Lung Cytology: Lessons Learned from Errors in Practice

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Overview

- Cases in which medical error occurred
- Root cause analysis showed cognitive and technical components
- Cognitive components reflected biases secondary to criteria and pattern recognition issues
Overview

- Thinking Fast and Slow (Daniel Kahneman)
- Pattern recognition versus slower, rational thought
- Heuristics
  - Mental shortcut
  - Pattern of thinking that allows for quick action
Overview

- Recognize cytologic criteria
- Name three criteria for each case
- Recognize patterns of criteria and biases that relate to pattern recognition
Case 1

- The patient is a 45 year old man who presented with a two week history of cough.
- Radiologic studies showed a 2.2 peripherally based mass.
- A fine needle aspiration was performed.
Case 1

- Original diagnosis: Spindle cell neoplasm, favor fibrous tumor of the pleura versus a malignant mesothelioma
- Immunohistochemical studies were not performed as little tissue was present on a cell block
- Three months later, a follow-up chest CT for pre-surgical staging showed mediastinal adenopathy
Case 1

- Criteria
  - Spindle cells
  - Uniform nuclei
  - Granular chromatin

- Patterns
  - Stromal lesion, mesothelial lesion, epithelial lesion
Case 1

- Correct diagnosis: Atypical carcinoid tumor (neuroendocrine carcinoma)

- Biases
  - Availability – more recent example comes to mind first
  - Recall – information in memory drives current process
Case 2

- The patient is a 61 year old woman who liked chocolate. She presented with shortness of breath and a chest CT showed a 2 cm mass in the right lung
- A fine needle aspiration was performed
Case 2

- Original diagnosis: Adenocarcinoma, poorly differentiated
- Surgical excision; all lymph nodes benign
- Pancytokeratin +, vimentin +, all other stains ordered -
- Eight months later, a follow-up chest CT showed three lesions in the right lung and two in the left lung, ranging in size from 2 cm to 4 cm
Case 2

- Criteria
  - Large malignant cells
  - Stripped nuclei
  - Hard cytoplasm in areas
  - Large nuceoli

- Patterns
  - Sarcoma, primary lung cancer, metastatic cancer
Case 2

- Correct diagnosis: Metastatic adenocarcinoma of renal origin

- Biases
  - Anchoring – tendency to heavily rely on one trait or criterion
  - Expectation – disbelieve data that does not conform to opinion
Case 3

- The patient is a 56 year old woman who had a parrot. She presented with shortness of breath and a chest CT showed a 2 cm mass in the right hilar region.
- Endoscopy showed a raised endobronchial lesion with ulcer.
- Bronchial brushing and washing were performed.
Case 3

- Original diagnosis: Reactive lung; no evidence of malignancy
- One year later, a follow-up chest CT showed enlargement of the lesion, now reaching 4 cm in diameter
Case 3

- **Criteria**
  - Small cells
  - Open nuclear chromatin
  - Thickened nuclear rims
  - No (or dot-like) nucleoli

- **Patterns**
  - Reactive bronchial cells, low grade tumor, viral effect
Case 3

- Correct diagnosis: Adenocarcinoma, well differentiated

- Biases
  - Neglect of probability – disregarding probability (of disease associated with criteria) under uncertainty
  - Confirmation bias – search for information that confirms expectations
Case 4

- The patient is a 58 year old man who had a Norwegian elkhound. He presented with shortness of breath and a chest CT showed a diffuse opacity in the left lung
- Bronchial brushing and washing were performed
Case 4

- Original diagnosis: Reactive changes; no evidence of malignancy
- Eight months later, a follow-up chest CT showed diffuse opacity
Case 4

- Criteria
  - Cell clusters
  - Prominent nucleoli
  - Nuclear rim thickening
  - Hard cytoplasm

- Patterns
  - Reactive changes, well differentiated tumor, viral
Case 4

Correct diagnosis: Adenocarcinoma, moderately differentiated

Biases
- Contrast - increase or decreasing a criterion compared to a recently observed contrasting object
- Do no harm – judgment based on desired outcome of no harm
Case 5

- The patient is a 56 year old man who liked to travel to exotic places. He presented with a cough and a chest CT showed a 2.9 cm mass in the left hilum.
- A transbronchial fine needle aspiration was performed.
Case 5

- Original diagnosis: Reactive changes; no evidence of malignancy
- Eight months later, a follow-up chest CT showed no regression in lesion size
Case 5

- **Criteria**
  - Cellular
  - Small cells, single and in small groups
  - Granular chromatin
  - Small nucleoli

- **Patterns**
  - Inflammation, well differentiated tumor, metastatic tumor
Case 5

- Correct diagnosis: Well differentiated neuroendocrine carcinoma (carcinoid tumor)

- Biases
  - Cluster illusion – seeing patterns where none actually exist
  - Focusing bias – placing too much emphasis on one event and not entire picture
Case 6

- The patient is a 56 year old man who liked to travel to exotic places. He presented with a cough and a chest CT showed a 2.9 cm mass in the hilum
- A transbronchial fine needle aspiration was performed
Case 6

- Original diagnosis: Negative for malignant cells
- One year later, a follow-up chest CT an increase in lesion size and additional small nodules (generally less than 1 cm) in both lung fields
Case 6

Criteria
- Cell clusters and single cells
- Spindled cells and plump cells
- Low nuclear to cytoplasmic ratios
- Cytoplasmic tails

