Annals of Medical Research
DOI: 10.5455/annalsmedres.2019.05.281 2019;26(8):1498-502

Original Article

Use of laryngeal mask airway in flexible bronchoscopy in children

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Abstract

Aim: Flexible bronchoscope is widely used by pediatric pulmonologists as a diagnostic and therapeutic tool. The objective of this study was to present our anesthesia experience in pediatric flexible bronchoscopy in which airway management was provided with laryngeal mask airway (LMA) and the complications developed.

Material and Methods: This study was conducted in children aged between 2-15 years who underwent bronchoscopy for diagnosis and/or treatment between January 2017 and November 2018. Patients' demographic data, diagnosis, anesthesia and airway management were recorded from the patient files. Times of anesthesia, operation and recovery were recorded. Complications during the procedure, awakening and recovery were recorded. Patients' sore throat and hoarseness during resting and swallowing were recorded.

Results: This study included 31 patients whose airway management was provided with LMA. The mean age was 8.58±4.14 years. Persistent cough was the most common indication for bronchoscopy (35.5%). Anesthesia time was 15.46±10.99 minutes, bronchoscopy time 12.87±10.57, awakening time 16.38±4.53 minutes, and recovery time 23.32±10.24 minutes. The most common complication was cough (45.2%). Sore throats of the patients were observed as mild and moderate at the 0th and 2th hours. Both resting and swallowing sore throats were observed as mild at the 4th hour, while no sore throat was seen in any patient at the 12th hour. Hoarseness was observed at mild level in 4 patients (12.9%) at the 0th hour.

Conclusion: Providing airway with LMA in pediatric flexible bronchoscopy applications offers a safe anesthetic management, and it has a low rate of complications.

Keywords: Flexible bronchoscopy; pediatric bronchoscopy; laryngeal mask airway.

INTRODUCTION

Flexible bronchoscopy (FB) has increasingly gain popularity as a diagnostic and therapeutic tool among pediatric pulmonologists within the last two decades. Unlike rigid bronchoscopy, FB is less invasive (1).

In pediatric patients undergoing FB, general anesthesia and Monitored Anesthesia Care (MAC) are preferred as anesthetic method because of high success rates (2). Short-acting opioids (fentanyl, remifentanil and sufentanil), benzodiazepines (midazolam), intravenous general anesthetics (propofol, etomidate, opioids), and inhalation agents (sevoflurane, desflurane) are usually used during flexible bronchoscopy (3,4). Combinations of these drugs and modern ventilation technologies (supraglottic airways and mechanical jet ventilators) have facilitated the procedure (5,6).

The anatomy of airway is protected during FB which enables evaluation of dynamic lesions (7). In addition, FB has small diameters and allows visualization of more peripheral airways. FB has an important diagnostic value in respiratory system diseases. However, FB has less pediatric area due to limited instrumental abilities (8).

Because bronchoscopy is an invasive procedure requiring anesthesia in pediatric patients, it has risk for some complications such as desaturation, airway trauma and laryngospasm (9,10).

Furthermore, numerous gaps remain in the literature about improvement of its diagnostic ability and minimizing the complications (11,12).

The objective of this study was to present our anesthesia experience and complications in pediatric FB performed

Received: 22.05.2019 **Accepted:** 18.06.2019 **Available online:** 19.07.2019
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in Necmettin Erbakan University within the last 2 years, in which airway management was provided with LMA.

MATERIAL and METHODS

In this study, a prospectively stored database and medical records of patients who underwent diagnostic and/or therapeutic FB in Necmettin Erbakan University Meram Medical Faculty between January 2017 and November 2018 were reviewed.

Patients were referred from inpatient and outpatient services for a diagnostic and/or therapeutic investigation, which included FB. Patients who underwent emergency FB and airway structural disorder were excluded from the study.

A flexible bronchoscope (external diameter: 4.9 mm) manufactured by Olympus Corp. (Medical Instrument Division, Strongsville, OH) was used in this study. Between the specified dates, patients' demographic data such as age, gender, and ASA (American Society of Anesthesiologists) risk score were recorded together with diagnosis of the patients. The patients did not take anything from the mouth 6 hours before the FB procedure, and were continuously monitored with routine monitorization for vital findings (noninvasive blood pressure (NIBP), heart rate, respiratory rate, end-tidal CO2 and pulse oximetry).

