Infection and Drug Resistance

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Clinical Features of 186 Cases of *Chlamydia psittaci* Pneumonia: A Multicenter Study

Changquan Fang[1,*], Yushan Zhang[2,*], Anbing Zhang[3,*], Junhong Lin[1,*], Jialiu Zou[4,*], Yuejiao Lin[5,*], Zhuxiang Zhao[6,7,*], Ziwen Zhao[6,7], Limin Xu[8]

[1]Department of Pulmonary and Critical Care Medicine, Huizhou Central People's Hospital, Huizhou, Guangdong, People's Republic of China; [2]Department of Pulmonary and Critical Care Chronic Disease Medicine, Hunan University of Medicine General Hospital, Huaihua, Hunan, People's Republic of China; [3]Department of Pulmonary and Critical Care Medicine, Zhongshan People's Hospital, Zhongshan, Guangdong, People's Republic of China; [4]Department of Pulmonary and Critical Care Medicine, Dongkeng Hospital of Dongguan, Dongguan, Guangdong, People's Republic of China; [5]Department of Pulmonary and Critical Care Medicine, Shaoguan First People's Hospital, Shaoguan, Guangdong, People's Republic of China; [6]Department of Pulmonary and Critical Care Medicine, Guangzhou First People's Hospital, South China University of Technology, Guangzhou, Guangdong, People's Republic of China; [7]Department of Pulmonary and Critical Care Medicine, Guangzhou First People's Hospital, Guangzhou Medical University, Guangzhou, Guangdong, People's Republic of China; [8]Department of Geriatrics, Huizhou First Hospital, Huizhou, Guangdong, People's Republic of China

*These authors contributed equally to this work

Correspondence: Ziwen Zhao, Department of Pulmonary and Critical Care Medicine, Guangzhou First People's Hospital, South China University of Technology, No. 1 Panfu Road, Yuexiu District, Guangzhou, Guangdong, 510180, People's Republic of China, Tel + 86 130-0687-2260, Email eyzhaoziwen@scut.edu.cn; Limin Xu, Department of Geriatrics, Huizhou First Hospital, No. 20 Sanxin South Road, Huicheng District, Huizhou, Guangdong, 516000, People's Republic of China, Tel + 86 136-3199-9563, Email 837899883@qq.com

Purpose: *Chlamydia psittaci* pneumonia is an uncommon type of pneumonia characterized by non-specific clinical manifestations. Current knowledge regarding its clinical features is insufficient. Therefore, we aimed to elucidate its epidemiological profile, clinical characteristics, and distinctions between severe and non-severe cases.

Patients and Methods: Clinical data of 186 patients diagnosed with *C. psittaci* pneumonia using next-generation sequencing (NGS) were systematically collected from seven hospitals in Guangdong Province, China, between January 2019 and June 2025. Epidemiological characteristics, clinical presentations, laboratory results, chest computed tomography (CT) features, bronchoscopy findings, and treatment outcomes were analyzed, with comparisons by disease severity.

Results: Of 186 patients (58.1% male, 50–74 years), 43.5% presented with severe disease, and 67.2% developed complications. Most cases occurred during autumn or winter (67.2%), and a history of bird or poultry exposure was reported in 68.3%. Prevalent clinical symptoms included fatigue (98.9%), high fever (90.3%), and headache (73.7%). Laboratory findings showed elevated serum levels of C-reactive protein, procalcitonin, fibrinogen, and D-dimer in most patients (over 90%). Additionally, over 70% had increased neutrophilia, alanine transaminase, aspartate transaminase, and lactate dehydrogenase levels, with reduced lymphocyte counts. Chest CT findings frequently revealed pulmonary consolidation (100%), ground-glass opacities (97.8%), and air bronchograms (81.2%). Severe cases showed extensive bilateral and multilobar consolidation, with increased prevalence of pleural and pericardial effusions. The median time from admission to diagnosis was 3 (2–4) days, with 96.2% of patients improving following targeted antimicrobial therapy and being discharged, while 3.2% died.

Conclusion: *C. psittaci* pneumonia is characterized by a high incidence of severe cases and both intrapulmonary and extrapulmonary complications. Its clinical manifestations are diverse and multifaceted, with hallmark features including high fever, relative bradycardia, normal white blood cell counts, elevated transaminases, and pulmonary consolidation. Early diagnosis through NGS and targeted antimicrobial therapy are associated with positive patient outcomes.

Keywords: psittacosis, community-acquired pneumonia, next-generation sequencing, zoonosis

Introduction

Chlamydia psittaci belongs to the genus Chlamydia and is an obligate intracellular bacterium characterized by a unique biphasic life cycle (elementary body, reticulate body).[1,2] *C. psittaci* is an uncommon atypical pathogen responsible for

https://doi.org/10.2147/IDR.S563892
Received: 18 September 2025
Accepted: 30 December 2025
Published: 9 January 2026

community-acquired pneumonia (CAP), with a prevalence of 1.03% in all CAP cases[1] and approximately 8% in severe CAP cases.[2] Typical clinical features include high fever, chills, headache, and dyspnea. However, its high pathogenicity often results in multisystem involvement beyond pulmonary infection, leading to complex and non-specific clinical presentations.[3] Routine pathogen testing for CAP does not typically include *C. psittaci*, increasing the risk of misdiagnosis or delayed treatment. Research suggests that untreated severe cases are associated with a mortality rate of 15–20%.[4]

Current diagnostic approaches for *C. psittaci* infection include pathogen isolation, which is technically challenging and time-intensive; serological testing, which is not suitable for early diagnosis; and polymerase chain reaction (PCR), which provides high sensitivity and specificity but is generally performed only when clinicians specifically suspect *C. psittaci* infection. Next-generation sequencing (NGS)—metagenomic (mNGS) and targeted (tNGS)—are advanced diagnostic tools that do not depend on traditional microbial culture. These methods enable direct high-throughput sequencing of nucleic acids from clinical specimens, such as bronchoalveolar lavage fluid, blood, sputum, or cerebrospinal fluid, establishing them as the most effective techniques for diagnosing difficult to culture or special pathogens such as *Chlamydia psittaci* or Coxiella pertussis infection.[5–7]

The increasing clinical application of NGS has led to a rise in diagnosed cases of *C. psittaci* pneumonia. Although several studies have been conducted to investigate its clinical characteristics,[8–10] limitations such as small sample size or incomplete disease understanding have restricted the depth of these analyses. Therefore, the present multicenter study was conducted examining clinical data of 186 patients with *C. psittaci* pneumonia to further explore its clinical characteristics and provide valuable guidance for clinical management.

