

## Case Report

# Clinical and epidemiological investigation of a fatal anthrax case in China

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### Abstract

Anthrax is a recessive infectious disease caused by the bacterium *Bacillus anthracis*, and is primarily a zoonotic disease. Until recently, *Bacillus anthracis* infections were relatively infrequent and confined to agrarian communities in underdeveloped countries. No anthrax cases were reported in Changchun City in the past few decades until a male patient from the Inner Mongolia Autonomous Region presented the anthrax disease manifestation. This paper describes an anthrax patient's diagnosis, isolation and treatment which involved institutions in two different Chinese provinces; the foci epidemiological investigation alongside with the outbreak management process, which is of great significance to control the spread of the recessive infection is also described.

**Key words:** anthrax; interprovincial; epidemiological investigation; outbreak control.

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### Introduction

Anthrax is an acute infection caused by the Gram-positive, rod-shaped, spore-forming bacterium *Bacillus anthracis*, and is primarily a zoonotic disease [1]. The *Bacillus anthracis* exists in two forms: vegetative and spore forming. The spores are remarkably resistant to physical stress and can remain viable in soil for decades. Spores cause disease only when they gain access to the body and germinate into the vegetative forms [2]. There are three clinical presentations of anthrax in humans: cutaneous (> 95% of cases), orogastric and inhalational [1,3]. Injectional anthrax associated with injection drug use has also been identified [4]. Humans contract the disease through contact with infected animals or meat, hides or animal fur containing anthrax spores [2]. Breathing in dust containing spores can provoke pulmonary anthrax. Severe cases progress rapidly to subsequent anthrax meningitis and sepsis, and the mortality of anthrax sepsis is between 80% and 100% [5]. Anthrax is one of the most important life-threatening health problems.

Until recently, infections caused by *Bacillus anthracis* were relatively infrequent and confined to agrarian communities in underdeveloped countries [6]. According to the Infectious Diseases Prevention Law of the People's Republic of China, anthrax belongs to the Class B infectious diseases; instead pulmonary anthrax, which is highly infectious with a death rate

accounting for more than 80%, needs to be isolated as it is considered a Class A infectious disease. In China, anthrax often occurs among herdsmen or butchers in pasture areas in the northern or western parts of China where livestock are not vaccinated due to poverty [7,8].

The Inner Mongolia Autonomous Region is the natural focus of anthrax. Livestock development in the province creates the basic condition for anthrax onset. Anthrax cases are sporadic with occasional outbreaks. To prevent the epidemic of this disease, animals should be vaccinated, however, the high cost of vaccination for a large number of animals is a limitation. Vaccination of human beings is even more difficult to carry out. Three hundred and three cases of anthrax have been reported in Mongolia between 2001 to 2011, with an incidence rate of 0.04-0.23/10 million [9]. No anthrax cases had been reported in Changchun City in the past ten years before this case was diagnosed. This paper describes an anthrax patient's diagnosis, isolation, treatment and foci epidemiological investigation, alongside with the outbreak management process managed by institutions from two provinces.

### Case Report

The 55-year old male patient was from a village of Ulanhot, Inner Mongolia Autonomous Region. He was admitted to the Emergency Room of the first hospital

of Jilin University on August 25, 2011 where 8-day open wound, 3-day fever and malaise, 2-day headache, 8-hour nausea and vomiting, and 4-hour unconsciousness were reported. Symptoms reported at admission were: body temperature 39 °C, pulse 120 times per minute, breathing 36 times per minute, blood pressure 130/80 mmHg, critically ill and unconscious. On the little finger of the left hand and on the hypothenar and anterior wall of the right hand there were about 1 x 1 cm<sup>2</sup> black skin lesions giving prominence to the skin, having no visible blisters around. A mild edema on the right forearm was reported. Crackles and wheeze in bilateral lung were heard during auscultation. The heart rate was 120 beat rhythm per minute and the bilateral Babinski sign was suspected positive. Blood test results were as follows: leukocyte count 21.24 x 10<sup>9</sup>/L, neutrophil ratio 91.81%, lymphocyte ratio 4.72%. After a consultation, an infection caused by cutaneous, meningial or pulmonary anthrax was suspected. The case was immediately reported to the Disease Control Center and notified the Changchun City Infectious Disease Hospital. In the evening of the same day of admission, the patient was treated with antimicrobials and other adjuvant therapies and transferred to the Changchun City Infectious Disease Hospital by ambulance for isolation treatment; during the transfer the patient had large volume hemoptysis. In spite of the positive rescue therapy, which included oxygen uptake, cerebral edema and increased intracranial pressure control, antimicrobial therapy, improved cardiac function, diuresis, adrenal cortical hormone injections, immune support, symptomatic treatment, the patient was declared clinically dead at 14:50 on August 26, 2011. The cause of death were irreversible increased intracranial pressure and cerebral hernia that caused respiratory and circulatory collapse. The laboratory report of Changchun City Disease Control and Prevention Center released the following day, showed the presence of Gram-positive bacilli in the Gram-stained smear of the skin lesion exudates of the patient, in which the typical *Bacillus anthracis* was detected by cultures first, and then confirmed by using the polymerase chain reaction testing and the animal inoculation test [10,11]. The expert group of Jilin Province had a consultation and gave the comprehensive indication that the clinical diagnosis of cutaneous anthrax, meningitis anthrax and pulmonary anthrax was confirmed and should have immediately been notified to the Ulanhot City Disease Control and Prevention Center.

