Excessive Dynamic Airway Collapse on Spirometry in Pediatric Asthma Patients

Gerald Miller, MD1; Albert Botchway, PhD2; Mark Johnson, MD1

1. Southern Illinois University Department of Pediatrics, Springfield, IL; 2. Southern Illinois University Medicine Center for Clinical Research, Springfield, IL.

Introduction

- During acute asthma there can be two forms of airflow obstruction, excessive dynamic airway collapse (EDAC) and airway obstruction due to airway inflammation and edema.
- EDAC results from collapse of the posterior membrane of tracheal walls due to hypotonia of the myoelastic components of the posterior membrane.1
- It has been suggested that a 50% fall in flow in the first 10% of the FVC (forced vital capacity) is characteristic of EDAC.2
- To our knowledge no study has tried to differentiate spirometric airflow characteristics in EDAC and inflammatory obstruction seen in those with asthma.
- We hypothesize that a sudden decrease (> 2 standard deviations) from peak flow could be consistent with EDAC.

Methods

- A retrospective chart review of patients who had spirometry at the SIU School of Medicine Pediatric Pulmonology Clinic from 1/1/2018 through 12/31/2018 was completed.
- Measured flow at 10% FVC and 20% FVC and compared it to the PEF (peak expiratory flow).
- Measurements were done using an electric digital caliper.
- Inclusion criteria: 8-18 years old, diagnosis of asthma, and forced expiratory volume at 1 second (FEV1)/FVC ≤ 80%.
- Exclusion criteria: Test done due for diagnosis other than asthma, a secondary respiratory diagnosis (i.e. cystic fibrosis), or inability to perform spirometry.
- Only the most recent spirometry test completed was evaluated if multiple were done during the study time.

Results

- There was a total of 952 unique spirometry tests performed.
- 233 of the spirometry tests showed signs of obstruction: FEV1/FVC ≤ 80%.
- 89 spirometry tests had a met all inclusion and exclusion criteria.
- At 10% of FVC the average decrease from PEF was 5% ± 7%.
- At 20% of FVC the average decrease from PEF was 24% ± 12%.

Discussion

- A decrease of greater than two SD could be consistent with EDAC based upon spirometry.
- A decrease of 20% from PEF at 10% of FVC is 2 standard deviations.
- A decrease of 50% from PEF at 20% of FVC is 2 standard deviations.
- The primary goal in this study was to determine what changes in spirometry may be consistent with EDAC as those with EDAC may respond better with positive pressure ventilation.
- Patients with spirometry not consistent with EDAC may have characteristics of airway inflammation and edema which may respond better to steroids and albuterol.

Discussion (cont.)

- Knowledge of the type of obstruction may be beneficial in future research to determine if patients with EDAC would respond better positive airway pressure as compared to albuterol and steroids.

Table 1. Number of spirometry tests which met diagnostic criteria at various percentages of FVC.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Number of Patients</th>
<th>Percent of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% of FVC</td>
<td>5/89</td>
<td>5.6%</td>
</tr>
<tr>
<td>20% of FVC</td>
<td>2/89</td>
<td>2.2%</td>
</tr>
<tr>
<td>Either 10% or 20% of FVC</td>
<td>6/89</td>
<td>6.7%</td>
</tr>
<tr>
<td>Both 10% and 20% of FVC</td>
<td>1/89</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

Figures

- Figure 1: Spirometry test showing PEF and FVC during expiratory phase.
- Figure 2: The red plus sign shows a greater than 20% reduction from PEF at 10% of the FVC.
- Figure 3: The red plus sign shows a greater than 50% reduction from PEF at 20% of the FVC.

References