

**Article @ Virology****An Investigation and Analysis on the Epidemic of Varicella in a University of Weifang***Shao lijun, Fang lei, Qi xiao, Wu xueqian, Niu guoyu\***School of Public Health, Weifang Medical University, ShanDong Province, P.R. China, 261053*

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**ABSTRACT**

**Objective** To investigate the reasons of the cluster outbreak of varicella in university. **Methods** The cases were diagnosed by clinical manifestations and serological test. An epidemiological survey was carried out using case study questionnaire combined with serological test of close contacts. **Results** This outbreak lasted 45 days from Oct 15th to Nov 30th, four cases were accumulated involving one major and two classes, with the incidence rate of 3.7% (4/107). The serological test results showed that the VZV-IgM antibody was positive in acute phase sera of 4 patients, and the level of VZV-IgG antibody in the recovery phase sera was 4 times higher than that in the acute phase. One of 45 contacts was VZV-IgM positive while 4 of 45 contacts were VZV-IgG positive. **Conclusion** This cluster varicella epidemic was caused by VZV. Close contact may be the risk factor. Copyright©2012-2020 Published by Hong Kong Institute of Biologicals Standardization Limited. All rights reserved.

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**Key Words:** Varicella; VZV-IgM; VZV-IgG; Serological test

**Introduction**

Varicella was a common, acute, highly contagious respiratory disease caused by varicella-zoster virus after the initial infection. The patients presented with systemic skin mucous membrane rash, papules, partial water sores and scabs, accompanied by fever, malaise and other symptoms <sup>[1]</sup>. After the recovery of the patients, the residual virus could lurk in the host's spinal ganglion, brain ganglion and the nerve cells of enteric ganglia for life, and

cannot be completely removed by serum neutralizing antibodies<sup>[2]</sup>. When the body's immune function decreases, the latent virus was activated, reach the control of the chest or facial skin cells along the sensory nerve and propagate, leading to the formation of herpes zoster. Varicella was highly contagious, and can be found all year round. The population was susceptible to VZV, varicella patients are the only source of infection, and virus exists in respiratory tract and herpes of

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\* Corresponding author, PhD. , Major in Virology

E-mail: niugy@wfmcc.edu.cn

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patients. The patients shed VZV continually from the period of latency to complete crusted herpes through respiratory apparatus, direct contact transmission and contact with VZV-contaminated appliances. Varicella mainly occurred in children, but in recent years, the incidence of adult varicella showed an upward trend [3]. Patients could obtain the persistent immune after rehabilitation.

## Materials and Methods

### 1. Objects

Four cases of varicella were diagnosed by second or third-grade class-A hospital in one university of Weifang city from October 15 to November 30th, 2015. Forty-five students had close contact with these cases, but no obvious clinical symptoms were found. Blood samples (3ml) were collected from the 4 patients in sick period and one month after recovery and from the 45 students within one week after having contact with patients, respectively.

### 2. Diagnostic criteria

Fever, runny nose, cough, anorexia and other symptoms were observed in the early stage. Red maculopapule appear in head and face, hair and other parts 1-2 days later, which more in trunk and less limbs. The maculopapule became oval herpes, varied in size around the flush containing liquid, often accompanied by itching, and finally the scab fall off with no scar. Rash, papules, blisters and scabs could be found in batches or simultaneously [4].

### 3. Criteria for judging the clusters of varicella epidemic

According to the "People's Republic of China communicable disease prevention act", "school health regulations" and "infectious diseases in schools and kindergartens reporting standards", combined with the actual situation of the university, the epidemic of varicella was defined as: more than 3 definite cases occurred in the same dormitory or the same class or the same university industry in one month.

### 4. Methods

Investigation about the 4 patients were carry out as followed: (1) general survey: including age, residence, time of diagnosis, vaccination history, disease course and other information collection. (2): clinical manifestations: include fever, headache, chills, cough, lymphadenopathy, rash, gastrointestinal symptoms and other information collection. (3) epidemiological survey: including travel history, contact history, isolation, taking drugs, etc. (4) laboratory examination: including WBC, RBC, HGB, PLT, etc. (5) serological detection, including the detection of VZV-IgM and VZV-IgG antibodies in acute phase and recovery phase of 4 patients and VZV-IgM and VZV-IgG antibodies in acute phase of 45 students. Reagent kits were products of the human VZV-IgM and VZV-IgG antibody test kit, which were produced by virion-serion medical diagnostic reagent company, Germany.

