CASE REPORT

Large endotracheal tumour presenting as severe COPD: flow–volume loop analysis, not always a straightforward diagnostic test

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SUMMARY

The flow–volume loop (FVL) analysis is typically helpful in establishing the diagnosis of airway obstruction caused by endobronchial lesions. In this report, we describe a patient with emphysema and tobacco abuse who presented with chronic dry cough and severe chronic obstructive pulmonary disease (COPD) refractory to standard therapy. The initial FVL showed a relatively normal forced expiratory peak flow shape followed by a smooth flattening of the expiratory curve on spirometry, a pattern consistent with distal airway obstruction as seen in severe asthma or COPD. The patient was later found to have a large endotracheal mass. This atypical presentation, along with the unusual FVL, led to a significant delay in the diagnosis of the tracheal mass. A high level of suspicion is needed to diagnose variable intrathoracic airway obstruction in patients presenting with severe asthma or COPD who fail to improve with standard therapy.

BACKGROUND

The flow-volume loop (FVL) on spirometry is often helpful in the diagnosis of ventilatory defects as well as central and upper airway obstructions. The classic patterns of FVLs for central or upper airway obstruction have been well-described.[1–3] These patterns, however, lack significant sensitivity, which needs to be considered when evaluating patients with breathing abnormalities in order to make the correct diagnosis and avoid delaying appropriate therapy. Here, we report a patient with emphysema and a history of tobacco use presenting with a tracheal mass and FVL mimicking distal airway obstruction due to severe chronic obstructive pulmonary disease (COPD). A written consent was obtained from the patient to publish this report.

CASE PRESENTATION

A 58-year-old woman presented to the clinic with 6 months of dry cough. Pertinent history included a 40 pack-year tobacco use and choroidal melanoma of the left eye diagnosed 8 years earlier. The tumour was treated with brachytherapy with complete resolution on further surveillance. Physical examination was unrevealing with stable vital signs and absence of adenopathy, wheezing or rales.

INVESTIGATIONS

Chest X-ray showed hyperinflated lungs and a flattened diaphragm suggestive of emphysema. Spirometry demonstrated a ratio of forced expiratory volume in one second (FEV1) to forced vital capacity (FVC) of 0.39, FEV1 of 1.01 L (39% of predicted value) and FVC of 2.58 L (81% of predicted value), consistent with severe airflow obstruction. The FVL showed a forced expiratory peak flow with a relatively normal shape followed by a smooth flattening of the rest of the expiratory curve (figure 1A). Based on these findings, the patient was initially diagnosed with severe COPD and treated with long-acting bronchodilators without improvement. A CT scan of the chest obtained for further evaluation at a follow-up visit 2 months later revealed 1.5×1.5 cm intraluminal distal tracheal mass (figure 2A) and mild emphysematous changes (figure 2B). Bronchoscopy was performed and revealed a large mass in the distal trachea which was nearly occluding the lumen (figure 3A).

TREATMENT

The tracheal mass was completely resected endoscopically (figure 3B) and pathological examination of the mass was consistent with metastatic melanoma.

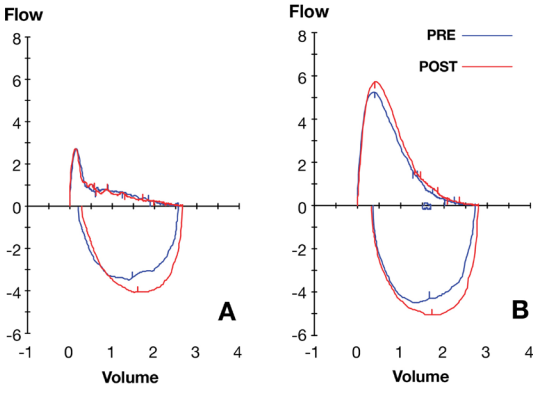

Figure 1 (A) Flow–volume loop (FVL) pattern prior to resection of the tracheal tumour; mild flattening of expiratory curve following peak expiratory flow can be observed. (B) Near-normalisation of the FVL on patient's spirometry after the resection of the tracheal mass.

