Pulmonary tuberculosis in children

based on diagnostic atlas of endothoracic tuberculosis in children. Robert Gie.UIATLD.2003 and some illustrations from Pr Savas Andronikou (Bristol university and Bristol royal hospital for children)
We shall begin by a qui of 20 children’s X-rays
Only 3 possible responses for each
You have 30 seconds per patient
Record your answers 1 - 20

From Pr Savvas Andronikou
Quiz
(pre test)
Answer options:

1 = TB
   = enough features to treat for TB

2 = INCONCLUSIVE
   = Abnormal BUT inseparable from other infection

3 = NORMAL
   = no abnormality is seen
From Pr Savvas Andronikou
3.

From Dr Pavvas Andronikou
MBBCh, FCRad, FRCR, PhD
5.

From Pr Savvas Andronikou
From Pr Savvas Andronikou
13.

From Pr Savvas Andronikou
15.

From Dr Savvas Andronikou
MBBCh, FCRad, FRCR, PhD
TB in children is often paucibacillary and AFB negative in sputum

**Diagnosis based on:**

- Contact with adult AFB+
- Symptoms of chronic or subacute pulmonary infection
- Chest radiography and sometimes tuberculin skin test
Contact with an adult index case

- Less than 2 years: infection in the household by parents or caregivers.
- More than 2 years: infection in the household or in the community.
- In countries with high incidence of TB, the absence of household contact does not exclude TB.
Symptoms and signs of pulmonary TB in children

- They are non-specific and can be seen in other chronic pulmonary diseases: chronic cough, weight loss, fever, dyspnea and respiratory failure.
**Tuberculin skin test**

- A tuberculin skin test is sometimes useful for the diagnosis of TB in children but identify infection, not necessarily active disease.

- The interpretation of a test result is often very difficult:
  - **False positive**: BCG vaccination, technical error in injection or in the induration measurement, other mycobacterial infection.
  - **False negative**: technical error in injection or in the induration measurement, viral infection, immunodepression (HIV, malnutrition, severe infections) anergic time (+/- 40 days)…
Chest radiography

- The quality is often poor
- The interpretation require a good training
Inhalation of myc. tuberculosis → proliferation in alveoli → Spread via the lymphatic system

- The infection is contained. Hypersensitivity to tuberculoprotein leading to positive skin test (possible reactivation in the future)
- Proliferation of the infection → hilar nodes enlargement, bronchus, alveolar, pleural involvement
- Hematogenous dissemination: pulmonary miliary and extra-pulmonary TB
Age and immun status influence clinical and radiological course of TB

- Hematogenous dissemination is more frequent in young children, and immunodepressed children who cannot contain infection.
- Young infants have compliant airways, easily compressed by tuberculous adenopathies.
- Older children develops similar TB than adults: pleural TB, alveolar infiltration and cavitations in upper lobes.
Process for analysis of the chest radiography: the checklist

• Verification of the name and the date
• Verification of the factors for good quality
• Analysis of the thoracic wall and thoracic skeleton
• Analysis of the mediastinum
• Analysis of each lung field, one after the other

NO EXCEPTIONS IN THIS PROCESS!
Particularity of chest X ray in infant and young children (1)

Radiography in antero-posterior incidence

Deep inspiration not always obtained
Particularity of chest X ray in infant and young children (2)

A common cause of widened mediastinum is a large physiological thymus

Chateil j-f. and coll EMC. 2005
Asymmetric hypertrophy of the right lobe of the thymus

Hypertrophy of the right lobe. « boat sail » appearance

Chateil j-f. and coll. EMC. 2005
« Wave » sign. Undulating appearance of the left side of mediastinum.

