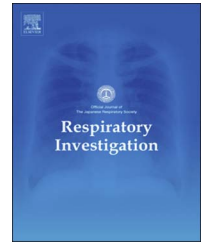




ELSEVIER

Contents lists available at ScienceDirect

Respiratory Investigation

journal homepage: www.elsevier.com/locate/resinv

Original article

Usefulness of the forced oscillation technique in assessing the therapeutic result of tracheobronchial central airway obstruction

Masanori Yasuo^{a,*}, Yoshiaki Kitaguchi^{a,1}, Fumiya Kinota^a, Makoto Kosaka^a, Kazuhisa Urushihata^a, Atsuhito Ushiki^a, Hiroshi Yamamoto^a, Satoshi Kawakami^b, Masayuki Hanaoka^a

^aThe First Department of Internal Medicine, Shinshu University School of Medicine, 3-1-1 Asahi, Matsumoto 390-8621, Japan

^bDepartment of Radiology, Shinshu University School of Medicine, 3-1-1 Asahi, Matsumoto 390-8621, Japan

ARTICLE INFO

Article history:

Received 29 August 2017

Received in revised form

7 November 2017

Accepted 21 January 2018

Keywords:

Forced oscillation technique (FOT)

Interventional bronchoscopy

Pulmonary function test (PFT)

Therapeutic effect

ABSTRACT

Background: Pulmonary function tests (PFTs) comprise the traditional method for detecting central airway obstruction (CAO) and evaluating therapeutic effects, but are effort-dependent. By contrast, the forced oscillation technique (FOT) is performed during tidal breathing in an effort-independent mode and is universally used to assess respiratory function in patients with chronic obstructive pulmonary disease (COPD) and asthma. We used the FOT to measure airway resistance and reactance in patients with CAO before and after interventional bronchoscopy and compared the results to data obtained using PFTs. **Methods:** Twelve patients with CAO were recruited from December 2013 to July 2016. The FOT, PFTs, chest computed tomography (CT), COPD Assessment Test (CAT), and the modified Medical Research Council (mMRC) dyspnea scale were employed before and after interventional bronchoscopy. The minimum airway cross-sectional area (MACSA) was calculated using a CT image calculator.

Results: Of the 12 patients, 6 had tracheal obstruction and 6 had bronchial obstruction. All FOT measurements, except ΔX_5 , were significantly improved after interventional bronchoscopy in all cases. The significance of the improvement was greater with the FOT than PFTs. The MACSA, CAT, and mMRC dyspnea scale scores also significantly improved in all cases. Furthermore, only alteration of resistance at 20 Hz (R20) significantly correlated with the alteration of the MACSA after intervention. No significant correlations were found for PFTs.

Conclusions: The FOT is suitable and convenient for assessing therapeutic results in

Abbreviations: CAO, central airway obstruction; CAT, COPD Assessment Test; CT, computed tomography; FOT, forced oscillation technique; mMRC, modified Medical Research Council; MACSA, minimum airway cross-sectional area; PFT, pulmonary function test

*Correspondence to: The First Department of Internal Medicine, Shinshu University School of Medicine, 3-1-1 Asahi, Matsumoto 390-8621, Japan. Fax: +81 263 36 3722.

E-mail addresses: yasumasa@shinshu-u.ac.jp (M. Yasuo), kitaguti@shinshu-u.ac.jp (Y. Kitaguchi), kinota@shinshu-u.ac.jp (F. Kinota), kosaka@shinshu-u.ac.jp (M. Kosaka), ichiju@shinshu-u.ac.jp (K. Urushihata), atsuhito@shinshu-u.ac.jp (A. Ushiki), yama5252@shinshu-u.ac.jp (H. Yamamoto), kawasato@shinshu-u.ac.jp (S. Kawakami), masayuki@shinshu-u.ac.jp (M. Hanaoka).

¹Both of these authors contributed equally to this work.

<https://doi.org/10.1016/j.resinv.2018.01.005>

2212-5345/© 2018 The Japanese Respiratory Society. Published by Elsevier B.V. All rights reserved.

Please cite this article as: Yasuo M, et al. Usefulness of the forced oscillation technique in assessing the therapeutic result of tracheobronchial central airway obstruction. *Respiratory Investigation* (2018), <https://doi.org/10.1016/j.resinv.2018.01.005>

patients with tracheobronchial CAO. The alteration of R20 is useful for estimating the airway dilation of CAO after interventional bronchoscopy.

© 2018 The Japanese Respiratory Society. Published by Elsevier B.V. All rights reserved.

