Research article

The correlation between the chest X-ray classifications and the pathogens of hand−foot−mouth disease

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Abstract

Objective: To study the correlation between the chest X-ray classifications and different pathogens in patients with hand−foot−mouth disease.
Methods: The images and the results of laboratory examination of patients with HFMD and positive chest X-ray were analyzed retrospectively.
Results: There were 83 cases (21.013%) with positive chest X-ray in this group, including 19 cases of type 1, 19 cases of type 2, 28 cases of type 3, 13 cases of type 4, 4 cases of type 5. The distribution of pathogens had significantly statistical difference between mild and severe HFMD group, critical HFMD group respectively (mild HFMD group VS severe HFMD group, $\chi^2 = 78.523$, $P = 0.000$; mild HFMD group VS critical HFMD group, $\chi^2 = 30.222$, $P = 0.000$). The distribution of pathogens in different the chest X-ray classifications had no statistical difference ($P > 0.05$), but the proportion of the EV71 was more than that of CVA16 in type 1and 2 chest X-ray ($P = 0.029$ and 0.001).
Conclusions: There was some relativity between clinical grade and pathogens. The severe and critical HFMD were caused mainly by EV71, and the mild HFMD was caused mainly by other pathogens except EV71. There was no significant correlation between chest X-ray classification and pathogens, but in the same chest X-ray classification, the distribution of pathogens was not identical. For the limitations of this study, we will do more research in the future work.
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Keywords: Hand−foot−mouth disease; Chest X-ray classifications; Enterovirus 71

1. Introduction

Hand−foot−mouth disease (HFMD) was a kind of virus disease, which was caused by enterovirus (EV) mainly, including coxsackievirus A2 (CVA2), CVA4, CVA5, CVA6, CVA10, CVA16, CVB1-5, some serotypes echovims (ECHO) and enterovirus 71 (EV71) [1,2]. Clinical symptoms and signs of most HFMD were mild, whose characteristic performances were fever and rashes on hands, feet, mouth and hips of the skin. HFMD was a spontaneous healing disease, so its general prognosis was well. But a few patients complicated by encephalitis, pulmonary infection, myocarditis and other complications, which may cause bad prognosis and even death.

The purpose of this paper was to study the correlation between the chest X-ray classification and different pathogens and improve the recognition of HFMD chest X-ray.

2. Materials and methods

2.1. Patients

There were 395 inpatients collected in our study during March 2014 to May, whose gender and age were distributed as shown in Table 1. All patients had fever in varying degrees (average temperature 38.78 ± 0.51 °C) and had varying numbers of rashes in hands, feet, hips and mouth. There were 83 inpatients with positive chest X-ray in our study. Those patients had heavy breathing, wheezing or coughing in varying degrees. There were 2 patients with neutropenia, 1 patient with severe pneumonia, and 1 critical patient died.

Table 1
The distribution of gender and age in different HFMD clinical grade.

Clinical grade	Total	Male			Female		
		Cases	Age range (months)	Average age (months)	Cases	Age range (months)	Average age (months)
Mild	180 (41)	105 (25)	6−48 (8−33)	25.813 ± 13.504 ((18.740 ± 8.089)	75 (16)	10−64 (4.5−48)	29.870 ± 15.378 (29.094 ± 13.818)
Severe	192 (33)	121 (19)	3−102 (12−63)	29.649 ± 18.165 (31.421 ± 13.910)	71 (14)	2−69 (2−69)	35.727 ± 17.715 (32.286 ± 20.480)
Critical	23 (9)	9 (5)	10-40 (12−34)	26.410 ± 13.473 (25.400 ± 8.473)	14 (4)	13−42 (13−31)	25.356 ± 10.732 (20.250 ± 7.719)

'( )'values for the distribution of gender and age of the inpatients with positive chest X-ray.

