Disease of the Respiratory system in Children

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Introduction

- The disease of respiratory system is one of the most frequent reasons for hospitalization of infants and children.
- Basic knowledge of the development and functions of respiratory system are essential to understand many of these respiratory tract diseases.
1. Anatomical characteristics of respiratory system

- (1) The upper airway
  - nose;
  - paranasal sinuses;
  - pharynx;
  - Eustachian tube
  - larynx
Nose cavity is relatively short and small in infant;
The mucous membrane (mucosa) is tender and soft, rich in vascularity;
Infection occurs, leading to swelling and congestion of the mucous membrane, causing nasal obstruction and dyspnea.
paranasal sinuses

- Maxillary sinuses appear at 2yrs, develop fully after 12yrs.
- Frontal sinuses appear at 2-3yrs, enlarge at 6yrs → Paranasal sinusitis rarely occurs in infants.
Relatively narrow and vertical, rich in lymphoid tissue.

Palatine tonsils begin to enlarge gradually at the end of 1 yrs → develop at 4-10 yrs → degenerated gradually after 14-15 yrs.

Tonsillitis is often seen in elder children than in infants.
Eustachian tube

- Broad, straight and short in infant;
- The position → horizontal;
- So when an infant catches cold, he may be complicated with otitis media (tympanitis).
larynx

- Narrow in infants
- The mucous membrane is rich in vascularity.
- Congested and swollen in inflammation → dyspnea.
(2) The low airway

- Trachea;
- bronchus;
- lungs;
Trachea and bronchus

- The lumen of trachea and bronchus → relatively narrow;
- Mucosa → rich in vascularity;
- Cillium movement → poor;
- So easy to get infection → develop obstruction.
- The right bronchus → direct continuation of the trachea;
- The left bronchus spreads out from the lateral surface of trachea;
- So foreign body → often aspirated into right bronchus → atelectasis or emphysema of right lung segment.
lungs

- Interstitial tissue ↑
- Alveoli ↓
- Blood ↑
- Air ↓
- → easy to get inflammation → atelectasis.
(3) Mediastinum and chest wall

- mediastinum → relatively larger in infant than in adult.
- Surrounding tissue of mediastinum → loose and elastic.
- If the pleural effusion or pneumothorax occurs → mediastinal organs are easily displaced.
The chest wall → short and barrel-shaped (barrel-shaped thorax or barrel chest)

The position of diaphragm → high → small chest cavity, while the lungs are relatively large, the respiratory muscles are not well developed → chest wall movement is limited relatively and the expansion of lungs are limited during respiration.

When the respiratory tract disease occur, exchange of gas → insufficient.
2. physiological characteristics

(1) Frequency and rhythm of respiration

The younger the child, the more rapid the respiration is.

The metabolism and oxygen requirement of infants → high, but respiratory volume is limited → have to increase frequency of respiration for metabolic requirement.

When the child begins to stand up and walk → the diaphragm decline gradually to the level of 5th intercostal space.
(2) Type of respiration
- In infant → abdominal respiration.
- After the child stands up and walks → the diaphragm moves downward → the chest cavity → increased (above 2 yrs) 
  → abdominal-chest respiration appears.

(3) Volume of tidal air
- 6 ml per kg when the respiration is peaceful.
3. The immune characteristics

- The principal antibody in respiratory tract → 
- S-IgA
- S-IgA is produced by plasma cells in the submucosa of airway → can neutralize certain viruses and toxins, and help the lysis of bacteria.
- The serum levels of IgA remain low during early childhood → infants and children are susceptible to infection of respiratory tract.
Pneumonia

1. Classification of pneumonia
   (1) According to pathological changes
   A: lobar pneumonia
   - one or more lobes are involved.
   - lobar pneumonia is often present in old children.
B: lobular pneumonia (brochopneumonia):
lobular pneumonia is the most common pattern in infants and younger children.
So it is the focal point in our study.
C: Interstitial pneumonia:
(2) According to etiologic agents

A: virus pneumonia

Caused by viruses such as respiratory syncytial virus (RSV), adenovirus (ADV), cytomegalovirus (CMV), parainfluenza virus, et al.

