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Laryngeal Mask Airway Application During Flexible Fiberoptic Bronchoscopy in Pediatric Patients: Evaluation of 125 Cases

Çocuk Hastalarda Fleksibl Fiberoptik Bronkoskopide Laringeal Maske Uygulaması: 125 Olgunun Değerlendirilmesi

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ABSTRACT

Objective: *The use of the laryngeal mask airway (LMA) during flexible fiberoptic bronchoscopy (FFB) is more advantageous compared to other airway devices. In this study, it was planned to evaluate, the success rates of the usage of LMA for airway maintenance in pediatric patients in FFB and the postoperative complications encountered, together with demographic characteristics, ASA risk groups, duration of anesthesia and bronchoscopic diagnoses of patients, in the light of the literature.*
Methods: *The files of pediatric patients who underwent FFB between March 2013 and October 2015 were reviewed retrospectively. Demographic data of the patients, airway devices used for airway maintenance in FFB (LMA, endotracheal tube, face mask), indications of bronchoscopy, bronchoscopic diagnoses, duration of anesthesia, postprocedural desaturation, laryngospasm, bronchospasm, and the number of patients requiring reintubation were recorded.*
Results: *A total of 125 children with an age range of 7 days-18 years were included in the study. The median age of the patients was found to be 44 months (interquartile range 11.5-124 months), and median weight was 15 kg (interquartile range 8-30 kg). The most common indication for FFB was recurrent lung infection (26.4%). LMA was successfully performed in 95.9% of the patients. In total, 7 (5.6%) patients had temporary hypoxia and 1 (0.8%) had bronchospasm. Two patients were intubated and transferred into intensive care unit. Multivariate logistic regression test showed that the duration of anesthesia lasting longer than 45 minutes increased the risk of complications 7 times.*
Conclusion: *FFB via LMA is a safe method in the pediatric patient group. The risk of complications increases with the duration of anesthesia, rather than with ASA risk group, age, weight and dimensions of LMA.*

Keywords: *Child, flexible fiberoptic bronchoscopy, laryngeal mask airway*

ÖZ

Amaç: *Laringeal maske (LMA)'nin fleksibl fiberoptik bronkoskopi (FFB) sırasında kullanımı diğer hava yolu araçlarıyla karşılaştırıldığında daha avantajlıdır. Bu çalışmada, çocuk hastalarda FFB'de hava yolu idamesi için LMA kullanımının uygulama başarı oranları ve karşılaşılan postoperatif komplikasyonları hastaların demografik özellikleri, ASA risk grupları, anestezi süresi ve bronkoskopik tanıları ile değerlendirerek literatür eşliğinde gözden geçirilmesi planlandı.*
Yöntem: *Mart 2013-Ekim 2015 tarihleri arasında FFB yapılan çocuk hastaların dosyaları geriye dönük olarak incelendi. Hastaların demografik verileri, FFB'de hava yolu idamesi için kullanılan hava yolu gereci (LMA, endotrakeal tüp, yüz maskesi), bronkoskopi endikasyonları, bronkoskopik tanıları, anestezi süresi, işlem sonrası desaturasyon, laringospazm, bronkospazm ve reentübasyon gereken hasta sayısı kaydedildi.*
Bulgular: *Yaş aralığı 7 gün-18 yaş olan toplam 125 çocuk hasta değerlendirmeye alındı. Median yaş 44 ay (çeyrekler arası aralık 11.5-124), median ağırlık 15 kg (çeyrekler arası aralık 8-30) olarak bulundu. En sık FFB endikasyonu tekrarlayan akciğer enfeksiyonu (%26,4) idi. LMA hastaların %95,9'unda başarı ile uygulandı. Toplamda 7 hastada (%5,6) geçici hipoksi, 1 hastada (%0,8) bronkospazm görüldü. İki hasta entübe edilerek yoğun bakıma alındı. Çok değişkenli logistic regresyon testi ile anestezi süresinin 45 dk.'dan uzun sürmesinin komplikasyon riskini 7 kat arttırdığı saptandı.*
Sonuç: *LMA yoluyla FFB çocuk hasta grubunda güvenli bir yöntemdir. Komplikasyon riski ASA risk grubu, yaş, kilo, LMA boyutları ile değil uzun anestezi süresi ile artmaktadır.*

