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Clinical Medical Equipment Disinfection in Children with Mycoplasma Pneumoniae Pneumonia and Extrapulmonary Complications Based on Smart Big Data

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Keywords: Smart Big Data, Mycoplasma Pneumoniae Pneumonia, Extrapulmonary Complications, Lung Function, Retrospective Analysis

Abstract: Mycoplasma pneumoniae pneumonia (MPP) is mostly benign and self-limiting. After regular treatment with macrolide antibacterial drugs, most of them can heal themselves, but severe MPP will have serious complications, such as hypoxia and respiratory failure. Therefore, this article conducts clinical research on children's MPP and extrapulmonary complications based on the disinfection of smart big data(BD) medical equipment, discusses the clinical characteristics and changes of lung function in children with MPP in different degrees of illness, and provides a certain theoretical basis for the timely diagnosis and treatment of children with MPP. This article adopts a retrospective analysis method to select 88 MPP patients who were hospitalized in a pediatric department of a hospital from March 2019 to February 2020. According to the severity of the disease, they were divided into a severe MPP group and a mild MPP group. According to their clinical manifestations, they were divided into a severe MPP group and a mild MPP group. The wheezing group and the non-wheezing group are divided into the acute phase and the recovery phase according to the period of the disease. The clinical manifestations, laboratory indicators, chest imaging findings, and complications are compared and analyzed. The experiment proved that there were 33 cases in the severe MPP group, the average duration of fever was 11.09±4.72 days, the average duration of cough was 17.46±3.37 days, and the average hospital stay was 11.32±5.47 days; there were 55 cases in the mild MPP group, and the average fever the duration was 8.59±3.79 days, the average duration of cough was 13.89±3.97 days, and the average hospital stay was 6.97±2.29 days. This shows that the disinfection of medical equipment based on smart BD plays a role in the treatment of children's MPP and extrapulmonary complications, and provides a certain theoretical basis for the clinical treatment of children's MPP.

1. Introduction

With the continuous development of hospital informatization, huge data sets have been generated

in the process of medical services, and huge medical data have been formed. However, due to the current limitations of various physical and technological means, medical BD has not reached the desired state. In addition to causing pneumonia, Mycoplasma pneumoniae (MP) infection can also cause a variety of extrapulmonary manifestations, involving almost all systems of the human body, including elevated myocardial enzymes and transaminase. Some extrapulmonary manifestations are insidious and require specific laboratory tests to discover. Early detection of its extrapulmonary manifestations and symptomatic treatment can reduce or even avoid some related sequelae.

MP is distributed throughout the year, and school-age children and adolescents are the population with a high incidence of mycoplasma pneumoniae infection. Regarding the mechanism of wheezing after MP infection, many documents have reported that it may be caused by direct damage to the respiratory mucosa and immune damage by MP, but the current mechanism is still uncertain and needs to be explored in follow-up studies. Pulmonary function test is a very important auxiliary examination method. It has good monitoring of various respiratory diseases in children, especially wheezing diseases. It has been widely used to judge the severity of respiratory diseases, evaluate clinical efficacy, and infer prognosis.