Methods

Study Design and Subjects

Clinical data of 186 patients diagnosed with *C. psittaci* pneumonia were systematically collected from seven hospitals (Huizhou Central People's Hospital, Huizhou First Hospital, Zhongshan People's Hospital, People's Hospital of Boluo county, Dongkeng Hospital of Dongguan, Shaoguan First People's Hospital, and Guangzhou First People's Hospital) in Guangdong Province, China, between January 2019 and June 2025. Inclusion criteria were 1) clinical and chest imaging findings consistent with the diagnostic criteria for CAP;[11] 2) identification of *C. psittaci* nucleic acid sequences in bronchoalveolar lavage fluid or blood samples through mNGS or tNGS; 3) negative results from conventional microbiological tests, including blood, sputum, and bronchoalveolar lavage fluid smears and cultures. Exclusion criteria were 1) age <18 years; 2) pregnancy; 3) incomplete clinical data. The diagnostic criteria for severe CAP were as follows: respiratory failure requiring mechanical ventilation and septic shock requiring vasoactive drugs (major criteria), and respiratory rate ≥30 times/minute, oxygenation index ≤250, multilobar infiltrates, consciousness disorders, blood urea nitrogen ≥20mg/dL, decreased white blood cells, thrombocytopenia, low body temperature (<36°C), and hypotension that requires rapid fluid replacement for correction (minor criteria). If one of the major criteria or at least three minor criteria are met, severe pneumonia is diagnosed.[11]

Next-Generation Sequencing

Per clinical guidelines, 5–10 mL of clinical specimens (bronchoalveolar lavage fluid or venous blood) were obtained. These samples were submitted to Guangzhou DaAn Gene Co., Ltd., Guangzhou Weiyuan Gene Technology Co., Ltd., BGI Shenzhen, or Seegene Biotechnology Co., Ltd. for mNGS. Standardized protocols were followed for nucleic acid extraction and purification, library preparation, high-throughput sequencing, and bioinformatics analysis to produce pathogen detection reports. Bronchoalveolar lavage fluid samples were also sent to Guangzhou DaAn Gene Co., Ltd., Guangzhou KingMed Diagnostics, or Guangzhou Huayin Medical Laboratory Center for tNGS, adhering to standardized procedures for nucleic acid extraction, multiplex PCR, library preparation, sequencing, bioinformatics analysis, and report generation.

Data Collection

A clinical case report form was developed to document patients' demographic and clinical data, including age, sex, epidemiological history, duration of hospitalization, and comorbidities, as well as clinical manifestations and signs following disease onset, laboratory findings, chest computed tomography (CT) results, bronchoscopy findings, and treatment outcomes. CURB-65 (Confusion, Urea >7 mmol/L, Respiratory rate ≥30, Blood pressure low, Age ≥65), Pneumonia Severity Index (PSI), and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores were calculated upon admission. Of 186 patients, clinical data of 102 were collected prospectively, while data of 84 were gathered retrospectively.

Statistical Analysis

Statistical analyses were performed using SPSS 25.0 software (IBM Corp., Armonk, NY, USA), with a p-value <0.05 considered statistically significant. Normally distributed continuous variables were expressed as mean ± standard deviation (x ± s), and group differences were assessed using the *t*-test. Non-normally distributed variables were reported as median (interquartile range) [M (P25–P75)], with differences analyzed using the Mann–Whitney *U*-test. Categorical variables were presented as counts (percentages) and evaluated using the chi-square test.

Results

Patient Demographic Data

All 186 patients included in this study were diagnosed using NGS (81 severe, 105 non-severe), and bronchoalveolar lavage fluid (95.2%, n=177) and whole blood (4.8%, n=9) samples were obtained. The cohort comprised mostly males (58.1%, n=108) of an average age of 58.3 ± 11.8 years, with no significant difference in sex or age between severe and non-severe cases. A history of exposure to birds or poultry was reported by 127 (68.3%) patients. Comorbidities were present in 92 (49.5%) patients, including hypertension (46 cases), diabetes (32 cases), chronic liver disease (15 cases), and coronary artery disease (12 cases). The median duration from symptom onset to hospitalization was 5 (3–7) days, and that from admission to confirmed diagnosis was 3 (2–4) days (Table 1).

As illustrated in Figure 1, *C. psittaci* pneumonia affected individuals across all age groups, with a predominance in middle-aged and elderly populations aged 50–74 years (75.3%). No significant difference in age distribution was noted between severe and non-severe cases. As shown in Figure 2, cases were reported year-round but demonstrated marked

Table 1 Demographic Data of Patients with *C. psittaci* Pneumonia

Characteristics	Disease Severity		Total	*p* value
	Severe	Non-Severe		
N	81	105	186	–
Age, years, mean (SD)	59.1±11.8	57.6±11.9	58.3±11.8	0.380
Males, n (%)	52 (64.2)	56 (53.3)	108 (58.1)	0.137
History of contact with avian, n (%)	13 (16.0)	22 (21.0)	35 (18.8)	0.396
History of contact with poultry, n (%)	45 (55.6)	47 (44.8)	92 (49.7)	0.144
Smoking history, n (%)	36 (44.4)	30 (28.6)	66 (35.5)	0.025
Drinking history, n (%)	26 (32.1)	12 (11.4)	38 (20.4)	0.001
Duration from symptom onset to admission, days, Median (IQR)	5 (3–7)	5 (3–7)	5 (3–7)	0.585
Time from admission to confirmed diagnosis, days, median (IQR)	3 (2–5)	3 (2–4)	3 (2–4)	0.970
CURB-65, median (IQR)	2 (1–3)	0 (0–1)	1 (0–2)	0.000
PSI, median (IQR)	121 (110–140)	67 (51–83)	87 (65–118)	0.000
APACHE II, median (IQR)	17 (15–19)	7 (5–8)	10 (6–16)	0.000
BALF for mNGS, n (%)	45 (55.6)	30 (28.6)	75 (40.3)	0.000
Blood samples for mNGS, n (%)	8 (9.9)	1 (0.9)	9 (4.8)	0.011
BALF for tNGS, n (%)	28 (34.6)	74 (70.5)	102 (54.8)	0.000

(*Continued*)

Table 1 (Continued).

Characteristics	Disease Severity		Total	*p* value
	Severe	Non-Severe		
Comorbidities, n (%)	46 (56.8)	46 (43.8)	92 (49.5)	0.079
Hypertension	23 (28.4)	23 (21.9)	46 (24.7)	0.309
Diabetes	18 (22.2)	14 (13.3)	32 (17.2)	0.111
Chronic liver disease	6 (7.4)	9 (8.6)	15 (8.1)	0.773
Coronary artery disease	9 (11.1)	3 (2.9)	12 (6.5)	0.033
Cerebrovascular disease	3 (3.7)	5 (4.8)	8 (4.3)	1.0
Chronic pulmonary disease	1 (1.2)	3 (2.9)	4 (2.2)	0.634
Chronic kidney disease	2 (2.5)	1 (0.9)	3 (1.6)	0.581
Solid malignant tumor	2 (2.5)	1 (0.9)	3 (1.6)	0.581
Hematologic disorders	1 (1.2)	3 (2.9)	4 (2.2)	0.634

Abbreviations: CURB-65, British Thoracic Society's modified pneumonia score; PSI, pneumonia severity index; APACHE II, acute physiology and chronic health evaluation; BALF, bronchoalveolar lavage fluid.

seasonality, with the highest incidence in winter (December, January, and February), followed by autumn (September, October, and November). Summer had the lowest incidence, with 125 (67.2%) cases occurring in autumn or winter. No statistically significant difference in age distribution.