## Results

### 1. Basic situation

The outbreak occurred in the main campus of one boarding medical university. The varicella cases were confined to the 4th male dormitory building, a total of 6 layers, with each layer 30 rooms, each room covered an area of about 20m<sup>2</sup>, contained 6 people. The 4 cases were all accommodate in 6th layer, and the incidence was 3.3‰ because of the total 1200 students.

### 2. Epidemic situation

Initial case was a male student studied in the 2015 session health inspection and quarantine major of public health and management school. Symptoms were appeared such as sporadic red papules in face at first, fever, chills, like common cold on October 14, 2015. Then the symptoms were aggravating the next morning, the number and area of rash increased gradually, and the rash itched but no other complications, which was diagnosed as clinical varicella case by hospital.

Since the initial case, a total of 3 varicella cases appeared three times successively in the medical observation period from October 30 to November 30. The patients were presented with typical clinical symptoms and were self-isolated at home, taking amoxicillin, acyclovir, and adopting calamine lotion to clean the rash.

### 3. Clinical manifestations

The 4 varicella cases were mild clinical cases, with no hospitalization and death cases. All cases had symptoms such as fever,

chills, sweating, sore throat, skin rash, 100% degree of mild-to-moderate (less than 100 scattered rashes). Some cases had headache, lymph node enlargement (50%). Herpes scabbing time was 5 to 11 days, and no other complications and sequela occurred.

### 4. Epidemiological characteristics

#### 4.1 Time distribution

This epidemic lasted 45 d, pathogens went through three generations in the patients, and 4 cases were separated by 15d. The process was relatively smooth, and no obvious peaks were observed.

#### 4.2 Geographical distribution

The cases were distributed in the same grade, professional. The rooms they lived were also adjacent (NO.632 and NO. 630). Among them, the initial and second case lived in room 632, and the third and fourth cases lived in room 630. All cases denied travel history within two weeks, and the initial case denied he had been in contact with varicella patient. Besides, a total of 45 cases of students admitted they had close contact with four classmates.

#### 4.3 Population distribution

All cases were male. One case was 18 years old, the others were all 19. The 4 cases were not vaccinated with related vaccine.

### 5. Laboratory examination

The WBC, RBC, HGB, PLT values of 4 cases were all within the normal range.

### 6. Serological detection

#### 6.1 The test of VZV-IgM antibody in sera

Blood collection and sera separation

were conducted to the 4 patients (within one week after onset of diagnose) and the 45 close contacts (within one week after close contact). The VZV-IgM antibody status in sera of 49 samples was detected using enzyme linked immunosorbent assay. The results showed that the VZV-IgM antibody status of the 4 patients were all positive, whereas only one positive of 45 contacts (A4 sample was positive).

#### 6.2 The test of VZV-IgG antibody in sera

The blood collection and serum separation were conducted to the 4 patients (within one week after recovery). Using ELISA, the VZV-IgG antibody status in serum of 53 samples was detected including 4 sera of patients in acute period, 4 sera of patients in recovery period and 45 contacts in early stage. The results showed that the VZV-IgG in acute period sera of 4 patients were all negative, however, the VZV-IgG in recovery period sera of 4 patients all turned positive. There were 4 VZV-IgG positive out of 45 early sera of close contacts (Sample A1 A4, A6, and A40), hence the VZV-IgG antibody positive rate of close contacts was 8.9% (4/45).

### 7. Measures

According to the clinical features of the cases, epidemiological and serological results, this epidemic was determined the outbreak of varicella caused by VZV infection. In order to prevent the spread of the epidemic, field investigation was conducted by the school hospital and the student dormitory management staff. Series

of measures were taken as followed.

#### 7.1 Isolate the source of infection

Informed cases' parents immediately, and sent the patients back home to isolate, rest, and treat. Going out and students visit were forbidden. Patients were allowed to go back to school only when all herpes were scabby and completely dry off. Besides, certification of Community Health Service Center was also necessary.

#### 7.2 Cut off the route of transmission

Since the confirmed case appeared, a thorough disinfection to dormitory was carried out by the school dormitory administrator center, and the focus was the patient's dormitory floor. Use chlorine containing disinfectants to clean the classroom, corridor, toilets, canteens, desk and chair, door handles, stair handrail once day, until 2 weeks after the final confirmed case. Natural or mechanical ventilation should be applied to the students' room and corridor to ensure the air circulation, at least three times a day, every time 30 min.

