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Psittacosis, also known as ornithosis, is an acute infectious disease caused by *Chlamydia psittaci* (Cps) and commonly prevails in poultry and other species of bird. Humans infected by *Chlamydia psittaci* may suffer from unapparent subclinical infection, with symptoms ranging from mild flulike illness to severe SARS. As a typical animal-based infectious disease, psittacosis rarely has pulmonary signs but a long illness course, despite its clinical manifestation characterized by severe pulmonary lesions. Repeated onsets of psittacosis may lead to chronic diseases.

## 20.1 Etiology

Initially isolated from parrots, *Chlamydia psittaci* (Cps) is the pathogen of psittacosis. With a diameter of 150–200 nm, the elementary body is ring-shaped and characterized by a narrow protoplasmic margin around the nucleoplasm, a non-glycogen inclusion body and iodine staining negative. Cps develops well in several cell culture systems, among which HeLa cells, Vero cells, and L cells as well as McCoy cells are commonly used. The Cps can also develop in the yolk sac of the chicken embryo. The number of susceptible animals is relatively large, and the laboratory rats are usually used in the animal inoculation. As Cps and *Chlamydia trachomatis* share the same antigen, both of them cannot be distinguished by the complement fixation test (CFT). With a weak resistance to the surroundings, Cps can be easily killed by the general chemical disinfectants. It can be inactivated in 48 h at 37 °C, in 10 min at 60 °C, in 24 h with 0.1 % formaldehyde or 0.5 % phenol, and in 30 min with diethyl ether or with ultraviolet radiation. It is resistant to low temperature and can remain infectious for several years if it is kept at –70 °C.

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## 20.2 Epidemiology

### 20.2.1 Source of Infection

Birds which are infected by psittacosis or serve as the pathogen carriers are considered as the source of infection. Currently, more than 140 types of birds are known to contract or carry the pathogen which is mostly found in secretions and feathers. Infections in birds are unapparent and the signs are characteristic. Although most of the infected birds show no or mild symptoms, the pathogens can be excreted for several months. A patient can also become a minor source of infection if he/she excretes pathogens in sputum.

### 20.2.2 Route of Transmission

Psittacosis can be transmitted via the respiratory tract. Besides being directly transmitted to humans via droplet, the bacteria can be indirectly transmitted by inhaling an aerosol of infected birds' feces via the respiratory tract. However, according to the reports, few patients experience the onsets without the contact history of birds. Psittacosis is rarely transmitted via direct person-to-person contact.

### 20.2.3 Susceptible Population

Populations are generally susceptible and the occurrence has no significant gender difference. It is an epidemic disease all year round. The infection rate is closely related to the frequency of bird contact: parrot and poultry raisers easily contract the disease. Although certain immunity can be acquired after the infection is cured, it is not strong enough to prevent the repeated onsets and the following infection.

## 20.2.4 Epidemic Features

Psittacosis affects many areas around the world. Although severe outbreaks have occurred, few cases have been reported in recent years. Ritter reported the case of human psittacosis in Switzerland in 1879. In the early 1960s, psittacosis was proved to exist in China. The disease usually spread sporadically, while outbreaks and epidemics occur on a small scale sometimes. As people who are often exposed to poultry and birds have a higher infection rate, psittacosis is considered as an occupational disease for poultry workers.

## 20.3 Pathogenesis and Pathological Changes

### 20.3.1 Pathogenesis

The pathogenesis of psittacosis is still not clear. After being inhaled by humans via the respiratory tract, Cps enters the blood circulation, then attacks the mononuclear macrophage system, and proliferates inside. After the above process, Cps invades the lung and other organs via blood. Thus, human psittacosis may be a respiratory tract infection (RTI) or a general infection mainly with respiratory symptoms. The pulmonary lesions often occur in the hilum of the lung and then spread around, resulting in the lobular pneumonia and interstitial pneumonia. Via microscopic examination, infiltration of the mononuclear lymphocytes can be discovered in the alveolar wall and interstitial tissue; deciduous epithelial cells, fibrous protein, lymphocytes, and few neutrophils can be found in the pulmonary alveoli; the inclusion bodies and pathogens can be seen in the cytoplasm of the macrophage in the exudation of pulmonary alveoli. SARS and lobular pneumonia often occur. In severe cases, necrosis of lung tissue may occur accompanying pleurisy. Beside the lung, relative lesions can be found in other involved organs such as the liver, spleen, kidney, meninges, cardiac muscles, and endocardium.