Clinical Symptoms

As depicted in Figure 3, the most prevalent symptoms following disease onset were fatigue (98.9%) and fever (97.8%), with 90.3% of patients experiencing high fever (Body temperature exceeding 39.0°C). Additional clinical features included wet rales (79.6%), headache (73.7%), relative bradycardia[12] (71.5%), dry cough (66.1%), myalgia (64.5%),

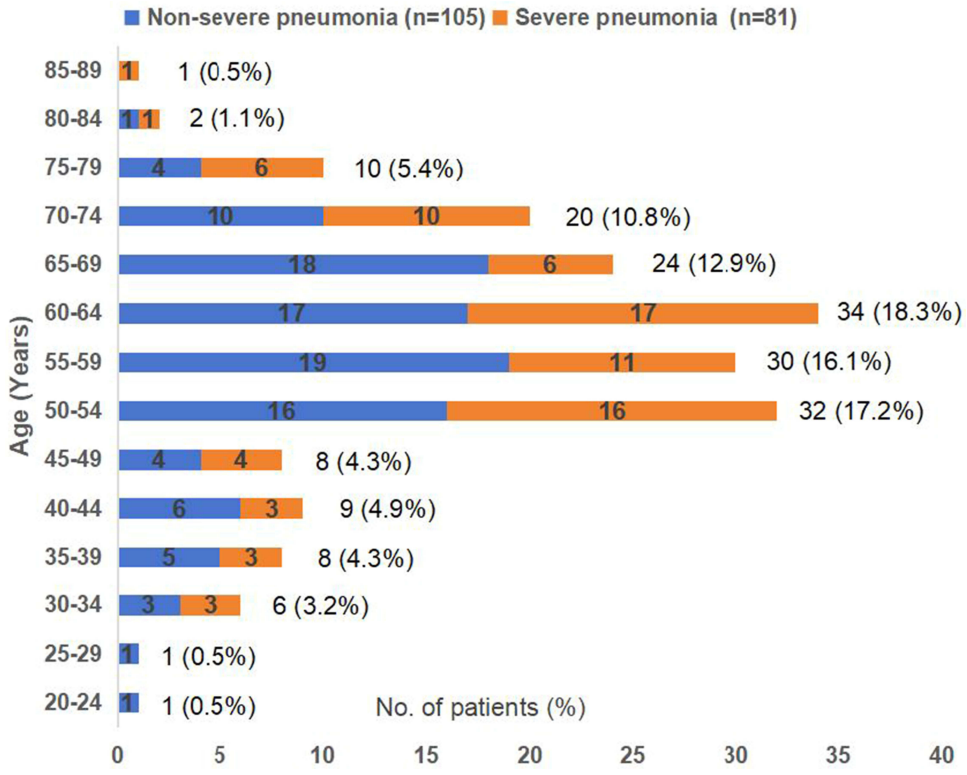

Figure 1 Age distribution of patients with *C. psittaci* pneumonia.

https://doi.org/10.2147/IDR.S563892

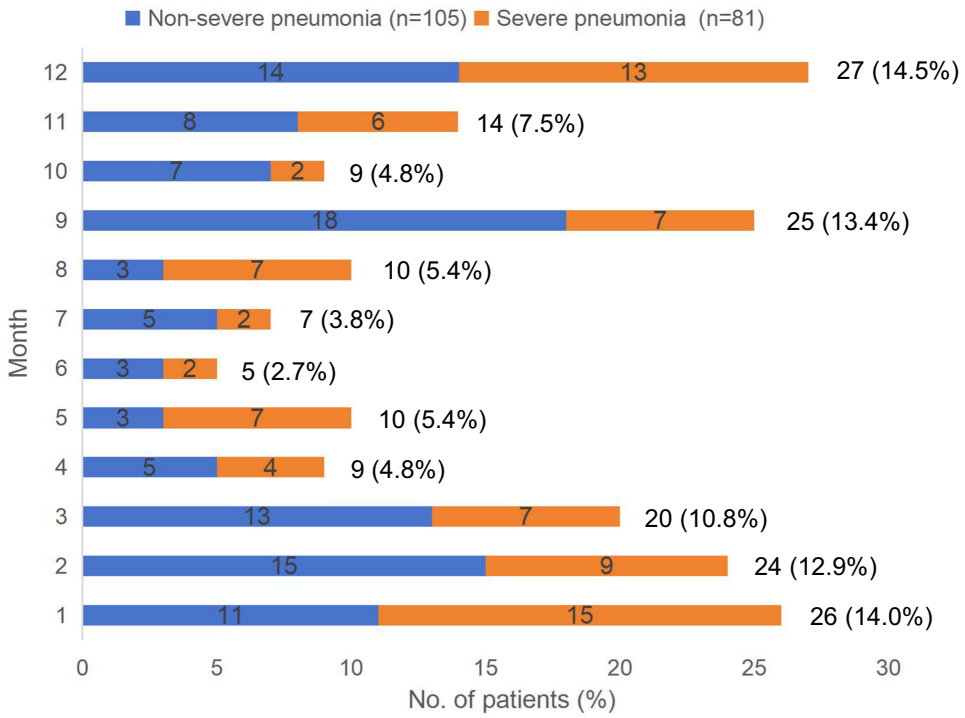

Figure 2 Cumulative hospital admissions of *C. psittaci* pneumonia per month.

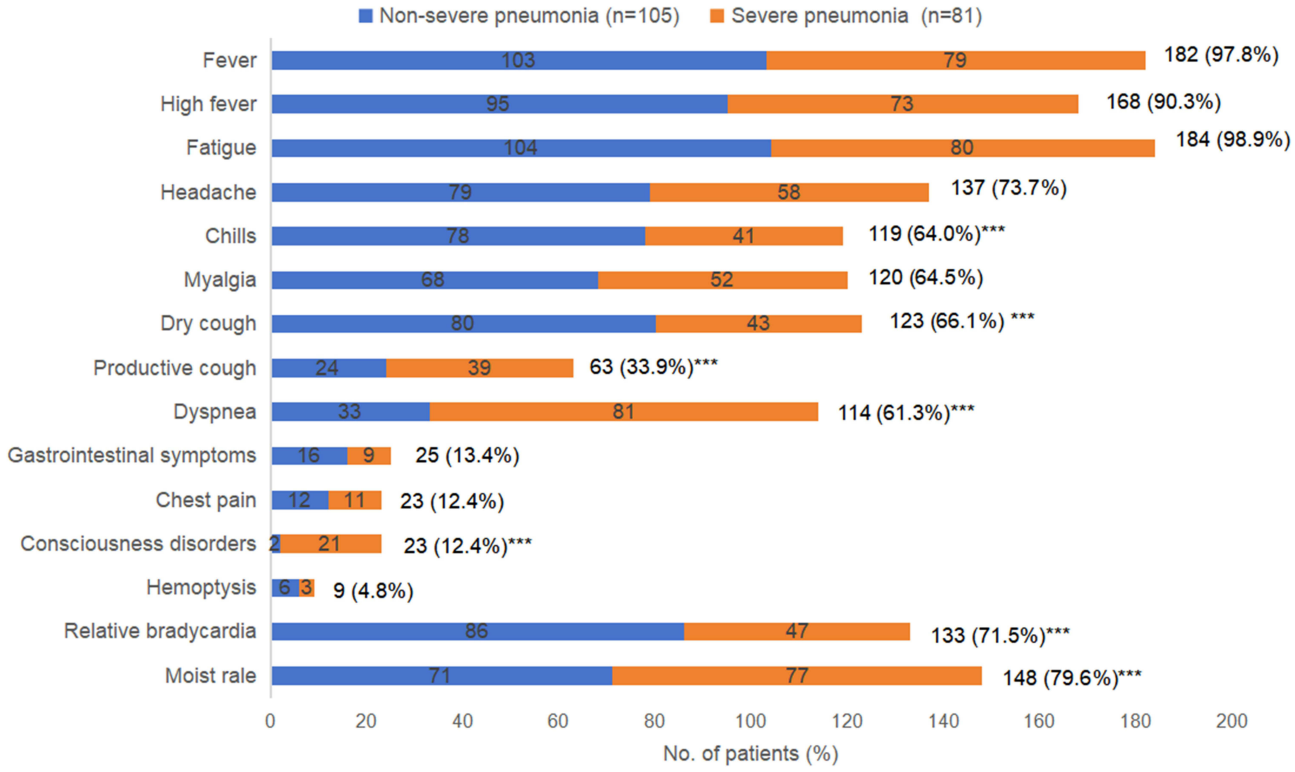

Figure 3 Symptoms and signs on presentation of patients diagnosed with *C. psittaci* pneumonia. ***P< 0.001 when comparing severe and non-severe pneumonia groups.

https://doi.org/10.2147/IDR.S563892

chills (64.0%), dyspnea (61.3%), gastrointestinal symptoms (13.4%), chest pain (12.0%), altered mental status (12.4%), and hemoptysis (4.8%). Dyspnea, wet cough, and altered mental status occurred more commonly in severe than in non-severe cases.

