Available online at www.medicinescience.org

ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2024;13(2):278-83

Ventilation with a full face mask in rhinoplasty: A new method

Erdinc Koca[1], Cigdem Firat Koca[2]

[1]Malatya Turgut Özal University, Faculty of Medicine, Departmant of Anesthesiology and Reanimation, Malatya, Türkiye
[2]İnönü University, Faculty of Medicine, Department of Otolaryngology Head and Neck Surgery, Malatya, Türkiye

Received 26 December 2023; Accepted 19 March 2024
Available online 31 May 2024 with doi: 10.5455/medscience.2023.12.235

Abstract

Effectual mask ventilation is necessary for confident airway administration in the course of general anesthesia. Following septoplasty procedures, nasal packing is often utilized and after rhinoplasty operations, plaster is often used on the nose. A face mask cannot be used to ventilate the patient after the rhinoplasty operation. We aimed to evaluate the efficacy of full face mask as an alternative in these patients. Our study was conducted a prospective study. 69 patients were included in this present study. After extubation, one group was ventilated using an oral mask, while the other group was ventilated using a full face mask. A numerically significance was detected in terms of the distribution of cough status according to the groups (p=0.046). Additionally, a numerically significance was detected in terms of agitation status according to the groups (p=0.046). A numerically significance was determined between the oral mask and full face mask groups in terms of SpO_2 values at the 1st minute after extubation (p=0.001). We believe that the use of full face masks in ventilation after rhinoplasty is advantageous compared to the use of oral masks.

Keywords: Full face mask, oral mask, rhinoplasty

Introduction

Cases with facial anatomical deformities or facial trauma may represent distinctive difficulties for mask ventilation (MV), as effective MV requires the creation of a seal among the mask and the face to provide the clarity of external airway composition. Therefore, it may be necessary to evaluate alternating methods for effectual MV in these patients. Classically, poor MV can be concluded any of the following situations: leakage due to an insufficient mask gasket between the mask and face; increased airflow reluctance among the external airway composition and as well as lungs; or declined lung or chest wall adherence resulting in rised distal airway pressures [1].

Among the approaches listed in the literature are the usage of a pediatric mask to ventilate a case with a nasal tumor [2]. MV may be challenging or impossible for some cases. Previous researches have declared that the rate of difficult MV in patients undergoing general anesthesia varies between 1.06% and 5% [3]. Bajwa mentions the oral use of a traditional face mask in an inverted position for MV. Oral ventilation was successfully used with a silicone mask no. 2 in a patient who had undergone rhinoplasty [4].

Respiratory complicated conditions following tracheal extubation are more frequent in cases who have experienced eye, otolaryngology, and dental surgical procedure [5]. Septoplasty is one of the most frequently carried out surgical processes in otolaryngology [6]. Nasal packing is often utilized after septoplasty operations, and plaster is often used on the nose following rhinoplasty surgeries [7]. Rised risk of respiratory complicated situations due to nasal packing following septoplasty has been declared [8]. Nasal packing and plaster create an occluded nasopharynx and facial abnormality, and a stable airway may be a more complicated one following extubation. The usage of an oral mask (OM) for ventilation was declared in a case with a previous nasal tumor and in a case following rhinoplasty [3,9]. Tracheal extubation under deep anesthesia decreases the risk of compulsion, laryngospasm, and desaturation [5].

Awake extubation itself may rise chest wall muscle tone and create a predisposition to a difficult MV [10]. In rhinoplasty, extubation under deep anesthesia can be performed in the

CITATION
Koca E, Firat Koca C. Ventilation with a full face mask in rhinoplasty: A new method. Med Science. 2024;13(2):278-83.

Corresponding Author: Erdinc Koca, Malatya Turgut Özal University, Faculty of Medicine, Departmant of Anesthesiology and Reanimation, Malatya, Türkiye
Email: drerdinckoca@hotmail.com

presence of effective MV. In this case, a full face mask (FFM) may become more effectual, as it overcomes mouth leakage [11].