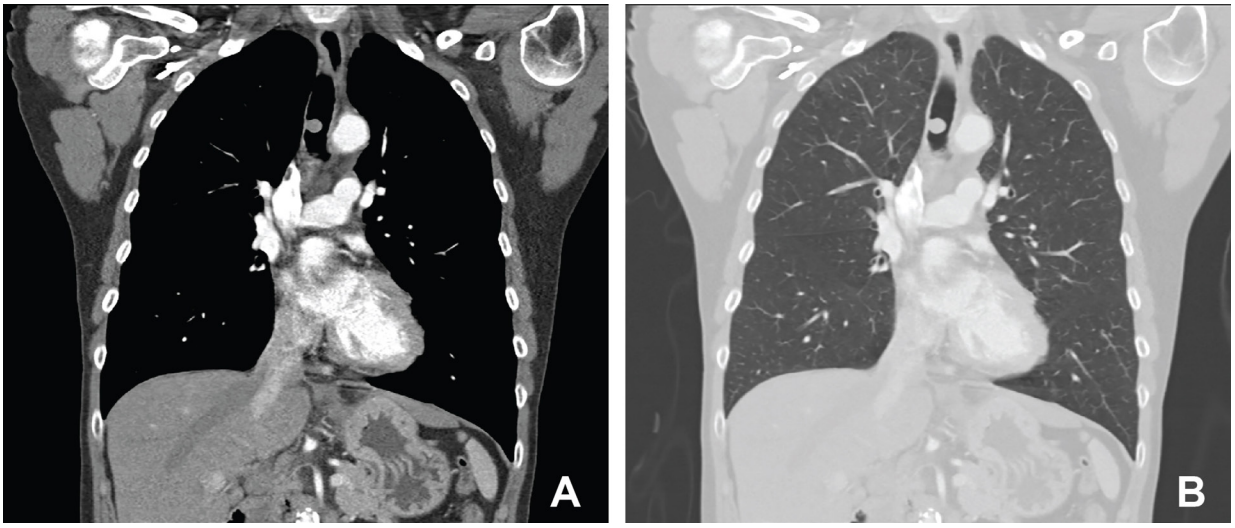

Figure 2 Coronal reconstruction of CT scan of the chest, revealing a large tracheal mass on the mediastinal window (A), and mild emphysema on the lung window (B).

OUTCOME AND FOLLOW-UP

Following the resection of the tracheal mass, the patient's cough resolved, and a follow-up spirometry showed only mild airway obstruction—FEV1 to FVC ratio of 0.65, FEV1 of 1.78 L (70% of predicted value), FVC of 2.73 L (83% of predicted value)—and near-normalisation of the FVL (figure 1B).

DISCUSSION

Malignant tracheal tumours include primary (eg, squamous cell, adenoid cystic and mucoepidermoid carcinomas) and metastatic neoplasms (eg, colon cancer, renal cancer, breast cancer and melanoma).[4] These tumours usually manifest with persistent cough, haemoptysis, progressive dyspnoea, stridor and, ultimately, airway obstruction with respiratory failure. Delay in the diagnosis and treatment of these tumours can have deleterious consequences for the overall prognosis and survival in these patients.

The tracheal mass in our patient was found to be metastatic melanoma likely from the choroidal melanoma of the eye diagnosed and treated 8 years prior. Ocular melanomas account for 3.1%–3.7% of all melanomas.[5 6] Extracutaneous melanomas are relatively rare but have been shown to have worse outcomes than cutaneous melanomas.[5 6] Metastatic melanomas have a uniformly poor 5-year survival rates regardless of the primary site.[6] The lung is one of the most common sites for metastasis of melanomas although involvement of the trachea is relatively uncommon.[7–9] Up to 5% of the metastatic tumours to the airway are melanomas.[10]

The FVL is a vital component in evaluating patients presenting with respiratory symptoms.[2 11] Typical FVL patterns have been described for variable intrathoracic and extrathoracic airway obstructions (figure 4).[1–3] In variable extrathoracic obstruction, the maximal airflow limitation occurs during inspiration when the positive atmospheric extraluminal pressure combined with the negative intraluminal pressure decreases the extrathoracic airway diameter. The decreased airway diameter, in turn, magnifies the resistance to airflow already present due to the obstructive process. This effect results in flattening of the inspiratory curve of the FVL (figure 4A). In variable intrathoracic obstruction, the maximal airflow limitation occurs in expiration. During expiration, pleural pressure becomes positive relative to the intraluminal airway pressure, decreasing the diameter of the intrathoracic airways. Therefore, any intrathoracic airway obstruction is more prominent during expiration and demonstrated on FVL as flattening of the expiratory curve (figure 4B).