In recent years, there have been a series of problems such as the increasing proportion of refractory mycoplasma pneumonia and macrolide-resistant Mycoplasma. Therefore, domestic and foreign scholars have never stopped studying mycoplasma pneumonia. Singh B in order to explore the characteristics of MPP in children of different ages, 161 hospitalized children were selected for retrospective analysis. All children with MPP were divided into 3 groups according to age: infant (≤3 years old) group, preschool children (3-6 years old)Group and school-age children (6 years old) group. Compare the differences in clinical symptoms, lung signs, chest X-ray, extrapulmonary complications and accompanying microorganisms in children with MPP at different ages. Babies are different from older children. Babies with more wet coughs, wheezing, and rales are more acute, but the degree of body temperature rise is lower. And the fever time is short, and MPP school-age children mostly show high fever, severe dry cough, mild lung signs, and longer fever time. However, the experiment did not take into account the deviation of the subject's gender and treatment methods [1]. Altin O investigated and analyzed the related factors of children with severe MPP in the acute stage, with a view to early detection and treatment of the disease. A retrospective study of 101 cases of severe (severe group) and 102 cases of mild (control group) children with MPP in the respiratory department of a children's hospital factor comparison. Age, gender, location of lung lesions, time to receive effective antibiotics, ratio of white blood cells, neutrophils, platelets, C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), lactate dehydrogenase (LDH), fibrinogen, D-dimer. Then, the binary logistic regression analysis was used to independently identify the factors significantly related to severe MPP, and the receiver operating characteristic curve analysis was performed to find the critical value of the significant related factors. However, the lack of experimental data in his research led to the sample The difference between the sets is small, which leads to inaccurate results [2]. Pragalathan B retrospectively analyzed the clinical data of children's MPP, explored the risk factors of severe mycoplasma pneumonia pneumonia (SMPP) in children, and provided evidence for early diagnosis and early application of glucocorticoids. The clinical data of 372 children with acute MPP admitted to Shanghai Children's Hospital from October 2015 to October 2016 were collected. The children were divided into SMPP group (84 cases) and non-SMPP group (237 cases). Through univariate and multivariate logistic regression analysis between the two groups, the risk factors related to SMPP were studied. Results Compared with the non-SMPP group, the children in the SMPP group were significantly older, and the duration of fever was significantly longer (all $P<0.05$). However, the overall study lacks data

support, and more data are needed to support its conclusions [3].

In this study, we retrospectively analyzed the clinical data of children with MPP to explore the pulmonary function status of children with MPP at different disease levels, acute phase and recovery phase, understand the status of small airway involvement in children with MPP, and compare the changes in various indicators of small airway function. And this article proposes a combined examination of serum iron, serum hypersensitivity CRP and plasma D-dimer for early prediction of MPP, providing for the study of the role of smart BD medical equipment disinfection in children's MPP and extrapulmonary complications objective theoretical basis.

2. Big Data Medical Treatment and Children with Mycoplasma Pneumoniae Pneumonia and Extrapulmonary Complications

2.1. Smart Big Data

(1)Health big data

This is a very ideal model, which enables consumers to enjoy the content of health management services they deserve while sitting at home, so that the cost of medical services can be optimally controlled. At present, this model has become possible, and it can do more. Professionalism is more in place[4-5]. Through the use of health-related BD, we can conduct in-depth and effective research on the etiology of epidemics, assist clinical treatment and decision-making, help the formulation of health policies, and serve the improvement of human health. First, a modified dense residual block is used to form a generative network [6-7]. After the prediction and discrimination reference image is generated, the edge enhancement network constructed by the Laplacian operator is used to extract and enhance the edge of the prediction and discrimination reference image. After the enhanced edge is obtained, the predicted and discriminant reference image is fused to generate a child MPP image with clear edges, so as to alleviate the problem of blurred edges of mycoplasma pneumonia images [8-9]. Intelligent BD image processing of Mycoplasma pneumonia is shown in Figure 1.

