.6 ± 1.6	1.7 ± 1.8
Lip trauma	0	0	0
Tongue trauma	0	0	0
Dental trauma	0	0	0

Data are mean ± SD, mean (range), or numbers.

* FM *versus* LMA-High and FM *versus* LMA-Low, all $P < 0.05$.

† Airway management grades: easy (LMA, one attempt, no tactile resistance; FM, chin lift only), some difficulty (LMA, one attempt, some tactile resistance; FM, chin lift plus oral airway required), and difficult (LMA, two attempts; FM, chin lift plus oral airway plus jaw thrust required).

‡ Guedel airway insertion.

Results

Three patients in the FM group had an ineffective airway and were successfully treated with the LMA. One patient in the LMA-High group had an ineffective airway after two failed insertion attempts and was successfully treated with the FM. Data from these patients have been excluded and the cases repeated. There were no demographic or surgical differences among groups (table 1). The dose of propofol was lower in the FM compared with the LMA-High and LMA-Low groups (both: $P < 0.0001$). The dose of fentanyl was lower in the FM compared with the LMA-High ($P = 0.05$) and LMA-Low groups ($P = 0.01$). The dose of morphine in the PACU was higher for the FM than the LMA-High ($P = 0.01$) and LMA-Low ($P = 0.04$) groups. Airway management was more difficult with the FM than LMA-High ($P = 0.005$) and LMA-Low ($P = 0.02$). Data for postoperative morbidity are presented in table 2.

The incidence of sore throat was lower in the FM (8%)

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Table 2. Incidence of Postoperative Morbidity for the Face Mask (FM), the Laryngeal Mask Airway High-volume (LMA-High), and the Laryngeal Mask Airway Low-volume (LMA-Low) Groups

	FM				LMA-High				LMA-Low				Statistics		
Severity score*	1	2	3	T	1	2	3	T	1	2	3	T	FM *versus* LMA-High	FM *versus* LMA-Low	LMA-High *versus* LMA-Low
N	100				100				100						
Surgical pain	18	7	3	28	21	5	7	33	21	7	3	31	NS	NS	NS
Sore throat	6	1	1	8	33	6	3	42	17	1	2	20	<0.0001	0.02	0.01
Sore neck	13	1	0	14	6	0	0	6	7	1	0	8	0.05	NS	NS
Sore jaw	10	1	0	11	3	0	0	3	2	1	0	3	0.02	0.02	NS
Dysphonia	1	1	0	2	2	1	0	3	0	1	0	1	NS	NS	NS
Dysphagia	0	1	0	1	7	4	0	11	0	1	0	1	0.003	NS	0.003

Data are numbers and percentage.

* Severity score: 1 = mild; 2 = moderate; 3 = severe; T = total.

NS = not significant.

than the LMA-High (42%) and LMA-Low (20%) groups (both: $P \leq 0.02$). The incidence of sore neck was higher for the FM (14%) than the LMA-High group (6%; $P = 0.05$) but similar to the LMA-Low group (8%). The incidence of sore jaw was higher in the FM (11%) than the LMA-High (3%) and LMA-Low (3%) groups (both: $P = 0.02$). There were no differences among groups for surgical pain and dysphonia. The incidence of dysphagia was lower in the FM (1%) than the LMA-High group (11%; $P = 0.003$) but similar to the LMA-Low group (1%). The incidence of sore throat and dysphagia was lower in the LMA-Low group than the LMA-High group (all: $P \leq 0.01$). The incidence of sore throat and dysphagia was significantly lower in the LMA-Low group than the LMA-High group for both males and females (table 3). There were no differences in discomfort levels between males and females in any group. For all groups, there was no significant correlation between airway management grade and the incidence and severity of symptoms. Two patients from the FM group and one from the LMA-High group were not satisfied with their anesthetic. One patient in the LMA-High group and one in the LMA-Low group said that they would not be happy to have the same anesthetic again. These complaints were unrelated to postoperative morbidity.