« notch » sign.
« notch » sign.
Thymus picture in children

- Particularly visible before 2 years old
- Never compressive
- Mobile with change of position
- Change in size if inspiration or expiration
- Radiological appearance is varied
Uncomplicated primary disease

- The most common form of TB in children
- The complete primary complex (peripheric nodule + lymph gland enlargement) is rarely visible
- **Only mediastinal lymph node enlargement is the most common appearance on chest X-ray:**
  - usually unilateral
  - sometimes bilateral
  - most often hilar lymph nodes enlargement
  - sometimes latero-tracheal lymph nodes enlargement, but rarely isolated (hilar lymph node associated)
  - infiltration into the surrounding lung tissue is common
Diagnosis of TB in children = identify lymphadenopathy
Uncomplicated right hilar lymph node enlargement.
Primary complex not visible

right hilar lymph node enlargement.
Infiltration into the surrounded lung tissue
Para-tracheal lymph node enlargement. The most often, it is accompanied with hilar node enlargement, not in this case.

Lateral view is useful to analyse the involvement of the hilar lymph node.
Normal lateral view
Lateral view is useful to analyse the involvement of the hilar lymph node

From Pr Savvas Andronikou
Middle lobe pneumonia associated with adenopathies = TB
Same middle lobe pneumonia but without adenopathy: non conclusive; One must begin amoxicillin before considering tb treatment

From Pr Savvas Andronikou
Complicated primary pulmonary disease
Involvement of the lymph gland

The airway lumen decreases

obstruction of the bronchi

Partial obstruction
« check valve »
Hyper inflated Lobe or lung (not frequent)

Complete obstruction
Atelectasis of a lobe or a segment

Ulceration of the gland in the airway
Aspiration of infected material in the lobe
Expansile TB pneumonia
Complicated primary disease is the result of lymph nodes narrowing, obstructing, or ulcerating into airways.
Large airway obstruction

Enlargement of mediastinal lymph nodes >>> large Bronchial obstruction: Clinical signs of asthma but no response to bronchodilatator
Check valve: the main left bronchus is partially obstructed
One differential diagnosis in this situation:
3 years old child, cough and dyspnea with quick onset.
Decreased respiratory sounds on the right side

The air is trapped in expiration in the right lung:
**Foreign body in the main right bronchus**
The air is trapped in expiration in the right lung:

**Foreign body in the main right bronchus**
The air is trapped in expiration in the left lung

*Foreign body in the main right bronchus*
Left inferior bronchus is completely obstructed: atelectasis of left inf. lobe.

Notice the right hilar adenopathy with infiltrate of surrounded lung tissue.
Expansile pneumonia of the left upper lobe with compression of the left main bronchus and displacement of the mediastinum on the right.
Expansile pneumonia of the left upper lobe with compression of the left main bronchus and trachea. Displacement of the mediastinum on the right. Small cavity is seen in the pneumonia.
Expansile pneumonia with necrosis and large cavities in the middle and right inferior lobe
TB cavity in the right lung, with bronchogen spread on the opposit side
Expansile TB pneumonia

- Densely consolidated lobe or lung without aeric bronchogram (different from Tb pneumonia in adult case)
- The fissura is displaced and the size of the lobe increases (different from Tb pneumonia in adult case)
- Lymph nodes are hidden by the opacified lobe
- If delay in treatment, cavities are possible
- The lesions recover to a large degree underf treatment but sequela are possible: - small fibrotic lobe
  - bronchiectasis
Pleural disease

- The frequency increases in adolescence
- Pleural effusion results of the immun response to the bacilli coming from the primary focus rupture into the pleural cavity.
- In younger children the pleural disease is the consequence of miliary TB (hematogeneous dissemination) or of extension of an expansile pneumonia.
- Pleural fluid: lymphocytic predominance and exsudative (proteine fluid /serum ratio > 0.5)
Uncomplicated left pleural TB
Small pleural effusion, with complicated underlying TB: Retraction, fibrosis. Probable important sequelae with pleural thickness.
Miliary TB

• Hematogenous dissemination
• Development of granulomas in all the involved organs (lungs, liver, spleen, bones, meninx…)
• Severe dyspnea and worsening condition, often accompanied by TB meningitis
• Difficult to distinguish from lymphocytic interstitial pneumonia in HIV infected children
Pericardic effusion: less than 1% of children with TB
Neonatal cases

- Increasing with HIV.
- Possible but rare infection « in utero ». The liver is first involved (via umbilical vein or infection of amniotic fluid and inhalation by the foetus).

