Case Report

Biphasic flow volume curve due to obstruction of main bronchus by bronchogenic cyst

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ABSTRACT

The biphasic curve or bicompartamental flow volume obtained during the forced maneuver is the characteristic of the obstruction of a main bronchus. We report the case of a 64-year-old woman, with progressive dyspnea, coughing and wheezing localized in the left hemithorax, who had been diagnosed with bronchial asthma and was not responding to treatment. The flow volume curve showed an end inspiratory arm configuration compatible with unilateral obstruction of a main bronchus. Chest computed tomography with three-dimensional reconstruction showed a left main bronchus compression by a cyst formation, the bronchoscopy confirmed the obstruction. At surgery a bronchogenic cyst was resected.

After the procedure, dyspnea, cough, expectoration and wheezing disappeared. The postoperative flow volume curve showed a normal configuration. We are not aware of a previous report of a biphasic flow volume curve due to a mediastinal bronchogenic cyst.

The flow volume curve is a noninvasive procedure useful in the diagnosis of unilateral obstruction of a main bronchus.

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1. Introduction

Obstruction of the main airways may manifest clinically by means of dyspnea, cough, and abnormal auscultatory findings.

The association between unilateral obstruction of a main bronchus and changes of the flow volume curve has been known for more than two decades. This unilateral obstruction of a main bronchus is a rare finding and can be produced by malignant neoplasm, Wegener’s granulomatosis, relapsing polychondritis, unilateral pulmonary emphysema or MacLeod’s syndrome and main stem bronchial obstruction after single lung transplantation. The main bronchus stenosis modifies the configuration of the flow volume curve and its analysis provides useful information for the diagnosis of airway obstruction. Unilateral obstruction of a main bronchus was studied by Williams et al., but it was Gascoigne et al. who first described the biphasic curve or flow volume in patients with obstruction of main bronchus. Later, Roos and Braat developed the theory of the phenomenon of the two compartments whereby unilateral obstruction to airflow in a bronchus is manifested as a delay in the end inspiratory and expiratory limb of the flow/volume curve, representing the disturbed filling and emptying of the lung with main bronchus stenosis.

In this presentation we analyze the abnormalities of the flow volume curve in a patient with obstruction of main bronchus due to a bronchogenic cyst and the resulting normalization after surgical resection of the mass. We wish to emphasize the value of analysis of the shape of the flow volume curve in the diagnosis and monitoring of unilateral main bronchus obstructions.

2. Case report

Female patient, 64 years old, retired, comes to consultation because of progressive dyspnea during the last year. In the interview she complains about dyspnea on walking 100 m, which increases at bedtime and is associated with productive cough and occasional wheezing located in the left hemithorax. The patient had multiple medical history: asthma, hiatus hernia, colonic diverticulitis, hypertension, kidney stones, tonsillectomy and total abdominal hysterectomy and bilateral salpingo-oophorectomy.

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She has been diagnosed and treated for bronchial asthma, without relief of symptoms. On physical examination, a left expiratory wheeze is detected. The flow/volume curve (Fig. 1) shows an end inspiratory arm configuration compatible with unilateral obstruction of a main bronchus. The values of the spirometry are shown in Table 1.

The thoracic computed tomography (Fig. 2) showed a subcarinal and prevertebral mediastinal mass, 64 × 62 mm. The 3D reconstruction showed a significant stenosis of left main bronchus (Fig. 3).

The bronchoscopy showed a thin displaced membranous carina with a curve in the distal third, with extrinsic compression of left bronchus, which involved 80% of the light but allowed the passage of the bronchoscope, normal mucosa was observed distally.

During surgery, a cystic mass located at mediastinal level, behind the left bronchus was resected. At the macroscopy, the cystic mass measured 5 × 3 × 1.5 cm, laminar brownish fragments were observed inside as well as fragments of bone consistency. The histological examination showed a cystic wall lined by respiratory epithelium, with fibrotic adjacent tissue with mild lymphocytic inflammatory infiltrate, and fragments of cartilage and muscle tissue. The diagnosis was bronchogenic cyst.

After surgery the patient improved and the dyspnea (breathlessness MRC = 0), cough, expectoration, and wheezing disappeared. The postoperative spirometry (Table 2) and the flow volume curve (Fig. 4) were normal.

3. Comments

The value of the shape of the flow volume curve in maximal inspiration and expiration for the study of airway obstruction has been diagnostic. The values of the spirometry in preoperative and postoperative are shown in Tables 1 and 2.

