

Dissertation presented at Uppsala University to be publicly examined in Robergsalen, Akademiska sjukhuset, Uppsala, Friday, May 9, 2003 at 09:15 for the degree of Doctor of Philosophy (Faculty of Medicine). The examination will be conducted in Swedish.

Abstract

Appelberg, J. 2003. Ventilation and Lung Volume During Sleep and in Obstructive Sleep Apnea. Acta Universitatis Upsaliensis. *Comprehensive Summaries of Uppsala Dissertations from the Faculty of Medicine* 1246. 76 pp. Uppsala. ISBN 91-554-5588-3

Obstructive sleep apnea (OSA) appears to affect up to 5% of the population. The extent to what pulmonary function awake and during sleep relates to obstructive breathing and hypoxemia during sleep in these patients is unclear. The aim of this study was to investigate respiratory function in patients with varying degree of snoring and OSA and to analyse regional lung aeration during sleep.

In all, 35 healthy subjects and 90 patients with snoring and OSA were studied. The ventilatory response to CO₂ (VRCO₂) was measured. Lung function tests were performed. A technique based on computed tomography was developed to study lung aeration during sleep.

Patients with OSA displayed a higher VRCO₂ in comparison to healthy subjects and snorers ($p < 0.01$). Increased closing volume and reduced expiratory reserve volume (ERV) were found in patients with OSA ($p < 0.001$). In a multiple regression analysis, ERV was an independent predictor of nocturnal apnea ($R^2 = 0.13$; $p = 0.001$) and desaturation frequency ($R^2 = 0.11$; $p < 0.01$). In both healthy subjects and OSA patients, lung aeration was reduced during sleep by 0.10 ml gas/g tissue in the dorsal lung region ($p < 0.05$ and $p < 0.01$). OSA patients had a significantly lower gas/tissue ratio in comparison to healthy subjects both awake (-23%; $p < 0.04$) and during sleep (-25%; $p < 0.04$). In a univariate analysis, functional residual capacity (FRC) correlated with the change in lung aeration from wakefulness to sleep ($r = -0.78$; $p < 0.001$). In patients with OSA, ERV ($r = -0.69$; $p < 0.05$) and sleep time ($r = 0.69$; $p < 0.05$) correlated with the fall in lung aeration.

In conclusion, patients with OSA display an increased ventilatory response to CO₂, reduced ERV and increased closing volume. ERV predicts nocturnal apnea and desaturation frequency to a similar extent as obesity. Lung aeration is reduced in the dorsal region during sleep and patients with OSA display a lower amount of gas in comparison to healthy subjects. Decrease in lung volumes, promoting airway closure, and loss of muscle tone contributed to the altered lung function during sleep.

Keywords: Sleep, Ventilation, Sleep apnea syndromes, Snoring, Lung volume, Respiration, Computed tomography, Ventilatory response, Ventilation-perfusion, Airway closure

Jonas Appelberg, Department of Medical Sciences, Clinical Physiology, Uppsala University, SE-75185 Uppsala, Sweden

© Jonas Appelberg 2003

ISSN 0282-7476

ISBN 91-554-5588-3

urn:nbn:se:uu:diva-3363 (<http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-3363>)