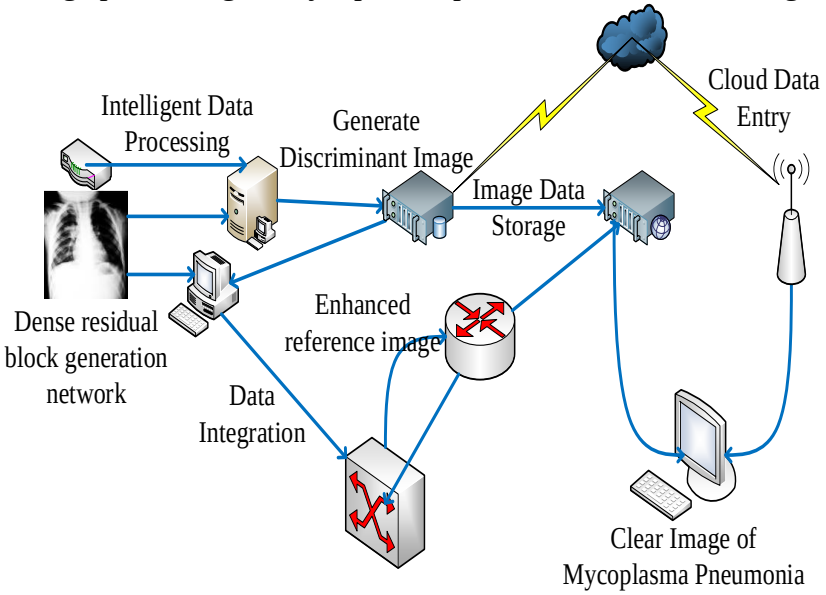


Figure 1. Intelligent BD mycoplasma pneumonia image processing

(2) Medical big data

The hospital information system is the most important system of modern hospitals and the basic system of modern hospital informatization. All medical activities at various stages will form corresponding data [8-9], which is mainly divided into two main data: outpatient data and hospitalization data. In addition, there are various auxiliary data under it, such as teaching and scientific research management, prevention, medical technology, pharmacy management, and many other data. Medical image storage and transmission data refers to images generated by daily ultrasound, various X-ray machines, nuclear magnetic resonance, electronic computed tomography, various infrared instruments, microscopes and other equipment that are stored in digital technology[10-11]. The maximum convenience of personnel allows them to see the results of the patient's inspection and analysis in the shortest time, thereby providing laboratory evidence for diagnosis and treatment activities [12].

2.2. Lung Detection and Recognition Algorithm Based on Snake Model

(1) Mathematical Morphological Filtering

The main content of mathematical morphology filtering is to design a set of changing concepts and methods to describe the topological structure of an object. It uses an element with a certain structure and characteristics to collect image information, by examining the relationship between various parts of the image and shape, so as to achieve the purpose of understanding the image. The structural element itself can be a set, which includes information such as shape, size, and gray to study the structural characteristics of the image [13-14]. Mathematical morphology consists of four basic algebraic operators: expansion, corrosion, opening operation(OOP), and closing operation(COP). Among them, the OOP and the COP are obtained through the compound operation of corrosion and expansion, and their respective mathematical definitions are as follows:

Let A and B be sets in integer space, where A is the original image and B is the structural element. Then,

1) Bloat

$$A \oplus B = \{z \mid (\hat{B})_z \cap A \neq X\} \tag{1}$$

$$f(m, w_k) = \sum_{n=1}^{N} x[n] w[n-m] e^{-jw_k n} \tag{2}$$

In the above formula, X is defined as the empty set, $\hat{B}$ is the reflection set of set B, and z is the set formed by the translation of B to the expansion of A. $w_k = 2\pi k / N, k = 0,1,\Lambda, N-1$ is the angular frequency, m is discrete and ω is continuous, and $w[n]$ represents the window function.

2) Corrosion calculation

$$A \Theta B = \{z \mid (B)_z \subseteq A\} \tag{3}$$

$$\Phi(w) = \left| \frac{1}{\sqrt{2\pi}} \sum_{n=-\infty}^{\infty} f_n e^{-jw_k n} \right| = \frac{F(w) F^*(w)}{2\pi} \tag{4}$$

The translation amount satisfies that the set B still belongs to A after being shifted by z, and the eroded image is somewhat smaller than the original image, and the eroded result is a subset of the original image. f_n is the signal sequence, $F(w)$ is the Fourier transform of signal f_n, and

$F^*(w)$ is the conjugate function of $F(w)$.

3) Open operation

$$A \circ B = (A \Theta B) \oplus B \tag{5}$$

$$p_1 = \sum_{i=0}^{t} \frac{n_i}{N}, p_2 = \sum_{i=t+1}^{t} \frac{n_i}{N}, p_1 + p_2 = 1 \tag{6}$$

The OOP is to first use structural element B to corrode image A, and then use B to expand the corrosion result.

4) Closed operation

$$A \bullet B = (A \oplus B) \Theta B \tag{7}$$

$$\mu_1 = \sum_{i=0}^{t} ip_i / p_1, \mu_2 = \sum_{i=t+1}^{L-1} ip_i / p_2 \tag{8}$$

According to the formula, the COP is opposite to the OOP. It first expands the original image, and then corrodes the expansion result. The area closure operation is used to process low-brightness areas whose area is smaller than a preset value. The area here refers to the connected area where the image gray is concentrated[15]. The area OOP can filter out small areas or delicate points with areas smaller than a preset value. The area OOP can also achieve a better smoothing effect, eliminate small noises, separate the targets at the slender connection, and do not significantly change the image area. This operation is a further development and improvement on the basis of the basic morphological OOP. The calculation process is shown in Equation 9.

$$\psi_{areaopen} = f \circ (a)_{B_C} = \overline{B \in \beta_{B_C,a}} f \circ B \tag{9}$$

In the formula, B_C is a structural element, and its connection mode can be 4-connection or 8-connection, and a is the set area value.