- Infection of the neonate during the birth process or shortly after birth: contact with mother or any other household member.

- Neonatal TB infection image is very non-specific: no hilar or mediastinal enlargement visible (on the opposite 50% of older infants with TB have visible lymph node enlargement with compression of the airways).
A 2 month-old infant with severe bronchopneumonia and cavity on the right side.
HIV infected children and tuberculosis

• The immune suppression leads to more rapidly progressive disease: the occurrence of miliary, pleurisy, and massive gland is more common.

• Tuberculin skin tests are usually negative

• Miliary and lymphocytic interstitial pneumonia (LIP) are difficult to distinguish.
Bulky lymph node involvement which can be observed in HIV infected children. Confusion with lymphoma is possible.
Bulky lymph node involvement which can be observed in HIV infected children. Confusion with lymphoma is possible.
Miliary TB and LIP

(from Robert Gie, Diagnostic atlas of intrathoracic tuberculosis in children)

- LIP usually starts in the second year of life
- Miliary is seldom associated with clubbing of the fingers and toes, which occurs in most cases of LIP
- Parotid enlargement is sometimes present in LIP, very rarely in TB miliary
- Most children with miliary TB have a very worsening condition, with central nervous involvement, while children with LIP are not so ill, and sometimes asymptomatic
LIP: nodules and micronodules of varying size and sometimes reticular associated pattern

Long term consequence of intrathoracic tuberculosis

- Extensive TB can, in few cases, have long-term damage of the lungs and airways
- Most often consequence: limited area of lung fibrosis
- The most troublesome long term consequence is bronchiectasis
Bronchiectasis of the middle and right inferior lobe

TB primary infection when 1 year old (1945)
22 years later ... (1967)

60 years later ... (2006)
Bronchiectasis post TB infection
Conclusion(1)

- TB can occur at any age. The highest burden of disease is found among children before 4 years.
- Adult smear positive cases are 10 times more infective than smear negative cases.
- The younger the child the greater the risk of developing disease: 40% if <1 year, 30% if <4 years, 15% in children attending school.
Conclusion(2)

- Acute disseminated TB (miliary) and TB meningitidis are the most dangerous forms of TB
- The chest radiography image in children is the result of mediastinal lymph node enlargement and his complications (compression, ulceration in the airways)
- MDR TB is as infective that sensitive TB. The treatment of the child depends of the adult index case who is suspected to have contaminated.
Conclusion (3)

- Chemoprophylaxis of latent infection is very important for young children (<2 years) as they have a high risk to develop a severe TB.
- The risk of contamination and developing severe TB disease is higher in HIV infected children.
- In HIV infected children, the differential diagnosis is sometimes difficult with other lung diseases, particularly LIP.
Quiz
(post test)
Answer options:

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   = enough features to treat for TB

2 = INCONCLUSIVE
   = Abnormal BUT inseparable from other infection

3 = NORMAL
   = no abnormality is seen
1. TB

From Pr Savvas Andronikou
2. Normal

From Pr Savvas Andronikou
3. TB

From Pr Savvas Andronikou
4. Inconclusive

From Pr Savvas Andronikou
5. Inconclusive

From Pr Savvas Andronikou
6. Normal

From Pr Savvas Andronikou
7. TB

From Pr Savvas Andronikou
8. TB

From Pr Savvas Andronikou
9. Normal

From Pr Savvas Andronikou
10. ТВ
11. Normal
12. TB

From Pr Savvas Andronikou
13. TB

From Pr Savvas Andronikou
14. Normal
(normal picture of thymus in mediastinum)

From Pr Savvas Andronikou
15. TB

From Pr Savvas Andronikou
16. Normal
17. Inconclusive )
19. Inconclusive