ISSN: 0975-1556

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2021; 13(6); 242-249

Original Research Article

Evaluation of Anatomical Position of Baska Mask in Different Head and Neck Positions in Anaesthetized Paralyzed Patient

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Received: 06-07-2021 / Revised: 10-08-2021 / Accepted: 28-11-2021
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Conflict of interest: Nil

Abstract

Background: Head and neck movement can lead to the changes in shape and volume of pharyngeal space. This may result in displacement of the airway device due to alteration of the forces transmitted along the device during ventilation. This study was designed to determine the effect of different head and neck positions on the anatomical position of Baska mask in anaesthetized paralyzed patients.

Methods: In this randomized prospective trial, Baska mask was inserted in 40 anesthetized paralyzed adult patients. Anatomical position of Baska mask was assessed by fibreoptic evaluation of glottis, after passing a fibreoptic scope through airway tube of the mask. Brimacombe scoring system was used for the scoring of fibreoptic view of glottis. The position of the head and neck was changed randomly from neutral to flexion, extension and lateral rotation. Brimacombe score and ventilation score were measured in all positions.

Results: Brimacombe score was reduced in flexion position as compared to neutral position. 3 (7.5%) patients had score 1 in flexion position whereas none of patients had score 1 in all other positions of head & neck. Brimacombe score 4 was observed in 47.5% cases in neutral, 50% cases in extension, 37.5% cases in flexion and 42.5% cases in lateral position of head & neck. Ventilation score was comparable in all positions.

Conclusion: Fibreoptic view of glottis assessing the anatomical position of Baska mask is deteriorated in flexion position without any statistical and clinical impact on ventilation. There is no correlation between fibreoptic view and performance of Baska mask in anaesthetized and paralyzed patients.

Keywords: Baska Mask, Anaesthetized Paralyzed Patients.

Introduction

Supraglottic Airway Devices (SADs) are used more extensively during general anaesthesia. The Baska mask is a new generation novel SAD which is designed by Australian anesthetists Kanag and Meena Baska. As compared to other SADs, Baska Mask has number of innovations.[1] It has unique oval shape which fits the shape of the mouth and reduces its rotation within the pharynx.

Head and neck movement can lead to the changes in shape and volume of pharyngeal space.[2] This may result in displacement of the airway device due to alteration of the forces transmitted along the device during ventilation.[3] The primary aim of this study was to determine the effect of different head and neck positions namely neutral, flexion, extension, and lateral rotation on the anatomical position of Baska mask in anaesthetized paralyzed patients. The secondary aim was to assess the correlation between anatomical position and ventilation adequacy at different head and neck positions**.**

Material and Methods

The study was a randomized prospective trial conducted at a tertiary level armed forces referral hospital in India. Study was approved by institutional ethics committee of the hospital. All patients with age 18–60 years, American Society of Anaesthesiology (ASA) grade I or II undergoing elective minor gastrointestinal, urologic, gynaecologic, plastic and onco-surgery procedures under general anaesthesia were included in the study. Exclusion criteria included patents with cervical spine disease, obstructive sleep apnoea, anticipated difficult airway, gastro-oesophageal reflux disease, body mass index >30 kg/m2, oral cavity pathology and pregnancy. Patients were counselled about nature of the study and procedure involved.

All the patients included in study underwent standard pre-anaesthetic check-up and assessment. Fasting protocol as per standard guidelines was used for all the surgical procedures. Mandatory standard monitoring lines including Electrocardiograph (ECG), pulse oximetry and Non-invasive Blood Pressure (NIBP) were connected to the patient on arrival to the operating room. Baska Mask size was selected according to patient weight: size three for 30 to 50 kg, size four for 50 to 70 kg, size five for 70 to 100 kg. Induction of anaesthesia was conducted in the supine position with the head in the neutral position, propofol in dose of 2 mg/kg. Non-depolarizing muscle relaxant as intravenous atracurium in dose of 0.5 mg/kg was used for muscle relaxation before intubation. After 03 minutes of mask ventilation, Baska mask was inserted as per technique recommended by the manufacturer.[4] Successful placement of Baska mask was confirmed with symmetrical bilateral chest lift, auscultation of breath sounds and appearance of square-wave capnograph. Endotracheal intubation was performed in case of inadequate ventilation in-spite of various manoeuvres including change of head and neck position, repositioning of Baska Mask and use of different size of the device. Patients undergoing endotracheal intubation were excluded from the study group.