(2) Application of Morphological Filtering in Lung CT Image

Considering that the noise gray scale range in the original CT image is widely distributed and the position is relatively random, the original image is first binarized, and the gray value of the gray value is slightly larger than the gray value of the lung parenchyma as the threshold value. Then perform morphological OOP on the obtained binary image. Since the noise of the lung parenchyma is usually small white dots, the circular structure operator that is larger than the general noise point is usually considered when selecting the structure operator. Through the open operation operation, the noise points in the binary image can be effectively removed, and then the binary image of the original image and the denoised binary image are subjected to the difference operation to obtain the noisy binary image. This is also the idea of TopHat transformation.

TopHat is based on the basic shape opening and COPs. Through transformation, large changes in the gray value of the image can be detected. The calculation formula is as follows.

$$\psi_{TopHat}(f) = f + (f - (f \circ B_C)) - (f - (f \bullet B_C)) \tag{10}$$

(3) Active contour (Snake) algorithm

Let $f(s) = (m(s), n(s))$ be the contour, where $s \in [0,1]$ is the curve parameter, it achieves the purpose of locking the image contour by minimizing the following energy function:

$$E_{snake} = \int_0^s [E_x(f(s)) + E_y(f(s))]ds \quad (11)$$

$E_{ext}(v(s))$ in Equation 11 is the external energy, including two parts: the image gradient field energy E_{image} and the external binding force energy E_{con}:

$$E_{ext}(V(s)) = \gamma(s)E_{image}(V(S)) + E_{con}(V(s)) \quad (12)$$

The latter is generally 0. For image $I(x,y)$. The definition of E_{image} is:

$$E_{image} = -\left|\nabla(G_\sigma(x,y) * I(x,y))\right|^2 \quad (13)$$

Among them: $G_\sigma(x,y)$ is the two-dimensional Gaussian function of variance σ; ∇ is the gradient operator. Under discretization conditions, from Euler's equation, the final answer is equivalent to solving $av'(s) - \beta v''(s) - \nabla E_{ext} = 0$. then:

$$av'(s) - \beta v''(s) - \nabla E_{ext} = \frac{\partial v(s,t)}{\partial t} \quad (14)$$

When $\frac{\partial v(s,t)}{\partial t}$ tends to 0, the function energy has a minimum value, and the curve converges to the target position. In the image edge detection, the dynamic contour curve needs to be discretized. Assuming that the contour curve can be divided into n equal parts, and (v_1, v_2, Λ, v_n) is n points on the contour curve, the discrete form of the contour curve is as follows:

$$E_{snake} = \sum_{i=1}^{n} (E_{\text{int}}(v_i) + E_{ext}(v_i)) \quad (15)$$

3. Experimental Design of Medical Equipment Disinfection in Children with Mycoplasma Pneumoniae Pneumonia and Extrapulmonary Complications

3.1. Test Subject

The subjects of the study were 88 MPP patients who were hospitalized in a pediatric department of a hospital from March 2019 to February 2020. Among these cases, there were 39 cases with extrapulmonary complications and 49 cases without extrapulmonary complications.

Admission criteria: no mental or intellectual disability; full medical history, no defects; complete auxiliary examination; the child and his parents know and allow, and comply with the hospital ethics requirements, with the approval of the hospital ethics committee.

Exclusion criteria: past chronic lung disease or repeated respiratory infections; past history of cardiovascular system, nervous system, liver, kidney, skin, joints and other chronic diseases; combined with infections of other pathogens; history of mistaking drugs or other symptoms that may cause organ damage Knowing factors.

3.2. Experimental Method

According to the severity of MPP children, they were divided into: severe MPP group: those who

were clinically diagnosed with severe MPP; mild MPP group: those who were clinically in line with the diagnosis of MPP but had no clinical manifestations of severe MPP. According to the clinical manifestations of children with MPP, they were divided into: wheezing group: wheezing symptoms during the course of the disease; non-wheezing group: no wheezing symptoms during the course of the disease. Compare the differences in the duration of fever, duration of cough, length of hospitalization, laboratory indicators, chest imaging examinations, internal and external lung complications between the severe MPP group and the mild MPP group; observe the lung function status of children with acute MPP and compare Pulmonary function abnormality rate, degree of abnormality, and differences in various indicators between the severe MPP group and the mild MPP group, compare the differences in lung function indicators between the wheezing group and the non-wheezing group; observe the pulmonary function status of children with MPP during the recovery period, Compare the differences of the lung function indexes of children with MPP in the acute phase and in the recovery phase.