Anahtar kelimeler: *Çocuk, fleksible fiberoptik bronkoskopi, laringeal maske*

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INTRODUCTION

After its introduction by Brain in 1983, laryngeal mask airway (LMA) has been increasingly used by anesthesiologists [1]. Most important causes for this trend are as follows: Compared with other airway management tools, it provides the opportunity to evaluate supraglottic airways during bronchoscopy and to allow dynamic visualization of the airways without the need for muscle relaxants [2]. LMA insertion success is 67-99% in the child [3]. The success rate of LMA placement in children is associated with the practitioner's experience. The most important problem identified in children is the increase in LMA application difficulties due to the decrease in age.

FFB has become a major tool for evaluating respiratory disorders in children but is often considered to be invasive. Pediatric bronchoscopy requires teamwork for both the anesthesiologist and the pulmonologist because the patient's airway is the common denominator [4].

With this study, we planned to review the literature concerning the placement success rates and postoperative complications of the classical LMA used during FFB that began to be applied in our clinic.

MATERIAL and METHOD

Preoperative Procedures:
After obtaining the approval of the local ethics committee (2015-074), records of 125 pediatric patients aged between 0-18 years in whom FFB was performed between March 2013 and October 2015 were evaluated retrospectively. Patients were examined by an anesthetist at least a day before the procedure, and their informed consent was taken. Salbutamol inhaler 0.15 mg kg^{-1} (max. 2.5 mg) was given 30 minutes before the FFB, and intravenous (IV) 0.1 mg kg^{-1} midazolam was given for premedication. In the operating room, heart rates (HRs) of the patients were monitored using three-channel electrocardiography, noninvasive blood pressure, peripheral oxygen saturation (SpO_2) and end-tidal carbon dioxide ($EtCO_2$) were also routinely measured.

Operative Procedures:
Intravenous 2 mg kg^{-1} propofol, and 1 mcg kg^{-1} fentanyl were given for anesthesia induction. After 2 minutes of mask ventilation, anesthetist positioned lubricated classic LMA (LarySeal®, Flexicare, UK) selected according to the weight of the patient. During insertion of LMA, forefinger technique was used. LMA was insufflated according to instructions. Three criteria were used to determine the succes of manipulation. 1) Bilateral chest movements, 2) Equal lung ventilation by auscultation and 3) Capnography waveforms seen on monitor. Insertion failed under the circumstances of partial or complete obstruction and with serious air leakage. The second attempt was carried out by jaw thrust maneuver or repositioning the head. Catheter mount (Plastimed®, Turkey) permitting the passage of the bronchoscope, was used between respiratory circuit and the LMA (Figure 1). During FFB, anesthesia was maintained via inhalation of a mixture of 2-2.5% sevoflurane with 50% N_2O in 50% O_2.

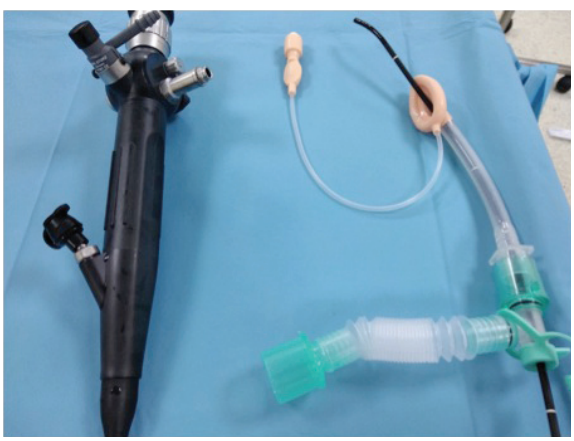

Figure 1. Mount catheter

All procedures were performed using the 3.7 mm (Karl Storz® 11002BD1) FFB and performed by the same pediatric pulmonologist. Cormack-Lehane score grade I-II was evaluated as a glottis image that allows bronchoscopy to be easily performed without any need for manipulation.

One ml of 2% prilocaine was sprayed via the suction channel of FFB to reduce the incidence of laryngospasm and bronchospasm, before FFB passing through vocal cords and carina. After bronchoscopy, LMA was removed if patients had spontaneous ventilation with sufficient tidal volume.