The total face mask is a type of mask that closes the patient's face with smooth contours and overcomes some of the problems that other mask types cannot. It can be utilized as an alternating to nasal or oronasal masks to increase patient comfort, and it overcomes the discomfort caused by other masks in difficult cases, such as a facial bone fracture [12,13].

Extubation should be avoided during superficial anesthesia (i.e., the state between deep anesthesia and wakefulness) due to the increased risk of laryngospasm. Extubation of an awake patient causes coughing (straining) through the tube. This reaction can cause bleeding. The presence of the tracheal tube at this stage often triggers bronchospasm. Such extubation may be contraindicated in cases with difficult airway control after removal of the tracheal tube. Laryngospasm can be prevented by extubation under deep anesthesia [14].

In our surgical group, which has the risk of laryngospasm due to both mask difficulty and surgical intervention, the use of FFM stands out with its advantages. Our aim was to demonstrate the applicability of FFM in rhinoplasty patients by taking advantage of its features mentioned in the literature.

Material and Methods

Ethical approval was gained from Malatya Turgut Özal University Clinical Research Ethics Committee (Ethical Number: 2022/44). Our study was conducted prospectively between 01.11.2022 and 15.01.2023 in Malatya Training and Research Hospital. 69 patients between the ages of 18 and 45 who underwent rhinoplasty were included in the study. Patients were informed about the study. Patients who did not accept the study and those with asthma or COPD (Chronic Obstructive Lung Disease) were excluded from the study. One patient in the OM group who developed negative pressure pulmonary edema was excluded from the study. Informed consent for the study was obtained from the patients. Demographics were recorded. For anesthesia induction, 1.5 mg/kg lidocaine, 2 mg/kg propofol, 0.6 mg/kg rocuronium and 2 μg/kg fentanyl were utilized.

Throughout the operation, 2% sevoflurane, 50% oxygen, and 50% nitrous oxide were used. During the controlled hypotension attempt, a 0.25-0.5 μg kg-1 min-1 dose range per minute i.v. with remifentanil infusion was used. For postoperative analgesia, 10 mg/kg paracetamol and 0.5-1 mg/kg tramadol were intravenously administered to all cases 30 minutes prior to the final stage of the surgical process.

As a surgical procedure, open technique rhinoplasty was performed with external and internal medial and lateral osteotomies and primary rhinoplasty. Piezo was not used in the patients. There was no bleeding beyond the expected perioperative bleeding amount and no bleeding requiring blood transfusion occurred. Postoperative neuromuscular blockade was relieved with 3 mg neostigmine and 1 mg atropine. Sugammadex was not administered to our patients because the necessary indications did not exist in line with the recommendations of the Ministry of Health. Our cases were classified into two groups due to the mask shape utilized during ventilation after extubation. One group was ventilated using an OM, while the other group was ventilated using a FFM. For female patients, medium-size FFM (Drager NIV ClassicStar® total-face mask) were used. For male patients, large-size FFM (Drager NIV ClassicStar® total-face mask) were used. The FFM was placed on the forehead, cheeks and chin. During ventilation, the mask's contact with the face was ensured with both hands by protecting the nose from contact (Figure 1).