The laboratory tests involved in this study: the determination of Mycoplasma pneumoniae IgM was carried out semi-quantitatively by ELISA; the determination of CRP was carried out by immunochromatography.

3.3. Statistical Processing

Microsoft Excel and SPSS22.0 software were used to establish a database, count data was tested by χ^2, measurement data was tested by rank sum, and comprehensive analysis was performed by Logistic regression analysis. With a test level of $\alpha=0.05$, $p<0.05$ was statistically significant.

4. Experimental Medical Equipment Disinfection in Children with Mycoplasma Pneumoniae Pneumonia and Extrapulmonary Complications

4.1. Generally

Here we first analyze the basic conditions of the 88 children with MPP included in the criteria, and the results are shown in Table 1.

Table 1. The basic situation of children with Mycoplasma pneumoniae pneumonia

Group	Number of Cases		Years	Course of Disease
	Male	Female		
Total	46	42	8.26±1.42	9.79±3.23
Severe MPP	18	15	8.01±1.67	11.32±5.47
Mild MPP	28	27	8.37±1.78	6.97±2.29

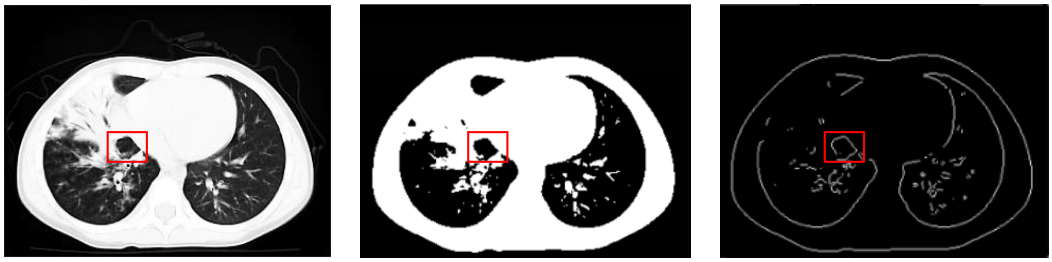
It can be seen from Table 1 that there are 33 children in the severe MPP group, with an average age of 8.01±1.67 years; 55 children in the mild MPP group, with an average age of 8.37±1.78 years, the gender and age of the two groups The difference in data comparison is not significant, not statistically significant (P>0.05), and it is comparable.

4.2. Clinical Manifestations of MPP

The clinical manifestations of 88 children with MPP included in the criteria are analyzed here. The results are shown in Table 2, and the typical ones are shown in Figure 2.

Table 2. Clinical manifestations of children in severe MPP group and mild MPP group

Group	Duration of Fever	Cough Duration	Course of Disease
Severe MPP	11.09±4.72	17.46±3.37	11.32±5.47
Mild MPP	8.59±3.79	13.89±3.97	6.97±2.29



Chest CT consolidation | Image segmentation result | Image edge detection result

Figure 2. Chest CT shows a large consolidation of the right lung

It can be seen from Table 2 that there were 33 cases in the severe MPP group, the average duration of fever was 11.09±4.72 days, the average duration of cough was 17.46±3.37 days, and the average hospital stay was 11.32±5.47 days; the mild MPP group had 55 For example, the average duration of fever was 8.59±3.79 days, the average duration of cough was 13.89±3.97 days, and the average length of stay was 6.97±2.29 days. It shows that the duration of fever, cough duration and hospital stay in the severe MPP group are higher than those in the mild MPP group (P<0.05), which is statistically significant.

4.3. Laboratory Indicators of MPP

The laboratory indicators of 88 children with MPP included in the criteria are analyzed here, and the results are shown in Figure 3.