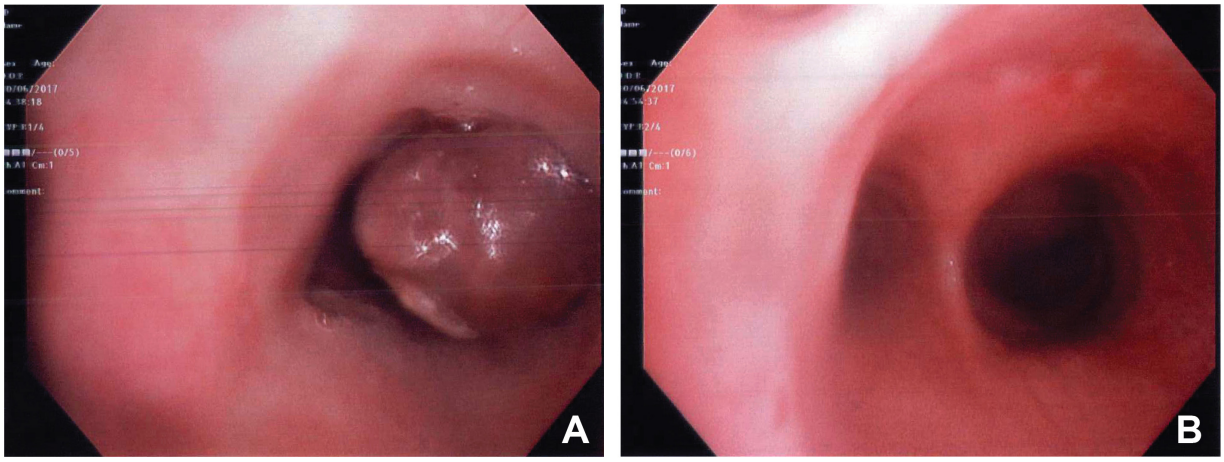

Figure 3 Endoscopic view of the trachea before (A) and after (B) resection of the tracheal mass.