Evaluated parameters of patients' anesthesia and bronchoscopy records included demographic data, insertions of LMA/other instruments, causes of success/failure of LMA applications, and desaturation after removal of LMA, laryngeal spasm/bronchial spasm and re-intubations and transfers to intensive care units.

SpO_2, which went down below 92% but did not last longer than 60 seconds (s), was evaluated as transient hypoxia. Lower SpO_2 values that lasted longer than 60 s and/or accompanied by laryngospasm or bronchospasm were accepted as major complications.

Statistical Analysis

First, the descriptive characteristics of variables (mean, median and number and percentage) were calculated. Compliance of numerical variables with normal distribution was checked. In the comparison of two groups, Student t test was used for normally distributed numerical variables, and Mann-Whitney U test was used for non-normally distributed numerical variables. Comparison of categorical variables was performed with chi-square test and Fisher exact test. The risk factor analysis was performed for the complications. Therefore firstly a univariate logistic regression analysis, then multivariate logistic regression test were performed with all variables. $p<0.05$ was considered statistically significant. "Statistical Package for Social Sciences-SPSS 17" (Chicago, USA) program was used in the evaluation of the results.

RESULTS

Between March 2013 and October 2015, 125 children were given general anesthesia for FFB. The median age was 44 months (interquartile range 11.5 to 124 months), and median weight was 15 kg (interquartile range 8-30 kg). Seventy-two (57.6%) patients were male and 53 (42.4%) were female. Demographic data and ASA classifications of the patients were given in Table I. Namely, 45.6% of the patients were in the ASA III-IV risk group. Disease distributions for bronchoscopy indications were given in Figure 2. Mostly seen indications were recurrent lung infections (26.4%) and atelectasis (24.8%). The diagnoses of cases after FFB were given in Figure 3. FFB results were considered to be normal in 28% of the cases. The structural airway abnormalities were determined in 30% and infection in 28% of the patients. LMA was used in 116 patients (92.8%). Five patients underwent FFB via ETT and two via face mask. FFB was applied to two patients who underwent tracheostomy using their tracheostomy canules in the intensive care unit due to prolonged mechanical ventilation (Table II). Among 5 patients who under-

Table I. Demographic data and ASA classification

	Median	Interquartile range
Age (months)	44	11.5-124
Weight (kg)	15	8-30
	Patient (n)	**Percentage (%)**
Gender (M/F)	72/53	57.6/42.4
ASA classification I/II/III/IV	18/50/46/11	14.4/40/36.8/8.8

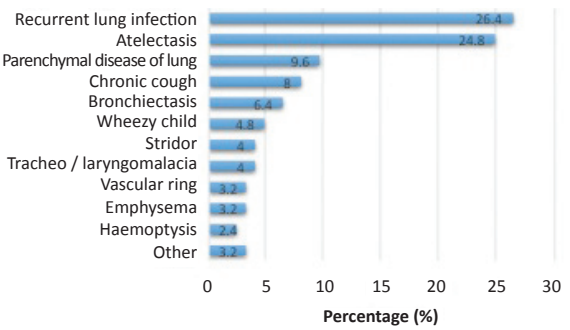

Figure 2. Indications for flexible bronchoscopy

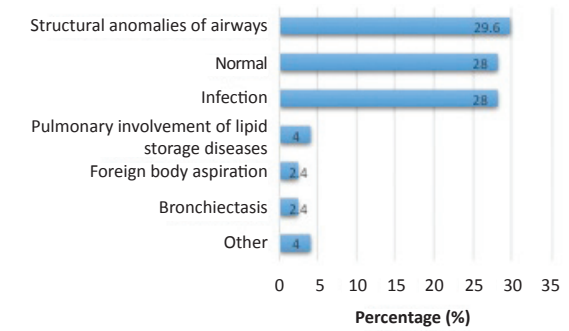

Figure 3. Bronchoscopic findings

Table II. Demographic data and ASA classification

Instruments	Patient (n)	Percentage (%)
LMA	116	92.8
ETT	5	4
Face mask	2	1.6
Tracheostomy tube	2	1.6

LMA; Laryngeal mask airway, ETT; Endotracheal tube

went FFB via ETT, 3 were intubated due to inadequate airway control with LMA and FFB was performed using the intubation tube. Two patients with inhalation burns came from the service as intubated. In two patients, FFB was performed with the help of a mount catheter attached between the face mask and the breathing circuit.