Sevoflurane in air and oxygen mixture was used for maintenance of anaesthesia. Muscle relaxation was maintained with incremental doses of atracurium. Ventilatory settings were adjusted to keep the End-tidal Carbon Dioxide (EtCO2) between 35- and 40-mm Hg. An independent anaesthesiologist, highly experienced in using fibreoptic scope, assessed the anatomical position of Baska mask by fibreoptic evaluation of glottis, after passing fibreoptic scope through airway tube of the mask. Brimacombe scoring system was used for the scoring of fibreoptic view of glottis. Brimacombe scoring system is based on fibreoptic visualization of epiglottis and vocal cords (score 1 if the vocal cords are not visible, score 2 if the vocal cords plus anterior epiglottis are visible, score 3 if the vocal cords plus posterior epiglottis are visible, and score 4 if only vocal cords are visible).[5,6]

Ventilation score was calculated based upon three criteria: no leakage of air with an airway pressure of 15 cm H_2O; bilateral chest excursion at a peak inspiratory pressure of 20 cm H_2O; and a square wave capnogram; each item was scored 0 or 1 point. Maximum ventilation score was 3 in the presence of all three criterias.[7,8] Oropharyngeal seal pressure was measured as the pressure of aneroid manometer attached to breathing circuit, at which the airway pressure had reached equilibrium, when the pressure-limiting valve of the anaesthesia machine was closed and the fresh gas flow rate was maintained at 3 litres per min.[9]

Effect of head and neck position on anatomical position of Baska mask was evaluated by assessing the fibreoptic glottic view in the different positions. Various other parameters as ventilation score, oropharyngeal seal pressure, peak inspiratory pressure and expiratory tidal volume were also recorded at different head and neck positions. All parameters were first recorded in neutral position (when line joining external ear canal and superior orbital margin with the top of the shoulder is vertical) and then recorded in a random order for each patient, in different head and neck positions including flexion (45^0 flexion of neck), extension (45^0 extension of neck) and lateral rotation (90^0 rotation of neck towards right). All the data was collected one minute after each position adjustment.

Sequence of randomization was generated using free online Research Randomizer program (https://www.randomizer.org). Baska Mask was removed at the end of surgery after reversal of neuromuscular blockade.

Statistics

Sample Size: - Sample size was calculated while considering the assumptions of minimum 80% power and 5% significance level (significant at 95% confidence level). With detection of standard deviation of 15% of the mean from a pilot survey and with assumption of requirement of 0.05 precision, sample size was estimated as 35. However, we had considered sample size of 40 for this study. Type I error probability associated with the test was 0.05.

Statistical analysis: - Statistical analysis was done by using descriptive and inferential statistics. Paired t-test was used to test the relative change in anatomical position of Baska Mask with respect to change in head & neck position. The P-value less than 0.05 was considered as significant at 95% confidence level. Statistical software SPSS 24.0 was used in the statistical analysis.

Spearman's Rho test was used measure the strength of association between fibreoptic view and ventilation score, where the value r =1 means a perfect positive correlation and the value r = -1 means a perfect negative correlation.

Mean and standard deviation were calculated for demographic (age, height, weight and BMI) and for other continuous variables. Numbers and percentages were calculated for categorical variables (gender, size of device used, ASA status).