Patterns
- Reactive changes, well differentiated tumor, specific inflammatory condition
Case 6

- **Correct diagnosis:** Granulomatous inflammation
- **Cultures were positive for acid fast organisms**
- **Biases**
  - Framing - drawing different conclusions from same information, depending on how information is presented
  - Congruence – failure to test alternative hypotheses
Case 7

- The patient is a 50 year old man who liked spicy hot Mexican food. He had a history of squamous cell carcinoma of the lip with metastasis in the head and neck region. One year later, a follow-up chest CT that showed a 2.5 cm mass in the left hilum.
- A bronchial brushing was performed.
Case 7

- Original diagnosis: Metastatic squamous cell carcinoma
- The patient was treated with radiation therapy
- One year later the lesion had grown in size and a biopsy was performed
Case 7

- **Criteria**
  - Squamoid cells
  - Benign lung
  - Mild atypia
  - Rare cells

- **Patterns**
  - Reactive changes, primary tumor, metastatic tumor
Case 7

- Correct diagnosis: Reactive changes
- The biopsy showed granulomatous inflammation
- Biases
  - Observer-expectancy – observer expects a result and misinterprets criteria to support result
  - Overconfidence
Case 8

- The patient is a 50 year old man who was seen in the Emergency Department following a car accident. A chest CT showed a 2.2 cm lesion in the left lung.
- A bronchial brushing and washing were performed.
Case 8

- Original diagnosis: Malignant cells, favor poorly differentiated adenocarcinoma
- Insufficient material for immunohistochemical studies was available
- A surgical excision was performed
Case 8

■ Criteria
  ■ Single cells
  ■ Large nuclei with prominent nucleoli
  ■ Pseudoinclusions
  ■ Hard cytoplasm

■ Patterns
  ■ Primary carcinoma, sarcoma, metastatic malignancy
Case 8

- Correct diagnosis: Malignant melanoma
- Biases
  - Availability
  - Exposure – more familiarity with some diagnoses compared to others
Case 9

- The patient is a 60 year old man who was an art historian. He had a history of malignant melanoma of the back with metastasis to the axillary lymph nodes. On a follow-up chest CT a 2 cm mass was seen in the left upper lobe.

- A bronchial brushing was performed.
Case 9

- Original diagnosis: Malignant melanoma
- Immunohistochemistry studies were not performed
- Two years later, the patient died and an autopsy was performed
Case 9

- **Criteria**
  - Single cells
  - Multi-nucleated cells
  - Nuclear rim thickening
  - Eccentric nuclei

- **Patterns**
  - Metastatic malignancy, primary malignancy
Case 9

Correct diagnosis: Poorly differentiated adenocarcinoma

Biases

- Observer-expectancy
- Wishful thinking bias – making decisions based on what one wants to see instead of evidence
Case 10

- The patient is an 81 year old woman who had a history of serous papillary carcinoma of the ovary. She presented with shortness of breath. A chest CT that showed a pleural effusion.
- A bronchioaveolar lavage was performed.
Case 10

- Original diagnosis: Metastatic adenocarcinoma
Case 10

- Criteria
  - Cell clusters
  - Prominent nucleoli
  - Variable cell size
  - Finely granular chromatin

- Patterns
  - Metastatic malignancy, primary malignancy
Case 10

- Correct diagnosis: Adenocarcinoma, with bronchioalveolar features

- Biases
  - Framing
  - Focusing
Case 11

- The patient is a 59 year old man who smoked Cuban cigars. He presented with chest pain and shortness of breath. A chest CT showed a 2.1 cm mass was seen in the right upper lobe.
- A fine needle aspiration was performed.
Case 11

- Original diagnosis: Non-small cell carcinoma
Case 11

**Criteria**
- Single cells
- Stripped nuclei
- Granular chromatin
- Crushed nuclei

**Patterns**
- Malignancies of various types
Case 11

Correct diagnosis: Small cell carcinoma
Case 12

- The patient is a 47 year old woman who uses an inhaler for asthma. A chest CT showed an ill defined opacity in the right lower lobe
- A bronchial washing was performed
Case 12

- Original diagnosis: Adenocarcinoma
- Immunohistochemically, the cells were reactive for cytokeratin 7 and TTF-1
- A surgical excision was performed
Case 12

- Criteria
  - ?
- Patterns
  - ?
Case 12

- Correct diagnosis: Reactive changes
- Biases
  - ?
Case 13

- The patient is a 50 year old man who was a tobacco user. He had a history of small cell carcinoma that was treated with chemotherapy and radiation therapy. A follow-up CT showed a 1.6 cm left hilar lesion.
- A bronchial brushing was performed.
Case 13

- Original diagnosis: Reactive changes
Case 13

- Criteria
  - ?
- Patterns
  - ?
Case 13

- Correct diagnosis: Squamous cell carcinoma
- Biases
  - ?
Case 14

- The patient is a 38 year old man who runs marathons. He began experiencing weakness and difficulty breathing. A chest CT showed an anterior mediastinal 4 cm mass and a 2 cm mass in the left lung.
- A fine needle aspiration of the lung mass was performed.
Case 13

- Original diagnosis: Atypical lymphoid cells, cannot rule out lymphoma
Case 14

- Criteria
  - ?
- Patterns
  - ?
Case 13

- Correct diagnosis: Thymoma
- Biases
  - ?