

# Excessive Dynamic Airway Collapse on Spirometry in Pediatric Asthma Patients #378

SIU MEDICINE

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## Introduction

- During acute asthma there can be two forms of airflow obstruction, excessive dynamic airway collapse (EDAC) and airflow 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.<sup>1</sup>
- It has been suggested that a 50% fall in flow in the first 10% of the FVC (forced vital capacity) is characteristic of EDAC.<sup>2</sup>
- 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 a electric digital caliper.
- Inclusion criteria: 8-18 years old, diagnosis of asthma, and forced expiratory volume at 1 second ( $FEV_1$ )/FVC  $\leq 80\%$ .
- 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.

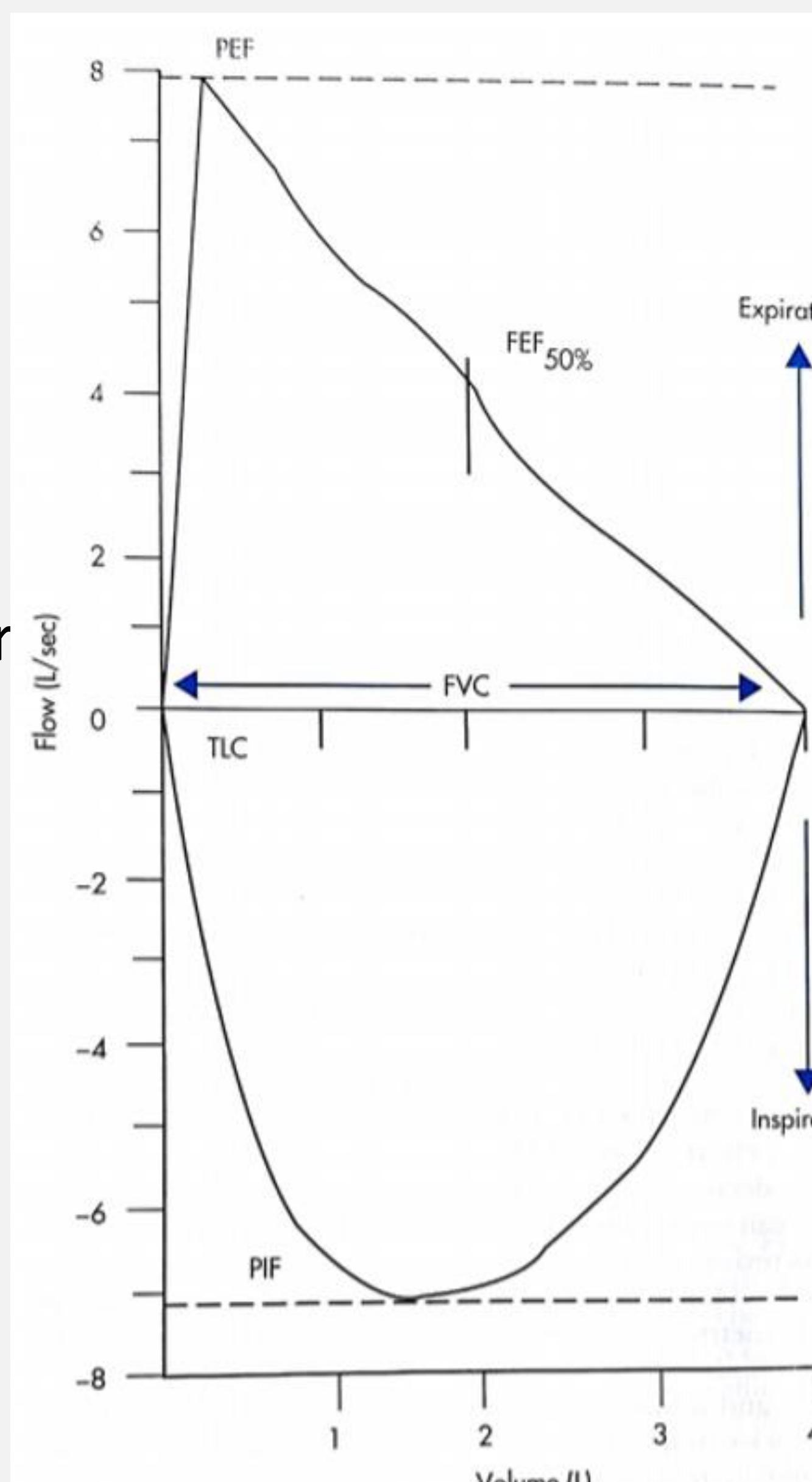


Figure 1.<sup>3</sup>

Spirometry test showing PEF and FVC during expiratory phase.