An intravenous line was secured and general anesthesia was performed. IV induction was carried out in patients with IV cannula, while the induction was provided with inhalation in patients without IV cannula. Sevoflurane and remifentanil infusion was used in the maintenance of all patients. No muscle relaxant was used. Following the induction, LMA of appropriate size was placed. Methylprednisolone (1 mg/kg) was administered in all patients during bronchoscopy procedure. Methods of anesthesia (Intravenous (IV)- Inhalation/IV), the drugs used in maintenance (IV or inhalation anesthetics) and patient's status during arrival to the operating room (crying-calm- agitated) were recorded.

LMA insertion time was determined as the time between initiation of anesthesia induction and insertion of LMA (seconds), anesthesia time as the time between initiation of anesthesia induction and termination of anesthesia maintenance (minutes), and bronchoscopy time as the time between passing of the vocal cords by bronchoscopy through LMA (minutes) and termination of bronchoscopy. All these durations were recorded.

Bronchoalveolar lavage (BAL) was obtained when clinically indicated by wedging the bronchoscope in the relevant lung segment and lavaging with 0.9% sterile, preservative-free sodium chloride injection. Specimens were collected by gentle suction in 40-cc sterile specimen traps. Aliquots of the fluid were Gram-stained and cultured for bacteria, using a quantitative loop. A positive quantitative culture was defined when bacteria were cultured from BAL samples at a concentration of 1 × 104 CFU/mL or more.

Awakening time (minutes) was determined as the time from termination of anesthesia until RSS was 1-2 (Appendix 1) (13), and recovery time (minutes) was determined as the time from awakening until MAS was 10 (Appendix 2) (14) and these durations were recorded. Complications during the procedure were determined as hypoxia, strain, hiccough, aspiration-regurgitation, bronchospasm, laryngospasm; complications at the awakening stage were defined as hypoxia, desaturation, cough, gaging, vomiting and laryngospasm; and complications in the recovery room were defined as desaturation, cough, sore throat, and hoarseness, and the complications were recorded from the patient files.

It was recorded where transfer of the patients (hospital room / intensive care). Whether the patients used oxygen during the transfer, in the hospital room or intensive care unit, and whether bronchodilator treatment was needed in the meantime were also recorded. Patients' sore throat and hoarseness were questioned at the 0th, 2nd, 4th and 24th hours after the procedure and recorded. Sore throat was evaluated with a scale as (0, no sore throat; 1, mild sore throat [sore throat complaints only upon asking]; 2, moderate sore throat [accompanied by sore throat]; and 3, severe sore throat [sore throat related voice or hoarseness changes]. Hoarseness was evaluated with a scale as (0, no hoarseness; 1, minimal hoarseness (it can be said that there is minimal change in the quality of the patient's reply to speech when asked); 2, moderate hoarseness (a disturbing change in the patient's own opinion in voice quality); and 3, severe hoarseness (significant change in voice quality detected by the observer).

Statistical Analysis

Data obtained were analyzed using SPSS 20.00 software (Statistical Package for Social Sciences Inc Chicago, IL). The continuous variables are expressed as mean ± SD or number (%). Whereas categorical variables are expressed as number and percentages (%).

RESULTS

In this study, we reviewed the data obtained from the FB procedure performed for 31 patients whose airway management was provided by LMA.

Of all patients included in this study. 51.6% (16) were girls, and 48.4% (15) were boys. Of the patients, 9.7% (3) were ASA I and 90.3% (28) were ASA II. Primary indications for FB performed for diagnosis and treatment are given in Table 1.

Twenty-eight (90.3%) patients came to the operating room as calm. Methods of induction was IV in 13 (41.9%), and Inhaler / IV in 18 (58.1%) patients. Sevoflurane (2%-3.5%) and Remifentanil (14-612 Mcg) were used in anesthesia maintenance of all patients. The methods of induction used in anesthetic management, drug doses, and times of anesthesia and bronchoscopy procedure, awakening and recovery are shown in Table 2.

