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Laryngeal and respiratory patterns in patients with paradoxical vocal fold motion

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Summary
The purposes of this study were to determine the differences in spirometric measures obtained from patients with endoscopically-documented paradoxical vocal fold motion (PVFM) and to compare them to a group of normal subjects without endoscopically-documented paradoxical vocal fold motion during non-provocative breathing and following speech. Thirty eight subjects with documented paradoxical vocal fold motion using transnasal flexible laryngoscopy (TFL) and no history of asthma and 21 normal subjects with documented normal breathing patterns and normal findings on endoscopy underwent flow-volume loop studies. Endoscopic judgments of vocal fold motion from three breathing conditions were made by two observers. The results of the endoscopic judgments indicate that paradoxical motion occurs whether breathing through the nose or mouth in the PVFM subjects, mainly after speaking and inhalation. In addition, the spirometry results indicated that the inspiratory measure of FIVC%, FVC% and $FIV_{0.5}$/FIVC were significantly lower in the PVFM group compared to the normal subjects. The data supports the hypothesis that in patients with PVFM, inspiratory spirometric values play a role in identifying patients with PVFM. The finding of vocal fold closure following a speech utterance in the majority of the PVFM subjects but not in the normal control group warrants further investigation.

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Introduction

Paradoxical vocal fold movement (PVFM) is a condition characterized by upper airway obstruction secondary to the paradoxical complete or partial adduction of the vocal folds, occurring primarily on inhalation, and occasionally during exhalation. PVFM is the current term used by otolaryngologists and speech-language pathologists while vocal cord dysfunction (VCD) is the term used primarily by pulmonologists and allergists. Throughout the allergy, asthma, otolaryngology and speech pathology literature, these terms are used interchangeably. The term PVFM will be used consistently in this study. .Diagnosis of PVFM is based on case history, pulmonary function testing and the visualization of the abnormal (paradoxical) movement of the vocal folds during transnasal flexible laryngoscopic (TFL) examination. This movement may be seen while the patient is performing an exercise task such as riding a bicycle or it may occur spontaneously during restful breathing.[1]

Spirometry has been reported as an additional investigational tool in the diagnosis of PVFM. The flow-volume loop pattern in PVFM is characterized by flattening of truncation of the inspiratory limb, compared to a U-shaped pattern in normal subjects.[2] Abnormal expiratory measures and concomitant diagnosis of asthma in patients with PVFM is variable. An incidence of 15%—50% of PFVM concomitant with asthma is described in the literature.[3] Although the majority of the patients with PVFM are known to have normal pulmonary function, treatment of patients with PVFM (misdiagnosed as asthma) often begins with pharmacological management of typical pulmonary symptoms, and in those cases, the results are often unsuccessful.

The flow-volume loop is uniquely helpful in the evaluation of upper airway obstruction in that the site (extra thoracic or intra thoracic), the nature (variable or fixed), and the severity of obstruction can be predicted by the configuration of this loop. The flow-volume loop can assist in accurate differential diagnosis of PVFM versus other respiratory complaints. Vertigan et al.[4] found that those people with a definite diagnosis of PVFM tended to have normal expiratory phases, but attenuation in the inspiratory phase, and those diagnosed with asthma, presented in an opposite manner.

Recently, it has been suggested that the diagnosis of PVFM should include both laryngoscopy and pulmonary function testing, since the sensitivity of the flow-volume loop may be very low.[5] Studies have, in fact, reported a range of incidence of 23%—100% showing an abnormal inspiratory loop in patients diagnosed PVFM.[6] In PVFM subjects with abnormal spirometric measures, earlier findings by Morris and colleagues report a decrease in forced expiratory volume at 1 s/forced vital capacity (FEV1/FVC) compared to normal subjects.[2] They, along with other investigators, also report a significant elevation in the ratio of the mid-vital capacity of the expiratory air flow to the mid-vital capacity inspiratory capacity of inspiratory air flow (FEF_{50}/FIF_{50})[7,8] Moreover, other studies have reported that abnormally large FEF_{50}/FIF_{50} ratios may be present in some but not all patients with PVFM.[3,9] Others have shown that decreased inspiratory flow is the ventilatory characteristic of extra thoracic obstruction and results in higher FEV0.5/FIV0.5.[10—12]

Only cursory observations of endoscopic examinations to identify the presence of paradoxical motion of the vocal folds have been reported in the groups that have been investigated with spirometry and compared to control groups. The purposes of this study were to determine the differences in spirometric measures obtained from patients with endoscopically-documented PVFM and to compare them to a group of normal subjects without endoscopically-documented paradoxical vocal fold motion during non-provocative breathing and following speech.

Materials and methods

Subjects

The Columbia University Internal Review Board approved this study. The subjects of this study included 38 patients diagnosed with PVFM based upon the transnasal flexible laryngoscopic (TFL) examination, case history, and symptomatic complaints, such as shortness of breath, coughing and throat clearing. They were selected based on a retrospective medical chart review of the patients seen at the Voice and Swallowing Center at Columbia University Medical Center between September, 2006 and July 2008. All subjects were adults between the ages of 23—70 years. Subjects were excluded if they were over 70 years of age, had concomitant active diseases of asthma or chronic obstructive pulmonary disease (COPD) or were being medicated for asthma, chronic obstructive pulmonary disease (COPD), diabetes mellitus and neurological disorders such as Parkinson's, cerebral vascular accident or a progressive neurological conditions or with a more than 20 pack/year history of cigarette smoking. No subjects were currently smoking. Patients with a forced vital capacity lower than 75% were also excluded.

A group of 21 healthy non-smoking individuals was selected to compose the control group. They were recruited from individuals visiting the clinic with other patients, and from families and friends of the investigators. Data for both groups of subjects was collected in the time period between September 2006 and July 2008.

Procedure

Following a thorough case history that included inquiring about shortness of breath, coughing, dysphonia, dysphagia and other symptoms, the patients and subjects underwent (TFL). Once the individual was comfortable with the endoscope in place, he/she was asked to breathe through his/her nose for 20—30 s followed by breathing through his/her mouth for 20—30 s. The patient was then asked to say the sound/i/and to repeat a sentence "We see green trees." If there was greater than 50% vocal fold adduction during or after any of the tasks, the subject was considered to be in the PVFM group. The data was stored for later judgment by two individuals familiar with endoscopic views of the vocal folds. In all cases, during the examination, the subjects were not coughing nor were they experiencing acute symptoms of dyspnea.