Spirometry: Case studies

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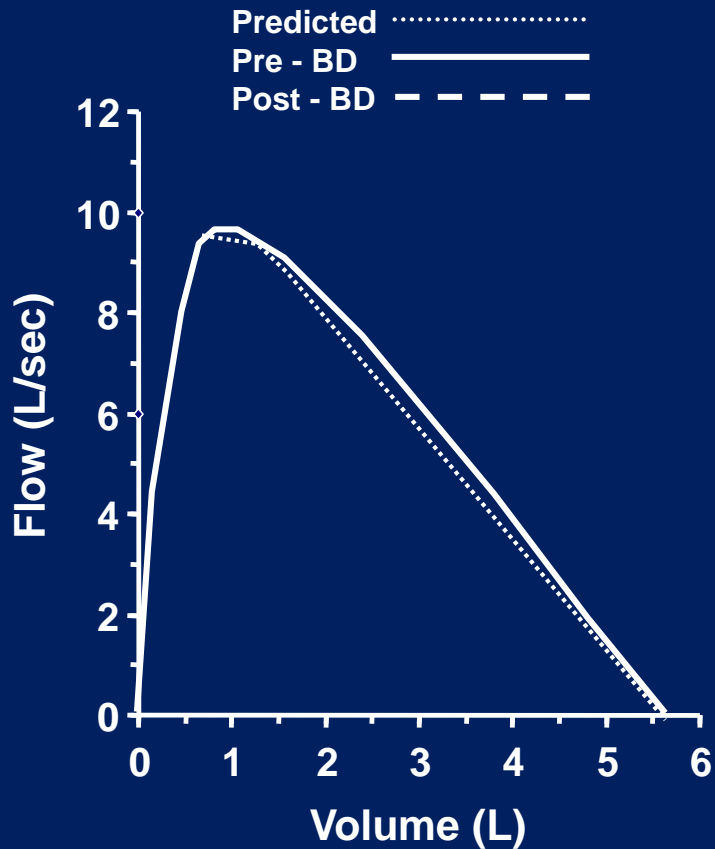# Case 1

Case history

- Male
- 25 years, height 175 cm
- Never smoked
- No history of respiratory disease
- Normal chest x-ray
- Referred for pre-employment lung function tests

Case 1: Results

Predicted ·············
Pre - BD ──────
Post - BD ▬ ▬ ▬ ▬ ▬

	Predicted		Pre-BD	Post-BD
	Mean	LLN		
FEV_1 L	4.44	3.67	4.35 (98%)	-
FVC L	5.36	4.46	5.60 (104%)	-
FEV_1/FVC %	83	73	78	-
$FEF_{25-75\%}$ L/s	4.6	3.1	5.3	-
PEF L/s	10.0	7.7	9.8	-

Case 1: Interpretation

Interpretation: Normal ventilatory function

- The shape of the flow volume loop and all spirometric indices are within the normal range

- These results indicate normal ventilatory function

- This provides useful baseline lung function data for future comparison

Case 2

Case history

- Female
- 40 years, height 165 cm
- Ex-smoker for 10 years; estimated consumption of 11 pack years
- No significant history of respiratory disease other than occasional URTI
- No unusual findings on recent chest X-ray
- Referred for routine lung function tests prior to abdominal surgery

