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Changes in CAP Treatment Methods: A Comprehensive Framework for Reducing the Incidence of Adult Community-Acquired Pneumonia

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Abstract. Community-acquired pneumonia is still a very serious public health problem in China, especially for the elderly and people with chronic diseases. This review synthesizes the current epidemiological data, the causes of the disease, the progress of diagnosis, and the development of treatment. The goal is to come up with a comprehensive treatment plan based on evidence. Over the past two decades, the treatment of pneumonia has evolved significantly. Originally, it was treated with a fixed plan, but now it has become more flexible and pays more attention to the patient's own situation. There are several key changes. First, do diagnostic examinations according to the size of the risk. Second, use biomarkers to observe changes in the condition, instead of relying on them to decide when to start treatment. Third, adjust how long antibiotics should be used according to the patient's current condition. Fourth, it is necessary to deal with typical and atypical pathogens at the same time. Fifth, critically ill patients should reasonably use corticosteroids, pneumococcal vaccine, and influenza vaccine. At present, it is still an important way to prevent pneumonia. By combining the above practises, this framework can point out a direction for clinical work and health policy, so as to reduce the number of people infected with the disease and improve the treatment effect of patients.

Keywords: community-acquired pneumonia, antibiotic stewardship, clinical stability, atypical pathogens, vaccination

1. Introduction

Community-acquired pneumonia is an acute lung infection outside the hospital, which is located in the parenchymal part of the lung. If the patient has symptoms within 48 hours after hospitalisation, it can be considered to be infected with a pathogen. In China, because the population is getting older and there are more things in the environment, the health burden caused by community-acquired pneumonia is heavy. Of urban adults, 7.13 to 13 people per 1,000 people get this disease every year, and when they are over 65 years old, this number soars to 15.5 to 22 per thousand people [1].

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Elderly patients, as well as those with diabetes, chronic obstructive pulmonary disease, or cardiovascular disease, have a high mortality rate, so community-acquired pneumonia is a major cause of death from infectious diseases among Chinese adults. Unlike many other respiratory diseases, community-acquired pneumonia especially hurts the alveoli and causes inflammation. This disease has the highest incidence in winter and spring, especially in northern China. This shows that we need a set of standardised and flexible medical treatment methods.

The disease is mainly caused in the elderly and those with chronic diseases. Seasonal respiratory virus outbreaks will also increase the number of patients with acquired pneumonia in the community and make the medical system more tight. In the past two decades, the treatment of community-acquired pneumonia has changed a lot. In the past, antibiotics were mainly based on experience and fixed according to the scheme, but now more and more evidence says that more personalised treatments are more effective. With the improvement of diagnostic technology, people know more about the characteristics of pathogens and have a deeper understanding of antibiotic resistance, which is promoting the current change in treatment methods. Therefore, it is helpful to sort out the recent progress to see the current trend and set the research focus in the future.

This review systematically focuses on the changes in community-acquired pneumonia in China's adult community in the past 20 years, including epidemiology, pathophysiology, diagnosis, treatment, and prevention. The study found that China has slowly shifted from the "one-size-fits-all" treatment path in the past to a patient-centred, precise layered treatment model. Because China's population is ageing rapidly, and the incidence and death of people over 65 years old and patients with complications are high, it is very important to establish a standardised approach to identify and manage high-risk people, which is very important to reduce the public health burden. In terms of treatment, the biggest change is from a fixed antibiotic course to a short-term plan according to the stability of the patient's condition. For cases of simultaneous infection of typical and atypical pathogens, the latest (released in 2025) guidelines recommend the treatment of beta-lactams and macrolides, which can cover more types of pathogens. In addition, the CAPE-COD trial shows that early use of hydrocortisone can significantly reduce the mortality rate of critically ill ICU patients and the number of people who need ventilators. In addition, new vaccines such as the 21-valent pneumococcal conjugate vaccine (PCV21) have been developed and popularised, so that the prevention and control of pneumonia has reached a level that has not been seen before. In the future, a comprehensive framework that can bring together active prevention, accurate diagnosis, personalised treatment and doctor-patient cooperation will be crucial, which can suppress the development of pneumonia and help Chinese patients recover effectively.