Insertion success rate for LMA was 95.9 %. The success was 90.9% for infants under 1 year old. Forty-four patients (35.2%) were under 1-year-old.

Bronchoscopy procedure was completed in all patients. The duration of anesthesia was found to be 38.56±14.17 min. The duration of anesthesia was longer in patients with complications (Figure 4). After removal of the LMA at the end of the procedure, 7 patients with LMA (5.6%) developed transient hypoxia, and 1 patient had bronchospasm (0.8%). Two patients underwent the procedure with LMA, but the patient was intubated with the appropriate ETT because of insufficient airway maintenance and was transferred to intensive care unit as intubated due to respiratory and hemodynamic parameters which could not tolerate extubation at the end of the procedure (1.6%). In Table III, complications after LMA removal were shown. When the variables were evaluated individually (age <12 months, weight <16 kg, 1 and 1.5 no LMA, being in the ASA III and IV risk group and duration of anesthesia longer than 45

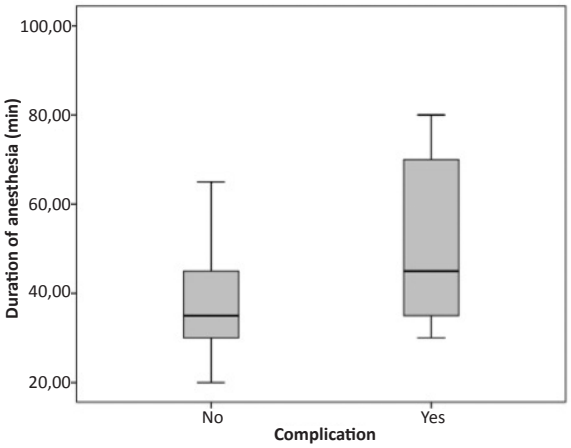

Figure 4. Anesthesia duration of patients with and without postoperative complication

Table III. Patients with complication

Patient	Age (months)	Gender	ASA	Indication	Bronchoscopic Finding	Preoperative Hypoxia	Complication
1	14	M	3	Stridor	Structural anomalies of airways	No	Transient hypoxia
2	0.5	M	4	Tracheo/laryngomalacia	Structural anomalies of airways	Yes	Transient hypoxia
3	21	F	2	Atelectasis	Structural anomalies of airways	No	Transient hypoxia
4	18	M	3	Infection	Normal	No	Transient hypoxia
5	144	F	3	Infection	Infection	No	Transient hypoxia
6	3.5	F	3	Atelectasis	Infection	Yes	Transient hypoxia
7	81	F	2	Atelectasis	Bronchial cyst	No	Transient hypoxia
8	72	M	1	Atelectasis	Foreign body aspiration	No	Bronchospasm
9	44	M	4	Bronchiectasis	Infection	Yes	Transfer to ICU with ETT
10	16	M	3	Infection	Structural anomalies of airways	Yes	Transfer to ICU With ETT

ICU: Intensive Care Unit, ETT: Endotracheal tube

Table IV. Univariate and multivariate logistic regression analysis results for complication development

	Univariate logistic regression analysis for complication development				Multivariate logistic regression analysis for complication development			
	OR	Confidence interval		p	OR	Confidence interval		p
Duration >45 min[a]	6.611	1.606	27.217	0.009	7.054	1.294	38.439	0.024
Age<12 month[b]	0.741	0.149	3.693	0.715				
Weight<16 kg[c]	2.458	0.606	9.98	0.208				
LMA 1/1.5[d]	2.743	0.582	12.929	0.202				
ASA III/IV[e]	3.033	0.747	12.324	0.121				
Gender[f]	0.898	0.24	3.355	0.873				

[a](Ref:Duration <45min), [b](Ref:>12 month), [c](Ref:weight>16 kg), [d](Ref:LMA>1/1.5), [e](Ref:ASA=I-II), [f](Ref=girl)
No interaction was found between the independent variables

min), long duration of anesthesia was found to be a risk factor (p<0.05). Two of the patients who developed transient hypoxia were in need of O_2 because of preoperative hypoxia. Both patients who intubated and transferred to the intensive care unit after FFB needed O_2 during the preoperative period due to hypoxia. Since preoperative SpO_2 values could not be found completely in the records of patients, preoperative hypoxia could not be evaluated as a risk factor.