- There was a total of 952 unique spirometry tests performed.
- 233 of the spirometry tests showed signs of obstruction:  $FEV_1/FVC \leq 80\%$ .
- 89 spirometry tests had a met all inclusion and exclusion criteria.
- At 10% of FVC the average decrease from PEF was  $5\% \pm 7\%$ .
- At 20% of FVC the average decrease from PEF was  $24\% \pm 12\%$ .

| Criteria                 | Number of Patients | Percent of Patients |
|--------------------------|--------------------|---------------------|
| 10% of FVC               | 5/89               | 5.6%                |
| 20% of FVC               | 2/89               | 2.2%                |
| Either 10% or 20% of FVC | 6/89               | 6.7%                |
| Both 10% and 20% of FVC  | 1/89               | 1.1%                |

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

## Results

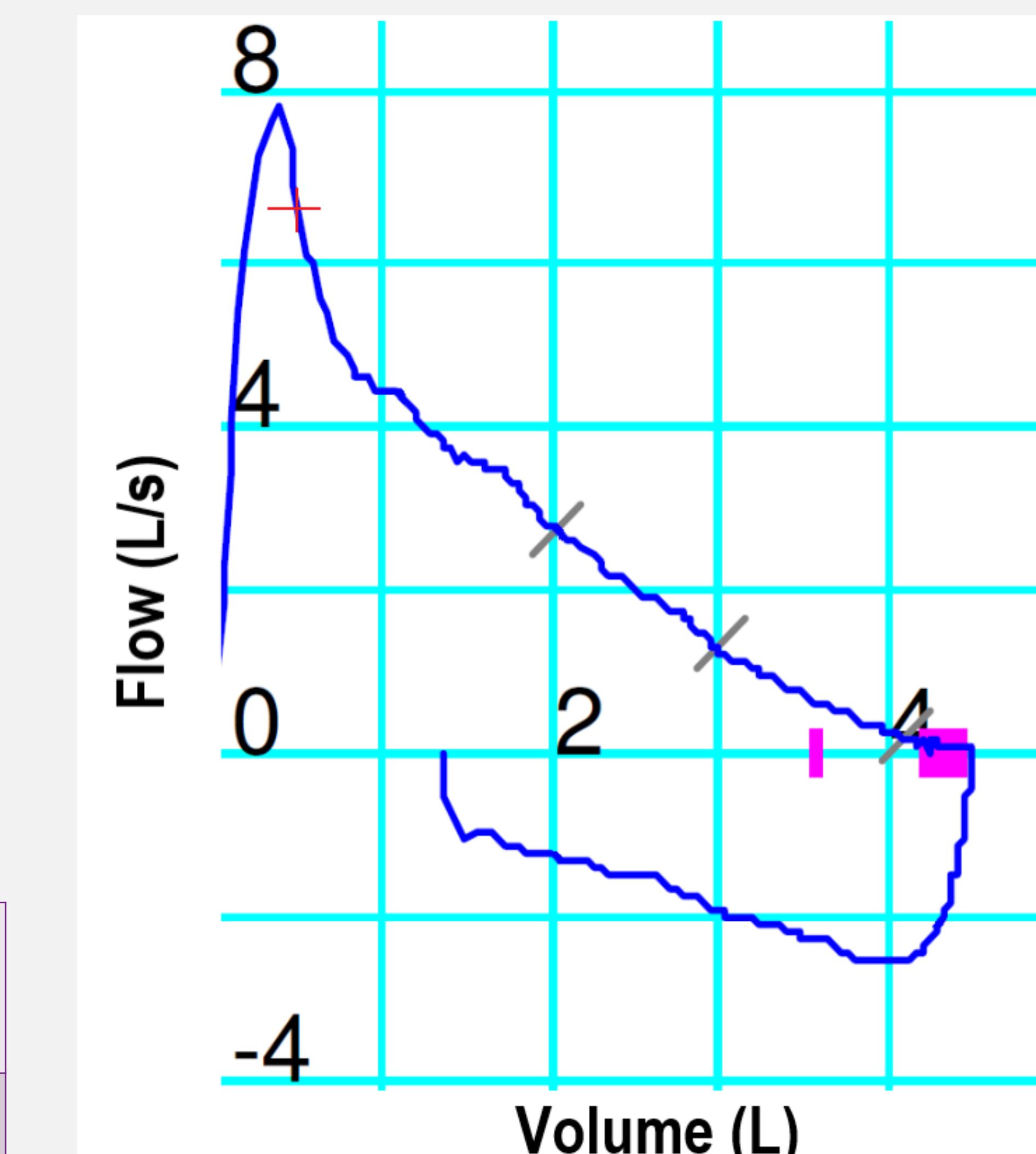


Figure 2.

The red plus sign shows a greater than 20% reduction from PEF at 10% of the FVC.

- At 10% of FVC 2 standard deviations from average is approximately a 20% decrease from PEF.
- Only 5 of 89 tests show a > 20% reduction from PEF at 10% of the FVC.