Results

Demographic data of patients was shown in Table 1. Brimacombe score based on fibreoptic visualization of anatomical position of Baska mask at different head and neck positions as flexion, extension and lateral rotation, were compared with the same at the neutral position. Score was comparable in neutral and extension positions. Brimacombe score was reduced in flexion position as compared to neutral position. 3 (7.5%) patients had score 1 in flexion position whereas none of patients had score 1 in all other positions of head & neck (Table 2). Brimacombe score 4 was observed in 47.5% cases in neutral, 50% cases in extension, 37.5% cases in flexion and 42.5% cases in lateral position of head & neck (Table 2)

Table 1: Descriptive Statistics

Age (yr)	**40.13 11.68**
Sex (M/F)	7(17.5)/33(82.5)
Weight (kg)	64.13
Height (cm)	163.88
BMI (kg/m^2)	23.78
ASA Class (I/II)	23(57.5)/17(42.5)
Size of Device used (3/4/5)	4(10)/29(72.5)/7(17.5)

Data shown are mean ± SD or number (percentage).
BMI – Body Mass Index, ASA - American Society of Anaesthesiologists

Table 2: Brimacombe Score

Brimacombe score	Neutral	Flexion	Extension	Lateral Rotation
4	19	15	20	17
3	18	16	18	18
2	3	6	2	5
1	0	3	0	0
P value	-	0.205	0.893	0.737

Data are in actual numbers. P value is in comparison with neutral position; P<0.05 is considered significant.

All other parameters as oropharyngeal seal pressure, peak inspiratory pressure, expiratory tidal volume, ventilation score and end tidal carbon dioxide at different head and neck positions were also compared. Oropharyngeal seal pressure was significantly increased in flexion position (mean 30.88 cm H_2O, p<0.001) and significantly decreased in extension position (mean 25.90 cm H_2O, p<0.001) as compared to neutral position (mean 27.98 cm H_2O) (Table 3). However, no significant change was observed in oropharyngeal seal pressure with lateral rotation of neck. Peak inspiratory pressure was significantly increased during flexion of head and neck (mean 19.53 cm H_2O, p<0.001) (Table 3). However, peak inspiratory pressure was comparable between neutral, extension and lateral positions without any significant change (Table 3). Expiratory tidal volume and end tidal carbon dioxide did not change significantly with the change of head and neck position (Table 3). Ventilation score was comparable in all positions of head and neck (Table 4).

Table 3: Oropharyngeal Seal Pressure and Ventilation Parameters

Position	**Oropharyngeal Seal Pressure (cm H_2O)**		**Peak Inspiratory Pressure (cm H_2O)**		**Expiratory Tidal Volume (ml)**		**End Tidal Carbon Dioxide (mm Hg)**	
	Mean SD	p Value	Mean SD	p Value	Mean SD	p Value	Mean SD	p Value
Neutral	27.98		17.63		461.00		30.20	
Flexion	30.88	**<0.001**	19.53	**<0.001**	462.70	0.069	30.45	0.115
Extension	25.90	**<0.001**	17.30	0.062	462.62	0.198	30.28	0.755
Lateral Rotation	27.95	0.878	17.78	0.083	462.60	0.137	30.15	0.789

P value is in comparison with neutral position; *P*<0.05 is considered significant

Table 4: Ventilation Score

Ventilation score	Neutral	Flexion	Extension	Lateral Rotation
3	40	39	40	39
2	0	1	0	1
1	0	0	0	0
0	0	0	0	0
3/2/1/0	40/0/0/0	39/1/0/0	40/0/0/0	39/1/0/0

Data are in actual numbers.

Spearman's Rho test showed that there was non-significant correlation between ventilation score and Brimacombe score at flexion (p=0.786) and lateral position (p value=0.575) of head and neck (Table 5). During neutral and extension positions, value of ventilation score remained constant, hence correlation between ventilation and Brimacombe score could not be assessed.

Table 5: Spearman's Rho Correlation between Brimacombe and Ventilation score

			Brimacombe Score	
			Flexion	**Lateral Rotation**
Ventilation Score	**Flexion**	Correlation Coefficient	0.044	
		p value	0.786	
	Lateral Rotation	Correlation Coefficient		0.091
		p value		0.575

P<0.05 is considered significant

Discussion

The primary aim of this study was to determine the effect of different head and neck positions on the anatomical position of Baska mask in anaesthetized paralyzed patients. We have demonstrated in this study that fibreoptic view of vocal cords was deteriorated in some patients during flexion position as compared to neutral position. Vocal cords were not visible in fibreoptic view during flexion position in three patients. However, vocal cords were visible in all patients during neutral, extension and lateral positions of head and neck. Fibreoptic view depicting anatomical position of Baska mask was improved with extension but without any statistical difference from the other positions of head and neck.