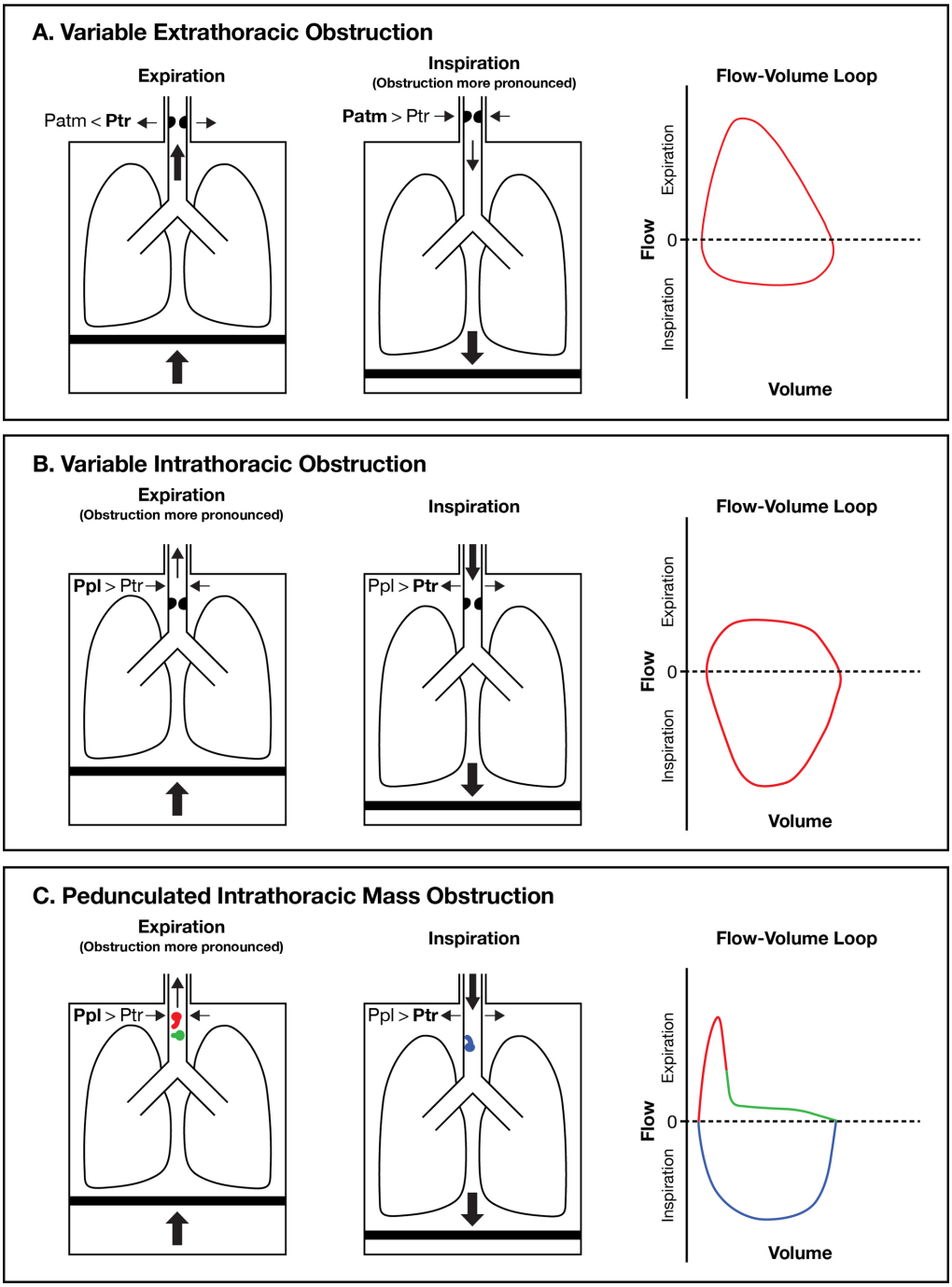

Figure 4 Typical flow–volume loop (FVL) patterns expected with variable extrathoracic (A) and intrathoracic obstructions (B). A less typical FVL pattern of variable intrathoracic obstruction (C) can be observed with pedunculated tumours in intrathoracic airways. Patm, atmospheric pressure; Ptr, intratracheal pressure; Ppl, pleural pressure.

The sensitivity of FVL patterns to determine the correct airway obstruction is dependent on the severity and aetiology of the obstruction.[3 12] Large intrathoracic tracheal tumours can present with either fixed or variable intrathoracic airway obstruction FVL patterns, with immobile tracheal tumours more commonly leading to fixed obstruction. Less commonly, as in our patient, intrathoracic tracheal tumours can present with a normal inspiratory curve followed by a reduced peak expiratory flow with normal morphology and plateauing in the early or midexpiratory curve mimicking a distal airway obstruction like asthma or COPD.[13–15] This unusual FVL pattern can be seen with pedunculated mobile tumours (figure 4C). During inspiration, the airflow, which is primarily dependent on patient effort, is strong enough to overcome airway obstruction caused by the tumour and results in a normal inspiratory curve. This temporary relief from obstruction is further assisted by gravity, tumour mobility and the increased diameter of the intrathoracic airway during inspiration. During expiration, the first 25% of the expiratory flow is primarily dependent on patient effort. The tumor mobility combined with the strong patient's expiratory effort may be enough to overcome the increased airway resistance generated by the tumour producing a mildly reduced peak expiratory flow curve with an almost normal morphology. The remaining 75% of the expiratory flow is almost exclusively dependent on the

airflow resistance of the intrathoracic airways. The presence of a positive pleural pressure relative to intraluminal airway pressure along with the natural decline in the expiratory flow accentuates the obstructive effect of the tumour. This effect is reflected on the FVL as plateauing of the midexpiratory curve after the peak flow and resulting in an overall FVL similar to the pattern observed in severe distal airway obstruction. Resection of the tracheal tumour should result in normalisation of the expiratory curve as evidenced in this case (figure 1B).

In conclusion, severe variable intrathoracic airway obstruction might not always present with a typical flat expiratory curve as described in the literature. Especially in the case of pedunculated tracheal tumours, the FVL might appear similar to FVL of distal airway obstruction. A high level of suspicion for further evaluation is needed for obstructive lung diseases refractory to standard therapy to avoid any delays in the diagnosis and appropriate therapy.

Learning points

- The flow–volume loop has limitations in detecting variable airway obstruction.
- The severity of the obstruction, combined with the physical properties of the obstructing mass, can significantly impact the sensitivity of flow–volume loops in detecting variable airway obstruction.
- A high level of suspicion is needed to diagnose variable intrathoracic airway obstruction in patients with severe asthma or chronic obstructive pulmonary disease who fail to improve with standard therapy.

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