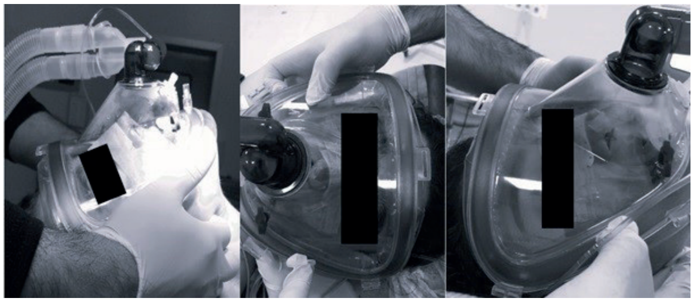

Figure 1. Ventilated using a full face mask

Pressure was applied to prevent air leakage. In the other group, a standard (Anatomical, anesthetic face mask, size 2, pediatric, 22F, Intersurgical) mask was used. Mask no. 2 was chosen, and the upper part of the mask was settled on the upper lip and the lower part on the chin in such a way as to provide MV. Classically, the EC hand position was utilized to hold the mask and ensure an appropriate seal (Figure 2). EC technique: It is a technique in which the little, ring and middle fingers form an "E" and rest on the lower jaw, allowing the chin to be lifted, while the index finger and thumb form a "C" around the mask, ensuring that there is no leakage in the airway of the mask.

Figure 2. Ventilated using a oral mask

Ventilation and spontaneous breathing followed, and patient recovery was ensured in both groups. Hemodynamic data of the patients heart rate (HR), average arterial pressure (MAP), and peripheral oxygen saturation (SpO_2) were recorded. Any coughing, agitation, or laryngospasm occurring during ventilation was saved. Those with frequent aimless movements were considered agitated. The patients were determined by simple randomization method.

Statistical Analysis

While evaluating the study data, frequencies (number (n), percentage (%) were used for categorical variables. The Shapiro-Wilk test was utilized to analyse whether the variables in the research were with respect to the normal dispersion.

It was determined that the continuous variables fit the normal distribution, except SpO_2. Mean±SD (standard deviation) and median (interquartile range-CIW Interquartile Range-IQR) values were given for the descriptive statistics of the variables. Cross tables were created for the comparison of categorical variables according to the OM–FFM grouping; number (n), percentage (%), and Fisher Exact test statistics were given.

The independent samples t-test was utilized to match the hemodynamic data according to the OM–FFM grouping. The Mann-Whitney U test was utilized to match the SpO_2 values according to the OM–FFM grouping.

Repeated assessments of variance (ANOVA) results were utilized to examine whether hemodynamic data differed in the measurement times (i.e., before extubation (BE), 1 minute after extubation (AE1), and 5th minute after extubation (AE5). The dependent sample Friedman's test was used to compare SpO_2 values at the measurement times (i.e., before extubation, 1 minute after extubation, and 5th minute after extubation). In paired matches, the Bonferroni correction was made, and the analysis outcomes were presented.

IBM SPSS Statistics 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and MS-Excel 2007 programs were utilized for statistical analysis and calculations. Numerical significance level was admitted as $p<0.05$.

Results

Of the cases included in the study, 58.0% (n=40) were female and 42.0% (n=29) male. 71.4% (n=25) of the individuals in the OM group were female, 28.6% (n=10) were male; 44.1% (n=15) of the individuals in the FFM group were female, and 55.9% (n=19) were male. The average age of the individuals was 24.17±7.04 years, the average height was 168.55±7.86 cm, and the mean weight was 62.65±10.14 kg (Table 1).

Table 1. Demographic characteristics

		OM group (n=35)	FFM group (n=34)	All cases (n=69)
		n (%)	n (%)	n (%)
Gender	**Female**	25 (71.4)	15 (44.1)	40 (58.0)
	Male	10 (28.6)	19 (55.9)	29 (42.0)
ASA	**1**	32 (91.4)	32 (94.1)	64 (92.8)
	2	3 (8.6)	2 (5.9)	5 (7.2)
Mallampati	**1**	28 (80.0)	25 (73.5)	53 (76.8)
	2	7 (20.0)	9 (26.5)	16 (23.2)
Cormack-Lehane's Classification	**1**	30 (85.7)	30 (88.2)	60 (87.0)
	2	5 (14.3)	3 (8.9)	8 (11.6)
	3	0 (0.0)	1 (2.9)	1 (1.4)
Age (Years) Mean±Sd		24.57±7.11	23.76±7.04	24.17±7.04
Height (Cm) Mean±Sd		168.54±7.77	168.56±8.06	168.55±7.86
Weight (Kg) Mean±Sd		61.66±9.13	63.68±11.12	62.65±10.14