B: Bacterial pneumonia:

Such as pneumococcal pneumonia, staphylococcal aureus pneumonia, colibacillus pneumonia.
C: Mycoplasma pneumonia.
(3) According to clinical manifestation
   - Mild pneumonia
   - Severe pneumonia → heart failure, respiratory failure, toxic encephalopathy, toxic intestinal paralysis, DIC.
Bronchopneumonia

1. Etiology of bronchopneumonia

- The incidence of
- Bacterial ↓
  - (pneumococcal, Staphylococcus, streptococcus, colibacillus)
- Mycoplasma ↑
- Viruses (RSV, ADV)
2. Pathophysiology of bronchopneumonia

- Edema and accumulation of mucus → bronchiolar obstruction
- Walls of alveoli → thicken
- Alveoli are filled with inflammatory exudates
- → impairs the normal exchange of gases in the lungs
Diminished ventilation of the alveoli
→ hypoxemia and carbon dioxide retention
→ interfere normal metabolic process and normal function of the chief organs.
(1) Hypoxemia

- Normal gas exchange is impaired \(\rightarrow\) PaO\(_2\) and Sa O\(_2\) ↓
- Cyanosis will appear when
  - Sa O\(_2\) ↓ < 85%
  - reduced Hb > Hb5g/dl
- flow rate is increased by increase respiratory frequency and heart rate in order to compensate the hypoxemia.
- The respiratory failure occurs when PaO\(_2\) < 50mmHg and PaCO\(_2\) > 50mmHg.
(2) acid and basic disorder

- \( \text{PaO}_2 \downarrow \rightarrow \text{O}_2 \text{ metabolism interruption} \)
  - \( \rightarrow \text{acid metabolic} \uparrow \)
  - \( \text{metabolic acidosis.} \)

- \( \text{PaCO}_2 \uparrow (\text{retention of CO}_2) \)
  - \( \rightarrow \text{respiratory acidosis.} \)
(3)cardiovascular system

- PaCO₂ ↑ and PaO₂ ↓ → reflectory contraction of pulmonary artery → pulmonary hypertension.
- Toxemia → toxic myocarditis.
- The pulmonary hypertension and toxic myocarditis → heart failure.
(4) Nervous system

- Retention of CO₂ and hypoxemia → increase of capillary permeability → cerebral edema → central respiratory failure.

- PaO₂ ↓ → acid metabolic products ↑ → ATP ↓ → cerebral edema.

- Toxemia → toxic encephalopathy.
(5) Digestive system

- Hypoxemia and toxemia → toxic intestinal paralysis → hemorrhage of gastrointestinal tract.
3. Clinic manifestation

- Fever
- Cough dry cough $\rightarrow$ wet cough
- Dyspnea cyanosis $\rightarrow$ face, finger nails.
  - respiratory distress
  ↓
  - grunting, flaring of nares, retractions
- Retractions (supraclavicular, intercostal, and subcostal areas)
- Tachypnea and tachycardia
Physical examination

- Inspection
- Palpation
- Percussion → dullness
- → confluent and pleural effusion
- Auscultation → coarse breath
  - breath sound ↓ dry rales
  - moist rales
Severe pneumonia

- A: Congestive heart failure
- B: Toxic encephalopathy
- C: Toxic intestinal paralysis
- D: Disseminated intravascular coagulation
A: Congestive heart failure

- a. Restlessness, dyspnea becomes more severe suddenly, paleness or cyanosis.
- b. Heart rate >180/min (infants); >160/min (children); heart sounds becomes low and dull.
- c. Liver enlarge >2cm in a short time.
- d. Edema of face and feet may be seen. Oliguria or anuria (some patients).
B. Toxic encephalopathy

- a. irritability, restless, lethargy
- b. convulsion, coma, irregular respiration and apnea (in severe case)
C: Toxic intestinal paralysis

- a. Abdominal distension
- b. peristaltic sound disappear

D: Disseminated intravascular coagulation

Bleeding tendency: bleeding at sites of vein puncture, or scattered petechiae over the skin, or gastric-intestinal bleeding.
4. Laboratory finding

- A. White blood cell count (leukocyte)
  - pathogen → bacterium ↑
  - → virus → normal or slightly elevated
  - WBC may be normal when the pathogen is bacterium if the patient is malnutrition or very severe condition.
B. Etiologic agent isolated
from the nasopharyngeal secretions
(deep coughing, tracheal suction, or
pleural fluid obtained at thoracentesis).
Blood culture → bacteria pneumonia.
Serological test → specific antibody to
virus.
C. Roengenologic findings:

- in early stage:
  - lung markings $\uparrow$
  - transparency in lung field $\downarrow$

- in late stage:
  - patch shadows
  - emphysema
  - or atelectasis
5. Complications

A. Empyema:

- Purulent pleurisy is an accumulation of pus in the pleural spaces.
- Pathogen → staphylococci, pneumococci.
- Toxic symptom → respiratory difficulty, limited respiratory movement, dullness to percussion, breath sounds and vocal fremitus ↓ (over the effusion)
The radiological findings → collection of fluid in the costaphrenic angles.

