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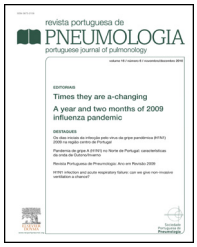

ORIGINAL ARTICLE

Transport of mucoid mucus in healthy individuals and patients with chronic obstructive pulmonary disease and bronchiectasis☆

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KEYWORDS
COPD;
Bronchiectasis;
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Abstract
Objective: To characterize and compare the in vitro transport properties of respiratory mucoid secretion in individuals with no lung disease and in stable patients with chronic obstructive pulmonary disease (COPD) and bronchiectasis.
Methodology: Samples of mucus were collected from 21 volunteers presenting no lung disease who had undergone surgery, from 10 patients presenting chronic COPD, and from 16 patients with bronchiectasis. Mucociliary transport (MCT), transport by cough (SCM), and contact angle (CAM) were evaluated.
Results: MCT was found to be greater in healthy individuals (1.0 ± 0.19) than in COPD (0.91 ± 0.17) and bronchiectasis (0.76 ± 0.23) patients ($p < 0.05$), whereas SCM was greater in COPD patients (16.31 ± 7.35 cm) than in patients with bronchiectasis (12.16 ± 6.64 cm) and healthy individuals (10.50 ± 25.8 cm) ($p < 0.05$). No significant differences were observed between the groups regarding CAM.
Conclusion: Mucus from healthy individuals allows better mucociliary transport compared to that from patients with lung diseases. However, the mucus from COPD patients allows a better transport by coughing, demonstrating that these individuals have adapted to a defence mechanism compared to patients with bronchiectasis, who have impairment in their ciliary and cough transport mechanisms.
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PALAVRAS-CHAVE
DPOC;
Bronquiectasia;
Muco respiratório;
Depuração mucociliar

Transporte de secreção mucoide de indivíduos saudáveis e pacientes com doença pulmonar obstrutiva crónica e bronquiectasias

Resumo
Objetivo: Analisar e comparar as propriedades de transporte in vitro da secreção respiratória de aspeto mucoide (M) de indivíduos sem doença respiratória e de pacientes com doença pulmonar obstrutiva crónica (DPOC) e bronquiectasias estáveis.
Métodos: Foram avaliadas 21 amostras de indivíduos sem doença pulmonar submetidos a processos cirúrgicos, 10 amostras de pacientes com DPOC e 16 amostras de pacientes com bronquiectasias quanto ao transporte mucociliar (TMC), deslocamento na máquina simuladora de tosse (MST) e ângulo de contacto (AC).
Resultados: Maior TMC das amostras de indivíduos sem doença respiratória ($1{,}0 \pm 0{,}19$) quando comparado com o dos pacientes com DPOC ($0{,}91 \pm 0{,}17$) e bronquiectasias ($0{,}76 \pm 0{,}23$) ($p < 0{,}05$), enquanto que o deslocamento na MST foi maior nos pacientes com DPOC ($16{,}31 \pm 7{,}35$ cm) quando comparado com o de pacientes com bronquiectasias ($12{,}16 \pm 6{,}64$ cm) e de indivíduos sem doença respiratória ($10{,}50 \pm 25{,}8$ cm) ($p < 0{,}05$). Não houve diferença envolvendo a avaliação do AC.
Conclusão: O muco respiratório dos indivíduos saudáveis tem um melhor transporte ciliar do que o de pacientes com doenças de pulmão. No entanto, o muco de pacientes com DPOC tem uma melhor transportabilidade pela tosse, sugerindo que esses pacientes apresentam adaptações para tais mecanismos de defesa, enquanto que os pacientes com bronquiectasias têm deficiência no transporte ciliar, assim como no transporte pela tosse.
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Introduction

The respiratory system presents several defence mechanisms against inhaled harmful particles from the external environment.[1] Mucociliary transport is considered to be the main mechanism in healthy individuals, eliminating the inhaled particles by an effective interaction between mucus and cilia.

Under normal conditions, respiratory mucus spreads out to form a 5-μm layer throughout the bronchial tree, with secretion being minimally produced and varying from 10 to 100 ml/day, which is not enough to stimulate the cough receptors.[2] However, under adverse conditions such as respiratory diseases (e.g. COPD or bronchiectasis) there is an increase in the thickness of the mucus layer due to alterations in rheological and surface properties and macroscopic aspect, thus favoring the production of more viscous mucus. These alterations impair mucociliary clearance, which could be compensated by the cough mechanism.[3–5]

Mucus transport in different diseases is related to several factors including the mechanism of the diseases, infection episodes, duration of the disease, aggressiveness of the disease, and drugs used.[4–7] since all of them can promote changes in the mucus properties, resulting in different macroscopic aspects and transport by ciliary system or air flow.[8,9]

Therefore, the objective of the present study was to compare the in vitro transport properties of respiratory mucoid mucus secretion in individuals with no lung disease with stable patients with COPD and bronchiectasis.

Materials and methods

This study was approved by the local Ethical Committee, and the subjects signed an informed consent form.

Mucoid mucus samples were collected from 47 individuals as follows:

- 21 healthy volunteers with no lung disease who had undergone surgical intervention, including general anesthesia and orotracheal intubation;
- 10 stable patients with chronic obstructive pulmonary disease (COPD) who were selected according to criteria established by the American Thoracic Society (ATS);
- 16 patients with non-cystic fibrosis bronchiectasis confirmed by computerized tomography.

Sputum collection

Bronchiectasis and COPD: patients were instructed to cough and expectorate into a glass container covered with gauze so that saliva was separated and sample contamination reduced. Then, the samples were stored in eppendorf tubes filled with vaseline oil to avoid dehydration[10] and frozen.[11]

Healthy volunteers: samples from the group that did not have a respiratory disease were collected from the mucus retained in the endotracheal tube immediately following removal using a cotton stick according to criteria and procedures described by Rubin et al.[12]

In vitro mucociliary transport

The frog palate is a convenient system for studying mucociliary transport, since the frog's palate epithelium is similar to that of the airways of vertebrates. Anesthetized frogs were decapitated, their jaws disarticulated, and the upper portion of the head was removed. The frog palate was kept in a refrigerator at 4 °C for two days covered with plastic wrap in a humidified chamber to deplete the frog

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