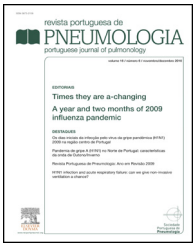
Rev Port Pneumol. 2015;21(3):126–131

revista portuguesa de PNEUMOLOGIA
portuguese journal of pulmonology
www.revportpneumol.org



ORIGINAL ARTICLE

Respiratory functional evaluation and pulmonary hyperinflation in asymptomatic smokers: Preliminary study

R. Gomes[a,b,*], F. Luís[a,b], A. Tavares[a,b], N. Sousa[a,b], S. Correia[a,b], M. Reis[a]

[a] *Pulmonology Service, Sousa Martins Hospital, Local Health Unit, Guarda, Portugal*
[b] *Faculty of Health Sciences of the University of Beira Interior, Covilhã, Portugal*

Received 15 March 2014; accepted 14 July 2014
Available online 9 March 2015

KEYWORDS
Smoking;
Spirometry;
Plethysmography;
Cotinine;
Radiography;
Thoracic

Abstract
Objectives: To investigate the respiratory function and lung hyperinflation in asymptomatic smokers without previous pulmonary pathology and with normal chest radiography. To identify tobacco-related diseases and to correlate tobacco consumption, duration of exposure to tobacco smoke and urinary cotinine with the existence of tobacco-related disease.
Material and methods: Case-controlled study with pairing by sex, age, and body mass index. Case definition: smokers who presented to the first appointment of smoking cessation at the Hospital Sousa Martins (HSM) without respiratory symptoms and with normal chest radiography. Definition of control: users without current and/or past tobacco exposition and with plethysmography and chest radiography at HSM within normal parameters.
Results: Reductions in FEV1/FVC, FEF 75%, FEF 25–75% and the cardiothoracic index were detected in smokers and showed a moderated inverse correlation of TLC (with statistical meaning) compared with the control group. Approximately 31.2% of the smokers showed extrapulmonary disease related to tobacco, and 9.38% of the smokers exhibited subclinical chronic obstructive pulmonary disease (COPD). Smokers with tobacco-related diseases presented a mean age and RV/TLC ratio superior to smokers without pathology.
Discussion: The reduction of the mean values of FEV1/FVC, FEF 75%, FEF 25–75% and the cardiothoracic index seems to indicate precocious pulmonary dysfunction. This work aims to reveal the importance of detecting premonitory anomalies of pulmonary disease during the subclinical phase in patients at risk. Smoking must be considered a factor of multisystemic repercussion; thus, intervention opportunities in this particular group must not be wasted. This preliminary study identifies potentially promising variables with the aim of testing the hypothesis that

* Corresponding author.
E-mail addresses: gomes.rita.dm@gmail.com, ritad_gomes@hotmail.com (R. Gomes).

http://dx.doi.org/10.1016/j.rppnen.2014.07.007

there can be premonitory alterations in COPD, according to its evolution versus reversibility after smoking cessation. This work will be concluded in a future study.

Introduction

Smoking has devastating health effects and is a recognized risk factor for the development of cardiovascular, cerebrovascular, respiratory, and oncological diseases.[1] The Global Initiative for Chronic Obstructive Lung Disease (GOLD) recommends the diagnosis of chronic obstructive pulmonary disease (COPD) based on a reduction in the FEV1/FVC ratio.[2] However, this diagnostic criterion is valid only for advanced COPD, leading to the underdiagnosis of early functional changes in chronic smoking.[3] There are few studies concerning pulmonary function alterations in smokers and the deleterious effects of smoking on functional parameters vary, depending on the studies.

Cigarette smoking has a detrimental effect on the airways, causing inflammation and, consequently, airflow limitations and lung hyperinflation.[4,5] In thoracic radiographs, one sign of lung hyperinflation is the reduction in the cardiothoracic index ('heart in gout'). Some authors claim that a reduction in FEV1 is more than just a measure of airflow limitation, that it is, in fact, a marker of premature death, with a wideranging utility in assessing the risks of COPD, lung cancer, coronary artery disease, and stroke, which collectively account for 70–80% of premature deaths in smokers.[6] Some studies have encouraged the use of new methods in the detection of precursory anomalies of pulmonary disease during the subclinical phase in patients at risk.

The authors present a case control study developed in outpatient clinic with the smoking cessation program at Sousa Martins Hospital (HSM), Local Health Unit, Guarda (Portugal). The main objective of our study was to investigate the respiratory function and lung hyperinflation in asymptomatic smokers without a history of lung pathology and with normal chest radiographs. Secondary objectives consisted of identifying tobacco-related diseases and correlating tobacco consumption, duration of exposure to tobacco smoke, and urinary cotinine with the existence of tobacco-related disease.

Materials and methods

The authors developed a case-controlled study paired by sex, age and body mass index. The cases were defined as smokers (with a smoking habit for at least one year), who presented for their first appointment at the smoking cessation program at HSM during the period of 11 December 2012 to 8 December 2013, without respiratory symptoms and with normal chest radiographs. Smoking subgroups were integrated using evidence of the history of tobacco-related pathology. The exclusion criterion was applied to cases previously diagnosed with pulmonary pathology.

The controls were participants who exhibited normal examination in plethysmography and chest radiographs in HSM. The following exclusion criteria were applied to the controls: known prior history of pulmonary pathology and current and/or past smoking. In the controls, maximum passive exposure was assumed for the determination of carbon monoxide (CO) in the exhaled air (0–6 ppm) and urinary cotinine (<150 ng/mL).

The pulmonary function tests were performed using the Plethysmograph Autobox DI SensorMedics 6200 (California, USA) at the Department of Pathophysiology of Respiratory Diseases at HSM. The technical recommendations and standardized reference values of the American Thoracic Society were used to perform the functional tests. A chest X-ray was obtained while the patient was in the standing and forward positions at maximal inspiration, which complies with the criteria for good technical quality. The ratio between the maximum transverse diameter of the heart and the maximum internal diameter of the chest (the calculation of the cardiothoracic index) was determined. A normal thoracic radiograph was considered to be one without pleuroparenchymal alterations and with a cardiothoracic index below 0.5.

As a biomarker of current smoking, a determination of the CO in the exhaled air was used. Cotinine in the urine was used as a marker for the cumulative consumption of tobacco intake. The measurement of the CO in the exhaled air was performed during the consultation period of smoking cessation in the Micro Medical smoke check (Kent, England). Assays were stratified into the following CO levels: 0–6 ppm, green = no smoking; 7–10 ppm, yellow = light smoker; 11–20 ppm, red = strong smoker; and >20 ppm, red with beep = very strong smoker. The assay of urinary cotinine was executed using gas/mass spectrophotometry chromatography. The assays of urinary cotinine were stratified as follows: <150 ng/mL = passive smoking; 150–499 ng/mL = light smoker; 500–2500 ng/mL = moderate smoker; and >2500 ng/mL = strong smoker.

The criteria for hyperinflation included the presence of either a reduction in the cardiothoracic index or an increase in RV/TLC measured using plethysmography. The minimum value of the cardiothoracic index that defines hyperinflation is not yet clearly established in the literature.

Statistical analyses were performed using IBM SPSS Statistics software 19®. Exploratory and descriptive analyses were applied to the variables, and in the continuous variables, such as the *T*-test (2 groups) and the Pearson correlation coefficient. The level of significance was set at $p < 0.05$.