Laboratory Examination Results

As presented in Table 2, of the 186 patients, 118 (63.4%) had normal white blood cell counts, 67 had mildly elevated counts, and only one had leukopenia. Over 90% of patients showed elevated serum levels of C-reactive protein (CRP), procalcitonin (PCT), fibrinogen, and D-dimer, alongside reduced albumin levels. Over 70% had increased neutrophil ratios, alanine transaminase (ALT), aspartate transaminase (AST), and lactate dehydrogenase (LDH) levels, with decreased lymphocyte counts. Additional findings included elevated serum creatine kinase (CK) in 90 (48.4%) patients, cardiac troponin T (CTnT) in 60 (32.3%), serum creatinine in 47 (25.3%), hyponatremia in 86 (46.2%), and hypokalemia in 88 (47.3%) patients.

Compared with non-severe cases, severe cases showed significantly higher neutrophil counts, neutrophil-to-lymphocyte ratio (NLR), CRP, C-reactive protein-to-albumin ratio (CAR), PCT, ALT, AST, CK, LDH, D-dimer, blood urea nitrogen (BUN), serum creatinine (SCr), N-terminal pro-brain natriuretic peptide (NT-proBNP), and CTnT levels, with significantly lower lymphocyte counts and albumin levels (p-value < 0.01) (Table 3).

Table 2 Analysis of Laboratory Examination Results in Patients with *C. psittaci* Pneumonia

Laboratory Test (Unit)	*C. psittaci* Pneumonia	Abnormal Proportion (%)
		Elevated Above Normal Range
WBC, $\times 10^9$/L	8.8 (6.7–10.9)	68 (36.6)
Neutrophil percentage, %	84 (76–90)	148 (79.6)
CRP, mg/L	182 (114–237)	186 (100)
PCT, ng/mL	0.5 (0.2–1.7)	181 (97.3)
ALT, U/L	57 (35–87)	134 (72.0)
AST, U/L	68 (39–133)	143 (76.9)
CK, U/L	250 (89–917)	90 (48.4)
LDH, U/L	321 (246–542)	134 (72.0)
Prothrombin time, s	13.6 (12.5–14.4)	42 (22.6)
APTT, s	36.9 (31.3–42.6)	42 (22.6)
Fibrin, g/L	7.1 (6.2–8.1)	173 (93.0)
D-dimer, ng/mL	2050 (1070–4160)	176 (94.6)
BUN, mmol/L	5.4 (3.8–7.0)	21 (11.3)
SCr, umol/L	79 (63–97)	47 (25.3)
NT-proBNP, pg/mL	314 (141–766)	30 (16.1)
CTnT, ng/L	12 (7–24)	60 (32.3)
		Below the normal lower limit
WBC, $\times 10^9$/L	8.8 (6.7–10.9)	1 (0.5)
Hemoglobin, g/L	122 (109–133)	62 (33.3)
Lymphocyte count, $\times 10^9$/L	0.7 (0.5–1.1)	133 (71.5)
Platelet count, $\times 10^9$/L	204 (154–256)	25 (13.4)
Albumin, g/L	32.8 (28.6–36.5)	179 (96.2)
Sodium, mmol/L	135 (131–137)	86 (46.2)
Potassium, mmol/L	3.5 (3.2–3.8)	88 (47.3)

Abbreviations: WBC, white blood cells; CRP, C-reactive protein; PCT, procalcitonin; ALT, alanine transaminase; AST, aspartate transaminase; CK, creatine kinase; LDH, lactate dehydrogenase; APTT, activated partial thromboplastin time; BUN, blood urea nitrogen; SCr, serum creatinine; NT-proBNP, N-terminal fragment brain natriuretic peptide; CTnT, cardiac troponin T.

Table 3 Laboratory Findings Upon Hospital Admission of Patients with *C. psittaci* Pneumonia

Variables	Disease Severity		*p* value
	Severe	Non-Severe	
Laboratory testing, median (IQR)			
WBC, $\times 10^9$/L	9.0 (7.0–11.5)	8.8 (6.4–10.6)	0.192
Neutrophil count, $\times 10^9$/L	8.3 (5.8–10.7)	7.1 (4.9–8.5)	0.001
Lymphocyte count, $\times 10^9$/L	0.5 (0.4–0.7)	1.0 (0.7–1.4)	0.000
NLR	14.9 (9.9–23.4)	6.5 (4.6–9.9)	0.000
CRP, mg/L	227 (186–288)	134 (96–193)	0.000
Albumin, g/L	30 (25–32)	36 (32–38)	0.000
CAR	8.3 (5.8–9.9)	3.9 (2.6–5.4)	0.000
PCT, ng/mL	1.7 (0.8–9.2)	0.2 (0.1–0.5)	0.000
ALT, U/L	68 (43–116)	52 (30–67)	0.001
AST, U/L	119 (58–258)	51 (29–77)	0.000
CK, U/L	480 (174–2366)	121 (63–331)	0.000
LDH, U/L	527 (361–720)	270 (218–336)	0.000
D–dimer, ng/mL	4160 (2370–8410)	1215 (757–1752)	0.000
BUN, mmol/L	6.7 (4.6–9.8)	4.4 (3.5–5.8)	0.000
SCr, umol/L	85 (65–122)	75 (62–90)	0.003
NT-proBNP, pg/mL	505 (196–1275)	177 (95–373)	0.000
CTnT, ng/L	19.7 (10–34)	8.3 (5.3–12.6)	0.000
Sodium, mmol/L	135 (130–138)	135 (132–137)	0.867
Potassium, mmol/L	3.4 (3.1–3.8)	3.6 (3.3–3.9)	0.048

Abbreviations: WBC, white blood cells; NLR, neutrophil-to-lymphocyte ratio; CRP, C-reactive protein; CAR, C-reactive protein to albumin ratio; PCT, procalcitonin; ALT, alanine transaminase; AST, aspartate transaminase; CK, creatine kinase; LDH, lactate dehydrogenase; BUN, blood urea nitrogen; SCr, serum creatinine; NT-proBNP, N-terminal fragment brain natriuretic peptide; CTnT, cardiac troponin T.

Chest Computed Tomographic Findings and Changes

All 186 patients underwent high-resolution chest CT prior to or upon admission. Common findings included pulmonary consolidation (100%), ground-glass opacities (97.8%), and air bronchograms (81.2%), with lesions primarily distributed subpleurally (95.2%) as segmental patchy or extensive consolidation, frequently surrounded by ground-glass opacities and accompanied by air bronchograms. No instances of necrosis, cavitation, or tree-in-bud signs were observed. Lesions were unilateral in 128 (68.8%) cases, with multiple lobes affected in 90 (48.4%), lower lobe involvement in 54 (29.0%), and upper lobe involvement in 40 (21.5%), only two cases involved the middle lobe. Pleural effusion was noted in 90 (48.4%) cases, and pericardial effusion in 21 (11.3%) cases, typically in small volumes. Severe cases showed more extensive consolidation, often bilateral and multilobar, with a higher prevalence of pleural and pericardial effusions (Table 4 and Figure 4).