## 20.4 Clinical Symptoms and Signs

The incubation period generally lasts for 7–40 days, with symptoms ranging from mild to severe. Documents and reports show that the shorter the incubation period, the more severe the symptoms. Mild cases can lead to flulike illness or even no apparent symptoms, while severe cases can result in death. Although SARS is considered as the major manifestation, there is no specific clinical manifestation of psittacosis. Manifestations can be divided into the following types based on the clinical symptoms.

## 20.4.1 Pneumonia

### 20.4.1.1 Fever and Flulike Symptoms

The onset is acute, with body temperature up to 40 °C in 1–2 days, chills, general upset, headache, muscular soreness, and obvious muscle shapes in the neck and back. In some cases, patients may suffer from conjunctivitis, epistaxis, and rash. The high body temperature may gradually decline in 1–2 weeks. The fever course is 3–4 weeks, while it may last for several months in some cases.

### 20.4.1.2 Pneumonia

Pneumonia often occurs after the 1st week of onset, accompanying worsening coughs, which are mostly dry coughs with a small amount of phlegm or bloody sputum, choking sensation in chest, and chest pain. In severe cases, patients may suffer from dyspnea, cyanosis, tachycardia, delirium, and even coma. The physical signs of the lung are often milder than the symptoms. At the beginning stage of the onset or in mild cases, patients have no apparent physical signs or only suffer from moist rales in the lung and pharyngeal hyperemia. As the disease develops, signs of lung consolidation and moist rales occur, accompanying pleural friction rub and pleural effusion in few cases.

### 20.4.1.3 Other Symptoms

Digestive symptoms such as anorexia, nausea and vomiting, abdominal pain, and diarrhea may occur. The liver and spleen may be enlarged accompanying the occurrence of jaundice. The onset of myocarditis, endocarditis, and pericarditis may be triggered, with circulatory failure and pulmonary edema in the severe cases. Psychiatric symptoms such as headache, insomnia, slow response, and nervousness may occur, with sleepiness, delirium, mental disorientation, and unconsciousness in severe cases. The disease can result in serious conditions and adverse outcomes.

The above symptoms are lack of the specificity. The manifestations of pneumonia as well as the enlargement of the spleen play the most important role in the diagnosis of psittacosis.

## 20.4.2 Typhoid Sepsis and Blood Poisoning

The symptoms include high fever and headache, accompanying relative bradycardia and enlargement of the spleen. Complications such as myocarditis, endocarditis, and meningitis easily occur. In severe cases, the coma and renal failure may lead to patients' death.

The illness course is long, with a fever course lasting for 3–4 weeks or even several months. The recurrence rate may reach 20 %.

## 20.5 Psittacosis Related Complications

The complications of psittacosis seldom occur. In severe cases, the cardiovascular system and nervous system can be negatively affected. Cardiac complications include myocarditis, endocarditis, and pericarditis. Cps may attack the aortic valves and mitral valves as well. The disease may lead to artery embolization and have a negative effect on the liver, kidney, skin, and other organs.

## 20.6 Diagnostic Examinations

### 20.6.1 Laboratory Tests

#### 20.6.1.1 Routine Tests

At the acute stage, the WBC count is normal or slightly lower, with a normal or slightly accelerating ESR. Transient proteinuria can be discovered via the uronscopy.

#### 20.6.1.2 Etiological Tests

Etiological tests serve as the diagnostic basis of psittacosis. In clinical cases, blood, sputum, and throat swab are taken at the acute stage to detect Cps.

#### 20.6.1.3 Serological Tests

Serological tests are often used in the diagnosis of psittacosis.

#### Microimmunofluorescence Test

The test is applied to detect the IgM-specific and IgG-specific antibodies. The positive result of IgM can be found in the early stage of the diagnosis. The positive rate reaches 80–95 %. It is reported that the microimmunofluorescence test is more sensitive than CFT.

#### CFT or Hemagglutination Inhibition (HI)

A diagnosis is needed if the paired serum titers increased at a four-time speed during the detection of specific antibodies.

### 20.6.2 Diagnostic Imaging

#### 20.6.2.1 X-Ray Radiology and CT Scanning

X-ray radiology and CT scanning are commonly applied for the diagnosis as well as the differential diagnosis of the psittacosis pneumonia.