*Fisher Exact test results are given

77.1% (n=27) of the individuals in the OM group had no cough, and 22.9% (n=8) had a cough. 94.1% (n=32) of the individuals in the FFM group had no cough, and 5.9% (n=2) had a cough. A numerically significance was found in terms of the distribution of cough status basis on the groups (p=0.046). Additionally, a numerically significance was observed in terms of agitation status according to the groups (p=0.046). The presence of agitation in the FFM group was lower than in the OM group. While 91.4% (n=32) of the individuals in the OM group did not have spasm, 8.6% (n=3) had spasm, while all individuals in the FFM group did not have spasm (Table 2).

Table 2. Comparison of smoking, cough, agitation, and spasm status according to groups

		Groups		Test statistic
		OM group n (%)	FFM group n (%)	p*
Smoking	**No**	30 (85.7)	30 (88.2)	0.519
	Yes	5 (14.3)	4 (11.8)	
Cough	**No**	27 (77.1)	32 (94.1)	**0.046**
	Yes	8 (22.9)	2 (5.9)	
Agitation	**No**	27 (77.1)	32 (94.1)	**0.046**
	Yes	8 (22.9)	2 (5.9)	
Laryngospasm	**No**	32 (91.4)	34 (100.0)	0.125
	Yes	3 (8.6)	0 (0.0)	

*Fisher Exact test results are given, A statistically significant difference was found in terms of the distribution of cough status according to the groups (p=0.046) In addition, a statistically significant difference was found in terms of agitation status according to the groups (p=0.046)

DOI: 10.5455/medscience.2023.12.235

A statistically significant difference was found in terms of the distribution of cough status according to the groups (p=0.046). In addition, a statistically significant difference was found in terms of agitation status according to the groups (p=0.046).

No numerically significance was observed among the OM and FFM groups in terms of average systolic blood pressure before extubation, 1 minute following extubation, and 5 minutes following extubation (p>0.05). A numerically significance was detected among the three time-dependent measurements of the average systolic blood pressure of the individuals in the OM group (BE, AE1, and AE5) (F=5.710, p=0.005). Additionally, a numerically significance was observed among the systolic blood pressure averages of the individuals in the FFM group and among the three time-dependent measurements (BE, AE1, and AE5) (F=3.677, p=0.031).

The mean diastolic blood pressure at the 1st minute after extubation of the individuals in the OM group was 80.54±11.25, and the mean diastolic blood pressure at the 1st minute after the extubation of the individuals in the FFM group was 74.59±12.52. A numerically significance was observed among the OM and FFM groups in terms of the mean diastolic blood pressure at the 1st minute after extubation (t=2.079, p=0.041). There was no statistically significance among the OM and FFM groups in terms of mean diastolic blood pressure before and after extubation at the 5th minute (p>0.05).

No numerically significance was observed among the OM and FFM groups in terms of average blood pressure values before extubation, 1 minute following extubation, and 5 minutes following extubation (p>0.05). No numerically significance among the three time-dependent measurements of the average blood pressure values of the individuals in the OM group (BE, AE1, and AE5) (p>0.05). There was also no numerically significance among the average blood pressure values of the individuals in the FFM group and among the three time-dependent measurements (BE, AE1, and AE5) (p>0.05).

A numerically significance was detected among the OM and FFM groups in terms of SpO_2 values at the 1st minute after extubation (z=3.346, p=0.001). Individuals in the FFM group had higher SpO_2 averages at the 1st minute after extubation than those in the OM group. No numerically significance was among the OM and FFM groups in terms of SpO_2 values before and at the 5th minute after extubation (p>0.05).

A statistically significance was found among the three time-dependent measurements of the SpO_2 values of the individuals in the OM group (BE, AE1, and AE5) (χ2=38.309 p<0.001). Additionally, a numerically significance was determined among the three time-dependent measurements of the SpO_2 values of the individuals in the FFM group (BE, AE1, and AE5) (χ2=18.352 p<0.001).