2. Pathogenic and disease mechanisms

The incidence of community-acquired pneumonia is the result of the complex interaction between incoming microorganisms and the body's lower respiratory tract Defence system. Pathogens include bacteria, viruses, and atypical microorganisms, which enter the body by inhaling bacterial droplets or inhaling pharyngeal secretions. Among Chinese adults, Streptococcus pneumoniae is also the main bacterial pathogen, accounting for a large part of the cases [2]. Mycoplasma pneumoniae is especially common among young urban people and school-age children. Even after a comprehensive examination, only about 38% of inpatients can find specific pathogens [3]; sometimes, the virus is the cause of the disease, accounting for nearly 40% of the cases [4].

After the pathogen reaches the alveoli, it can break through the first line of defence, such as muciliary cleaning and the cough reflex, and then cause a severe inflammatory reaction. The alveoli will be filled with exudate, that is, liquid, white blood cells, and cell fragments mixed together,

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which is called consolidation. These accumulated fluids will block gas exchange, making people have difficulty breathing and hypoxia. From a whole-body perspective, infection will also cause the body to release pro-inflammatory cytokines. If this reaction cannot be controlled, it may eventually develop into sepsis or multiple organ failure.

3. Clinical diagnosis

In clinical practice in China, the diagnosis of CAP usually relies on the patient's medical history, physical examination, and imaging examination. When at least two of the following symptoms appear, the doctor may suspect that the patient has pneumonia: body temperature is higher than 38°C or lower than 36°C, and the white blood cell count is more than 10,000/μL or less than 4,000/μL [5]. Common symptoms include emerging or worsening coughs, purulent sputum, and dyspnoea. During chest auscultation, you may hear rhonchi or bronchial breathing sounds.

Diagnosis requires chest X-ray or computed tomography to observe new invasive shadows or changes in air density. In China, CT is more often used for examination than in many Western countries because of the higher sensitivity of CT in the early diagnosis of lung changes. However, in mild cases, it is still necessary to consider the risk of radiation. Laboratory detection indicators such as C-reactive protein and calcitonin can help assess the severity of inflammation. For patients with severe disease, sputum culture, blood culture, and nucleic acid amplification testing will be carried out to determine the type of pathogen and distinguish the infection caused by bacteria, viruses, or fungi.

4. Treatment strategies

A stratified and step-by-step diagnosis method according to the size of the risk has replaced the old method of no goal and checking everything. Although routine blood sampling can also help to see how serious the disease is, the use of inflammatory markers in diagnosis has been changed. Because these markers can't tell whether they are bacteria or viruses, it is not recommended to routinely check C-reactive protein or calcitonin. It was originally decided whether to use antibiotics. However, for those patients who do not recover effectively after treatment, regular examination can still provide useful clues for drug adjustment. It is worth mentioning that in 2024, a randomised trial found that using biomarkers to guide medication can safely reduce antibiotics from seven days to four days, and the short-term treatment effect has not deteriorated [6].

Everyone thinks that blood culture and sputum tests should be done for people with serious illness, those who are going to be hospitalised, or patients who have no reaction after taking the medicine. These tests can find out what kind of germ it is, so that it can be changed from broad-spectrum drugs to more targeted drugs. For outpatient mild patients, there is generally no need for aetiological examination.

The biggest change in treatment is how long antibiotics are used. The old model of a fixed course of treatment has now been changed to a more flexible way to determine the stability of the patient. The key is to see whether the patient has reached "clinical stability", that is, the body temperature is stable, the heartbeat, blood pressure, and breathing have returned to normal, and he can eat normally. Many studies have confirmed that short courses are as effective as long courses. Therefore, the latest guidelines suggest that the course of treatment should be set according to the individual situation: if the patient is stable on the fifth day, five days of medicine is enough; for patients who have no other complications, seven days is also acceptable; if there are complications, such as lung abscess, it will

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take a longer time. This has changed from "eating a fixed course" to "restore the patient to a stable state as soon as possible".