#### 20.6.2.2 CT Scanning and MR Imaging

MR imaging is commonly applied for the diagnosis of the neurological complications caused by psittacosis.

## 20.7 Imaging Demonstrations

Pneumonia is the major manifestation when psittacosis invades the lung. The imaging demonstrations have certain characteristics and are similar to other types of pneumonia but are lack of specific manifestations.

### 20.7.1 X-Ray Radiology

The X-ray demonstration is abnormal in 80–95 % of cases. It may demonstrate the patches of infiltration shadows in the pulmonary segment or the lung lobe and the fan-shaped shadows distributed from the pulmonary segment in the radial pattern as well as the wedge-shaped shadows under the pleura. Most shadows are found in the inferior lobe with an inhomogeneous density, accompanying the signs of diffuse panbronchiolitis and interstitial pneumonia. Corn-shaped nodules and obvious consolidation can be found in some cases (Fig. 20.1) and even cover the whole pulmonary lobe of severe patients.

#### Case Study 1

A male patient, aged 35 years, was admitted to hospital on the sixth day of the continued high fever, with chills, muscular soreness, general upset, and mental confusion. Pleurisy occurred in the left thorax 9 months before being admitted to hospital, accompanying no fever. The X-ray demonstrates the pneumonia in the inferior lobe of the left lung with pleural effusion. Two days after being admitted to hospital, pain occurred under the sternum, accompanying dry coughs. The patient had a contact history of cockatiel and rabbit fur. He was diagnosed as having psittacosis via serological tests, with the *paired serum titers of 1:8–1:32*.

For case detail and figures, please refer to Mcphee SJ, et al. *West J Med*, 1987, 146(1): 91.

#### Case Study 2

A man aged 12 years, with pain occurring in the left upper quadrant. He once suffered from gastric ulcer. The pain transferred from the left upper quadrant to the axilla, chest, and back, accompanying the respiratory failure, bilateral pneumonia, and pleurisy. In the microimmunofluorescence test, the results of the specific-antibody titers were as follows: IgG 1:16, IgM 1:32. He had no contact history of parrots.

For case detail and figures, please refer to Homma T, et al. *J Med Microbiol*, 2011, 60 (4): 547.

**Case Study 3**

A female patient, aged 69 years, was admitted to hospital due to dyspnea, accompanying general upset, fever, intense coughs, and diarrhea. The patient once worked in the poultry processing room and had a contact history of infected parrots. The biopsy demonstrated the extensive bronchopneumonia in the left lung and the small lesions of the diffuse pneumonia in the inferior lobe of the right lung. In the microimmunofluorescence test, the results of the serum specimen were as follows: IgM 1:16, IgG 1:512. The clinical diagnosis was psittacosis pneumonia.

For case detail and figures, please refer to Petrovay and Balla *J Med Microbiol*, 2008, 57(10): 1296.

**Case Study 4**

A female patient aged 69 years, with a high fever for 2 weeks, dry coughs, and dyspnea. The manifestations include respiratory failure, hypoxia and apparent symptoms of poisoning, accompanying the failure of several organs. The oxygen saturation is 26 %. In the microimmunofluorescence test, the results were as follows: IgG 1:256, IgA 1:32. The clinical diagnosis was psittacosis pneumonia.

For case detail and figures, please refer to Petrovay and Balla *J Med Microbiol*, 2008, 57(10): 1296.

**Case Study 5**

A female patient, aging 35 years, was admitted to hospital due to a high body temperature of 38 °C accompanying general upset, chills, fever, dizziness, anorexia, and nausea. She had the positive results of the infectious mononucleosis, with a slight increase in AST and ALT. She was diagnosed as having the virus hepatitis. After she took the aspirin, the fever was not reduced. Dry coughs and dyspnea as well as moist rales occurred as the disease developed. She had a contact history of parrots. In the microimmunofluorescence test, the results were as follows: IgG 1:128, IgM 1:128. The clinical diagnosis was psittacosis pneumonia.

For case detail and figures, please refer to Mcphee SJ, et al. *West J Med*, 1987, 146(1): 91.

**Case Study 6**

A female patient, aging 57 years, was admitted to hospital due to a high fever and chills for 5 days. Other symptoms included mild dry coughs, nausea, vomiting, trance, and tachycardia. She had the contact history of two infected parrots, one of which contracted the respiratory system disease. In the microimmunofluorescence test, the antibody titers increased. The clinical diagnosis was psittacosis pneumonia.