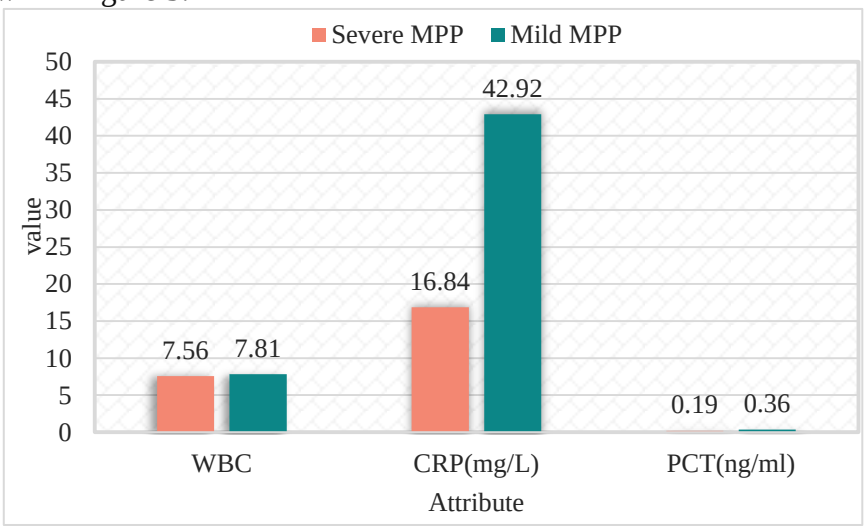


Figure 3. Laboratory indicators of children with severe MPP group and mild MPP group

It can be seen from Figure 3 that there were 33 cases in the severe MPP group. The average

white blood cell count (WBC) was (7.56±2.11)×109/L, and the average C-reactive protein (CRP) value was 42.92±41.73 mg/L. The procalcitonin (PCT) value was 0.36±0.93ng/ml; there were 55 cases in the mild MPP group, the average WBC was (7.81±1.97)×109/L, the average CRP value was 16.84±19.19mg/L, the average the PCT value was 0.19±0.33ng/ml; and the changes in the values of the two groups of children in the severe MPP group and the mild MPP group were compared.

4.4. Chest Imaging of MPP

(1) Type of lesion

Here we analyze the lesion types of the 88 children with MPP included in the criteria, and the results are shown in Figure 4.

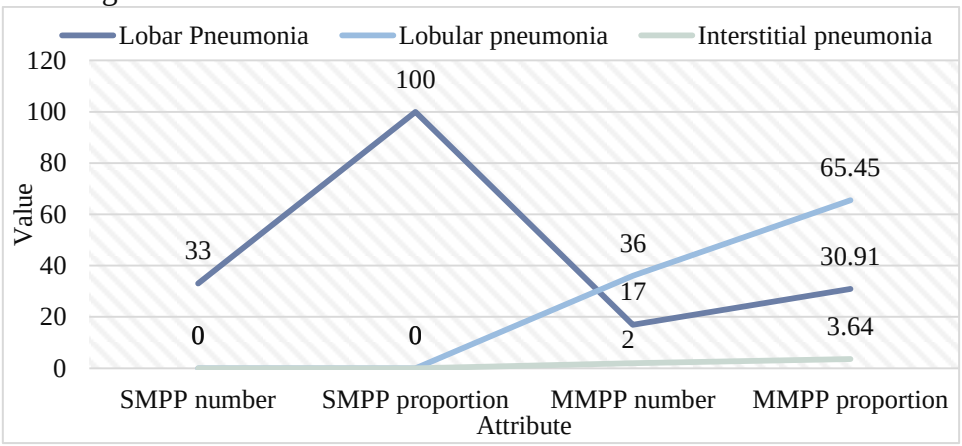


Figure 4. The composition ratio of chest imaging lesions in children with severe MPP group and mild MPP group

It can be seen from Figure 4 that the types of chest imaging lesions of the child are: lobar pneumonia, lobular pneumonia, and interstitial pneumonia. The results showed that the 88 cases of MPP children were mainly lobar pneumonia, accounting for 56.82%, followed by lobular pneumonia, accounting for 40.91%, and lobar pneumonia was the most in the severe MPP group.

(2) Involved area

Here we analyze the involved sites of 88 children with MPP included in the criteria, and the results are shown in Figure 5.