There was no significance among the OM and FFM groups in terms of the mean HR before extubation, 1 minute after extubation, and 5 minutes after extubation (p>0.05). A numerically significance was observed among the three time-dependent measurements of the mean HR of the individuals in the oral group (BE, AE1, and AE5) (F=8.884, p<0.001). Additionally, a numerically significance was observed among the three time-dependent measurements of the mean HR of the individuals in the FFM group (BE, AE1, and AE5) (F=12.471, p<0.001) (Table 3).

Table 3. Comparison of parameters by groups and times

	OM group		FFM group		
	Mean±SD	**Median (MAG)**	**Mean±SD**	**Median (MAG)**	**p (group)**
Systolic blood pressure					
BE	120.14±18.33	120.0 (33.0)	116.62±16.37	114.50 (27.0)	t=0.842; p=0.403
AE1	130.29±15.58	133.0 (20.0)	125.06±14.60	124.0 (26.0)	t=1.437; p=0.155
AE5	127.91±18.34	126.0 (28.0)	123.12±13.89	121.5 (22.0)	t=1.222; p=0.226
p (time)	F=5.710; p=0.005		F=3.677; p=0.031		
Diastolic blood pressure					
BE	78.54±14.54	80.0 (24.0)	77.21±13.48	74.5 (21.0)	t=0.396; p=0.694
AE1	80.54±11.25	82.0 (19.0)	74.59±12.52	74.5 (17.0)	t=2.079; **p=0.041**
AE5	82.23±16.05	82.0 (25.0)	79.06±13.56	79.5 (17.0)	t=0.885; p=0.379
p (time)	F=0.885; p=0.417		F=1.234; p=0.298		
Average blood pressure					
BE	95.23±15.66	93.0 (31.0)	92.97±13.99	91.5 (21.0)	t=0.631; p=0.530
AE1	100.03±12.46	101.0 (21.0)	95.71±11.24	95.0 (16.0)	t=1.511; p=0.135
AE5	98.20±16.32	99.0 (26.0)	95.91±12.58	96.5 (21.0)	t=0.651; p=0.517
p (time)	F=1.373; p=0.260		F=0.670; p=0.515		
SpO_2					
BE	98.69±0.99	99.0 (2.0)	98.85±0.86	99.0 (2.0)	z=0.674; p=0.500
AE1	96.03±2.38	97.0 (3.0)	97.76±1.18	98.0 (1.0)	z=3.346; **p=0.001**
AE5	98.43±2.09	99.0 (2.0)	98.53±1.19	99.0 (2.0)	z=;0.645 p=0.519
p (time)	χ2=38.309; p<0.001		χ2=18.352; p<0.001		
Heart rate					
BE	81.17±15.35	84.0 (22.0)	81.71±17.19	85.0 (29.0)	t=0.136; p=0.892
AE1	91.34±13.31	88.0 (16.0)	96.35±12.85	94.5 (20.0)	t=1.590; p=0.116
AE5	91.20±9.86	92.0 (9.0)	91.50±11.56	93.5 (18.0)	t=0.116; p=0.908
p (time)	F=8.894; p<0.001		F=12.471; p<0.001		

t: Independent Sample t-test, F: ANOVA test statistic in repeated measures, z= Mann Whitney U Test Statistic χ2: Friedman test statistic

Discussion

In our study, FFM were successfully applied in ventilation after extubation in rhinoplasty surgeries, and it was observed that they caused less coughing and spasming compared to ventilation with OM. In patients who were ventilated with a FFM, the 1st and 5th minute SpO_2 values were maintained by providing adequate ventilation after extubation.

More than 600,000 cases experience sinonasal surgical procedures annually in the United States [6]. Varied commercial face masks are recently accessible to ease MV for cases with different face shapes and sizes. However, in patients with facial deformities, it may be impossible to create effective masking with the usage of conventional masks. Recently, there is no concurrence on the best method to MV in these cases because each patient is unique and should be designed with the patient's special anatomical deformity. Difficult MV is described as the disability to maintain ventilation in an unconscious patient due to gas leakage, inappropriate mask seal, and/or reluctance to gas entry [15].

