

# 83137\_Auto\_Edited.docx

---

WORD COUNT

4463

TIME SUBMITTED

17-APR-2023 03:26PM

PAPER ID

98796034

**Name of Journal:** *World Journal of Meta-Analysis*

**Manuscript NO:** 83137

**Manuscript Type:** SYSTEMATIC REVIEWS

## **Cytomegalovirus pulmonary infection: Case Report and Systematic Review**

Awotar Kanika, Jonathan Soldera

### **Abstract**

#### BACKGROUND

**Background:** Cytomegalovirus (CMV) is a common virus that can cause the first infection in childhood or adolescence and reactivate later in life due to immunosuppression. CMV pneumonia is a rare illness in immunocompetent patients but is one of the most significant opportunistic infections in immunocompromised patients.

#### AIM

**Aim:** The aim of this study is to report a case and review published cases of pulmonary CMV infection in both immunocompromised and immunocompetent patients.

**Case Report:** A 32-year-old male with no significant medical history presented with cough, dyspnea, high-grade fever, and jaundice. Physical examination revealed hepatosplenomegaly and initial blood tests showed pancytopenia, elevated liver enzymes, elevated bilirubin, and hypoalbuminemia. CT scans showed ground glass opacities and sinusitis. After developing sepsis and being admitted to the ICU, the patient was diagnosed with disseminated CMV infection and treated with ganciclovir, resulting in complete recovery after 6 wk of treatment.

#### METHODS

**Methods:** We conducted a systematic search on the MEDLINE (PubMed) database, without date or language restrictions, to identify relevant studies using Medical Subject Headings and Health Science Descriptors. We manually searched the reference lists of the included studies. Simple descriptive analysis was used to summarize the results.

## RESULTS

**Results:** Our search identified 445 references, and after screening, 43 studies reporting 45 cases were included in the final analysis, with 29 (64%) patients being immunocompromised and 16 (36%) being immunocompetent. Fever (82%) and dyspnoea (75%) were the most common clinical findings. Thoracic CT scan showed bilateral ground-glass opacities, a relevant differential for SARS-CoV-2. The majority of patients (85%) received antiviral therapy, and 89% of patients recovered, while 9% of patients died.

## CONCLUSION

**Conclusion:** CMV pneumonia should be considered as a differential diagnosis for COVID-19 pneumonia, especially in immunocompromised patients. Clinicians should be aware of the clinical presentation, management, and outcomes of CMV pneumonia to guide appropriate treatment decisions.

## INTRODUCTION

16

### Introduction:

Cytomegalovirus (CMV) is a DNA virus that belongs to the herpesviridae family and shares similarities with other herpes viruses. In immunocompetent adults, CMV infection is usually asymptomatic and causes mild mononucleosis-like syndrome, typically in childhood or adolescence. However, CMV can cause severe disease and pneumonia in immunocompetent individuals, albeit rarely <sup>[1, 2]</sup>. CMV infection may lead to severe viral pneumonitis in immunocompromised patients, such as those with autoimmune deficiency syndrome (AIDS), allogeneic bone marrow transplantation

recipients, or those on immunosuppressive drugs or high-dose steroids. The incidence of CMV infection is approximately 25-30% in recipients of hematopoietic stem cells transplantation [3]. The gastrointestinal tract and central nervous system are the most frequent sites of severe CMV infection. This research aims is still one of the three most common causes of severe viral community-acquired pneumonia (CAP), along with influenza and adenovirus [4]. However, this has changed with the emergence of Severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) in 2020. The pulmonary manifestations of CMV infection may vary from a dry cough to severe interstitial pneumonia, with patients presenting with diffuse pulmonary infiltrates resembling a ground glass appearance. The diagnosis of CMV pneumonia is based on radiological patterns and serology (CMV IgM antibody) or polymerase chain reaction (PCR) [4]. In 1968, the first case of CMV community-acquired pneumonia (CAP) was reported by Carlstorm and colleagues in their case series of CMV infection in immunocompetent hosts [5]. CMV CAP in immunocompetent hosts presents as prolonged fever and interstitial infiltrates on chest X-ray (CXR) that resolved slowly over 6 wk. Patients with CMV CAP present with relative lymphopenia, atypical lymphocytes, and mildly elevated serum transaminases. Primary CMV infection persists for life and is generally acquired through close physical contact involving direct inoculation with infected cells or body fluids. The spread of viral infection is through coughing, direct contact with body fluids such as blood, urine, feces, semen, vaginal fluid, breast milk, or *via* mucous membranes, including the mouth or genitals. CMV infection following transplantation can be acquired if the transmission is from the donor organ from a CMV-seropositive donor. Mothers infected with CMV during pregnancy may transmit this infection to their newborn baby, leading to congenital CMV. CMV infection is one of the leading causes of miscarriage [1]. Babies with congenital CMV sometimes may be healthy for months or years after birth but may have late occurring signs such as hearing loss, develop vision problems, and developmental delay. Latent CMV can reactivate and replicate rapidly when the immune system is suppressed. It can lead to high levels of CMV viremia, and infection of multiple organ systems can cause severe illness such as