Table 1
Preoperative spirometry.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UM</th>
<th>Description</th>
<th>Pred A</th>
<th>% Pred A</th>
<th>B</th>
<th>Δ%</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>l (btps)</td>
<td>Forced vital capacity</td>
<td>2.89</td>
<td>105.6</td>
<td>2.99</td>
<td>-2.0</td>
</tr>
<tr>
<td>FEV1</td>
<td>l (btps)</td>
<td>Forced expiratory volume in 1 s</td>
<td>2.44</td>
<td>79.4</td>
<td>1.94</td>
<td>+0.5</td>
</tr>
<tr>
<td>FEV1/FVC%</td>
<td>%</td>
<td>FEV1 as % of FVC</td>
<td>76.9</td>
<td>82.4</td>
<td>65.0</td>
<td></td>
</tr>
<tr>
<td>FEF25–75%</td>
<td>l (s)</td>
<td>Midexpiratory flow forced</td>
<td>2.84</td>
<td>34.9</td>
<td>1.08</td>
<td>+9.1</td>
</tr>
</tbody>
</table>

UM: Unit of measurement, Pred: predicted value, A: pre-bronchodilator value found, % Pred A: Percentage of predicted, pre-bronchodilation, B: post-bronchodilator value found, Δ%: Percentage change in post-bronchodilator. Preoperative spirometric findings.

Table 2
Postoperative spirometry.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UM</th>
<th>Description</th>
<th>Pred A</th>
<th>% Pred A</th>
<th>B</th>
<th>Δ%</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>l (btps)</td>
<td>Forced vital capacity</td>
<td>2.86</td>
<td>103.7</td>
<td>2.98</td>
<td>+0.3</td>
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<tr>
<td>FEV1</td>
<td>l (btps)</td>
<td>Forced expiratory volume in 1 s</td>
<td>2.41</td>
<td>85.5</td>
<td>2.23</td>
<td>+8.4</td>
</tr>
<tr>
<td>FEV1/FVC%</td>
<td>%</td>
<td>FEV1 as % of FVC</td>
<td>76.8</td>
<td>90.5</td>
<td>75.1</td>
<td></td>
</tr>
<tr>
<td>FEF25–75%</td>
<td>l (s)</td>
<td>Midexpiratory flow forced</td>
<td>2.81</td>
<td>48.0</td>
<td>1.77</td>
<td>+31.4</td>
</tr>
</tbody>
</table>

UM: Unit of measurement, Pred: predicted value, A: pre-bronchodilator value found, % Pred A: Percentage of predicted, post-bronchodilation value found, Δ%: Percentage change in post-bronchodilator. Postoperative spirometric findings.
been longly known.\textsuperscript{10–12} This test can show the level of the obstruction,\textsuperscript{5–7,13–16} and its condition of fixed or dynamic. Traditionally, the description of several patterns of large airway obstruction has been made (Table 3).

Unilateral obstruction of a main bronchus has a characteristic biphasic pattern also called “two compartments”. The physiological and anatomical models poise the hypothesis that this biphasic pattern is a phenomenon of two compartments characterized by sequential or asynchronous filling and emptying of lung units. The peak inspiratory and expiratory flow of the normal lung is followed by a delayed and reduced functioning of the lung whose path is blocked.\textsuperscript{5,7}

In the case of our patient the biphasic curve of the flow-volume curve preoperative reconfirms the phenomenon of the two chambers characteristic of obstruction of a main bronchus.\textsuperscript{1,9} The flow-volume curve performed after resection of bronchogenic cysts and completely restored bronchial permeability shows normalization of the shape. This finding is consistent with that reported by other authors who also found the return to normal pattern after elimination of the cause of luminal obstruction.\textsuperscript{1,19}

In the past, flow-volume curves were not performed or included among the routine tests in many pulmonary function tests laboratories. This was due to, among other reasons, the misconception that this test required expensive equipment or that the interpretation of its configuration was not valuable. Currently the curve flow-volume is determined during the forced expiratory maneuver, along with the curve volume/time for most commercially available spirometers. It is a simple test that, if properly interpreted, helps locate the site of the obstruction.\textsuperscript{10–20} Moreover, the flow-volume curve is used for monitoring the evolution of lung transplant patients anastomosis,\textsuperscript{6,7} as it is a simple test that can be repeated often avoiding bronchoscopy.

The curve flow/volume is a noninvasive and sensitive test, which can help and contributes to the diagnosis and monitoring of bronchial obstruction of the large airways.

Diclosures
The authors have no conflict of interest.

References