Case 2: Results

Legend:
- Predicted ·················
- Pre - BD ───────
- Post - BD ─ ─ ─ ─ ─
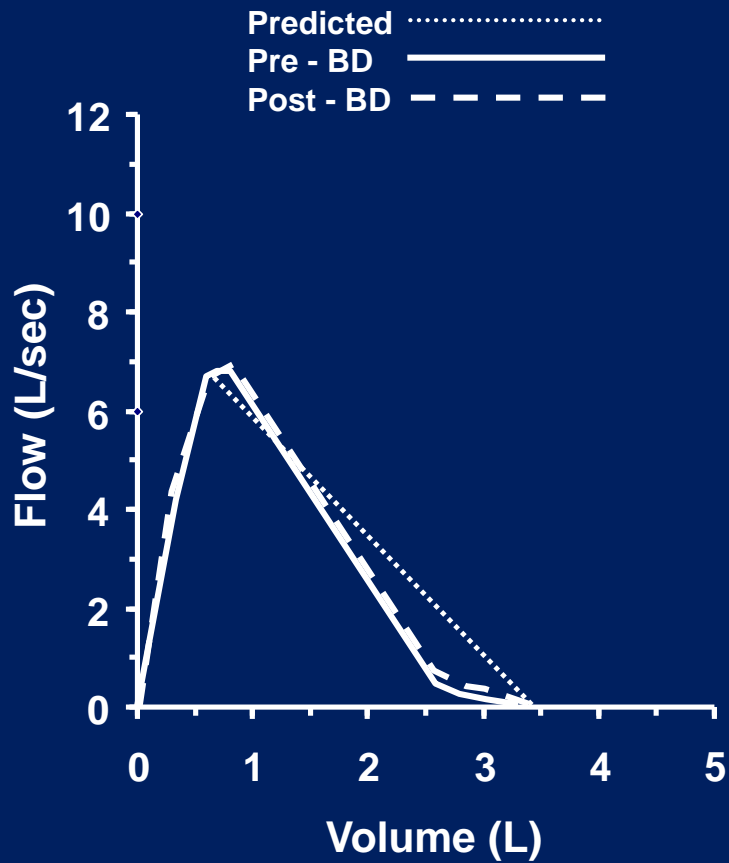
	Predicted		Pre-BD	Post-BD
	Mean	LLN		
FEV_1 L	3.11	2.51	2.81 (90%)	2.90
FVC L	3.81	3.10	3.70 (97%)	3.85
FEV_1/FVC %	82	73	76	75
$FEF_{25-75\%}$ L/s	3.2	1.9	1.8 (56%)	1.9 (59%)
PEF L/s	7.1	5.4	6.9	6.9

Case 2: Interpretation

Interpretation: Small airway disease

- The flow volume curve shows abnormally low flows at low lung volumes suggesting that the small airways rather than the large airways are abnormally narrow during forced expiration

- This is confirmed by the normal FEV_1, and PEF but abnormally low $FEF_{25-75\%}$ (56% predicted)

- Post-bronchodilator, there was no significant improvement in small airway function

- These results suggest the presence of small airway disease, probably the result of her smoking history

Case 3

Case history

- Male

- 20 years, height 170 cm

- Never smoked

- History of episodic wheeze and chest tightness, particularly in the early morning and during exercise

- PEF performed by his family doctor was 43% below the predicted value

- Referred to confirm diagnosis of asthma and document the degree of reversibility

Case 3: Results

Predicted ·········
Pre - BD ────────
Post - BD ─ ─ ─ ─ ─
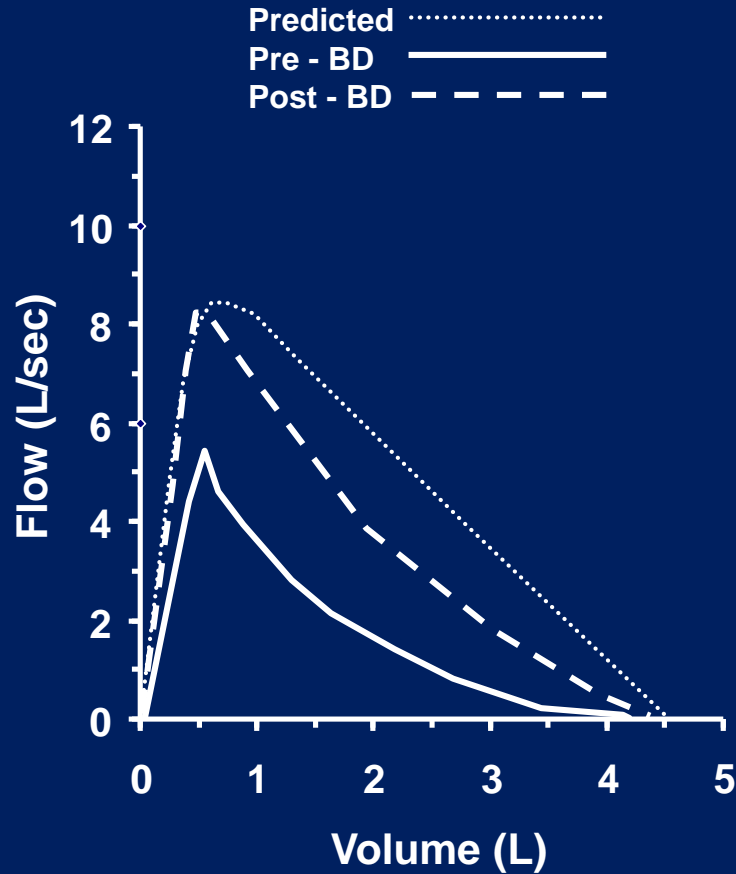
	Predicted		Pre-BD	Post-BD
	Mean	**LLN**		
FEV_1 L	4.30	3.58	2.31 (54%)	3.36 (78%)
FVC L	5.1	4.25	4.65 (91%)	4.90 (96%)
FEV_1/FVC %	84	74	50	69
$FEF_{25-75\%}$ L/s	4.7	3.2	2.1	3.9
PEF L/s	9.4	7.3	5.5	8.3