retinitis, colitis, hepatitis, pneumonia, or encephalitis. Fatal CMV pneumonia is more common in patients who have received marrow transplants than those who received solid organ transplants like lung, heart, liver, or kidney [6, 7]. CMV accentuates the sepsis-induced immunologic effects, leading to an increase in the risk for secondary infections. CMV infection in critically ill patients is associated with prolonged ventilator support, nosocomial infections, prolonged hospital/IC U stay, and increased mortality rates [8, 9].

As the COVID-19 pandemic continues and becomes an endemy, it is crucial to recognize that not all clinical and radiological presentations are solely attributable to COVID-19 [16]. Therefore, diagnostic differentiation is essential, and ground-glass opacities (GGOs) must be evaluated in conjunction with other imaging findings, laboratory tests, and clinical features to reach a definitive diagnosis. Cytomegalovirus (CMV) pneumonia can be diagnosed by detecting the virus in serum and/or respiratory samples such as bronchoalveolar lavage (BAL) or tracheal aspiration. Quantitative real-time PCR (qRT-PCR) can be utilized to measure viral loads in blood and BAL fluid. Lung biopsy histopathology is considered the gold standard for diagnosing pulmonary CMV infections, with the presence of cytomegalovirus inclusion bodies (owl's eye) in biopsy specimens being confirmatory of lung infection [12]. However, the diagnostic yield of lung biopsy for diagnosing lung CMV infections can vary as inclusions may not always be visualized. Immunohistochemical (IHC) staining for CMV in cytologic specimens of bronchial washing fluid can also detect CMV [14].

The first-line treatment for CMV disease is IV ganciclovir and its prodrug, oral valganciclovir, which inhibits viral DNA polymerase, thereby interfering with DNA elongation. Mild disease in immunosuppressed patients may be treated with oral valganciclovir, whereas severe illness requires initial treatment with intravenous ganciclovir or foscarnet at full doses (adjusted for renal function) [15]. Treatment at full doses should be continued until symptom resolution and blood antigenemia (or DNAemia) clears. Adjuvant treatment with intravenous immunoglobulin or CMV

hyperimmunoglobulin is recommended in immunocompromised patients and may be used in cases of severe CMV disease and hypogammaglobulinemia [12].

This study aims to report a case and review disseminated CMV in an immunocompetent patient, and systematically review published cases of pulmonary CMV infection in both immunocompromised and immunocompetent patients.

## Case Report

### Chief complaints:

A 32-year-old male presented with a cough, dyspnea, high-grade fever, and jaundice.

### History of present illness:

The patient had no significant medical history and was not taking any medication. Physical examination revealed a temperature of 39.5°C, tachypnea, icteric sclera, and hepatosplenomegaly. He had no skin rash or lymphadenopathy. The initial blood tests showed pancytopenia, elevated liver enzymes, elevated bilirubin, and hypoalbuminemia. CT of the thorax showed ground glass opacities, while CT of the face showed sinusitis, raising suspicion of an infectious etiology.

### History of past illness:

The patient had no significant past medical history.

### Personal and family history:

No significant personal or family history was reported.

### Physical examination:

The patient presented with a temperature of 39.5°C, tachypnea, icteric sclera, and hepatosplenomegaly. He had no skin rash or lymphadenopathy.

### Laboratory examinations:

Complete Blood Count (CBC) revealed a platelet count of 87,000/mm<sup>3</sup>, hemoglobin of 8.2 g/dL, and leukocyte count of 4,830 /mm<sup>3</sup>. Liver Function Tests showed Alkaline Phosphatase (FA) of 1174 U/L, Gamma-Glutamyl Transferase (GGT) of 804 U/L, Protein C-Reactive (PCR) of 53 mg/dL, Aspartate Aminotransferase (TGO) of 403 U/L,



Total Bilirubin (BT) of 17.2 mg/dL, Albumin of 1.7 g/dL and International Normalized Ratio (INR) of 1.11. Autoimmune Antibody Testing for Fluorescence Antinuclear Antibody (FAN) was negative. COVID-19 antigen swab test was negative.