#### 7.3 Protect vulnerable groups

Confirmed cases were isolated at home and forbidden to go out, with active treatment. Close contacts were actively observed, and gatherings were banned. Vaccination should be implemented as soon as possible. At the same time education and lectures about prevention and cure of respiratory infectious disease such as varicella should be carried out in school in order to cultivate the students to develop good health habits.

## Discussion

Varicella was an acute respiratory infectious disease caused by VZV, which occurred in every season of year, but more in winter and spring. The virus was mainly infected with infants and preschool children, adults can also be infected, and the symptoms were more serious. VZV was highly infectious, and spread through coughing, sneezing, respiratory droplets, and direct contact. The collective life and unvaccinated people were high-risk population. The collective accommodation, personnel intensive situation were benefit for the breeding and spread of virus, especially since the expansion of enrollment in 1999. Besides, the lack of propaganda and education about relevant infectious diseases, and poor awareness of prevention were also important reasons for the epidemic.

The number of patients of this outbreak was small, but the duration was long, 4 cases were separated by 15 days. It was illustrated that the previous case had spread the virus to the next one before diagnosis and isolation, or the next case had been infected by contaminated articles before the effective disinfection, but the range and degree of each transmission was limited. All cases were admitted to have had close contact with the varicella patients and denied travel history within 2 weeks except the initial case, indicating that the spread of this epidemic was mainly transmitted by close contact. In addition, the first case was October 15 2015, a week after the National

Day holiday. The students admitted had a travel history in this holiday. So it was possible that the first case was infected during the journey and became the source of the outbreak. Epidemiological survey results showed that 45 students who had contact with confirmed cases did not show the clinical symptoms of varicella, indicating that they were not infected or immune to infection because of vaccination. VZV infections were common in children, and people can obtain lasting immunity after the disease or vaccination. But the cases of this outbreak were all over 18 years old male adult, having typical clinical symptom, signified that the patients neither have varicella previously, nor receive varicella vaccine.

Serological survey showed that the VZV-IgM antibody were positive in acute phase sera of 4 patients, and the level of VZV-IgG antibody in the recovery phase was 4 times higher than that in the acute stage, which confirmed the diagnosis of VZV infection. The VZV-IgM antibody of one contact (A4) of 45 was weakly positive, while its VZV-IgG antibody was positive, this may be because the student had infected with VZV or inoculated with varicella vaccine. The student was infected through close contact but did not show clinical symptoms because of VZV-IgM mobilization. In addition, only 4 of 45 contacts were VZV-IgG positive, the positive rate was 8.9%, suggesting that the population vaccination rate was very low,

so the immune barrier can't be formed, which was a possibility of outbreak and epidemic of varicella.

There were still follow-up cases though the school adopted a series of control measures since the first confirmed cases of varicella, the reasons may be as followed: 1, VZV had a long incubation period, an average of 14 days, and the contact may be infected with VZV through contact before the symptoms of patients appeared. 2, varicella vaccine did not belong to the national immunization free plan, the majority of students were susceptible to VZV without inoculating varicella vaccine during childhood. 3, Low proportion of school dormitory administrator, lack of experience, and the disinfection measures taken was not through enough. 4, As the weather was getting colder and colder, the frequency of dormitory ventilation was low, and it would help VZV spread.

At present there was no effective treatment for varicella patients, antiviral and symptomatic treatment, Chinese medicine treatment were adopted to shorten the course of disease and prevent complications [5]. Although varicella was a self-limiting disease lasting about 2 weeks, the virus lurked in certain percentage of patients' dorsal root ganglia and brain nerve sensory ganglia after rehabilitation. VZV recurred to form herpes zoster when the immunity of organism declined. Varicella outbreaks often occurred in the school, covered a wide range, brought great harm, and seriously affected the normal teaching order<sup>[6]</sup>. At present, the

incidence of varicella was increasing year by year, so attention should be paid to the prevention and control of varicella. Aimed to control of varicella outbreaks and epidemics in schools, several suggestions were put forward as followed: 1, Promote the use of varicella vaccine vigorously, bring varicella vaccine into national planned immune range to form immune barrier, and protect vulnerable populations. 2, Dorm staff should strengthen to learn the knowledge of preventing infectious diseases, master the standard disinfection technology. 3, The school should attach great importance to the preventing and controlling of infectious diseases, formulating relevant regulations, taking response measures timely. 4, Increase the propaganda on prevention and treatment of infectious diseases, pay more attention to the hygienism and the ventilation of dormitory, develop good personal hygiene habits.

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