Case 3: Interpretation

Interpretation: asthma

- The concavity in the expiratory flow volume curve and low FEV_1/FVC ratio indicates an obstructive ventilatory defect

- Pre-bronchodilator FEV_1 is 54% predicted, indicating a moderate obstructive ventilatory defect

- There was a substantial 24% (1.05 L) improvement in FEV_1 post salbutamol with the FEV_1/FVC ratio increasing from 50% to 69%

- These results are highly suggestive of asthma

Case 3: Pathophysiology

- In asthma the airflow obstruction is due to:
  - Contraction of bronchial smooth muscle (reversible)
  - Inflammatory thickening of bronchial mucosa (may improve with steroids)
  - Mucus in the bronchial tubes

Case 4

Case history

- Male

- 35 years, height 163 cm

- Smoker for 15 years; estimated consumption of 12 pack years

- No significant history of respiratory disease other than occasional URTI and productive cough in morning

- Attended GP for unrelated reason

Case 4: Results
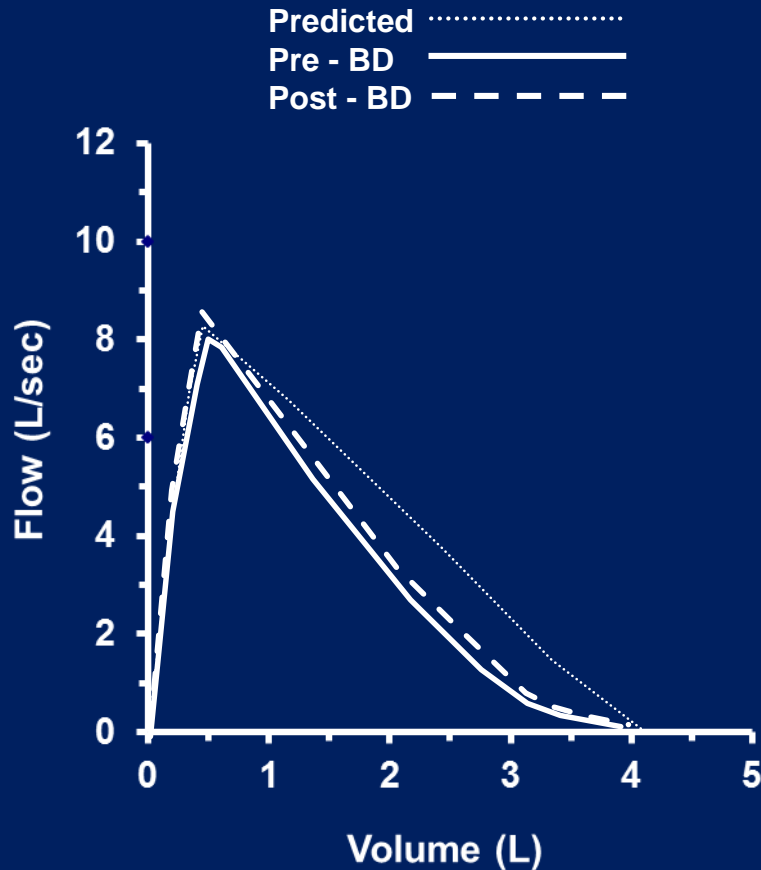
	Predicted		Pre-BD	Post-BD
	Mean	LLN		
FEV_1 L	3.65	2.97	2.78 (76%)	2.90 (79%)
FVC L	4.45	3.65	4.15 (93%)	4.29 (96%)
FEV_1/FVC %	81	71	67	68
$FEF_{25-75\%}$ L/s	3.7	2.4	1.9 (51%)	2.1 (54%)
PEF L/s	9.0	7.0	8.0	8.4