Of 126 patients who underwent at least two chest CT scans, the majority showed gradual lesion absorption following targeted antimicrobial therapy (81%, n=102). Fewer patients showed increased extent of consolidation (15.1%, n=19), dissemination to different lobes (16, n=12.7%), and increased pleural effusion (15.1%, n=19) (Table 4).

Seventy-four patients were followed until complete lesion absorption. The mean duration from onset to complete absorption was 36 ± 13 days, achieved within 4–6 weeks in most non-severe cases (82.9%, n=29/35) and 6–8 weeks in nearly all severe cases (94.9%, n=37/39) (Table 4 and Figure 5).

Bronchoscopy Examination

Bronchoscopy (N=177) revealed bronchial mucosal hyperemia and swelling in most patients (96%, n=170), which was more pronounced in severe cases. Minimal airway secretions were observed in 85.9% (n=152), with severe cases showing a higher rate of increased secretions (Table 4).

https://doi.org/10.2147/IDR.S563892

Table 4 Chest CT Findings and Bronchoscopy Examination of Patients with *C. psittaci* Pneumonia

Variables	Disease Severity		Total	*p* value
	Severe	Non-Severe		
Upon Hospital Admission (186[a])				
N	81	105	186	–
Patchy consolidation, n (%)	3 (3.7)	80 (76.2)	83 (44.6)	0.000
Large consolidation, n (%)	78 (96.3)	25 (23.8)	103 (55.4)	0.000
Air bronchogram, n (%)	79 (97.5)	72 (68.6)	151 (81.2)	0.000
Ground-glass opacity, n (%)	79 (97.5)	103 (98.1)	182 (97.8)	1.0
Spherical lesion, n (%)	0 (0)	5 (4.8)	5 (2.7)	0.07
Reversed halo sign, n (%)	1 (1.2)	4 (3.8)	5 (2.7)	0.389
Bilateral lungs involved, n (%)	52 (64.2)	6 (5.7)	58 (31.2)	0.000
Multiple lobular involved, n (%)	71 (87.7)	19 (18.1)	90 (48.4)	0.000
Lesion is limited to the upper lobe, n (%)	4 (4.9)	36 (34.3)	40 (21.5)	0.000
Lesion is limited to the middle lobe, n (%)	0 (0)	2 (1.9)	2 (1.1)	0.506
Lesion is limited to the lower lobe, n (%)	7 (8.6)	47 (44.7)	54 (29.0)	0.000
Upper lobe predominance of the lesion, n (%)	33 (40.7)	46 (43.8)	79 (42.5)	0.675
Lower lobe predominance of the lesion, n (%)	48 (59.3)	57 (54.3)	105 (56.5)	0.498
Subpleural distribution, n (%)	80 (98.8)	97 (92.4)	177 (95.2)	0.080
Pleural effusion, n (%)	64 (79.0)	26 (24.8)	90 (48.4)	0.001
Unilateral pleural effusion, n (%)	35 (43.2)	22 (21.0)	57 (30.6)	0.000
Bilateral pleural effusion, n (%)	29 (35.8)	4 (3.8)	33 (17.7)	0.000
Pericardial effusion, n (%)	16 (19.8)	5 (4.8)	21 (11.3)	0.001
Dynamic changes in chest CT (126[a])				
N	61	65	126	–
Lesions were absorbed and improved gradually, n (%)	46 (75.4)	56 (86.2)	102 (81.0)	0.125
Enlarged range of lung lesions, n (%)	12 (19.7)	7 (10.8)	19 (15.1)	0.163
Spread to different lung lobes, n (%)	15 (24.6)	1 (1.5)	16 (12.7)	0.000
Increased pleural effusion, n (%)	15 (24.6)	4 (6.2)	19 (15.1)	0.006
Absorption time of lung lesions (**74[a]**), days, mean (SD)	41±12	31±13	36±13	0.001
Bronchoscopy examination (177[a])				
N	73	104	177	–
Bronchial mucosal hyperemia and swelling, n (%)	73 (100)	97 (93.3)	170 (96.0)	0.042
Small amount of airway secretions, n (%)	54 (74.0)	98 (94.2)	152 (85.9)	0.000

Note: [a]Total number.
Abbreviation: CT, computed tomography.

Complications

During hospitalization (N=186), more than half of the patients (67.2%, n=125) had complications involving multiple critical organs, including respiratory failure (46.2%, n=86), acute liver injury (45.7%, n=85), anemia (33.3%, n=62), acute myocardial injury (32.3%, n=60), rhabdomyolysis (21.5%, n=40), acute respiratory distress syndrome (ARDS) (21.0%, n=39), and acute kidney injury (20.4%, n=38). Less frequent extrapulmonary complications included acute meningitis (4.3%, n=8), venous thromboembolism (3.2%, n=6), and Guillain-Barré syndrome (1.6%, n=3) (Table 5).

Treatment and Outcomes

Prior to confirmed diagnosis, the majority of patients (75.3%, n=140) received empirical antibiotics targeting atypical pathogens. Following diagnosis, approximately one-thirds (34.4%, n=64) were treated with combination therapy, typically tetracycline plus quinolones, while the rest (n=122) received monotherapy: tetracyclines (26.3%, n=49), quinolones (38.2%, n=71), or macrolides (1.1%, n=2). The median duration to fever resolution was 3 (2–4) days. Most patients received respiratory support (92.5%, n=172), including nasal cannula oxygen therapy (52.7%, n=98), invasive mechanical ventilation (20.4%, n=38), high-flow nasal cannula (16.1%, n=30), and non-invasive ventilation

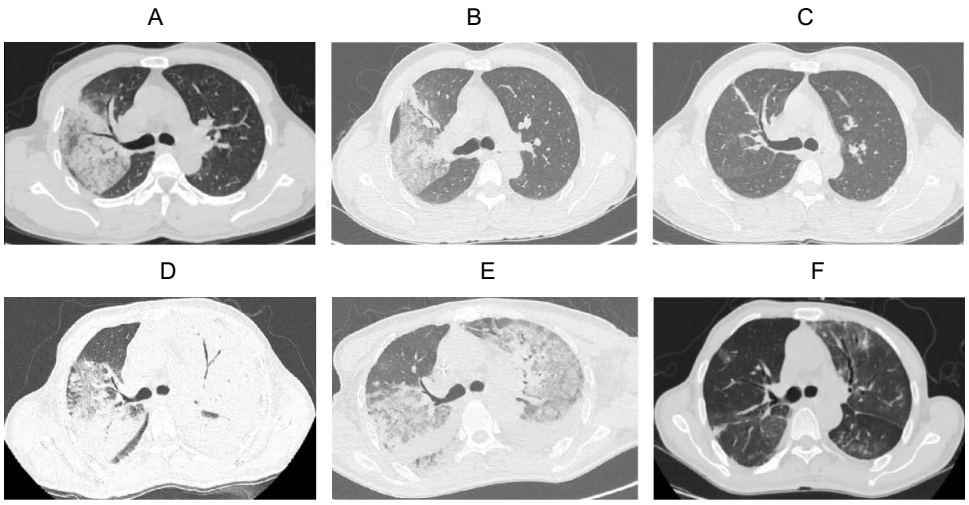

Figure 4 Chest computed tomography (CT) scans of two patients with *C. psittaci* pneumonia. A 46-year-old male with mild pneumonia: initial CT scan (3 days after onset) shows a fan-shaped patchy consolidation with ground-glass density in the upper lobe of the right lung (**A**). CT scan (10 days after onset) shows that the lesion in the right upper lobe of the lung was absorbed following targeted treatment (**B**). CT scan (28 days after the onset) shows that the consolidation disappeared (**C**). A 61-year-old male with severe pneumonia: initial CT scan (5 days after onset) shows bilateral large consolidation with air bronchogram and small bilateral pleural effusions **(D)**. CT scan (24 days after onset) shows that the consolidation gradually absorbed following targeted treatment (**E**). On follow-up (37 days after the onset), the lung lesions were largely resorbed, leaving only a few fibrous linear opacities (**F**).