- At 20% of FVC 2 standard deviations from average is approximately a 50% decrease from PEF.
- Only 2 of 89 test show a > 50% reduction from PEF at 20% of the FVC.

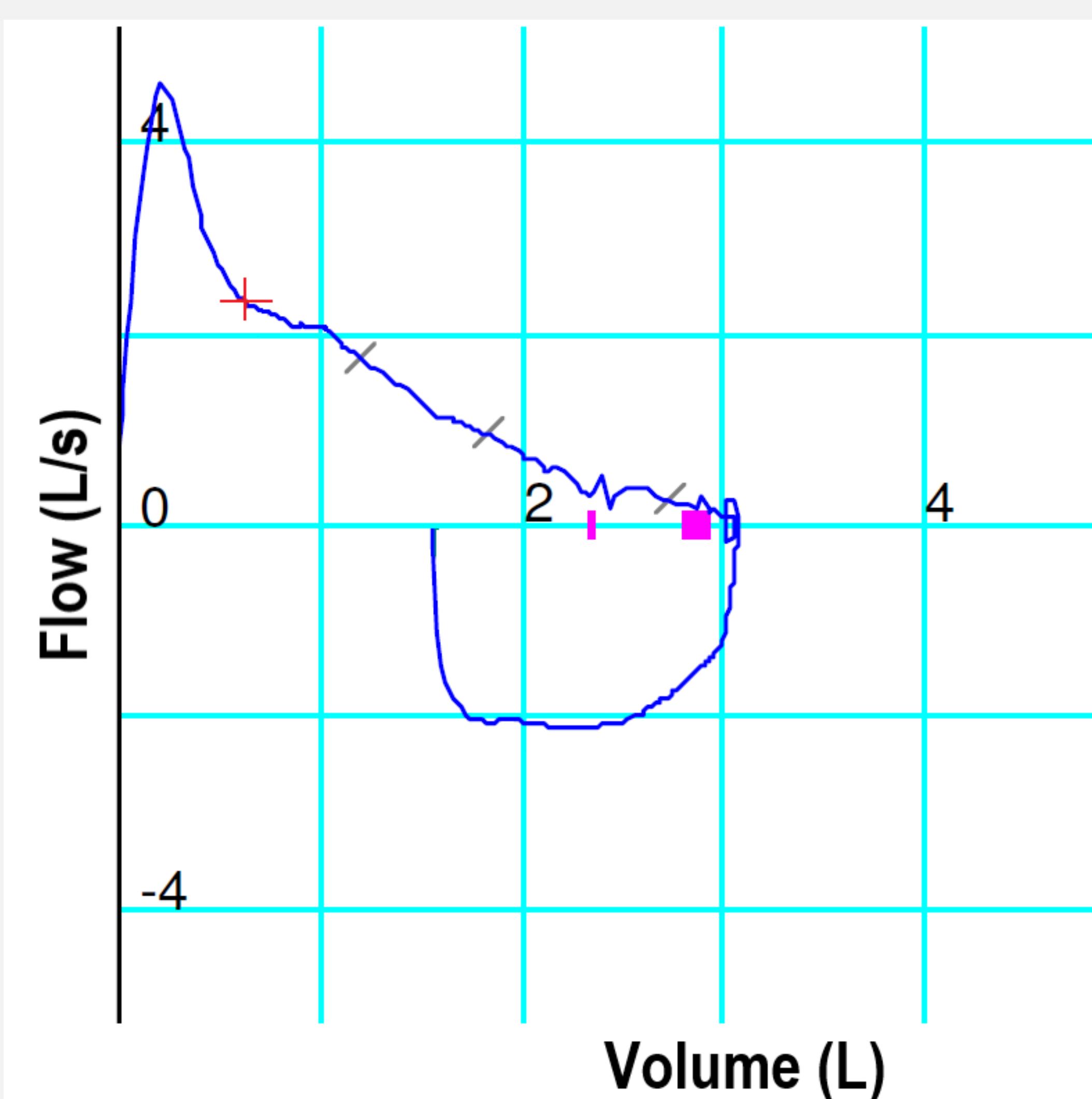


Figure 3.

The red plus sign shows a greater than 50% reduction from PEF at 20% of the FVC.

## 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.

## References

- Murgu S, Colt H. Tracheobronchomalacia and excessive dynamic airway collapse. Clin Chest Med. 2013 Sep;34(3):527-55.
- Healy F, Wilson AF, Fairshiter RD. Physiologic correlates of airway collapse in chronic airflow obstruction. Chest. 1984 Apr;85(4):476-81.
- Ruppel, G. (2003). *Ruppel's Manual of Pulmonary Function Testing*. Maryland Heights, MO: Mosby.