Case 4: Interpretation
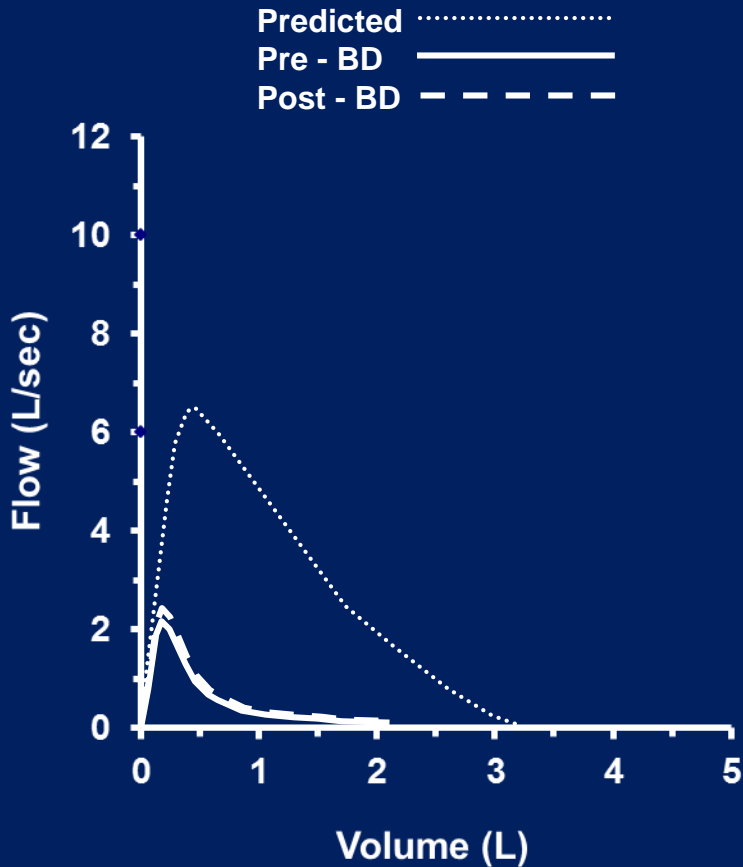
Interpretation: Mild COPD

- The reduced FEV_1/FVC ratio (67%) and slight concavity in the flow volume curve indicates airflow obstruction

- The pre-bronchodilator FEV_1 is 76% and $FEF_{25-75\%}$ only 51% indicating mild airflow obstruction

- Post-bronchodilator there was little improvement in FEV_1 (change in FEV_1 = 3% and 0.12 L)

- Together with his smoking history, these results suggest mild COPD

Case 5

Case history

- Male

- 73 years, height 165 cm

- Smoker of 50 years (65 pack years)

- History of increasing shortness of breath, chest infections, chronic cough and hospital admissions (×2 in past two years) for respiratory failure secondary to pneumonia

- Recent chest X-ray shows significant hyperinflation

- Referred for lung function tests to document ventilatory function and response to bronchodilator

Case 5: Results

	Predicted		Pre-BD	Post-BD
	Mean	**LLN**		
FEV$_1$ L	2.45	1.77	0.85 (35%)	0.90 (37%)
FVC L	3.42	2.61	2.10 (61%)	2.20 (64%)
FEV$_1$/FVC %	73	63	40	41
FEF$_{25-75\%}$ L/s	1.8	0.4	0.9	0.9
PEF L/s	6.7	4.7	2.2 (33%)	2.6 (39%)

TLC 132% predicted

Case 5: Interpretation

Interpretation: Severe chronic COPD

- The deep concavity in the flow-volume curve and very low pre-bronchodilator FEV_1 (35% predicted) and FEV_1/FVC ratio indicates a severe obstructive ventilatory defect

- There was no clinically significant improvement post bronchodilator (salbutamol plus ipratropium bromide)

- With this degree of airflow obstruction the reduced FVC is probably a consequence of airway closure
    - ie it is unlikely to be due to small lungs