Imaging examinations:

After undergoing a liver biopsy, the patient's results were suggestive of drug-induced liver injury, and subsequent immunochemistry testing returned negative results for CMV. Magnetic Resonance Imaging (MRI) of the abdomen showed a liver with enlarged dimensions, regular contours, and heterogeneous signal intensity, with predominance of hypersignal in the T2-weighted sequences, suggestive of an inflammatory process (hepatitis), splenomegaly and pancreatic edema suggestive of pancreatitis. CT of the thorax showed ground glass opacities (Figure 1), while CT of the face showed sinusitis.

FINAL DIAGNOSIS:

The patient's clinical condition worsened, and he developed hypotension and sepsis, requiring admission to the intensive care unit (ICU). Broad-spectrum antibiotics were started, and he was investigated for possible Wegener's granulomatosis. However, auto-antibodies were negative and his final diagnosis was disseminated CMV infection, confirmed by the high viral load of 325,192.5 copies/mL.

TREATMENT:

The patient was started on ganciclovir therapy.

OUTCOME AND FOLLOW-UP:

After 6 wk of treatment, the patient recovered completely from his symptoms, achieving a sustained undetectable viral load.

## **MATERIALS AND METHODS**

### **Methods**

Methods:

This study followed the recommendations outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [65].

Data sources:

The electronic database MEDLINE (PubMed) was searched using the terms described in the Appendix below. The searches were conducted in September and October 2022, with no date of publication restrictions and language restricted to English. References of included studies were screened for relevant records, and the reference lists of the retrieved studies were submitted to manual search.

Inclusion and exclusion criteria:

Case report or case series studies were eligible for selection. If there was more than one study published using the same case, the most recent study was selected for analysis. Studies published only as abstracts were also included, as long as the data available made data collection possible. Studies written in languages other than English were excluded. Studies having other co-existing causes of pneumonia were excluded from our study, for example, superimposed bacterial, parasitic, or fungal infections in existing CMV pneumonia, and also the patients with other lung pathologies.

Study selection and data extraction:

Titles were screened initially to select the cases of pulmonary complications of CMV infection and filter out non-relevant studies. Then, abstracts of chosen studies were read to select potentially relevant papers. The third step was the analysis of the full-length papers, and those which were not case reports of pulmonary CMV were filtered out. Data was extracted on the characteristics of the subjects and the outcomes measured from each eligible study. A table of extracted data on eligible studies was made in order to measure and identify patterns.

## **RESULTS**

### **Results**

Using the search strategy, a total of 435 references were retrieved. Reviewing titles, 232 studies were relevant for our topic and 203 studies were excluded. Analyzing abstracts, 172 studies were potential relevant papers for our topic and therefore 60 studies were excluded. After reading and analysing full length papers, 43 studies with 45 case



reports of pulmonary CMV infection were included. The data of 45 case reports was extracted and prepared in Table 1 to measure and identify the patterns to get the results to reach the conclusion. Figure 2 below shows Prisma search strategy. Every study included was a case report.

The baseline features described in Table 2 and Table 3 for the 45 patients who were included for data extraction. All patients were diagnosed with Cytomegalovirus pneumonia. The majority of patients were males (58%) and in the age group of 16-45 years (55.6%). The most common symptoms reported were fever (82%), dyspnea (76%), and cough (53%). Respiratory distress was observed in 58% of the patients. Almost two-thirds of the patients (64%) were immunocompromised. Radiographic findings were reported in 71% of the patients by chest x-ray and 69% by CT scan. Blood/serum was the most commonly used method for serology testing (89%), and bronchoalveolar fluid was used in 45% of the cases.

Immunohistochemistry was reported in 24% of the cases, and biopsy-histopathology was performed in 27% of the patients. The treatment was reported in 84% of the cases, with a high recovery rate of 89%. Unfortunately, the mortality rate was 9%, with 4 patients reported to have died.

## **DISCUSSION**

### **Discussion**

This paper analyzed 45 cases of CMV-induced pneumonia. Patients were divided into two main categories: immunocompetent and immunocompromised. Twenty-nine (64%) patients were immunocompromised, and 16 (36%) were immunocompetent and developed CMV pneumonia. This suggests that CMV infection prevalence is higher in immunocompromised patients [2].