1. Introduction

Pulmonary function tests (PFTs) are widely used to detect central airway obstruction (CAO) and assess treatment results. However, PFTs are unsuitable for patients with severe tracheobronchial CAO because of its effort dependence. Tracheobronchial CAO can have benign or malignant causes. The therapy for tracheobronchial CAO is also varied, including surgery, interventional bronchoscopy, and radiotherapy.

Recently, a broadband frequency forced oscillation technique (FOT) has been applied frequently for the measurement of lung function and the evaluation of pulmonary disease status, particularly chronic obstructive pulmonary disease (COPD) and asthma, because of its effort independence in demanding minimal cooperation from patients [1]. The FOT was originally reported in the 1950s [2]. In this technique, random pressure pulses of 5–35 Hz are generated by a small loudspeaker mounted in series with a pneumotachograph. These pulses are applied to a patient during tidal breathing. Pressure-flow oscillations are superimposed on the patient's tidal breaths and real-time recordings are used to estimate the total respiratory system impedance, including resistance and reactance, at different frequencies that may differentiate between central and peripheral airway obstruction [3].

Several researchers have tried to apply the FOT to assess CAO [4–6]. All of this research has used impulse oscillometry (IOS) (MasterScreen IOS, Jaeger, Hoechberg, Germany) to assess the therapeutic effect of the FOT and estimate the usefulness of follow-up [4], degree of tracheal stenosis [5], and correlation of the symptom improvements with the type of stenosis [6] in patients with tracheal or upper airway obstruction.

In the current study, we applied the FOT to the measurement of airway resistance in patients with CAO before and after interventional bronchoscopy to evaluate the therapeutic effects, which were then verified using the corresponding data obtained using PFTs. In addition, we evaluated the correlation of FOT measurements with the airway dilation of CAO after interventional bronchoscopy.

2. Patients and methods

This study was approved by the Ethics Review Board of Shinshu University (Permission number: 3505, Date of approval: September 6, 2016). The study protocols and interventional bronchoscopy were performed in accordance with the principles outlined in the Declaration of Helsinki of the World Medical Association. Before the study and interventional bronchoscopy, written informed consent was obtained from each patient.

2.1. Patients

Our institute is a major medical facility for the treatment of patients with CAO with interventional bronchoscopy in Nagano prefecture in Japan. Tracheobronchial CAO was defined as CAO with various causes (e.g., benign, malignant, iatrogenic, inflammatory). Tracheobronchial CAO was diagnosed using chest computed tomography (CT) and bronchoscopy. From December 2013 to July 2016, 23 patients with CAO were treated using interventional bronchoscopy, including 12 patients (9 males, 3 females) with CAO who systematically underwent the FOT, respiratory spirometry, modified Medical Research Council (mMRC) questionnaire for dyspnea assessment, COPD Assessment Test (CAT), and chest CT before and after interventional bronchoscopy. Of these 12 patients, 8 had malignant obstruction and 4 had benign causes of CAO (Table 1). According to the position of the obstruction, the 12 patients were further divided into those with tracheal obstruction ($n = 6$) and main bronchial obstruction ($n = 6$). Regarding the therapeutic procedure, 5 patients underwent endobronchial intervention (e.g., electrosurgical snare, argon plasma coagulation) and the other 7 patients underwent endobronchial intervention with stent insertion (1 silicone and 6 metallic stents; Table 1). All of the patients exhibited respiratory symptoms, such as coughing, dyspnea, and stridor. In this study, the central airway was defined as the trachea to the left main bronchus and bronchus intermedius in the right-side bronchus.

2.2. Measurements

The FOT, PFTs, chest CT, mMRC dyspnea scale, and CAT were performed for the 12 patients with CAO within 5 days before and 7 days after interventional bronchoscopy to avoid the stages of luminal edema and excessive secretion of blood and mucus.

2.2.1. FOT

Before any other PFT, the FOT was applied to measure the respiratory impedance using a commercially available multi-frequency FOT device (MostGraph-01, Chest Co., Ltd., Tokyo, Japan) following the standard recommendations [12] as described previously [1,11]. The resistance at 5 Hz (R5), resistance at 20 Hz (R20), reactance at 5 Hz (X5), resonant frequency (Fres), and low-frequency reactance area (ALX) were measured. The oscillatory parameters were measured at whole-breath, inspiratory, and expiratory phases. The difference between the inspiratory and expiratory phases was calculated for each oscillatory parameter.

Download English Version:

<https://daneshyari.com/en/article/8750686>

Download Persian Version:

<https://daneshyari.com/article/8750686>

[Daneshyari.com](https://daneshyari.com)