2.2. Imaging

Chest X-ray was performed using Philips Digital Diagnost Digital Radiography (Philips Healthcare, Eindhoven, Netherlands). If patients were less than 3 years old, they were examined in clinostatism anteroposterior position with the exposure conditions as follows: tube voltage 65 kV, tube current 2.5−3.5 mAs, focus film distance 110 cm. If patients were more than 3 years old, they were examined in standing anteroposterior position with exposure conditions as follows: tube voltage 70 kV, automatic mAs, focus film distance 180 cm.

2.3. Diagnostic criteria

The "hand−foot−mouth disease prevention and control guide (2010 Edition)" was used as the clinical diagnostic and grading criteria, which were as follows:

(1) mild: varying numbers of rashes in hands, feet, hips or mouths, with or without fever;
(2) severe: nervous system involved and brought clinic symptoms (such as poor spirit, somnolence, hyperarousal, deliration, headache and vomiting, limb jitter, myoclonia, nystagmus, ataxia, ocular movement disorder; adynamia or acute flaccid paralysis, convulsion) and signs (including meningeal irritation sign, tendon reflexes weakened or disappeared).
(3) critical: one of the following clinic symptoms: The nervous system symptoms: frequent convulsions, coma, hernia cerebri and so on; The respiratory system symptoms: dyspnea, cyanosis, bloody foam sputum, pulmonary rales and so on; The circulation system symptoms: shock and other circulatory insufficiency symptoms.

Imaging diagnostic criteria referred to the classification criteria proposed by Li Xue-qin et al. [3], which were as follows:

(1) Type 1: bronchitis type. The pulmonary interstitial was involved mainly in this type. Those images performed lung marking increased and disordered, and some grid-like or line-like changes, and speckle fuzzy shadows may be visualized among lung-markings;
(2) Type 2: localized lesions type. Only one pulmonary lobe or segment was involved in this type, in which some cloud floccule were visible;
(3) Type 3: localized-wide lesions type. In this type, more than one pulmonary lobes were involved, in which some localized cloud floccule were showed and air bronchogram sign may be visualized in lung consolidation;
(4) Type 4: wide lesions type. In this type, diffuse cloud floccule were visible in both lung fields on chest X-ray. Apart from diffuse cloud floccule, ground-glass, interstitial changes and localized emphysema were displayed by computerized tomography (CT). An example of this type was shown as Fig. 1;
(5) Type 5: pulmonary edema type (neurogenic pulmonary edema). Symmetry patchy opacities were visible in both internal zones of lung fields, which showed 'butterfly' sign that appeared inhomogeneous density from the inside outward gradually fades. Or symmetry patchy opacities were visible in one lung field. An example of this type was shown as Fig. 2.

All patients' throat swab samples were collected and enteroviruses were detected, including EV71, CVA16, and universal nucleic acid of enterovirus.

2.4. Imaging diagnosis and statistical methods

All images were diagnosed by two radiologists with 8 and 13 years experience commonly. The different distribution of pathogens in different HFMD clinical grade or different chest X-ray classifications were all compared by Kruskal−Wallis test. The different distribution of pathogens in the same clinical grade or same chest X-ray classifications were compared by χ^2 test. Dedicated software was used for statistical analysis (SPSS17.0, Chicago).
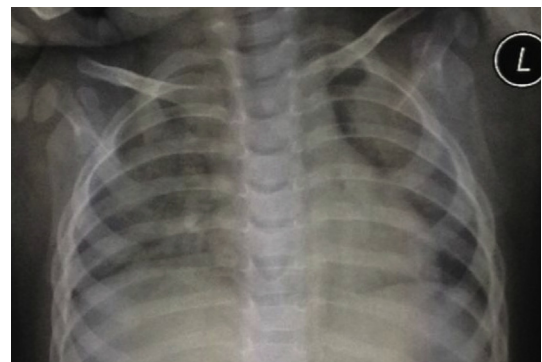

Fig. 1. Wide lesions type in a 28-month-old boy with severe HFMD. This chest X-ray shows diffuse cloud floccule in both lung fields.