Large collection of fluid → shift of trachea and mediastinal structure.

Thoracentesis should be performed when empyema is suspected, and it is a good procedure for diagnosis and treatment.
B. Pyopneumothorax or tension pneumothorax

- When the small abscess around the lung breaks, air leaks into thoracic cavity.
- Symptom $\rightarrow$ severe dyspnea and cyanosis suddenly;
  - percussion $\rightarrow$ hyperresonance
  - auscultation $\rightarrow$ breath sound ↓
- X-ray $\rightarrow$ air and fluid level
- When tension pneumothorax appears, the thoracentesis and thoracic drain are required.
6. Diagnosis

- **A. Symptoms** → fever, cough and dyspnea.
- **B. Signs** → moist rales in the lung.
- **C. Chest X-ray** → spotted-like or patchy shadows over the lung field.
- **D. Severe case** → Congestive heart failure, Toxic encephalopathy, Toxic intestinal paralysis, DIC
- **E. Complications** → empyema, pyopneumothorax and pneumatocele.
7. Differential diagnosis

A. Acute bronchitis:
- Symptoms → mild.
- Breath sound → coarse, or a few rales (sputum) at the end of inspiration and early expiration.
- Chest X-ray → lung markings ↑, no spotted or patchy shadows.
B. Bronchial foreign body:

- **history** → foreign bodies aspiration.
- **physical signs** → bronchial obstruction,
  - sudden onset of cough and wheezing.
- complete obstruction → atelectasis
- incomplete obstruction → emphysema.
C. Pulmonary tuberculosis:
- Toxic symptom of TB → fever, diminished appetite, weigh loss, irritability, malaise, easy fatigability, night sweating.
- ESR ↑
- Positive tuberculin test
- History of recent contact with TB
8. The characteristics of different types of pneumonia

A. Staphylococcal aureus pneumonia:
- Pneumonia caused by Staph. aureus is a serious and rapidly progressive infection, unless recognized early and treatment appropriately, the mortality is very high.
- Pathologic changes → extensive areas of hemorrhagic necrosis.
- **Clinical manifestations** → abrupt onset with fever, cough and evidence of respiratory distress. The sighs include tachypnea, grunting respiration, three retractions, cyanosis and restless.
- Convulsion and shock-like state may be present.
- Some infants may be associated with vomiting, diarrhea and abdominal distention.
Signs → diminished breath sounds and scattered rales are commonly heard over the affected lung.

Complications appear easily → lung abscess, empyema, pyopneumothorax, pneumatocele.
- WBC increase in peripheral blood with increased neutrophils.
- X-ray findings → small patches of shadows
- small abscess.
- Pleural effusion or empyema is noted during the course in the most patients.
- Sputum or blood culture → Staph.aureu growing.
**B. Adenovirus pneumonia**

- It occurs during the first 2 years of life, with a peak incidence at approximate 6 months of age. The illness usually occurs epidemically.
- Pathologic lesion $\rightarrow$ bronchiolar obstruction and interstitial lesion.
Clinical manifestations → sudden onset with higher fever, usually continuous for one week, in severe case, the fever lasts for 2-3 weeks.

Respiratory distress → wheezy cough, dyspnea, pale, restless and cyanosis.

Sighs → fine rales may be heard a few days later.
Hypoxemia (diminished ventilation of alveoli)
Carbon dioxide retention
Respiratory acidosis
In severe cases → toxic encephalopathy, congestive heart failure, toxic encephalopathy
WBC → usually normal
X-ray → small patch or perifocal emphysema.
Igm-ADV → positive
C. Respiratory syncytial virus pneumonia (bronchiolitis)

It occurs during the first 2 years of life with a peak incidence within 6 months of age.

