Abstract

Objective: To identify the utility of the pulmonary function measurement, peak inspiratory flow (PIF), in the analysis and management of subglottic stenosis and other forms of upper airway obstruction through correlation of symptoms and patient characteristics with PIF values (L/s).

Methods: A retrospective chart review was performed on all patients with upper airway obstruction who underwent pulmonary function testing during clinic visits between 2002-2014. The clinical course of each patient was reviewed along with the best effort PIF measurements. Clinical markers evaluated included the presence of shortness of breath and stridor. SPSS version 22.0 was used to analyze the data.

Results: Ninety-nine patient records were retrospectively reviewed. Diagnoses evaluated included subglottic stenosis (n=68), vocal cord paralysis (n=12), glottic stenosis (n=10), subglottic and laryngeal amyloidosis (n=5), tracheal stenosis (n=3), and pharyngeal stenosis (n=1). A greater frequency of stridor and shortness of breath was seen in patients with a PIF <2 L/s compared with patients with a PIF ≥2 L/s (p<0.001). Subglottic stenosis patients with shortness of breath and stridor correlated with a PIF <2 L/s (p<0.001). In the 44 patients who had 5 or more PIF tests performed, there was a correlation between patients' height and their lowest (p=0.042) and highest PIF values (p<0.001).

Conclusion: PIF measurements significantly correlate with the severity of clinical symptoms. Other covariates, such as height, weight, and gender can impact PIF values, stressing the importance of interpreting PIF in conjunction with a clinical exam. PIF is an objective marker that can help direct intervention and monitor treatment success and outcomes in individuals with subglottic stenosis as well as other forms of upper airway obstruction.

Methods and Materials

Patients diagnosed with an upper airway obstruction at the University of Iowa Department of Otolaryngology–Head and Neck Surgery between 2002 and 2014 were identified through the electronic medical record and evaluated retrospectively. SPSS 22.0 software was used for all statistical analysis. Chi square analyses were used to determine if PIF scores (grouped as <2 and ≥2 L/s) were associated with shortness of breath or stridor.

The subset of 44 patients with five or more PIF readings during the time frame of this study were analyzed to determine what characteristics were associated with their lowest and highest PIF score. Correlations were performed on the numeric variables (age, height, weight, and BMI) and t-tests were performed on the categorical variables (gender and smoking).

Height and weight were grouped into gender specific tertiles based on the distribution of all cases. BMI was grouped into underweight, normal, overweight, and obese based on WHO criteria. Results were considered significant for p values < 0.05.

Results

Ninety-nine patients were evaluated with 574 pulmonary function tests during the time frame of this study. Patient diagnoses included subglottic stenosis (n=68), vocal cord paralysis (n=12), glottic stenosis (n=10), subglottic and laryngeal amyloidosis (n=5), tracheal stenosis (n=3), and pharyngeal stenosis (n=1).

Among patients with subglottic stenosis (n=68), PIF values were lower in those with clinician-documented stridor (mean=2.4 L/s) compared with those who did not have stridor (mean=3.8 L/s; p<0.001). PIF values were lower in patients with documented shortness of breath (mean=2.9 L/s) compared with those who had no shortness of breath (mean=3.9 L/s; p<0.001).

Table 1 demonstrates the association of shortness of breath and stridor with PIF values among all patients. Table 2 illustrates patient characteristics impacting a patient’s highest and lowest PIF values.

Discussion

This study demonstrates that PIF values of <2 L/s correlate with the traditional clinical markers of shortness of breath and stridor. As many lab assessments, PIF is most ideally interpreted when it is personalized to a patient’s particular characteristics including height, weight and gender.

Current treatment management of subglottic stenosis and other forms of upper airway obstruction rely heavily on subjective markers, including patient-reported symptoms, physical examination, and patient’s desire for improved breathing to determine the timing for intervention. In frequently relapsing conditions, such as subglottic stenosis, slowly worsening shortness of breath over a protracted time may be tolerated without recognition by a patient until the associated obstruction is severe, leading to emergent intervention.

Utilizing PIF in upper airway obstruction management allows both the patient and clinician to track their progress with an accessible, objective marker.

Conclusions

This study is the first large-scale assessment demonstrating the utility of peak inspiratory flow as an objective marker for evaluating the severity of upper airway obstruction when used in conjunction with clinical evaluation. There is a significant association between a peak inspiratory flow rate of less than 2 L/s and clinical markers of shortness of breath and stridor.

Patient body habitus, height, and gender should be considered, as these factors can impact PIF values. Future studies will help to further validate the use of peak inspiratory flow in upper airway obstruction.