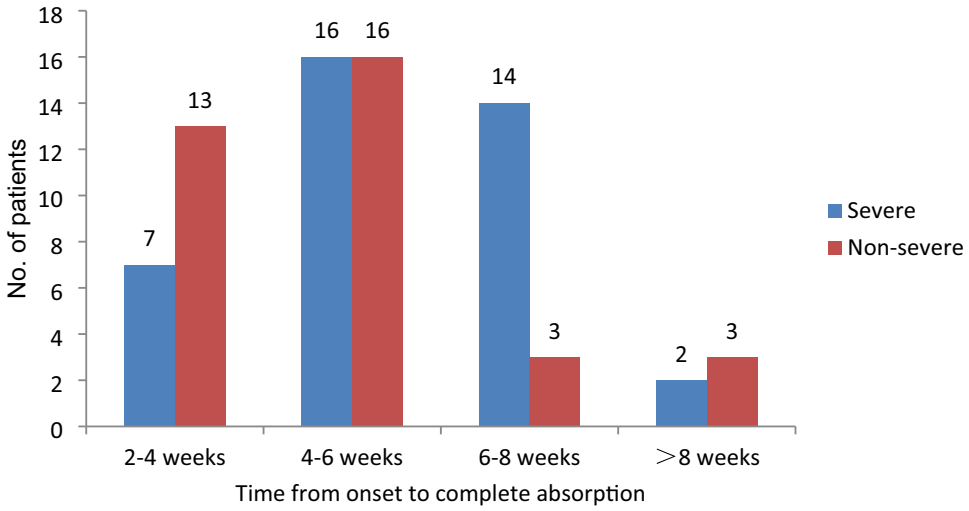

Figure 5 Time required from onset to complete absorption of lung lesions in 74 patients.

(3.2%, n=6). Additional treatments included anticoagulation (9.1%, n=17) and glucocorticoids (5.9%, n=11). Higher rates of anticoagulant use, glucocorticoid therapy, combination antimicrobial therapy, and mechanical ventilation were observed in non-severe than in severe cases. In-hospital mortality rate was 3.8%, exclusively in severe cases, which also showed longer median fever resolution time and hospital stay than non-severe cases (Table 5).

Discussion

To our knowledge, this represents the largest clinical investigation of *C. psittaci* pneumonia in China to date. Through a comprehensive analysis of patients' demographic characteristics, epidemiological profiles, clinical manifestations, laboratory results, imaging features, bronchoscopy findings, and treatment outcomes, we observed a high incidence of severe cases and both intrapulmonary and extrapulmonary complications. Despite the complexity and variability of

https://doi.org/10.2147/IDR.S563892

Table 5 Complications, Treatments, and Outcomes of *C. psittaci* Pneumonia

Characteristics	Disease Severity		Total	*p* value
	Severe	Non-Severe		
N	81	105	186	–
Complications				
Respiratory failure, n (%)	81 (100)	5 (4.8)	86 (46.2)	0.000
ARDS, n (%)	39 (48.1)	0 (0)	39 (21.0)	0.000
Acute liver injury, n (%)	52 (64.2)	33 (31.4)	85 (45.7)	0.000
Acute myocardial injury, n (%)	43 (53.1)	17 (16.2)	60 (32.3)	0.000
Acute kidney injury, n (%)	30 (37.0)	8 (7.6)	38 (20.4)	0.000
Anemia, n (%)	39 (48.1)	23 (21.9)	62 (33.3)	0.000
Rhabdomyolysis, n (%)	32 (39.5)	8 (7.6)	40 (21.5)	0.000
Acute Meningitis, n (%)	8 (9.9)	0 (0)	8 (4.3)	0.001
Guillain Barre syndrome, n (%)	3 (3.7)	0 (0)	3 (1.6)	0.081
Venous thromboembolism, n (%)	6 (7.4)	0 (0)	6 (3.2)	0.006
Septic Shock, n (%)	16 (19.8)	0 (0)	16 (8.6)	0.000
MODS, n (%)	31 (38.3)	0 (0)	31 (16.7)	0.000
Treatments				
Empirical antibiotic coverage for atypical pathogens, n (%)	60 (74.1)	80 (76.2)	140 (75.3)	0.740
Tetracycline, n (%)	23 (28.4)	26 (24.8)	49 (26.3)	0.000
Quinolones, n (%)	16 (19.8)	55 (52.4)	71 (38.2)	0.577
Azithromycin, n (%)	0 (0)	2 (1.9)	2 (1.1)	0.506
Combination therapy with target drugs, n (%)	42 (51.9)	22 (21.0)	64 (34.4)	0.000
Nasal cannula oxygen therapy, n (%)	8 (9.9)	90 (85.7)	98 (52.7)	0.000
HFNC, n (%)	29 (35.8)	1 (1.0)	30 (16.1)	0.000
Non-invasive ventilation, n (%)	6 (7.4)	0 (0)	6 (3.2)	0.000
Invasive mechanical ventilation, n (%)	38 (46.9)	0 (0)	38 (20.4)	0.006
ECMO, n (%)	6 (7.4)	0 (0)	6 (3.2)	0.006
Continuous renal replacement therapy, n (%)	5 (6.2)	0 (0)	5 (2.7)	0.015
Glucocorticoid therapy, n (%)	10 (12.3)	1 (1.0)	11 (5.9)	0.001
Anticoagulant therapy, n (%)	17 (21.0)	0 (0)	17 (9.1)	0.000
Outcomes				
Fever duration day after target antibiotics use, days, Median (IQR)	3 (3–5)	2 (2–3)	3 (2–4)	0.000
Death, n (%)	7 (8.6)	0 (0)	7 (3.8)	0.003
Length of stay, days, Median (IQR)	15 (11–22)	8 (7–10)	10 (8–15)	0.000

Abbreviations: ARDS, acute respiratory distress syndrome; MODS, Multiple organ dysfunction syndrome; HFNC, High-flow nasal cannula oxygen therapy; ECMO, extracorporeal membrane oxygenation.

clinical presentations, certain characteristic features were evident. Early diagnosis and appropriate antimicrobial therapy were associated with favorable outcomes.

C. psittaci infection, known as psittacosis, is a zoonotic infectious disease primarily characterized by pulmonary inflammation. Human infections are frequently associated with exposure to birds or poultry, with bird breeders, poultry workers, and pet bird owners at increased risk.[13] In the present study, 68.3% of patients reported a history of bird or poultry contact, consistent with prior findings.[8,10] Clinicians should therefore consider *C. psittaci* infection in patients presenting with fever and a history of such exposure. Although literature suggests potential human-to-human transmission,[14] our study identified a few instances of familial clustering, but person-to-person transmission could not be confirmed, possibly owing to shared exposure to a common infectious source.