Symptoms and signs → expiratory
dyspnea, prolonged expiratory time
expiratory grunting, pallor, restlessness, cyanosis and moderate fever.
- Auscultation $\rightarrow$ expiratory wheezes
- Inspiratory moist rales.
- Percussion $\rightarrow$ hyperresonance sound.
- The liver seems enlarged owing to
  - downward displacement of the right
  - diaphragm or to congestive heart failure.
- In severe case $\rightarrow$ hypoxemia
  - respiratory acidosis
  - respiratory failure
  - congestive heart failure
- WBC → usually normal
- X-ray → emphysema
- increased lung marking.
- IgM-RSV → positive
D. Mycoplasma pneumoniae

- pneumonia (MPP)
- mycoplasma (MP) can cause both upper and lower respiratory tract illness →
- bronchiolitis, pneumonia, bronchitis,
- tonsilitis and otitis media.

- MPP usually occurs in elder children (5-15 years), and in the climate of autumn and winter.
The incubation period $\rightarrow$ 1-3 weeks $\rightarrow$ may have headache, malaise, cough, fever, sore throat and muscular pain, or chest pain, loss of appetite, nausea, vomiting and diarrhea.

Auscultation $\rightarrow$ a few dry or moist rales

locally,

breth sound $\downarrow$ (pleural effusions)
- WBC → normal or slightly high.
- Serum cold agglutination test → positive
  (highest titer at 2-4 weeks)
- Specific antibody to MP (IgM-MP) → positive
- X-ray → characterized by cloudy infiltration both lower lungs. The shadow sometimes wandering (the infiltration disappear in one lung and reappear in another lung) → lobar, lobular, interstitial changes.
9. Treatment

- Principles of treatment →
  - Control the inflammation;
  - Improve ventilation;
  - Prevent complications
(1) General treatment

- A. Keep the ventilation well, relieving hypoxia and CO₂ retention.
  - when the secretion in airway is thick → intermittent ultrasonic inhalant therapy is recommended.
  - NS 20ml + gentamycin 4000u +
  - Dexamethason 2mg + α-chymotrypsin 5mg.
  - Sputum suction in time → best way to keep normal ventilation of airway.
B. Oxygen therapy

- oxygen inhalation can be administrated with nasal cannula, the flow is 0.5-1L/min.
- If the hypoxia continues, Oxyhood may be used with a flow of 2-4L/min.
- when respiratory failure occurs, ventilator is needed.
(2) Antibiotics

- The selection of antibiotics depends on the degree of illness and the kinds of bacteria. (the best way to give the most sensitive antibiotic to the bacteria by medicine sensitive test)
  - Intramuscular antibiotics → mild cases;
  - Intravenous antibiotics → severe cases
- **Pneumococcal pneumonia** → penicillin
  - 300,000-600,000u /kg.d  Bid  iv.
- **Staphylococcal aureus pneumonia**
  - → Oxacillin, 50-100mg /kg.d  q6h  iv.
- **Colibacillus pneumonia** → Amicillin,
  -  50-100mg /kg.d  bid  iv.
  - or Amikacin, 15mg /kg.d, bid  iv.
- **Virus pneumonia** →
  - *Virazole*, 10-15mg /kg.d qd iv.
  - Interferons, 20000u, qd im (injection intramuscularity), for 3 days.
  - Chinese traditional medicine (双黄连, 穿琥宁等)
- **Mycoplasma pneumoniae pneumonia** →
  - erythromycin 20-30mg /kg.d qd iv drip
• The **principle of discontinue antibiotics:**
  • The signs of lungs have disappeared for 3 days, no fever and cough.
  • *Mycoplasma pneumoniae pneumonia* → usually 2-3 weeks or longer.
  • *Staphylococcal aureus pneumonia* → should be treated with a long course, the antibiotics should be used for another 2 weeks if the signs of lungs have disappeared and no fever.
  •
(3) Symptomatic treatment

A. Sedate

- if the patient is restless (dysphoria), some sedative should be used, such as:
- 5% chloride hydras 1ml /kg, po (orally) or enema.
- PCP 1mg /kg, im or iv.
- Valum 0.1-0.3mg /kg, im or iv.
B. Control of heart failure:

The following cardiotonnic drug is used:

a. Strophanthin K, 0.007-0.01mg/kg, iv.
b. Cedilanid

total digitalizing dose 0.03-0.04 mg/kg, half od the total dose is used initially; after 6 hour, 1/4 of total dose is used again; the final 1/4 of total dose is used another 6 hour later.