In our study, Oropharyngeal seal pressure was also affected with change of position of the head and neck during surgery. Oropharyngeal seal pressure was significantly higher during flexion and lower during extension of head and neck. Ventilation score was comparable during all positions and had not changed with extension of head and neck. Peak inspiratory pressure was increased with statistical significance during flexion, but the ventilation was still not affected as evidenced by the comparable end tidal carbon dioxide and expiratory tidal volume between neutral and flexion positions.

During flexion and lateral position, Brimacombe score, and ventilation adequacy did not show any correlation. Ventilation through Baska mask was not related to its anatomical position during flexion and lateral rotation of head and neck. As ventilation score remained consistent during neutral and extension position, its correlation between fibreoptic view could not be ascertained statistically during these positions.

Various studies were done to evaluate the effects of head and neck position on anatomical position of cuff and ventilation using different supraglottic airway devices.[2,3,7,10-17] Our results are in accordance with previous studies regarding the influence of different positions on Brimacombe and ventilation scores.[3,11,15]

Mishra and Nawaz et al. compared the effect of head and neck position on oropharyngeal leak pressure, fibreoptic view of glottis and ventilation with Proseal laryngeal mask airway and I-gel.[3] They demonstrated that there was no significant change in cuff position with change of head and neck position and effective ventilation was possible in all positions. Similar to our study, it was also concluded that fibreoptic score was decreased in flexion position with both devices but same did not affect the ventilation.

Rehab and Yasser evaluated while using Baska mask at various head and neck positions, that fibreoptic score decreased frequently during flexion of head and neck but there was no affection on ventilation.[15] Effects of positions on oropharyngeal seal pressure, ventilation score and fibreoptic score were in accordance with our results. In contrast to this study, we had also demonstrated correlation between Brimacombe and ventilation scores at different positions.

Recent Systemic review and meta-analysis including seventeen studies regarding influence of head and neck position on the performance of supraglottic airway devices (I-gel, Cobra Perilaryngeal Airway, air-Q self-pressurizing airway, laryngeal tube, laryngeal tube suction, laryngeal mask airway Classic, laryngeal mask airway Flexible, laryngeal mask airway Proseal, laryngeal mask airway Supreme) showed that flexion of head and neck significantly improved airway sealing but adversely affected the ventilation and fibreoptic scores with most of airway devices.[17] This meta-analysis also demonstrated that extension did not affect ventilation and fibreoptic view with most of supraglottic airway devices. In contrast to this meta-analysis, we evaluated using Baska mask in flexion position that fibreoptic score was reduced without any adverse effect on ventilation.

Deterioration in fibreoptic view of glottis during flexion of head and neck could be due to increased deflection of posterior epiglottis and poor alignment of pharyngeal and laryngeal axis. In-spite of decreased fibreoptic score, adequate ventilation using Baska mask during flexion may be due to its more resilient and flexible sealing mechanism.

The results of our study should be considered in the light of some limitations. First, as the study was conducted in paralyzed patients, results could not be pertinent to the spontaneously breathing patients. Second, the investigator could not be blinded to the various positions of the head and neck. As all the measured parameters were clearly elucidated, results of our study were unlikely to have skewed due to unblinding. Third, radiological confirmation for changes in anatomical position of Baska mask due to positioning of head and neck could have added to the best of our knowledge but same was not practical and feasible in our settings.

Conclusion

Based on the results of this study, we conclude that fibreoptic view of glottis assessing the anatomical position of Baska mask is deteriorated in flexion position without any statistical and clinical impact on ventilation. Effective and adequate ventilation is possible in all positions of head and neck. There is no correlation between fibreoptic view and performance of Baska mask in anaesthetized and paralyzed patients.

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