Multivariate logistic regression test was used for complication development. It was determined that anesthesia duration longer than 45 min increased the risk of complications 7 times (p<0.05) (Table IV).

The patient with bronchospasm was 6-year-old, and risk classification was ASA 1E. This patient was treated for foreign body aspiration. 2 mg kg^{-1} IV methyl prednisolone and after pressure ventilation were performed.

DISCUSSION

The FFB, invented in 1964 by Shigeto Ikeda, has been used in children since 1980. FFB can be performed with different airway devices such as the endotracheal tube, laryngeal mask (LMA) and face mask [5]. However, LMA can provide a better airway evaluation [6]. Because the upper airway, larynx and subglottic regions can be easily and dynamically visualized by FFB performed by LMA [7]. LMA has become the first choice in FFB [2]. Different types of LMA, developed according to needs, which were produced in the 1980s, have been put into anesthesia practice. In the literature, the success rate of LMA in the first attempt was reported as 67-99% [3]. This difference in rates can be explained by a different definition of placement success and different placement techniques. In their study of the classical and Proseal-laryngeal mask (PLMA), Bağuş et al. [8] found success rates in the first attempt to be 100% in the PLMA group and 94% in the cLMA group, but they could not find a difference between the two groups in terms of ease of placement. In their study Güngör et al. [9] compared the Proseal-laryngeal mask (PLMA) with classical laryngeal mask (cLMA) in terms of placement characteristics, leakage pressure, and complications, they found no significant difference between the two groups in terms of placement success rates, insertion times, cuff inflation volumes, oropharyngeal gas leakage pressures and postoperative complications, and they suggested the usage of the method that the anesthetist got used to. In our clinic, cLMA is more commonly used for airway control in FFB. In our study, the success rate of LMA application in the first attempt was found to be 95.9% for all age groups. The success rates decrease in younger age groups [5]. In their study with 426 patients, Asida et al. [10] found the success rate to be 85.2% in the first attempt, and abnormal airway anatomy, age <5 years, weight <16 kg, side position and the usage of 1-1.5 LMA size as the reasons for the failure of the first attempts. In our patient group, although the median age and weight are in the specified groups, our success rate is higher. We think that this difference is related to the experience of the practitioner group.

When patients under 1 year of age were evaluated in our patient group, the average success rate of LMA placement was found to be 90.9%. The results are consistent with the literature.

In our study, the most common indications for bronchoscopy were determined as infection and atelectasis. This is consistent with the findings of the studies conducted in our country [11,12].

When the diagnosis of the patients was evaluated after bronchoscopy, structural airway abnormalities were found mostly (29.6%). FFB was evaluated as uneventful in 28% of patients.

In the study of Naguib et al. [7], FFB was found to have lower complication rates when performed via LMA compared with other airway methods. Minor complications (erythema, transient hypoxia and mild respiratory depression) reported due to FFB in childhood vary between 5-10% [13]. In the patient group of Kut et al. [11] this rate was found to be 7.8%. In another study, average rate of minor complications (transient oxygen desaturation, excessive cough alone, nausea with cough, transient laryngospasm, nosebleed) was reported as 5.2%, and major complication (<90% oxygen desaturation alone or with cough, laryngospasm or bronchospasm) rate as 1.7% [4]. In the study of Yüksel et al. [12] it was found to be 6.25%. In our series, the minor complication rate was found

to be 5.6%. The major complication rate was 2.4%.

The most remarkable part of our study was that the majority of patients were classified in ASA 3-4 risk groups. In the literature, to our knowledge, surprisingly, there were very few studies performed with especially ASA 3-4 pediatric patients. This is probably because of minimizing the risks of the patients. Using other instruments like endotracheal tube can be favorable to feel safe while ventilating the patient. We preferred to use LMA for ASA 3-4 patients in our series. In fact, the average age of ASA 3-4 group patients was less than others. Higher ASA risk groups, and younger ages were supposed to be the etiologic factors for complications in these patients. Fortunately, in contrast to these disadvantages causing complications, we solved the problems that disrupted patient condition. Being in the ASA 3-4 risk group was not a risk factor for the complications.