For case detail and figures, please refer to Convelli HD, et al. *West J Med*, 1980, 132(3): 245.

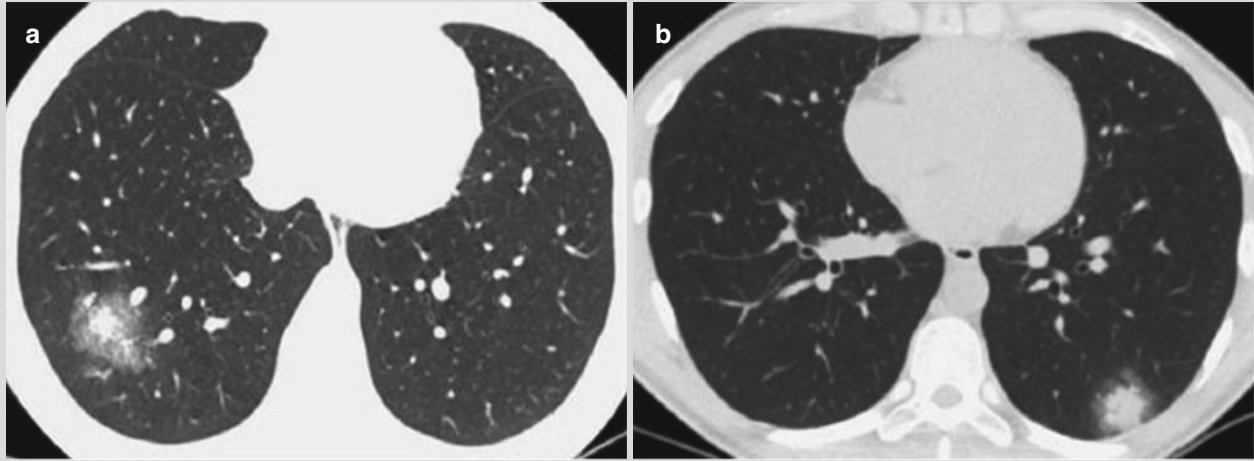
**20.7.2 CT Scanning**

Via the CT scanning, shadows in the shape of ground glass can be found. The CT scanning can also demonstrate the thickened markings and obscurity of the involved bronchus and blood vessels. Small lesions in the lung can be discovered via the CT scanning, which is helpful to the early diagnosis of the disease. Shadows in the shape of ground glass surround the nodule lesions of the consolidation in the lung, with a density lower than that of the consolidation nodules and accompanying halo-shaped signs. The air bronchography can be seen in the lung field outside the areas of lesions and consolidation. A small amount of pleural effusion can be discovered via the CT scanning.

**Case Study 7**

A male patient aged 30 years, with a high fever for 5 days, accompanying general upset and collapse and diffuse hernia pain in the stomach. He had the contact his-

tory of parakeets. In the microimmunofluorescence test, the results of the specific-antibody titers were 1:64. The clinical diagnosis was psittacosis pneumonia.



**Fig. 20.1** Psittacosis pneumonia. (a, b) HRCT demonstrates two high-density shadows of nodules in the posterior segment outside the inferior lobe, with the shadows in the shape of ground glass sur-

rounded around the nodule lesions. The signs are halo-shaped, with clearly defined boundaries (Reproduced with permission from Hochegger B, et al. *J Thorac Imaging*, 2009, 24(2): 136.)

**Case Study 8**

A male patient, aging 76 years, served as a businessman in the parrots sales. He was admitted to hospital due to general upset and fever, with no cough or sputum. His wife, aging 77 years, was admitted to hospital due to a high fever, with no cough and sputum as well. In the microimmunofluorescence test, their results of the specific-antibody titers increased. The clinical diagnosis was psittacosis pneumonia.

For case detail and figures, please refer to Saito T, et al. *J Chin Microbiol*, 2005, 43(6): 3011.

**Case Study 9**

A female patient aged 76 years, with a fever for 1 week, anorexia, dry coughs, tachycardia, and dysentery. She had a contact history of parakeet. In the physical examination, moist rales can be heard in the superior lobe of the left lung, the middle field of the right lung, and the posterior lobe of the right lung. CFT showed that the antibody titters increased. The clinical diagnosis was psittacosis pneumonia.

For case detail and figures, please refer to Ito I, et al. *Intern Med*, 2002, 41(7): 580.

