BJA

British Journal of Anaesthesia, 120(1): 181–187 (2018)

doi: 10.1016/j.bja.2017.11.016
Advance Access Publication Date: 21 November 2017
Respiration and the Airway

Dynamic behaviour of the soft palate during nasal positive pressure ventilation under anaesthesia and paralysis: comparison between patients with and without obstructive sleep-disordered breathing

M. Okuyama[1], S. Kato[1], S. Sato[1], J. Okazaki[2], Y. Kitamura[1], T. Ishikawa[2], Y. Sato[3] and S. Isono[2,*]

[1]Department of Anesthesiology, Chiba University Hospital, Chiba, Japan, [2]Department of Anesthesiology and Graduate School of Medicine, Chiba University, Chiba, Japan and [3]Department of Global Clinical Research, Graduate School of Medicine, Chiba University, Chiba, Japan

*Corresponding author. E-mail: shirohisono@yahoo.co.jp

Abstract

Background: Difficult mask ventilation is common and is known to be associated with sleep-disordered breathing (SDB). It is our hypothesis that the incidence of expiratory retropalatal (RP) airway closure (primary outcome) during nasal positive pressure ventilation (PPV) is more frequent in patients with SDB (apnea hypopnea index $\geq$5 h^{-1}) than non-SDB subjects.

Methods: The severity of SDB was assessed before surgery using a portable sleep monitor. In anaesthetized and paralysed patients with (n=11) and without SDB (n=9), we observed the behaviour of the RP airway endoscopically during nasal PPV with the mouth closed and determined the dynamic RP closing pressure, which was defined as the highest airway pressure above which the RP airway closure was reversed. The static RP closing pressure was obtained during cessation of mechanical ventilation in patients with dynamic RP closure during nasal PPV.

Results: The expiratory RP airway closure accompanied by expiratory flow limitation occurred more frequently in SDB patients (9/11, 82%) than in non-SDB subjects (2/9, 22%; exact logistic regression analysis: P=0.022, odds ratio 3.6, 95% confidence interval 1.1–15.4). Receiver operating characteristic curve analyses indicated AHI >10h^{-1} and presence of habitual snoring as clinically useful predictors for the occurrence of RP closure during PPV. Dynamic RP closing pressure was greater than the static RP closing pressure by approximately 4–5 cm H_2O.

Conclusions: Valve-like dynamic RP closure that limits expiratory flow during nasal PPV occurs more frequently in SDB patients.

Keywords: anaesthesia; airway obstruction; pharynx; sleep apnoea syndromes

Editorial decision: August 2, 2017; **Accepted:** August 28, 2017

© 2017 Published by Elsevier Ltd on behalf of British Journal of Anaesthesia.
For Permissions, please email: permissions@elsevier.com

Editor's key points

- Difficult mask ventilation is found in up to 5% of patients undergoing general anaesthesia.
- One risk factor for this is a history of sleep-disordered breathing.
- The authors found a higher incidence of expiratory retropalatal closure in patients with sleep-disordered breathing.
- This might explain the higher incidence of difficult mask ventilation in these patients.

Proper mask ventilation during induction of general anaesthesia prevents hypoxaemia and guarantees safe airway management before tracheal intubation. However, recent large epidemiological studies revealed an incidence difficult mask ventilation of 1.4–5% in adult patients undergoing elective surgery and identified features of patients with sleep-disordered breathing (SDB) as common independent risk factors for the difficult mask ventilation.[1,2] Our recent study reports that tidal volume during one-hand mask ventilation in patients with severe SDB was significantly lower than in non-SDB subjects.[3] Despite the clinical significance of difficult mask ventilation in patients with SDB, no study has systematically explored its mechanisms in SDB patients, nor has the dynamic behaviour of the pharyngeal airway during positive pressure ventilation (PPV) been described in these patients.