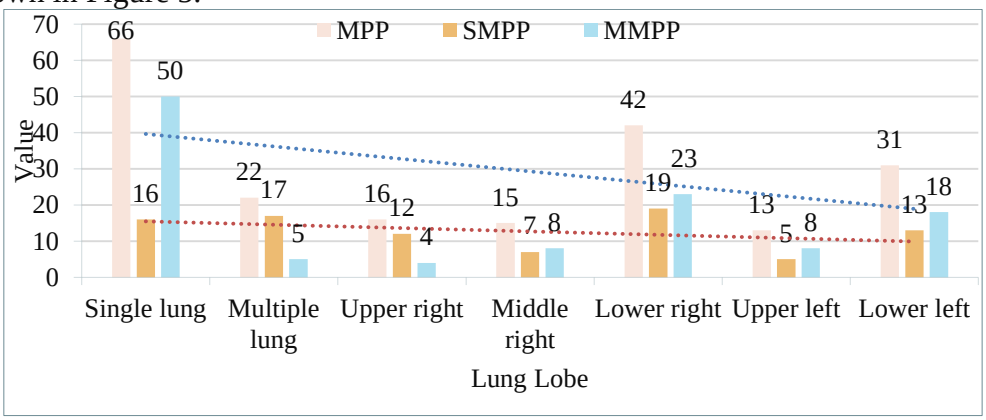


Figure 5. The composition ratio of chest imaging involvement of children

It can be seen from Figure 5 that the location of chest imaging lesions in children with MPP: 66 cases (75.0%) involving single lobes in acute phase lesions, 22 cases (25.0%) involving multiple lobes. There were 16 cases (18.2%) involving the right upper lobe of children with MPP, 15 cases (17.0%) involving the right middle lobe, 42 cases (47.7%) of the right lower lobe, and 13 cases of the left upper lobe (14.8%), 31 cases (35.2%) in the lower lobe of the left lung.

4.5. Intrapulmonary Complications of MPP

Here we analyze the pulmonary complications of 88 children with MPP included in the criteria, and the results are shown in Figure 6.

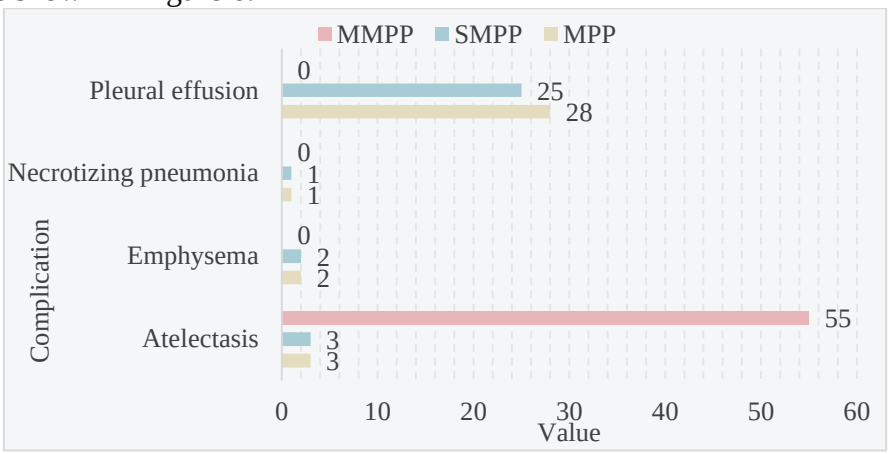


Figure 6. The composition ratio of pulmonary complications in children

As can be seen from Figure 6, there are 3 cases of atelectasis (9.09%) in the severe MPP group, 2 cases (6.06%) of emphysema, 1 case (3.03%) of necrotizing pneumonia, and 25 cases of pleural effusion (75.76%); there were 3 cases of pleural effusion in the mild MPP group (5.45%). In the acute phase of MPP, pleural effusion was the most common pulmonary complication, accounting for 31.82%.

4.6. Extrapulmonary Complications of MPP

Here we analyze the extrapulmonary complications of 88 children with MPP included in the criteria, and the results are shown in Figure 7.