All patients were transferred to hospital rooms after recovery in the PACU. Oxygen was used in 8 (25.8%)

patients during the transfer. Only 6 (19.4%) patients used oxygen in the ward, while 1 (3.2%) patients required hasta bronchodilator treatment.

According to the BAL results of the patients, pseudomonas aeruginosa (10×104 CFU/mL colony) was reproduced in 1 patient, enterobacter spp (3×104 CFU/mL colony) in 1 patient and streptococ pneumoniae (10×104 CFU/mL colony) in 2 patients.

Patients' complications during the procedure, awakening and recovery are given in Table 3.

Sore throats of the patients were observed as mild and moderate at the 0th and 2nd hours. Both resting and swallowing sore throats were seen at mild level at the 4th hour and no sore throat was observed in any patients at the 12th hour. Hoarseness was observed at mild level in 4 patients (12.9%) at the 0th hour, while no hoarseness was observed at the 2nd, 4th and 12th hours (Table 4).

Table 1. Demographic data and primary indications for FB

Patient	Age (years)	Gender (M/F)	ASA (I/II)	Comorbidity
1	11	F	II	Abscess
2	3	F	II	Opere Trachea Esophageal Fistula
3	15	F	II	Pneumonia
4	18	M	II	Primary Ciliary Dyskinesia
5	15	F	II	Cystic Fibrosis
6	5	M	II	Persistent Cough
7	11	F	II	Pneumonia
8	5	M	II	Persistent Cough
9	2	M	II	Foreign Body
10	2	F	I	Foreign Body
11	8	F	I	Persistent Cough
12	6	M	II	Persistent Cough
13	9	M	II	Bronchiectasis
14	13	M	II	Mediastinal Lymphadenopathy
15	11	F	II	Primary Ciliary Dyskinesia
16	8	F	II	Persistent Cough
17	12	M	II	Marfan Syndrome
18	5	F	II	Persistent Cough
19	6	F	II	Respiratory Papillomatosis
20	5	M	II	Persistent Cough
21	13	M	II	Cystic Fibrosis
22	8	F	II	Primary Ciliary Dyskinesia
23	4	F	II	Primary Ciliary Dyskinesia
24	9	M	II	Glycogen Storage Disease
25	9	M	II	Persistent Cough
26	15	F	II	Persistent Cough
27	10	M	II	Bronchiectasis
28	5	F	II	Opere Trachea Esophageal Fistula
29	15	F	II	Persistent Cough
30	4	M	II	Persistent Cough
31	6	M	II	Bronchiectasis

F; female M; male ASA; American Society of Anesthesiologists

Table 2. Anesthetic management and the durations

Arrival to the Operating Room	
Cry	2 (6.5%)
Quiet	28 (90.3%)
Agitated	1 (3.2%)
Anesthesia Induction	
Intravenous	13 (41.9%)
Inhaler / Intravenous	18 (58.1%)
Anesthetic agency	
Sevoflurane (%)	2.69±0.52 (2-3.5)
Remifentanil (mcg)	106.33±110.13 (14-612)
LMA insertion time (second)	130.80±42.09 (45-240)
Anesthesia time (min)	15.46±10.99 (7-54)
Bronchoscopy time (min)	12.87±10.57 (4-50)
Awakening time (min)	16.38±4.53 (10-35)
Recovery time (min)	23.32±10.24 (7-45)

LMA; Laryngeal maske airway

Table 3. Patients' complications during the procedure, awakening and recovery

Complications during the procedure	Complications during awaking	Complication during recovery
None 14 (45.2%)	None 14 (45.2%)	None 14 (45.2%)
Hypoxia 1 (3.2%)	Hypoxia 1 (3.2%)	Cough 17 (54.8%)
Bucking 14 (45.2%)	Cough 14 (45.2%)	
Hiccup 2 (6.4%)	Larengospazm 2 (6.4%)	
	Desaturation 1 (3.2%)	
	Retching 2 (6.4%)	