The reported case highlights the importance of considering CMV infection in patients who present with fever, respiratory symptoms, and abnormal liver function tests. Although CMV infection is more common in immunocompromised patients, this case demonstrates that it can also occur in immunocompetent individuals. It is important to

note that CMV is a common cause of pneumonia, particularly in immunocompromised patients, and should be considered in the differential diagnosis of patients with respiratory symptoms who do not respond to standard treatment. Early diagnosis and treatment are essential in improving patient outcomes, especially in severe cases. Therefore, clinicians should be aware of the clinical features and radiological findings of CMV pneumonia to enable early diagnosis and appropriate management.

The differential diagnosis of this case includes severe COVID-19 infection, which shares some clinical features with CMV pneumonia, such as cough, dyspnea, and fever. However, some features of the case, such as jaundice, hepatosplenomegaly, and pancytopenia, are not typically seen in severe COVID-19 cases. Additionally, ground glass opacities on CT imaging can be seen in both CMV pneumonia and COVID-19. Therefore, it is important to consider other infectious and non-infectious etiologies in patients with respiratory symptoms and abnormal liver function tests.

This correlates with the results of the systematic review: out of the total 45 patients, 26 (58%) were male, and 19 (42%) were female. Infection was more prevalent in males, with 11 immunocompetent and 15 immunocompromised male patients and 5 immunocompetent and 14 immunocompromised female patients. This suggests that CMV infection is more prevalent in immunosuppressed patients in both males and females. Immunocompromised states are an important host-associated risk factor to get CMV infection [2].

Regarding age, 25 patients were adults (13 male and 12 female), indicating that the adult population is more prone to developing pulmonary CMV infection. As it is estimated that more than half of the adult population is infected with CMV in the United States, and 80% of the adult population had this infection by the age of 40 years, the prevalence of CMV-induced pneumonia may increase with age [1]. The clinical findings of most patients were fever (82%), dyspnea (75%), cough (53%), and respiratory distress (53%) in both immunocompetent and immunocompromised patients. These findings are consistent with previous studies on CMV pneumonia [4].

Regarding radiological findings, 32 patients were submitted to a Chest X-ray mostly showing bilateral diffuse pulmonary infiltrates. CT scan thorax was done in 31 patients, and the main finding was bilateral ground-glass opacities (GGO). In some patients, there were small bilateral pulmonary nodules, confluent consolidations, and bronchiectasis. In case of atypical radiological findings other than bilateral infiltrates and ground glass opacities, further investigation, such as blood and BAL serology, lung biopsy HPE, and immunohistochemistry, should be considered to rule out CMV pneumonia [7].

Blood serology was done in 40 (89%) patients, and IgM and IgG were positive for CMV. Other tests, such as BAL fluid serology, lung biopsy histopathology, and IHC, were done to confirm the diagnosis in some patients. IgM CMV positive in blood represents acute CMV infection, and antiviral treatment was given to the patients with a successful outcome [2, 5].

Regarding treatment, 38 (85%) patients received antiviral therapy, and 2 patients recovered without receiving antiviral treatment. In total, 89% of patients recovered, indicating that the prognosis of CMV pneumonia is good if diagnosed early and treated in time, in both immunocompetent and immunocompromised patients [2]. A study by Al-Eyadhy *et al* in 2017 presented the case of a 12-year-old immunocompetent patient who was admitted with severe ARDS and developed multi-organ failure, which is an important differential diagnosis from SARS-CoV-2. Due to the correct diagnosis and treatment of CMV infection in time, the patient recovered [12]. Another study by Coussement *et al* in 2016 showed that a 63-year-old immunocompromised patient who did a bilateral lung transplant for chronic obstructive pulmonary disease admitted with severe CMV infection and due to timely diagnosis and antiviral treatment, the patient recovered well [22].

In immunocompetent patients, the recovery rate was 94%, while in immunocompromised patients, it was 86%. The study showed that there were four deaths, three of which were among immunocompromised patients. This suggests that immunocompromised patients may develop more severe CMV illness that deteriorates

quickly, sometimes making it challenging to make a timely diagnosis. Therefore, it is crucial to consider CMV infection as one of the important differentials in immunocompromised patients [1, 4].