Anesthesiologists should clarify these features before the induction of general anesthesia and be ready to perform maneuvers that can increase MV success, including the two-handed MV method, placement of the oropharyngeal airway, and shaving the patient's beard before surgery [16]. Surgery to be performed on the mouth, nose, and face area, tampons placed, plasters placed can put the patient with easy MV into the group with difficult MV after surgery.

In despite of the commercial presence of varied types of masks developed for MV usage, the use and sealing ability of these masks may be insufficient in facial deformities, such as tumors, burns and injuries. Currently, no studies focus on alternatives to MV in cases for whom a traditional face mask is not possible. In addition, the use of an unusual mask on a patient who is at high risk of failed MV brings its own difficulties [17].

As in our study, for the patient group, whose MV was easy, it was impossible to mask them with classical face masks that covered the mouth and nose due to the nasal packing and nasal plaster they underwent. Since the interventions to the nose will affect the surgical success, surgical teams usually have concerns.

With an ergonomically designed mask, the chin lift head extension maneuver can improve mask sealing [18]. A two-handed MV method is frequently utilized to balance for gas leakage around the mask, but this may inflate the stomach and may lead to regurgitation and as well as pulmonary aspiration [19]. Airway administration should be examined in all aspects; algorithms should be developed for the control of complicated airways and certain situations, and the usage of alternative instruments may be useful [20].

Oral MV, which is also applied in our clinic after rhinoplasty surgery, has been explored in the literature. Ventilation with an OM is a basic technique; on the other hand, differences in skill level among anesthesiologists, the experience levels of clinicians, and dissimilarities in gender and hand size can play an impact on the effectiveness of an OM [21]. Erbay et al. provided successful ventilation by OM after extubation in a patient who had undergone rhinoplasty surgery [9]. It is reported that FFM tolerance is lower, possibly due to facial disturbance, a claustrophobic feeling, and complication in overcoming airway secretions [11,22].

Studies involving intensive care patients have shown that FFM can more efficiently rise minute ventilation measures. Similarly, other researchers have detected that FFM reduce mask leaks, increase tolerability, and are more convenient for patients than other types of masks [23,24].

FFM application was successfully applied in our patient group. Thanks to two-handed pressure, the ventilation of the patients was successfully provided. Thanks to this safe masking, patients were extubated under deep anesthesia, which maintained the SpO_2 value and prevented patients from a laryngospasm state.

In our study, 8 patients in the OM group had a cough, while 2 patients in the FFM group had a cough. Although spasming, which is one of the most feared conditions for an anesthesiologist, was observed in 4 patients in the OM group, it was not seen in any patient in the FFM group. Negative pressure pulmonary edema occurred in 1 of the patients who developed spasm in the OM group. The patient was discharged after the treatment. This patient was excluded from the study.

The limitations of our study are the small patient group and the fact that the peroperative total opioid dose was not calculated.

Conclusion

FFM group, adequate masking and extubation under deep anesthesia ensured the preservation of SpO_2 values in the 1st minute after extubation. We believe that our study provides a new perspective on this situation, since this issue has not been mentioned in the literature in patients who underwent rhinoplasty. As a result, FFM allow for safe masking and allows for extubation under deep anesthesia.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
Ethical approval was gained from Malatya Turgut Özal University Clinical Research Ethics Committee (Ethical Number: 2022/44).

References

1. Saddawi-Konefka D, Hung SL, Kacmarek RM, Jiang Y. Optimizing mask ventilation: literature review and development of a conceptual framework. Respir Care. 2015;60:1834-40.

2. Sethi S, Arora V, Bhagat H, Sharma A. Use of paediatric face mask for adult ventilation in a patient with nasal tumour. Indian J Anaesth. 2010;54:75-6.