Table 4. Resting and swallowing sore throat and hoarseness of the patients

Sore Throat at Rest	Sore Throat at Swallowing	Hoarseness
0 Minutes Light 5 (16.1%) Middle 2 (6.5%)	0 Minutes Light 4 (12.9%) Middle 2 (6.5%)	**0 Minutes** **Light 4 (12.9%)**
2 hours Light 6 (19.4%) Middle 2 (6.5%)	2 hours Light 6 (19.4%) Middle 2 (6.5%)	**2 hours** **None**
4 hours Light 3 (9.7%)	4 hours Light 4 (12.9%)	**4 hours** **None**
12 hours None	12 hours None	**12 hours** **None**

DISCUSSION

Providing airway with LMA in pediatric flexible bronchoscopy applications offers a safe anesthetic management, and it has a low rate of complications.

Flexible bronchoscopy can be performed under general anesthesia or moderate sedation / analgesia. Propofol is more preferred as an intravenous anesthetic and sevoflurane as a volatile anesthetic for general anesthesia (16)

LMA is a safe and efficient method for pediatric FB and allows for evaluation of airway during spontaneous

ventilation. It offers a reasonable and safe alternative to the other methods (17). The use of LMA as a preferred way to perform FB is increasing and 59% of the procedures are performed using LMA. The use of LMA provides patient comfort, and stability of the upper airway, presenting a less contaminated way for the bronchoscope to enter the lower airway. The existing data show that FB with LMA is resulted in the lowest procedure related complications (1.9%). The incidence of bleeding and hypoxia as complications for FB (0.1% and 1.2%, respectively) are the lowest in children operated with LMA. In addition, LMA decreases the operation time, anesthesia time and complications (15).

In our series, airway management of the patients was provided with LMA under general anesthesia. Therefore, rates of hypoxia (3.2%) and bleeding (0%) were very low, consistently with the literature.

Well understanding of procedural complications is helpful for parents in terms of consulting, and enables a better preparation for appropriate patient management. As in all invasive procedures, bronchoscopy also has pros and cons. It bears the risk for complications due to the inserted bronchoscope, excess lavage and anesthetic drugs (18). Non-life threatening complications occur in 24% of children after the procedure, with the most common being desaturation (10,19). Cough reflex is an important complication during and after FB (19,20). It has been proposed that the use of remifentanil decreases the incidence of cough during the procedure, and deep sedation / anesthesia may decrease cough reflex when muscle relaxation is not desired (11,20).

In our patient series, desaturation was developed only in 1 (3.2%) patients, although the rate of cough was high. No muscle relaxant was used in patients, and despite the use of remifentanil infusion, the most significant complication was cough both at awakening and recovery stages. It was thought that this may be related to lavage.

Among the main indications for FB in children are aspiration, radiographic abnormalities (atelectasis-bronchiectasis), infection, airway obstruction and suspicion of cough. At the same time, suspected aspiration is also an indication for bronchoscopy. The most mentioned other indications for bronchoscopy include recurrent pneumonia, wheezing bronchitis or productive cough, unexplained stridor and tuberculosis. However, data show a kind of heterogeneity, and this prevent a definitive listing of these individual indications (16). In this series, the most common indication for FB was persistent cough by 35.5%.

Culture of BAL fluid was used to identify pneumonia causing organisms. The yield of quantitative BAL fluid in determination of the pathogens causing pneumonia in patients receiving antimicrobial therapy is very low (21). Since our patients received antimicrobial therapy before BAL, similarly BAL fluid culture positivity was low.

This study has several limitation. First, this study is not a randomized controlled prospective study, and is retrospective. Second, number of patients is limited.

CONCLUSION

In conclusion, when used by a well trained operator, flexible bronchoscopy is a simple, safe and minimal invasive procedure for evaluation of airways in pediatric practice. FB procedures where airway is managed using LMA provides patient comfort, causing less procedure related complications. With developed technology, smaller tools provide bronchoscopic evaluation of young patients. Further prospective randomized studies are needed for anesthesia safety and to minimize procedure related complications.

Competing interests: The authors declare that they have no competing interest.
Financial Disclosure: There are no financial supports
Ethical approval: This work has been approved by the Institutional Review Board.

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