In this study, the majority of patients were male, and age stratification revealed a predominance in the 50–74 age group, indicating potential sex- and age-related susceptibility. The higher incidence in autumn and winter may be attributed to migratory bird patterns facilitating transmission during co-feeding with poultry, as well as cooler, drier conditions favoring *C. psittaci* survival and airborne transmission.[13]

As a potential biological warfare and bioterrorism agent, *C. psittaci* exhibits high pathogenicity, enabling rapid replication and dissemination within the host. Its broad host cell spectrum (from epithelial cells to macrophages) facilitates systemic infection, resulting in multiorgan dysfunction.[15,16] The pathogen enters via the respiratory tract, initially proliferating in epithelial and mononuclear macrophage systems before disseminating through the bloodstream to various organs.[16] The present study revealed that nearly half of the patients developed severe pneumonia, and over two-thirds experienced intrapulmonary and extrapulmonary complications, including acute liver injury, anemia, acute myocardial injury, acute kidney injury, and rhabdomyolysis, with less frequent complications such as acute meningitis, Guillain–Barré syndrome, and venous thromboembolism. Previous studies have also made similar findings,[3,8,10] but the present study summarizes them more systematically. These findings highlight the involvement of the digestive, hematologic, renal, cardiovascular, and neuromuscular systems, emphasizing the need to monitor and manage extrapulmonary complications alongside pulmonary infection. Although prior studies have shown associations with arthritis and keratoconjunctivitis,[17,18] these were not observed in this cohort.

The clinical presentation of *C. psittaci* pneumonia is complex but exhibits distinct features: (1) all cases presented acutely, with some progressing rapidly and nearly half developing respiratory failure; (2) fever, particularly high fever (>39.0°C), was nearly universal; (3) cough was predominantly dry, with minimal sputum in wet cough cases; (4) relative bradycardia was common; (5) unlike typical bacterial pneumonia,[8,19,20] extrapulmonary manifestations were frequent and varied, with some patients initially presenting with neurological or gastrointestinal symptoms. Severe cases showed higher incidences of wet cough, dyspnea, and central nervous system complications, possibly due to increased pulse rates associated with dyspnea, which may account for the lower prevalence of relative bradycardia in severe cases.

Laboratory findings included (1) normal or mildly elevated white blood cell counts in most patients, with leukopenia rarely occurring (only 1 case); (2) significantly elevated C-reactive protein and variably elevated procalcitonin; (3) frequent abnormalities in liver function, muscle enzymes, and coagulation parameters, with some patients exhibiting renal or myocardial injury. These findings are consistent with prior reports,[9,21] though leukopenia was less common in the present study. Severe cases showed more pronounced inflammatory responses and organ dysfunction compared with non-severe cases.

All patients underwent chest CT, and given the limited attention to dynamic imaging changes in prior studies, this study focused on both initial and follow-up CT findings. Of 126 (67.7%) patients who underwent repeat CT, 74 (39.8%) were followed until complete lesion absorption. CT findings primarily revealed exudation and consolidation, with the extent of consolidation correlating with disease severity. Multilobar consolidation was associated with a higher risk of severe disease, and no patients exhibited necrosis, cavitation, or tree-in-bud signs, aligning with previous findings.[22,23] Isolated right middle lobe involvement was rare, though the underlying mechanism remains unclear. Dynamic monitoring revealed that most patients' lesions resolved gradually with targeted antimicrobial therapy, with a mean absorption time of 36 ± 13 days. Dissemination to different lobes or increased pleural effusion indicated a higher risk of severe disease.

Bronchoscopy findings typically showed airway mucosal hyperemia and edema, with minimal secretions, consistent with the low prevalence of productive cough. As a systemic disease primarily manifesting as pulmonary inflammation,[16] bronchoalveolar lavage fluid is the optimal specimen for NGS. For patients unable to tolerate bronchoscopy, testing of sputum, venous blood, pleural effusion, or cerebrospinal fluid may be performed, though these specimens yield lower positivity rates.[24] As *C. psittaci* is an intracellular pathogen absent from healthy human tissues, detection of its nucleic acid sequences strongly suggests pathogenicity, and diagnosis can be confirmed with clinical and imaging findings.[25]

Treatment of *C. psittaci* pneumonia is focused on targeted antimicrobial therapy and organ function support, particularly respiratory support, owing to the high risk of multiorgan dysfunction. As an intracellular bacterium with strong pathogenicity, antibiotics with high intracellular concentrations are required, with tetracyclines as the first-line choice, followed by macrolides and fluoroquinolones.[26] In cases of severe hepatic or renal dysfunction, novel tetracyclines such as omadacycline may be considered,[27] while fluoroquinolones should be used cautiously in rhabdomyolysis.[28] In the present study, the median time to diagnosis was 3 days, with most patients receiving empirical antibiotics covering atypical pathogens before confirmation. After diagnosis, treatment was adjusted to targeted therapy, with mild cases typically receiving monotherapy and severe cases often receiving combination therapy. The mortality rate was 3.8%, underscoring the importance of early diagnosis and appropriate antimicrobial therapy for improving outcomes.

https://doi.org/10.2147/IDR.S563892

Psittacosis is an animal infectious disease. In order to achieve effective prevention and control of psittacosis, it is necessary to adopt a coordinated and cooperative strategy within the framework of "One Health", including improving human monitoring, implementing animal monitoring, and ensuring data sharing and intelligence exchange between public health and veterinary departments.[29]

This study has limitations: (1) some clinical data were collected retrospectively, potentially resulting in incomplete pre-admission treatment or epidemiological data; (2) post-discharge follow-up data were lacking for some patients; (3) owing to testing limitations, all diagnoses relied on NGS, without confirmation via serology or PCR.

Conclusion

C. psittaci exhibits significant pathogenicity, causing both intrapulmonary and extrapulmonary complications. Clinicians should consider infection in patients with a history of bird or poultry exposure and characteristic findings, including high fever, relative bradycardia, normal white blood cell counts, elevated transaminases, and pulmonary consolidation. Early diagnosis through tNGS or mNGS, alongside appropriate antimicrobial therapy, leads to favorable patient outcomes.

Abbreviations

APACHE II, acute physiology and chronic health evaluation; ALT, alanine transaminase; AST, aspartate transaminase; APTT, activated partial thromboplastin time; ARDS, acute respiratory distress syndrome; BALF, bronchoalveolar lavage fluid; BUN, blood urea nitrogen; CURB-65, British Thoracic Society's modified pneumonia score; CRP, C-reactive protein; CAR, C-reactive protein to albumin ratio; CK, creatine kinase; CTnT, cardiac troponin T; ECMO, extracorporeal membrane oxygenation; HFNC, High-flow nasal cannula oxygen therapy; LDH, lactate dehydrogenase; MODS, Multiple organ dysfunction syndrome; NT-proBNP, N-terminalfragment brain natriuretic peptide; NLR, neutrophil-to-lymphocyte ratio; PSI, pneumonia severity index; PCT, procalcitonin; SCr, serum creatinine; WBC, white blood cells.

Data Sharing Statement

The datasets generated and analyzed during the current study are available from the corresponding author (Limin Xu) upon reasonable request.