Community-acquired pneumonia is mainly caused by two types of bacteria. A class of bacteria is called "typical" bacteria, such as Streptococcus pneumoniae. This kind of bacteria has a cell wall, so it can be killed with beta-lactam antibiotics (such as penicillin and cephalosporin). The other category is "atypical" microorganisms, such as Mycoplasma pneumoniae, Chlamydia pneumoniae, and Legionella pneumoniae. They either have no cell wall or live in cells, so β-lactams are useless for them. Macrolides, tetracyclines, or fluoroquinolones must be used. However, because Mycoplasma pneumoniae in China has a high resistance rate to macrolides, it may be more appropriate to use doxycycline or fluoroquinolones in some places, especially when seeing outpatients.

Atypical pathogens are the culprits of the disease in many cases, especially among young people. Legionella is one of the main causes of severe community-acquired pneumonia. Mixed infections are common among the elderly and patients with multiple diseases [7]. It is impossible to distinguish what kind of pathogen it is by clinical manifestations alone. Therefore, the latest guidelines suggest that inpatients should be treated with beta-lactams (such as cephalosporins) and macrolides, so that both typical and atypical bacteria can be covered. Outpatients can also use macrolides, but they must carefully look at the local drug resistance before making a decision.

The role of corticosteroids is now clearer. The previous guidelines did not recommend conventional use of corticosteroids. However, the CAPE-COD trial published in 2023 showed that early use of hydrocortisone (such as 200 mg per day for 7 days) can significantly reduce the mortality rate of critically ill ICU patients and the proportion of ventilators [8]. Therefore, for ICU patients with a very serious condition, a gradually reduced number of corticosteroids can be considered, but it cannot be used for those who need immunosuppressive treatment or have the flu. For mild community-acquired pneumonia, there is no benefit to using steroids, so it is not recommended in this case.

5. Prevention

Prevention now plays an important role in the management of community-acquired pneumonia. Streptococcus pneumoniae is also the main germ for adults to get this disease. There is a lot of evidence that the pneumococcal vaccine can reduce hospitalisation and reduce the total mortality rate, especially for the elderly (over 75 years old) and people with chronic diseases (such as diabetes, heart disease, chronic obstructive pulmonary disease). The newly released pneumococcal conjugate vaccine, especially the 21-valent one, covers more serotypes than the 13-valent and 20-valent ones, which can provide adequate protection for the elderly at high risk. Because bacterial pneumonia is often secondary to bacterial pneumonia after getting the flu, it is also important to get the flu vaccine every year.

Non-drug methods are equally important. Quitting smoking, taking care of chronic diseases, washing hands, and wearing masks during the flu season can help reduce risks. Environmental factors should also be paid attention to, especially the heavy air pollution in winter in northern China, which will affect the incidence of respiratory infections. Therefore, using public health methods to reduce the concentration of particulate matter in the environment can be an important part of personal prevention.

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6. Conclusion

The management of adult community-acquired pneumonia has developed into a complete and interlocking framework that includes diagnosis, treatment, and prevention. Nowadays, diagnosis is based on risk, and not everyone uses the same standard; how long the drug is used depends on the flexible adjustment of the patient's condition; the antibiotics used should not only control common bacteria but also treat atypical pathogens, and also depend on the local drug resistance; in critically ill patients, the role of corticosteroids is also increasingly valued. Vaccination is still the key way to prevent it. In the past two decades, the shift from strict standards to patient-centred strategies has not only improved the current level of treatment, but also laid the foundation for a future evidence-based and flexibly adjustable management framework [9]. All these practises have a common goal, which is to help patients fully recover while greatly reducing the incidence. In the future, research should focus on how effective short-term treatment is in practice. We should keep an eye on the changes in antibacterial resistance, and then analyse whether the new type of combination vaccine is cost-effective in Chinese people, so as to continuously improve the framework and make it more suitable for local actual needs.

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