CONCLUSION

As a result, FFB via LMA is a safe method in the pediatric patient group. The classic LMA was applied with a high success rate. The risk of complications after FFB increases with the longevity of anesthesia, not with ASA risk group, age, weight, and dimensions of LMA.

Ethics Committee Approval: Ankara Child Health and Diseases Hematology Oncology Training and Research Hospital Ethics Committee approval was obtained (2015-074)
Conflict of Interest: None.
Funding: None.
Informed Consent: The study was retrospective.

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REFERENCES

1. Erdoğan Arı D, Yıldırım Ar A, Şanlı Karip C, Siyahkoç İ, Arslan AH, Akgun FN. I-gel ile Klasik Laringeal Maskenin Kullanım Kolaylığı ve Klinik Performans Yönünden Karşılaştırılması. Turk J Anaesth Reanim. 2015;43:299-303.
2. Heard CMB, Caldicott LD, Fletcher JE, et al. Fiberoptic-Guided Endotracheal Intubation via the laryngeal Mask Airway in Pediatric Patients: A Report of a Series of Cases. Anesth Analg. 1996;82:1287-9.
3. Kanthed P, Sharma B, Sood J. Comparison of LMA-ProSeal with LMA Classic in Anaesthetised Paralysed Children. Indian J Anaesth. 2008;52:44-8.
4. de Blic J, Marchac V, Scheinmann P. Complications of flexible bronchoscopy in children: prospective study of 1,328 procedures. Eur Respir J. 2002;20:1271-6. https://doi.org/10.1183/09031936.02.02072001
5. Rechner J A, Loach VJ, Ali M T, et al. A comparison of the laryngeal mask airway with face mask and oropharyngeal airway for manual ventilation by critical care nurses in children. Anaesthesia. 2007;62:790-5. https://doi.org/10.1111/j.1365-2044.2007.05140.x
6. Niggemann B, Haack M, Machotta A. How to enter the pediatric airway for bronchoscopy. Pediatr Int. 2004;46:117-21. https://doi.org/10.1046/j.1442-200x.2004.01854.x
7. Naguib ML, Streetman DS, Clifton S et al. Use of laryngeal mask airway in flexible bronchoscopy in infants and children. Pediatr Pulmonol. 2005;39:56-63. https://doi.org/10.1002/ppul.20139
8. Bağuş F, Şahin Yıldız T, Solak M, Toker K. Pediyatrik Hastalarda Klasik ve Proseal LMA'nın Etkinliklerinin Karşılaştırılması. Türk Anest Rean Der Dergisi. 2011;39:311-7.
9. Güngör G, Sutaş Bozkurt P, Yüceyar L. Çocuk hastalarda klasik ve ProSeal laringeal maske (LMA) karşılaştırılması. İzmir Dr Behçet Uz Çocuk Hast Dergisi. 2016;6:46-52.
10. Asida SM, Ahmed SS. Ease of insertion of the laryngeal mask airway in pediatric surgical patients: Predictors of failure and outcome. Saudi J Anaesth 2016;10:295-300. https://doi.org/10.4103/1658-354X.174898
11. Kut A, Karakoç F, Karadağ B, Bakaç S, Dağlı E. Çocukluk çağında flexible bronkoskopi uygulaması: 169 olgunun değerlendirilmesi. T Klin J Pediatr. 2001;10:197-201.
12. Yüksel H, Söğüt A, Topçu İ, Yılmaz Ö, Okkalı Z, Keleş G. Çocukluk Çağında Fleksibl Fiberoptik Bronkoskopi Deneyimi: 96 Olgunun Değerlendirilmesi. Toraks Dergisi. 2008;9:17-21.
13. Wood RE. Bronchoscopy. In: Loughlin GM, Eigen H, eds. Respiratory disease in children: diagnosis and management. Maryland: Williams&Wilkins; 1994:117-33.