The daily maintaining dose → 1/4 of total dose.
The way of administration may be im or iv.
C. Dehydration;

- Furosemide, 1mg/kg, im or iv;
- 20% Mannitol 5ml/kg, q12h iv (used in toxic encephalopathy)
(4) Treatment of complication

- Empyema
- Pyopneumothorax
- \(\rightarrow\) thoracentesis and thoracic drain
(5) Supportive treatment

- A. Inhale clean air;
- B. good and enough nutrition;
- C. Elevate resistance of the body
  - (Ig, plasma or blood)
Tuberculosis in children

- Tuberculosis (TB) is a chronic infectious disease caused by tubercle bacillus.
- Primary TB is the chief type in children.
- Many cases of TB continue to occur in our country, so TB remains an important clinical problem in China.
1. Etiology

- The tubercle bacilli belong to the
  - mycobacterium
    - The stain has a property of acid-fastness.
2. Epidemiology

- Infants and children are most frequently infected by adult, usually close relative such as the members of the household.
- The mode of infection consists of three routes:
(1) From respiratory tract:

- Inhale the droplets of sputum, expelled by the infectious individual during his coughing.
- sneezing.
- even talking.
(2) From alimentary canal:

- Bovine tuberculosis is acquired by way of the oral route, such as:
  - ingestion of raw milk from infected cows;
  - ingestion of contaminated foods by tubercle bacillus;
- Pasteurization can destroy infectivity of contaminated milk.
(3) From the skin or placenta
3. The allergic reaction and immunity of TB

- Pathogen (tubercle bacillus)
  - Through infective route
  - Child
  - The thymus-dependent LC be sensitized and proliferates
  -
4-8 weeks ↓ delayed allergic reaction ↓ positive tuberculin test ↓ contact tubercle ↓ bacillus again Lymphokines
Activating factors  Inhibiting factors
of macrophage  of macrophage
↓ movement  ↓
activating Tubercle bacillus is
macrophage surrounded by sensitized TLC
• (activating macrophage)
• ↓
• Engulf and kill tubercle bacillus
• ↓ produce
• Epithelioid cells and tubercle
• ↓
• infection is focused
4. Diagnosis
(1) History

- TB toxic symptoms;
  - fatigue, cough or hemoptysis,
  - fever, malaise, loss of weigh,
  - night sweats.
- The history of contact with active TB;
- The history of vaccination of BCG (Bacilli Calmette-Guerin)
(2) Tuberculin test

- Four to eight weeks after infection with tubercle bacilli, an allergic reaction can be seen on the site of intracutaneous injection of tuberculin, which belongs to delayed allergic reactio.
A. Method

- Performed by the intradermal injection of 0.1mL PPD (protein purified derivative) into cleaned skin of the forearm. A pale elevation of the skin, 6-10mm in diameter, should be produced immediately after injection. If the wheal is smaller than 6mm, the injection should be repeated at another site.
B. Reading and recording of the test

The test should be read during 48-72 hours after injection. Reading should be made in a good light, the forearm slightly flexed. The basis of reading is the presence of induration that may be determined by inspection and by palpation with a gentle finger stroking.
- The diameter of induration should be measured transversely to the long axis and recorded in millimeters.
- The erythema without induration is of no significance.
C. Judge standard

- The diameter of induration
  - $<5$mm (-) negative
  - 5-9mm (+)
  - 10-20mm (++)
  - $>20$mm (++++)
- induration with blisters and necrosis
  - (++++)
D. Clinical significance

Positive reaction:

a. Vaccinated with BCG before 4-8 weeks.

b. Infected with tubercle bacillus but no active focus of infection was found.

c. Suffering from active of TB (>20mm).
d. There is new focus of TB in infant and child (≤ 3 years), the younger the child, the more possible the active TB is

e. Positive conversion (Mantoux conversion) from negative result within 2 years, or the diameter of induration enlarged from < 10mm to > 10mm, suggesting a new infection or an active focus of TB.
Negative reaction

a. Does not infect with the tubercle bacillus (including the failure of vaccination with BCG).

b. Immunoreaction is suppressed
   ① Severe tuberculosis (active miliary TB of the lung)
   ② Infected with some virus within 1 month, such as measles, rubella and influenza.
③ Vaccinated live measles vaccine within 2-3 weeks
④ Using immunosuppressors.
⑤ Sever malnutrition.
⑥ Primary immunodeficiency.
The differentiation of vaccination of BCG and infection by TB