Ethics Approval and Informed Consent

The Ethics Committees of the Huizhou Central People's Hospital approved this study (Approval No. ky112023154). All patients and legal guardians provided informed consent. This study follows the Helsinki Declaration.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This study was supported by the Medical Scientific Research Foundation of Guangdong Province of China (No. B2024131).

Disclosure

The authors report no conflicts of interest in this work.

References

1. Hogerwerf L, De Gier B, Baan B, et al. Chlamydia psittaci (psittacosis) as a cause of community-acquired pneumonia: a systematic review and meta-analysis. *Epidemiol Infect*. 2017;145(15):3096–3105. doi:10.1017/S0950268817002060

2. Wu X, Li Y, Zhang M, et al. Etiology of severe community-acquired pneumonia in adults based on metagenomic next-generation sequencing: a prospective multicenter study. *Infect Dis Ther*. 2020;9(4):1003–1015. doi:10.1007/s40121-020-00353-y
3. Deng H, Shi Y, Xie M, et al. Diagnosis and treatment experience of Chlamydia psittaci pneumonia: a multicenter retrospective study in China. *BMC Infect Dis*. 2024;24(1):1333. doi:10.1186/s12879-024-10198-2
4. Ravichandran K, Anbazhagan S, Karthik K, et al. A comprehensive review on avian chlamydiosis: a neglected zoonotic disease. *Trop Anim Health Pro*. 2021;53(4):414. doi:10.1007/s11250-021-02859-0
5. Flurin L, Wolf MJ, Fisher CR, et al. Pathogen detection in infective endocarditis using targeted metagenomics on whole blood and plasma: a prospective pilot study. *J Clin Microbiol*. 2022;60(9):e62122. doi:10.1128/jcm.00621-22
6. Nieuwenhuizen AA, Dijkstra F, Notermans DW, et al. Laboratory methods for case finding in human psittacosis outbreaks: a systematic review. *Bmc Infect Dis*. 2018;18(1):442. doi:10.1186/s12879-018-3317-0
7. Cui Z, Meng L. Psittacosis pneumonia: diagnosis, treatment and interhuman transmission. *Int J Gen Med*. 2023;16:1–6. doi:10.2147/IJGM.S396074
8. Liu K, Wu L, Chen G, et al. Clinical characteristics of Chlamydia psittaci infection diagnosed by metagenomic next-generation sequencing: a retrospective multi-center study in Fujian, China. *Infect Drug Resist*. 2024;17:697–708. doi:10.2147/IDR.S443953
9. Chen J, Wang J, Deng Z, et al. Clinical features of 50 cases of Chlamydia psittaci pneumonia identified through metagenomic next-generation sequencing. *Infect Drug Resist*. 2024;17:5775–5784. doi:10.2147/IDR.S493927
10. Yang M, Yang DH, Yang H, et al. Clinical characteristics of Chlamydia psittaci pneumonia infection in central south China. *Infect Dis Ther*. 2022;11(4):1631–1647. doi:10.1007/s40121-022-00662-4
11. Metlay JP, Waterer GW, Long AC, et al. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American thoracic society and infectious diseases society of America. *Am J Resp Crit Care*. 2019;200(7):e45–e67. doi:10.1164/rccm.201908-1581ST
12. Cunha BA. The diagnostic significance of relative bradycardia in infectious disease. *Clin Microbiol Infect*. 2000;6(12):633–634. doi:10.1046/j.1469-0691.2000.0194f.x
13. Wang J, Wang B, Xiao J, et al. Chlamydia psittaci: a zoonotic pathogen causing avian chlamydiosis and psittacosis. *Virulence*. 2024;15(1):2428411. doi:10.1080/21505594.2024.2428411
14. Zhang Z, Zhou H, Cao H, et al. Human-to-human transmission of Chlamydia psittaci in China, 2020: an epidemiological and aetiological investigation. *Lancet Microbe*. 2022;3(7):e512–e520. doi:10.1016/S2666-5247(22)00064-7
15. Read TD, Joseph SJ, Didelot X, et al. Comparative analysis of Chlamydia psittaci genomes reveals the recent emergence of a pathogenic lineage with a broad host range. *mBio*. 2013;4(2). doi:10.1128/mBio.00604-12
16. Knittler MR, Sachse K. Chlamydia psittaci: update on an underestimated zoonotic agent. *Pathog Dis*. 2015;73(1):1–15. doi:10.1093/femspd/ftu007
17. Gonski PN, Chan B. Reactive arthritis due to Chlamydia psittaci associated with HLA-B27 genotype. *Med J Australia*. 2009;190(11):649–650. doi:10.5694/j.1326-5377.2009.tb02600.x
18. Haller-Schober EM, El-Shabrawi Y. Chlamydial conjunctivitis (in adults), uveitis, and reactive arthritis, including SARA. *Best Pract Res Cl Ob*. 2002;16(6):815–828. doi:10.1053/beog.2002.0320
19. Cunha BA. The atypical pneumonias: clinical diagnosis and importance. *Clin Microbiol Infect*. 2006;12(Suppl 3):12–24. doi:10.1111/j.1469-0691.2006.01393.x
20. Georgakopoulou VE, Lempesis IG, Tarantinos K, et al. Atypical pneumonia (Review). *Exp Ther Med*. 2024;28(5):424. doi:10.3892/etm.2024.12713
21. Ni Y, Zhong H, Gu Y, et al. Clinical features, treatment, and outcome of psittacosis pneumonia: a multicenter study. *Open Forum Infect Dis*. 2023;10(2):ofac518. doi:10.1093/ofid/ofac518
22. Yang N, Ou Z, Sun Q, et al. Chlamydia psittaci pneumonia-evolutionary aspects on chest CT. *Bmc Infect Dis*. 2025;25(1):11. doi:10.1186/s12879-024-10374-4
23. Huang M, Wang Y, Lu Y, et al. Clinical characteristics and predicting disease severity in Chlamydia psittaci infection based on metagenomic next-generation sequencing. *Infect Drug Resist*. 2025;18:1171–1181. doi:10.2147/IDR.S509879
24. Chen Q, Yi J, Liu Y, et al. Clinical diagnostic value of targeted next-generation sequencing for infectious diseases (Review). *Mol Med Rep*. 2024;30(3):153. doi:10.3892/mmr.2024.13277
25. Li N, Cai Q, Miao Q, et al. High-throughput metagenomics for identification of pathogens in the clinical settings. *Small Methods*. 2021;5(1):2000792. doi:10.1002/smtd.202000792
26. Balsamo G, Maxted AM, Midla JW, et al. Compendium of measures to control Chlamydia psittaci infection among humans (psittacosis) and pet birds (avian chlamydiosis). *J Avian Med Surg*. 2017;31(3):262–282. doi:10.1647/217-265
27. Fang C, Xu L, Tan J, et al. Omadacycline for the treatment of severe Chlamydia psittaci pneumonia complicated with multiple organ failure: a case report. *Infect Drug Resist*. 2022;15:5831–5838. doi:10.2147/IDR.S384296
28. Wu M, Yang D. Levofloxacin-induced acute rhabdomyolysis: a case report. *Int J Clin Pharm Ther*. 2023;61(12):572–574. doi:10.5414/CP204377
29. Meurer IR. The importance of medical knowledge about Q fever in the context of timely diagnosis and treatment and the use of the one health approach in combating this and other neglected zoonotic diseases. *Infect Drug Resist*. 2025;18:5007–5008. doi:10.2147/IDR.S567142