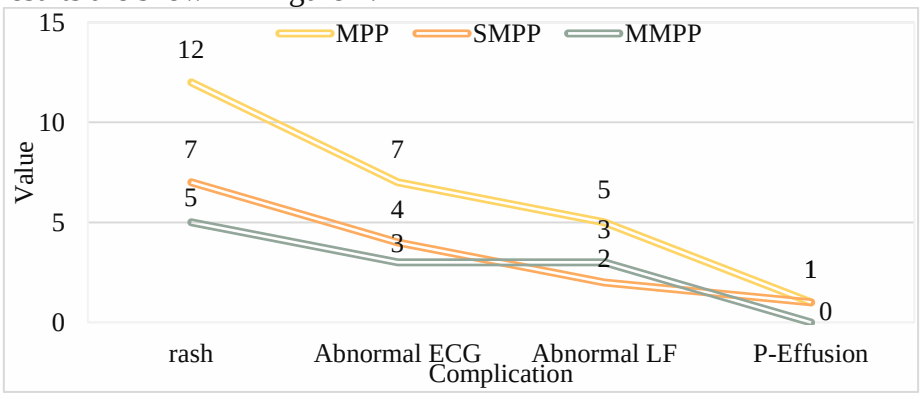


Figure 7. The composition ratio of extrapulmonary complications in children

It can be seen from Figure 7 that in the severe group, there were 7 cases (21.2%) of skin rash, 4 cases of abnormal electrocardiogram (12.1%), 2 cases of abnormal liver function (6.06%), and 1 case of pericardial effusion (3.03%); In the group, there were 5 cases (9.10%) of skin rash, 3 cases of abnormal electrocardiogram (5.45%), and 3 cases of abnormal liver function (5.45%). The results showed that the most common extrapulmonary complications in the acute phase of 88 children with MPP were skin rash, accounting for 13.63 %, abnormal electrocardiogram, abnormal liver function followed. The extrapulmonary complications in the severe MPP group included skin rash, abnormal electrocardiogram, abnormal liver function, and pericardial effusion. Among them, rash was more common, accounting for 21.2%.

4.7. Multivariate Logistic Regression Analysis

Select statistically significant indicators as independent variables, and whether they are accompanied by extrapulmonary manifestations as dependent variables. The results are shown in Table 3.

Table 3. Multivariate Logistic Regression Analysis

variable	Regression Coefficients	Standard Error	Waldχ^2 Value	P	OR(95%CI)
CRP	0.086	0.018	23.92	<0.001	1.086(1.051-1.123)
Chest Image	1.179	0.493	8.329	<0.001	3.311(1.468-7.470)
Drug Application Time	0.564	0.109	28.34	<0.001	1.726(1.412-2.110)
Constant	-4.138	0.654	45.115	<0.001	-

It can be seen from Table 3 that the time from the onset to the application of macrolides is long (OR=1.726, 95%CI: 1.412-2.110), CRP is high (OR=1.086, 95%CI: 1.051-1.123) and Imaging examinations revealed that large lung shadows (OR=3.311, 95%CI: 1.468-7.470) were independent risk factors for extrapulmonary manifestations in children with MPP (all $p<0.05$).

5. Conclusion

It is more common in school-aged children. If it is not diagnosed and treated in time, it will cause the epidemic of the disease, thereby posing a great threat to children's health. This article adopts the method of retrospective analysis to statistically analyze and compare its clinical manifestations, laboratory indicators, chest imaging examination results, and complications, especially the small airway function indicators. In the acute phase of MPP, compared with mild MPP, the duration of fever and cough in children with severe MPP are significantly longer, serum CRP, PCT and other infection indicators are significantly increased, and their hospitalization time is also significantly increased; chest imaging is more involved there are multiple lung lobes, mainly lobar pneumonia, the right lower lobe is the main affected site; pleural effusion is the main intrapulmonary complication, and skin rash is the main extrapulmonary complication. In the acute phase of MPP, regardless of severe MPP or mild MPP, about 4/5 of children with acute MPP have abnormal pulmonary ventilation function of varying degrees, mainly mixed ventilation dysfunction, and the severity of severe MPP is the most serious. Explain the application of bronchodilators in the acute phase of MPP. This study also has shortcomings. Because it is a retrospective study and the

sample size is small, the results of the study may be biased. Therefore, a multi-center, large sample, and long-term follow-up study should be carried out in future work to further explore the research. The impact of MP infection on small airway function lays a good foundation and provides a theoretical basis for the clinical diagnosis and treatment of MPP.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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