- These results together with his smoking history are consistent with severe COPD

Case 5: Pathophysiology

- In COPD the airflow limitation is due to:
  - Inflammatory thickening and distortion of the airway walls (smokers small airway disease)
  - Expiratory collapse of airways due to loss of elastic support (emphysema)
- The VC is often well preserved until the disease is severe
- In emphysema residual volume (RV), functional residual capacity (FRC) and TLC are usually increased indicating:
  - Gas trapping (high RV)
  - Hyperinflation (high FRC and TLC)

Case 6

Case history

- Female

- 40 years, height 170 cm

- Non-smoker, no past history of respiratory problems

- 5 years of joint aches and morning stiffness affecting hand, wrist, elbows, shoulders and knees

- Recent chest X-ray shows diffuse lung infiltrate

- Referred for assessment of dyspnoea

Case 6: Results

Predicted ·······························
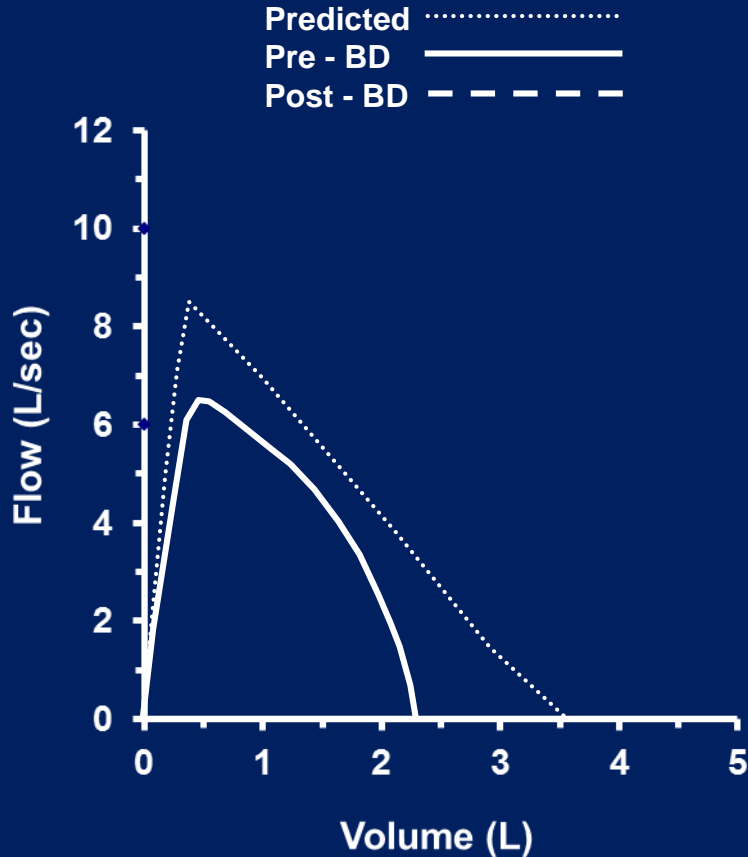
Pre - BD ——————————

Post - BD — — — — — —

	Predicted		Pre-BD	Post-BD
	Mean	**LLN**		
FEV_1 L	3.30	2.66	2.10 (64%)	2.15 (65%)
FVC L	4.06	3.31	2.35 (58%)	2.40 (59%)
FEV_1/FVC %	82	73	89	90
$FEF_{25-75\%}$ L/s	3.3	2.0	4.1	4.3
PEF L/s	7.4	5.6	6.3	6.4

TLC 64% predicted

Case 6: Interpretation

Interpretation: Restrictive ventilatory defect

- The flow-volume curve shows a reduced FVC and FEV_1 with a well preserved FEV_1/FVC ratio and maximal flows (ie no evidence of airway obstruction)

- These results are consistent with a restrictive ventilatory defect (confirmed by measuring lung volumes)

- There was no significant change after bronchodilator

Case 6: Pathophysiology

- In this patient the restrictive ventilatory defect was found to be due to fibrosing alveolitis associated with rheumatoid arthritis

- The supranormal flow rates are due to increased traction on the airways from the parenchymal tissue causing distension of the airways

- The dynamic lung volumes are reduced because the overall size of the lungs is restricted by inflammatory and fibrotic scar tissue