3. Lundstrom LH, Rosenstock CV, Wetterslev J, Norskov AK. The DIFFMASK score for predicting difficult facemask ventilation: a cohort study of 46,804 patients. Anaesthesia. 2019;74:1267-76.

4. Bajwa SS, Haldar R, Kaur J, Samanta S. Modified mask ventilation in post rhinoplasty patient. Natl J Maxillofac Surg. 2014;5:248-9.

5. Asai T, Koga K, Vaughan RS, Latto IP. Respiratory complications associated with tracheal extubation. Anaesthesia. 1998;53:540-4.

6. Bhattacharyya N. Ambulatory sinus and nasal surgery in the United States: demographics and perioperative outcomes. Laryngoscope. 2010;120:635-8.

7. Bangawala SM, Gill M, Soomer DD, et al. Is nasal packing necessary after septoplasty? A meta-analysis. Int Forum Allergy Rhinol. 2013;3:418-24.

8. Cayonu M, Acar A, Horasanlı E, et al. Comparison of totally occlusive nasal pack, internal nasal splint, and transseptal suture technique after septoplasty in terms of immediate respiratory distress related to anaesthesia and surgical complications. Acta Otolaryngol. 2014;134:390-4.

9. Erbay H, Kara CO, Kara IG, Tomatir E. Breathing or ventilation via a mouth mask for rhinoplasty operations in the early post anaesthetic period. Eur J Anaesthesiol. 2003;20:759.

10. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia. 1984;39:1105-10.

11. Turner RE. Noninvasive positive-pressure ventilation: face versus interface. Respir Care. 1997;42:389-93.

12. Criner GJ, Travaline JM, Brennan KJ, Kreimer DT. Efficacy of a new full face mask for noninvasive positive pressure ventilation. Chest. 1994;106:1109-15.

13. Roy B, Cordova FC, Travaline JM, et al. Full face mask for noninvasive positive-pressure ventilation in patients with acute respiratory failure. J Am Osteopath Assoc. 2007;107:148-56.

14. Butterworth JF, Mackey DC, Wasnick JD. Morgan And Mikhail's Clinical Anesthesiology, 5th edition. McGraw-Hill Publising, United States, 2013;333-6.

15. Han R, Tremper KK, Kheterpal S, O'Reilly M. Grading scale for mask ventilation. Anesthesiology. 2004;101:267.

16. Goranovic T, Milic M, Holjevac JK, et al. Inadequate face mask ventilation: clinical applications. Coll Antropol. 2010;34:1161-5.

17. Redfern D, Rassam S, Stacey MR, Mecklenburgh JS. Comparison of face masks in the bag-mask ventilation of a manikin. Eur J Anaesthesiol. 2006;23:169-72.

18. Matioc AA. The adult ergonomic face mask concept: historical and theoretical perspectives. J Clin Anesth. 2009;21:300-4.

19. Ball AJ, Craig J, Green RJ, Richardson DJ. Performance comparison of two anaesthetic facemasks. Anaesth Intensive Care. 2007;35:226-9.

20. Langeron O, Amour J, Vivien B, Auburn F. Clinical review: management of difficult airways. Crit Care. 2006;10:243-8.

21. Koga T, Kawamoto M. Gender difference in mask ventilation training of anesthesia residents. J Clin Anesth. 2009;21:178-82.

22. Brochard L. Non invasive ventilation: practical issues. Intensive Care Med. 1993;19:431-2.

23. Pelosi P, Severgnini P, Aspesi M, et al. Non-invasive ventilation delivered by conventional interfaces and helmet in the emergency department. Eur J Emerg Med 2003;10:79-86.

24. Rabitsch W, Schellongowski P, Köstler WJ, et al. Efficacy and tolerability of non-invasive ventilation delivered via a newly developed helmet in immunosuppressed patients with acute respiratory failure. Wien Klin Wochenschr. 2003;115:590-4.