**20.8 Basis for the Diagnosis****20.8.1 Epidemiological Materials**

The contact histories of infected birds serve as the epidemiological data.

**20.8.2 Clinical Manifestations**

The clinical manifestations include high fever, severe headache, muscular soreness, relative bradycardia, enlargement of the spleen, and symptoms of systemic sera. In addition, patients may suffer from the pneumonia with severe symptoms. Cyanosis, tachycardia, delirium, and coma may occur in the severe cases.

**20.8.3 Laboratory Diagnosis**

Pathogens can be detected in the etiological examination. The disease can also be diagnosed via the CFT of serum, with the single serum titer exceeding 1:64 and paired serum titers increasing at a four-time speed. Pathogens of birds should be detected in patients' bodies.

**20.8.4 Imaging Diagnosis**

The X-ray and CT demonstrate the patch-shaped, cloud-shaped, nodule-shaped, and corn-shaped shadows in the lung field, expanding from the hilum of the lung in a fan-shaped or wedge-shaped pattern. The infiltration is commonly found

in the inferior lobes of the bilateral lungs. Lesions are often found in the lobule, often accompanying the symptoms of diffuse panbronchiolitis and interstitial pneumonia. The lobar inflammation may occur as well, with an obvious demonstration of the chest X-ray and few pulmonary signs.

## 20.9 Differential Diagnosis

The clinical manifestation of psittacosis is lack of specificity. Psittacosis should be differentiated from other types of pneumonia caused by other pathogens, such as the *Legionella* pneumonia, *Mycoplasma pneumoniae*, and SARS.

### 20.9.1 *Legionella* Pneumonia

The clinical manifestations include fever, profuse sweating, coughs, white phlegm, dyspnea, and relative bradycardia. The WBC count may increase in the laboratory test. As the WBC count of the psittacosis carriers is usually normal, psittacosis can be easily differentiated from *Legionella* pneumonia and other bacterial pneumonia. The chest X-ray demonstrates the leaf-shaped, cotton-shaped, and cloud-shaped shadows. Lesions can spread either diffusely or focally, accompanying swellings. If the patient tests positive for the *Legionella* via the special stain of the lung tissues in the biopsy, he/she may contract *Legionella* pneumonia.

### 20.9.2 *Mycoplasma* Pneumonia

Characterized by the intensive coughs, the *Mycoplasma pneumoniae* often occurs in autumn and winter. The frequency and severity of coughs may increase in 1–2 days after the onset, accompanying the fever, headache, and general upset. Muscular soreness and gastrointestinal symptoms are seldom seen in the cases of *Mycoplasma pneumoniae*. *Mycoplasma pneumoniae* is mainly characterized by the apparent imaging manifestations as well as few positive physical signs in the lung. The X-ray demonstration is characterized by the interstitial changes, with the thickened and straight markings expanding from the hilum of the lung in the fan-shaped pattern. The X-ray also demonstrates the cloudy patches of the infiltration shadows with a low density and unclearly defined boundaries. The lesions are usually distributed segmentally on a small scale.

### 20.9.3 Virus Pneumonia

With the flulike symptoms, the psittacosis may sometimes be misdiagnosed as the virus pneumonia. Virus pneumonia is mostly caused by the influenza virus. With an acute onset, the variable symptoms of the virus pneumonia include fever, asthma, accelerating respiratory rate, and coughs with a small amount of sputum. The physical signs of the lung are inapparent. The X-ray

may demonstrate the net-shaped shadows in the lung, accompanying the thickened and obscure markings. In severe cases, the diffuse nodule-shaped shadows with homogeneous density can be found in the middle and inferior field of the lung. The consolidation is seldom seen.

### 20.9.4 SARS

SARS is a respiratory infection caused by the SARS *Coronavirus*, sharing similar symptoms with psittacosis. The clinical symptoms including the high fever, dry coughs, small amount of sputum, headache, muscular soreness, and anorexia can be found in both diseases. In severe cases, patients may suffer from the respiratory distress. The demonstration of the chest X-ray may be normal at the early stage, while in some cases, the thickened and disorderly markings as well as the patch-shaped and cloud-shaped shadows can be found in the lung. The lesions may be discovered in both the unilateral and bilateral field of the lung. The typical changes are characterized by the shadows in the shape of the ground glass as well as the pulmonary consolidation (the air bronchus sign).

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