Discussion

Our data show that the pattern, incidence, and severity of postoperative discomfort are different between the FM and LMA. The incidence of sore throat was higher with the LMA, and the incidence of sore jaw was higher with the FM. These differences are probably related to the pharyngeal location of the LMA and the use of chin support with the FM. We found that the frequency of sore throat for the FM (8%) was generally similar to other studies (5–22%).[4,14–16] The incidence of sore throat, dysphonia, and dysphagia for LMA-Low were similar to a previous double-blind study by our group with a similar mean cuff volume.[3] Our data support the findings of Dingley *et al.*,[5] who reported a higher incidence of sore throat with the LMA than with FM. Interestingly, the degree of airway difficulty did not correlate with the

Table 3. Incidence of Sore Throat and Dysphagia for Laryngeal Mask Airway (LMA) Groups in Men and Women

	LMA-High				LMA-Low				P Value: LMA-High *versus* LMA-Low
Severity score*	1	2	3	T	1	2	3	T	
Sore throat									
Men	19 (39)	1 (2)	1 (2)	21 (43)	9 (17)	1 (2)	1 (2)	11 (21)	0.01
Women	14 (27)	5 (10)	2 (4)	21 (41)	8 (17)	0 (0)	1 (2)	9 (19)	0.005
Dysphagia									
Men	5 (10)	1 (2)	0 (0)	7 (14)	1 (2)	0 (0)	0 (0)	1 (2)	0.04
Women	6 (12)	3 (6)	0 (0)	9 (18)	0 (0)	0 (0)	0 (0)	0 (0)	0.002

Data are numbers (%).

* Severity score: 1 = mild; 2 = moderate; 3 = severe; T = total. Male:female ratio 49:51 for LMA-High and 52:48 for LMA-Low.

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frequency or severity of symptoms. This may be related to the small sample size. It has been shown that the Guedel-type oropharyngeal airway does not increase the incidence of sore throat,[16] but there is no published data about jaw thrust and postoperative discomfort. It has been shown that multiple insertion attempts with the LMA increases the incidence of sore throat.[8,17] We found that sore neck was generally more common with the FM than with the LMA. This may be related to use of head-neck manipulation with the FM, but a larger study is required to confirm this finding.

Our data show that cuff volume predicts laryngopharyngeal discomfort after use of the LMA. This contrasts with the findings of Rieger *et al.*,[7] who studied 70 women and found no differences between an intracuff pressure of 30 and 180 mmHg, but supports the findings of Burgard *et al.*,[6] who studied 200 women and found that intracuff pressure limitation to the minimal required for an effective seal reduced the incidence of sore throat. Nott *et al.*[8] studied 839 patients and found that the incidence of sore throat could be reduced in women, but not men, by intracuff pressure limitation. Our data shows that a lower cuff volume is associated with a reduced incidence of sore throat for males and females and that the incidence of sore throat was similar between males and females. These interstudy differences might be related to the size of mask used, the precise volumes/intracuff pressures chosen, or differences in user skill, quality of data collection, or extent of blinding.

Based on the mucosal pressures exerted by the size 4 and size 5 LMA against the female and male pharyngeal mucosa, respectively,[18] there should be no difference in morbidity between males and females. The higher incidence of sore throat and dysphagia at higher LMA cuff volumes suggests that the cause may be impaired perfusion of the oropharyngeal mucosa. In a recent study, our group showed that pharyngeal mucosal perfusion is progressively reduced in the posterior pharynx when mucosal pressure is increased from 34 to 80 cm H_2O.[19] Although mucosal pressures with the LMA are generally lower than 34 cm H_2O, they can exceed this value in some locations at higher cuff volumes.[18,20,21]

We chose to vary cuff volume rather than *in vivo* intracuff pressure because intracuff pressure is rarely measured clinically. The relationship between cuff volume and *in vivo* intracuff pressure has been documented in several recent trials.[22,23] Cuff volumes of 15 and 30 ml for females with the size 4 corresponds to a mean *in vivo* intracuff pressure of 58 and 183 cm H_2O, respectively.[22] Cuff volumes of 20 and 40 ml for males with the size 5 corresponds to a mean *in vivo* intracuff pressure of 63 and 194 cm H_2O, respectively.[23] *In vivo* intracuff pressure would have been higher toward the end of surgery in the current study because of the diffusion of nitrous oxide into the cuff.[24]

We found no correlation between postoperative discomfort and airway management grade, coughing, or gagging. It would seem likely that multiple LMA insertions, or use of jaw thrust, or vigorous coughing and gagging, would lead to increased postoperative discomfort. The lack of correlation may be related to the low incidence of these problems in our study. Interestingly, the incidence of pharyngolaryngeal, neck, and jaw discomfort did not influence the degree of patient satisfaction with anesthesia. This may be related to the low incidence of moderate to severe symptoms.

We conclude that the LMA causes more sore throat and dysphagia but less jaw pain than the FM. Sore throat and dysphagia are more common with the LMA if the initial cuff volume is high. We detected no differences in morbidity between males and females. However, these discomforts do not influence patient satisfaction after LMA or FM anesthesia.

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