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<thead>
<tr>
<th></th>
<th>with BCG</th>
<th>by TB</th>
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<tbody>
<tr>
<td>The diameter of induration</td>
<td>weak reaction</td>
<td>strong reaction</td>
</tr>
<tr>
<td></td>
<td>D &lt; 5-9mm</td>
<td>D &gt; 10-15mm</td>
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<tr>
<td>Lasting of induration</td>
<td>short, &lt; 2-3d</td>
<td>7-10d, or above</td>
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<tr>
<td>Characteristics of the induration</td>
<td>soft,</td>
<td>hard with clear limit, dark red</td>
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<tr>
<td></td>
<td>no clear limit</td>
<td></td>
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<tr>
<td>Lasting of immunoreaction</td>
<td>short, 3-5 years</td>
<td>very long,</td>
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<td></td>
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<td>10-20 years</td>
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(3) Laboratory findings

- A. Tubercle bacillus may be found in the sputum, gastric juice, CSF, pleurorrhea and ascetic fluid.
- B. Biopsy of peripheral lymph node may show tubercle, caseation and Langhan’s cells.
C. Increased WBC and decreased RBC
D. Erythrocyte sedimentation rate accelerate.
E. Chest X-ray: Various clinical types of intrathoracic shadows can be found which is helpful for diagnosis and treatment.
F. Immunology diagnosis and biological gene diagnosis
   - ELISA, ELIEP,
   - PCR (polymerase chain reaction)
   - DNA probe (hybridization)
5. Prevention

- (1) Avoid contacting with tubercle bacilli.
- (2) Enhance natural resistance of body:
  - A. physical exercise
  - good nutrition
  - good environment
  - prevent infective disease
B. Vaccinate BCG vaccine

- The vaccine is composed of Bovine tubercle bacilli whose virulence has been reduced by special cultural procedures. Administered BCG to human being to produce a limited immunity against the reinfection.
- Intradermal injection is effective.
- The vaccine is given during the first few days of life. Vaccine should be repeated in 3, 7, and 12 years old.
(3) Preventive treatment with drug;

- Isoniazid 10mg/kg.d for 6-12 months.

The indications:

- A. Younger than 3 years of age, no vaccination with BCG, PPD test shows a positive result recently.
- B. Contacting with TB patient frequently and closely
C. No vaccination of BCG, but has a positive conversion from negative.
D. Tuberculin test is strong positive.
E. Having a history of TB or an old focus of TB in the lung, and need using immunosuppresor for long time.
5. Treatment

- The most useful drugs in the treatment of TB are:
  - Isoniazid (INH) 异烟肼
  - Rifampin (RFP) 利福平
  - Ethambutol (EMB) 乙胺丁醇
  - Ethionamide (ETH) 乙硫异烟胺
  - Streptomycin (SM) 链霉素
  - Pyrazinamide (PZA) 吡嗪酰胺
  - Dipasic 力排肺疾（新药）
Treatment

- **Purpose**
  - a. Kill tubercle bacillus in the focus.
  - b. Prevent dissemination from blood.

- **Principle**
  - Early, Regular, Enough course,
  - Combined therapy, Proper dose,
  - Different period treatment.
(1) Tuberculocide

- A. Highly active $\rightarrow$ INH, RFP
  - have a strong penetration, can kill tuberculosis whatever intra-macrophage or extra-macrophage.

- B. Partly active $\rightarrow$ SM, PZA
  - SM $\rightarrow$ only against the extra-macrophage tubercle bacilli that are active metabolism and in the alkaline condition.
  - PZA $\rightarrow$ only against the intra-macrophage tubercle bacilli that are low metabolism and in the acid condition.
(2) Tuberculostatic

- EMB
- Ethionamide (ETH)
The way of treatment

(1) Standard treatment

→ usually suitable for primary pulmonary tuberculosis

lasting for 9-12 months with INH, RFP and (or) EMB
(2) Two period treatment

- Suitable for active Primary pulmonary tuberculosis, Acute miliary TB of lungs, Tuberculous meningitis.
- A. Strengthen period → kill the activing tubercle bacilli quickly, 2-4 kinds of tuberculocide drugs are needed, such as INH + RFP + SM or INH + RFP + EMB.
- (3-4 month)
B. Consolidating period → kill the surplus tubercle bacilli and prevent relapses.

- INH + RFP → INH + EMB (acute miliary TB of lungs);
- INH + RFP + EMB → INH + RFP or INH + EMB (tuberculous meningitis)
(3) **Short period treatment**

- **2HRZ/4HR(INH + RFP + PZA for two months, INH + RFP for four months)**
- **2SHRZ/4HR(SM + INH + RFP + PZA for two months, INH + RFP for four months)**
- **2EHRZ/4HR(EMB + INH + RFP + PZA for two months, INH + RFP for four months)**