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## Lung volumes in the pathogenesis of obstructive sleep apnea

### Volumes pulmonares na patogénese de apneia obstrutiva do sono

To the Editor:

Obstructive sleep apnea (OSA) is a complex disorder characterized by recurrent episodes of upper airway obstruction. Obstructive events occur at the level of the pharynx and there are many factors which contribute to its collapsibility. It has been suggested that reduced end-expiratory lung volumes may play a role.<sup>1</sup> However it is not clear whether, and to what extent, lung volumes influence obstructive events and oxygen desaturations independently of other factors.

To find answers to this, all patients evaluated in a sleep consultation unit, over a 6-month period, with complaints of

snoring and excessive sleepiness, were examined with home or laboratory polysomnography and performed static and dynamic spirometry. Apnea-hypopnea index (AHI), oxygen desaturation index (ODI) and minimal oxygen desaturation (mO2) were evaluated in relation to patient lung volumes.

A total of 75 subjects (47 males, aged  $54.4 \pm 12.3$ , BMI  $30.9 \pm 4.7$  kg/m<sup>2</sup>) were evaluated, 50 had OSA, 8 severe (AHI > 30/h) and 14 moderate (AHI > 15/h). None had a history of lung disease. Age, weight, BMI and neck circumference were significantly higher in the OSA group. There was no significant difference in the lung volumes between the two groups. However, in the moderate/severe OSA patients, AHI correlated with expiratory reserve volume (ERV), airway resistance (Raw) and BMI; mO2 correlated with functional residual capacity (FRC) and BMI (Table 1). In regression analysis, BMI, FRC and ERV were found to be associated with AHI and/or mO2, but only ERV was found to be independently related to AHI.

We found that repeated ahead ERV, FRC and BMI were associated with the occurrence of obstructive events. This



**Table 1** Correlation and regression analysis of OSA variables with patients' characteristics and lung volumes.

Patients' parameters	AHI				mO2			
	Spearman's correlation		Regression analysis		Spearman's correlation		Regression analysis	
	R	p-Value	Univariate	Multivariate	R	p-Value	Univariate	Multivariate
Age (years)	0.129	(ns)	–	–	0.018	(ns)	–	–
BMI (kg/m <sup>2</sup> )	0.571	0.006	0.042	(ns)	–0.499	0.03	0.012	(ns)
Neck circumference (cm)	0.04	(ns)	–	–	–0.346	(ns)	–	–
Abdominal cir. (cm)	0.255	(ns)	–	–	–0.209	(ns)	–	–
Epworth's score	0.163	(ns)	–	–	–0.177	(ns)	–	–
FEV1 (l)	–0.287	(ns)	–	–	–0.169	(ns)	–	–
FVC (l)	–0.407	(ns)	–	–	0.029	(ns)	–	–
TLC (l)	–0.426	(ns)	–	–	0.203	(ns)	–	–
RV (l)	–0.102	(ns)	–	–	0.279	(ns)	–	–
FRC (l)	–0.388	(ns)	–	–	0.531	0.019	0.033	(ns)
ERV (l)	–0.577	0.005	0.007	0.0015	0.262	(ns)	–	–
Raw	0.516	0.014	–	–	–0.026	(ns)	–	–

BMI: body mass index; FEV1: forced expiratory volume in the 1st second; FVC: forced vital capacity; TLC: total lung capacity; RV: residual volume; FRC: forced residual capacity; ERV: expiratory reserve volume; Raw: airway resistance.

association has been described with similar results and could be due to a combination of the effects of obesity and diffuse airway obstruction.<sup>2</sup> Obesity is known to be a major risk factor for OSA linked with increased neck circumference and amounts of peripharyngeal fat, which could narrow and compress the upper airway<sup>3</sup>; obesity may also play a role by reducing lung volumes. Obesity affects ERV by decreasing FRC, and ERV may also be reduced with an increase in residual volume (RV) that occurs, not exclusively, but particularly in the obese, due to premature closure of the small peripheral airways.<sup>4</sup> We found that the absolute effect of the correlation of ERV with obstructive events was similar to the effect of BMI, but ERV remained influential independently of all confounders such as BMI. The reduction in end-expiratory lung volumes, which are accentuated in sleep, may lead to a reduction in tracheal traction on the pharynx and so increasing its collapsibility. Conversely, increases in lung volumes have been shown to increase tracheal traction with stabilization of the upper airway during inspiration,<sup>5</sup> and in OSA patients, they have been shown to decrease positive airway pressure requirements and OSA severity, suggesting improvements in pharyngeal collapsibility.<sup>6</sup> Although this relationship seems unequivocal, as shown in our study, more research is needed in order to define more precisely which end-expiratory volume – ERV, FRC or even RV – plays the major role and how it influences the occurrence of obstructive events during sleep.

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## CT-guided transthoracic lung biopsy: Predictive factors of pneumothorax



### Biópsia pulmonar transtorácica guiada por TC: factores preditivos de pneumotórax

Dear Editor,

Computed tomography (CT) guided transthoracic lung biopsy (TTLB) is a well established method in the diagnosis of intrathoracic lesions with good diagnostic yield.<sup>1</sup> Pneumothorax is the most frequent complication with an incidence varying between 8% and 64%.<sup>2</sup>

The objective of this study was to evaluate potential risk factors associated with the occurrence of pneumothorax in CT-guided TTLB. We performed a retrospective study of patients undergoing CT-guided TTLB between 2007 and 2012 in Braga Hospital. Clinical data and radiologic images of patients were reviewed.

A total of 269 TTLB were performed (201 fine needle aspiration biopsies and 68 core biopsies), in 209 patients with a mean age of 64.2 years, 75.8% male, 60% with smoking habits. Pneumothorax rate was 20.8%. Treatment of pneumothorax with chest drainage was necessary in 10/269 biopsies (3.7%). An initial univariate analysis

identified the following risk factors: larger needle size ( $p = 0.033$ ), smaller size of the lesion ( $p = 0.001$ ) and absence of pleural contact ( $p < 0.001$ ) – Table 1. A multiple logistic regression analysis has identified absence of pleural contact ( $p < 0.001$ ;  $R^2$  adjusted 0.107) and size of the lesion ( $p = 0.030$ ;  $R^2$  adjusted 0.120) as significant independent risk factors for the occurrence of pneumothorax. Pneumothorax occurred in 41/111 (36.9%) biopsies in lesions without pleural contact vs 15/158 (9.5%) with pleural contact. Pneumothorax rate for lesions  $\leq 2$  cm was 31% compared with 15.4% for lesions  $> 4$  cm. Age, gender, smoking habits, presence of emphysema, needle size, presence of cavitation, contours, location and depth of lesion were not significantly associated with increased risk of pneumothorax.

In our study, the absence of pleural contact was the most significant risk factor associated with the occurrence of post-TTLB pneumothorax. These data were corroborated by another retrospective study of Khan et al.<sup>3</sup> in which lesions in the lung parenchyma had a higher pneumothorax rate than lesions located in the pleura or thoracic wall. Another significant risk factor identified was lesion size. There seems to be a gradual increase in the risk of pneumothorax to progressively smaller lesions. In a retrospective analysis of 660 biopsies, Yeow et al.<sup>4</sup> showed that the risk of pneumothorax was about 11 times higher in lesions  $\leq 2$  cm than in lesions  $> 4$  cm.