Interpretation of the Chest X-ray in Children

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Diagnostic accuracy of chest radiography in detecting mediastinal lymphadenopathy in suspected pulmonary tuberculosis

G H Swingler, G du Toit, S Andronikou, et al.

Arch Dis Child 2005 90: 1153-1156

Sensitivity = 67%

Specificity = 59%

Pediatricians> general physicians
Observer variation in detecting lymphadenopathy on chest radiography

G. Du Toit, G. Swingler, K. Illoni
School of Child and Adolescent Health, Red Cross Children’s Hospital and University of Cape Town, Cape Town, South Africa

Inter-observer agreement = 0.33
Intra-observer agreement = 0.55
CT scanning for the detection of tuberculous mediastinal and hilar lymphadenopathy in children
<table>
<thead>
<tr>
<th>Disease manifestation</th>
<th>Total (%)</th>
<th>Bacteriologic yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 439</td>
<td></td>
</tr>
<tr>
<td><strong>Intra-thoracic TB</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not TB</td>
<td>85 (19.4)</td>
<td></td>
</tr>
<tr>
<td>Uncomplicated LN</td>
<td>307 (69.9)</td>
<td>120/195 (61.5)</td>
</tr>
<tr>
<td>Complicated LN</td>
<td>147 (47.9)</td>
<td>22/64 (34.4)</td>
</tr>
<tr>
<td>Other</td>
<td>106 (34.5)</td>
<td>59/80 (73.5)</td>
</tr>
<tr>
<td><strong>Extra-thoracic TB</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical lymphadenitis</td>
<td>54 (17.5)</td>
<td>39/51 (76.5)</td>
</tr>
<tr>
<td>TBM</td>
<td>72 (16.4)</td>
<td>31/46 (67.4)</td>
</tr>
<tr>
<td>Other</td>
<td>35 (48.6)</td>
<td>27/27 (100)</td>
</tr>
<tr>
<td><strong>Intra+Extra</strong></td>
<td>25 (5.7)</td>
<td>12/13 (92.3)</td>
</tr>
</tbody>
</table>

Diagnosing Childhood Tuberculosis - What do we have?

- **History**
  - Tuberculin-Skin Test (1890)
  - Low Specificity
  - Negative predictive value 99.8%

- **Chest X-ray** (1896)
  - Low Specificity

- **Bacteriology** (1882)
  - Low Sensitivity

Ozuah (2001) JAMA
DIAGNOSTIC ATLAS OF INTRATHORACIC TUBERCULOSIS IN CHILDREN

A Guide For Low Income Countries 2003

International Union Against Tuberculosis and Lung Disease
Value of the chest radiograph

Is the CXR normal?

Is there pathology?

Is this TB?
Quality of the CXR

• Essential for a good opinion
  – Rotation
  – Penetration
  – Inspiration
Rotation

- In children use the anterior rib ends
- Clavicle ends are difficult to locate
Penetration

• Correct penetration is ensured by being able to just distinguish the intervertebral spaces through the heart shadow.

• Under penetration
  – White x-ray

• Over penetration
  – Black x-ray
52/2
Liggend
Inspiration

• Adequate inspiration is when the 8-9th posterior rib is visible or 6th anterior rib
• Use only posterior ribs in younger children
• Hyperinflation
  – > 9 posterior ribs
• Poor inspiration
  – < 8 posterior ribs
• Unilateral hyperinflation (Ball-valve effect)
Systematic approach

- Identification
  - Name
  - Date
  - Supine or erect

- Quality
  - Rotation
  - Penetration
  - Inspiration
Systematic approach

• White
  • Soft tissue
  • Bones
  • Heart
    – Size
    – Shape
    – Position
Systematic approach

• Black structures
  • Trachea and bronchi
  • Lungs
    – Size
    – Compare 3 lung fields
    – Hilum and vascular structure
      » Size
      » Shape
      » Density
  • Stomach bell

• Other structures
Systematic approach

• Other structures
  – Diaphragm
  – Costrophrenic angles and pleura
  – Mediastinal structures
The great pretender
Look in the hidden spaces

• Behind the heart

• Below the diaphragm

• Behind the stenum
A proposed radiological classification of childhood intra-thoracic tuberculosis
Classification of intrathoracic pulmonary Tb in childhood

• Parenchymal involvement
  – Progressive primary TB
  – “Adult” type TB

• Lymph-node disease
  – Uncomplicated
  – Bronchial involvement (Lymphobronchial disease)
    • Obstruction
    • “Check valve” obstruction
    • Collapse
    • Ulceration into the bronchus
      – Bronchopneumonic spread
      – Lobar involvement
Classification of intrathoracic TB in childhood

- Lymph node involvement
  - With infiltration
    - Oesophagus
    - Phrenic nerve
    - Ductus thoracicus
- Pleural disease
  - With effusion
  - With empyema
  - With or without pneumothorax

- Pericardial disease
- Long-term consequences
  - Fibrosis
  - Calcifications
  - Bronchiectasis
- Unusual
- Unknown
Adult-type disease
Adult type disease
Uncomplicated lymph-node disease
Subcarinal lymphnodes

1. Fullness below carina
2. Narrowing of both left and right main bronchus
3. Shift of the esophageal adhesion line
Complicated lymph-node disease
Airway compression
Complicated lymph-node disease
Expansile pneumonia
Complicated lymphnode disease with collapse
Complicated Ghon focus  
(Poorly contained disease)
Ghon focus with breakdown and bronchopneumonia
Uncomplicated pleural effusion
Pleural effusion
Complicated
Disseminated disease
Spinal TB
Unusual cases
Consequences of TB
Bronchiectasis
Bronchiectasis and active TB
HIV related lung disease
Lymphocytic interstitial pneumonia (pneumonitis)
HIV/TB: the problem
Paratracheal glands
IRIS
Resolution:
Do not prognosticate too soon
Conclusion:

• Brief example of how to approach the CXR in a child suspected of TB

• There will always remain large variability between readers

• New technology: transmit images.