Our previous studies assessing the static mechanical properties of the passive pharyngeal airway in anaesthetized and paralysed SDB patients demonstrated that the airway size depends on the intraluminal pressure, and the airway closes completely above the atmospheric pressure, particularly at the retropalatal (RP) airway, which is a part of the nasal ventilation route.[4] During the PPV cycle, the luminal pressure reaches a nadir during the expiratory phase, indicating possible expiratory airway narrowing or obstruction, whereas a positive luminal pressure should dilate the pharyngeal airway during the inspiratory phase. In fact, in our recent study, the occurrence of expiratory flow limitation was found to be an independent risk factor for a reduction in the efficiency of mask ventilation.[3] Buffington and colleagues[5] also reported that expiratory airway obstruction, determined by clinical signs such as chest rise without falling and lack of a capnography waveform, occurred more frequently in anaesthetized persons with a narrower RP airway, and the presence of SDB was its independent risk factor. These findings are in agreement with Safar's milestone work, in which half of anaesthetized persons, particularly obese subjects, partially obstructed during nasal PPV.[6,7] Notably, Safar speculated that there was an occurrence of valve-like obstruction at the soft palate during expiration. These results strongly motivated us to explore the mechanisms of dynamic RP obstruction occurring through nasal airway passage ventilation. As no studies have directly confirmed an expiratory obstruction at the soft palate as a mechanism contributing to difficult mask ventilation in SDB patients, our group decided to test this possibility in SDB patients during PPV exclusively through the nasal passage.

Accordingly, we hypothesized that the incidence of RP airway closure (primary outcome) during nasal PPV is more frequent in patients with SDB than in non-SDB subjects. In order to test this hypothesis and explore the mechanisms of dynamic RP closure, endoscopic observation of the behaviour of the soft palate during nasal PPV in anaesthetized and paralysed patients with and without SDB was performed.

Methods

Study population

This non-randomized, parallel-arm observational study was approved by the institutional Ethics Committee (#1578; May 29, 2013: Graduate School of Medicine, Chiba University, Chiba, Japan) and registered in the UMIN Clinical Trial Registry (UMIN000011821, September 20, 2013: https://upload.umin.ac.jp/cgi-open-bin/ctr/ctr.cgi?function=brows&action=brows&type=summary&recptno=R000012344&language=E). Written informed consent was obtained from each subject after the aim and potential risks of the study were fully explained to each. Inclusion criteria were adult patients undergoing surgery under general anaesthesia in Chiba University Hospital, and exclusion criteria were patients with severe comorbidities, high risk of aspiration, allergies to neuromuscular blocking agents or propofol, apparent upper airway structural abnormalities, difficult mask fit, and full dentures.

The chief investigator (M.O.) approached 27 patients undergoing surgery under general anaesthesia (June 2013 to February 2015). Possible SDB patients were actively selected from the surgical lists based on clinical and physical features of SDB, such as higher STOP (Snoring, Tiredness, Observed apnea, high blood Pressure) score, obesity, and reduced cricomental space suggesting small maxilla-mandibular structure with excessive submandibular soft tissue.[8,9] Two patients declined participation in this study. Consents were obtained from 25 subjects, in which the in-hospital nocturnal sleep study was performed before surgery through use of a type IV portable sleep monitor, which measures the respiratory airflow and peripheral arterial O_2 saturation (Sp_{O_2}; SAS2100; Nihon Kohden, Tokyo, Japan). All subjects were instructed to attach an oximetry finger probe and nasal cannula before sleep and to remove them on awakening under nurse supervision. The investigator (M.O.) checked the quality of the recordings (monitoring period >4h, readable and reasonable airflow trace, and Sp_{O_2} changes). The respiratory and oximetry variables were calculated using computer software, in which apnoea and hypopnoea were defined as airflow reduction by 80100% and 50–80% for >10 s in association with >3% Sp_{O_2} reduction from the baseline, respectively. The severity of SDB was quantified by the apnoea-hypopnoea index (AHI), the percentage of time spent at Sp_{O_2} <90%, mean nadir Sp_{O_2}, and lowest Sp_{O_2}. Subjects with AHI $<5h^{-1}$ and AHI $\geq 5h^{-1}$ were designated as non-SDB and SDB groups, respectively. The sleep study was unsuccessful in two subjects. Recruitment of non-SDB subjects was unexpectedly more difficult than recruitment of SDB subjects, and the last three SDB patients were excluded before anaesthesia because of fulfilment of the preplanned number of SDB patients. One SDB patient was originally allocated to the non-SDB group because of an error in definitions in the calculation of the AHI. Consequently, the final number of subjects was uneven between the groups (non-SDB group, nine non-SDB subjects; SDB group, 11 SDB patients). Gender balance of SDB and non-SDB was not our intention; however, the selection consequently produced a significant gender imbalance.

Download English Version:

https://daneshyari.com/en/article/8929938

Download Persian Version:

https://daneshyari.com/article/8929938

Daneshyari.com