## Epidemiological investigation

The Ulanhot City Disease Control and Prevention Center immediately replied to the notification. The retrospective epidemiological inquiry disclosed the infection source. The tracking survey, isolation, and medical observation on close contacts were also carried out.

## Outbreak of this infection and people contacted

Between August 1 and 18, 2011, two animals from the cattle which belonged to the first patient's relatives died. The animal carcasses were divided and sold to the villagers. The contact of the patient with the carcasses was reported and also that his hands were lacerated on August 18, leading to infection; this may confirm that the infection source of the anthrax outbreak was domestic cattle, and the patient was the secondary infection source of pulmonary anthrax.

According to the survey, 27 people had close contact with the patient, 3 people had general contact, and 53 people consumed the infected meat of the cattle carcasses. Between August 1 and 30, there were 6 patients presenting the typical cutaneous anthrax carbuncle, accounting for 1.12% of the total number of investigated patients (6/536) with the age distribution 29-55 years of age, and all cases had been exposed, having eaten or been in contact with ill cattle. Among them, one case turned into pulmonary anthrax and died, two patients belonged to the group of people with close contact history (2/27), three patients belonged to the group of people who had consumed the infected meat (3/53). Five patients were discharged from hospital after receiving isolation treatment. No patients were diagnosed with gastrointestinal anthrax.

## Results of laboratory tests

According to the Diagnostic Criteria for Anthrax (WS283-2008) [12] and Diagnostic Techniques for Animal Anthrax (N Y/T561-2002) [13], on August 26, 31 blood samples of patients and people who had been in contact, 9 samples of skin exudate, and 3 samples of contaminated soil and material were collected. Of these, 3 samples of skin exudate were Gram-stained smear positive, in 2 of which the typical *Bacillus anthracis* was detected by culture and confirmed as *B. anthracis* by polymerase chain reaction (PCR) testing, phage lysis test and Penicillin-sensitive experiments [14]. Regrettably, no serological investigation for anthrax from serum samples obtained from patients or contacted people were conducted due to the lack of specific test reagents. Likewise, no laboratory

investigations for *B. anthracis* from meat samples were performed as all the infected meat had been consumed.

### Measures against transmission

With the close cooperation of the Department of Health, Agriculture, Animal Husbandry and Commerce, the tracks and the hides of infected animals were traced. Then infected animals were disinfected and destroyed as required. At the same time, new cases were searched and the dispatching and transaction of cows, horses, donkeys, sheep and other animals was stopped. As far as small-scale farming in village and cage-free households were concerned, a system of epidemic surveillance and daily reporting was implemented. According to this system, an emergency response plan is immediately initiated once a case is detected. The terminal disinfection to the patient's house, clothes, appliances, and vomit-contaminated items is carried out alongside with the terminal disinfection inside and outside of facilities where the infected cattle are slaughtered. Samples are collected both before and after the disinfection to evaluate the disinfection effect. A health education campaign is implemented to increase the disease prevention knowledge of residents, to prevent them from slaughtering or eating animals and immediately report if there is any prodromal symptom. By August 30, the anthrax outbreak was timely and effectively controlled.

### Discussion

Anthrax continues to be enzootic in less developed areas of the world lacking stringent preventive measures [15]. Rapid diagnosis, isolation, treatment with antimicrobials and other adjuvant therapies and measures against transmission, are essential to minimize disease progression and control the outbreak timely and effectively.

The patient studied in this case report was diagnosed with a suspected case of anthrax immediately after admission to our hospital and was disinfected and isolated in strict accordance with the Class A infectious diseases Guidelines. During the transfer, staff involved in the transport followed a strict protection protocol. Before admission to the Changchun City Infectious Disease Hospital, the medical staff had been informed in advance; as a consequence, they applied the strict disinfection and isolation system of the Class A infectious diseases Guidelines. These disinfection and isolation procedures eliminated the risk of recessive infections

in the hospital, the city, even in the province. At the same time, after the anthrax infection was diagnosed, staff immediately informed the provincial health and epidemic prevention departments to start the emergency preparation and response procedure, and visited the infection setting to carry out epidemiological investigations and treatment; these measures explain why the anthrax epidemic was limited and controlled.

Therefore, medical staff should always stay alert to diseases which should be isolated as Class A infectious diseases, as this is of great significance to control the spread of infection.

Moreover, further education among herdsmen or butchers in pasture areas on the modes of anthrax transmission and care of skin abrasions are needed. In addition, preventive measures and quarantine measures should be performed effectively.

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