A study by Basinger *et al* [3] demonstrated that immunocompromised states, particularly those with a history of allogenic hematopoietic stem cell transplant, can result in rapidly deteriorating conditions and respiratory status post-CMV infection. Radiologically, patients may present with rapidly progressive bilateral pulmonary nodules approximately two months after receiving a bone marrow transplant. This patient died shortly after admission, and the diagnosis was made on post-mortem microscopic examination of the pulmonary nodules that demonstrated viral cytopathologic changes consistent with CMV, confirmed by IHC. It is essential to note that the radiographic presentation is not always GGO, and rapidly enlarging pulmonary nodules in an immunosuppressed patient are highly suggestive of an infectious process. Therefore, careful histologic examination for viral cytopathologic changes is essential [3].

The final result of this analysis showed that 89% of total patients recovered, indicating that the prognosis of CMV pneumonia is good if patients are diagnosed early and treated promptly, even for immunocompromised patients [1, 4].

To reach a definitive diagnosis, clinical findings must be correlated with imaging tests and laboratory tests. Polymerase chain reaction (PCR) is the most sensitive method of detecting CMV, and quantitative real-time PCR (qRT-PCR) can be used to quantify viral loads in blood and bronchoalveolar lavage (BAL) fluid. BAL CMV-PCR is considered the most accepted approach for viral isolation in the lungs due to its high sensitivity. Lung biopsy histopathology is considered the gold standard for the diagnosis of pulmonary CMV infections, and the presence of CMV inclusions in the histopathological examination (HPE) report is confirmatory of lung infection. Additionally, CMV can be detected by immunohistochemical (IHC) staining for CMV in cytologic specimens of bronchial lavage fluid [1, 2].



10

In critically ill patients, cytomegalovirus infection is associated with prolonged mechanical ventilation, nosocomial infections, prolonged hospital and ICU stay, and increased mortality. The first-line treatment for CMV disease is intravenous (IV) ganciclovir and its prodrug, oral valganciclovir. Mild disease in immunosuppressed patients may be treated with oral valganciclovir, while severe illness is treated with IV ganciclovir or foscarnet at full doses (adjusted for renal function), followed by valganciclovir. Treatment at full doses should be continued until the resolution of symptoms and blood antigenemia (or DNAemia) is cleared. The prognosis of CMV pneumonia is good if patients are diagnosed and treated at an early stage [1, 2, 4]. A systematic review that aims to understand the pattern, presentations, clinical course, and outcome of patients with COVID-19 and cytomegalovirus coinfection and analyzed data from 34 reports with 59 patients. The results showed that middle-aged and elderly patients with comorbidities were more susceptible to coinfection, and cytomegalovirus colitis was the most common manifestation of end-organ involvement. The findings of this study may assist in detecting and treating patients with unusual clinical courses or severe, prolonged, or unexplained deterioration of end-organ function [66].

## **CONCLUSION**

### **Conclusion**

In conclusion, CMV pneumonia is a serious complication in both immunocompromised and immunocompetent patients, with a higher morbidity and mortality rate in the former group. The diagnosis of CMV pneumonia can be challenging as it may present with nonspecific clinical and radiological features similar to COVID-19 pneumonia. Therefore, it is crucial to consider CMV infection as a differential diagnosis in immunocompromised patients with respiratory symptoms. Early diagnosis and treatment with antiviral therapy can lead to a good prognosis, while delayed diagnosis and treatment can lead to a more severe illness and potentially fatal outcomes. Clinicians should have a high index of suspicion for CMV pneumonia in immunocompromised patients and perform appropriate diagnostic tests, such as PCR

and histopathological examination. Further research is needed to better understand the pathogenesis, risk factors, and optimal management of CMV pneumonia.

## **ARTICLE HIGHLIGHTS**

### ***Research background***

Cytomegalovirus (CMV) is a DNA virus that can cause severe disease, including viral pneumonitis, in immunocompromised patients. The incidence of CMV infection is high in recipients of hematopoietic stem cells transplantation. CMV infection is acquired through close physical contact involving direct inoculation with infected cells or body fluids, and transmission can occur from the donor organ of a CMV-seropositive donor. Mothers infected with CMV during pregnancy may transmit this infection to their newborn baby, leading to congenital CMV, which is one of the leading causes of miscarriage. CMV infection is one of the three most common causes of severe viral community-acquired pneumonia (CAP), along with influenza and adenovirus, although this has changed with the emergence of Severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) in 2020.

### ***Research motivation***

As the COVID-19 pandemic continues and becomes an endemic, it is crucial to recognize that not all clinical and radiological presentations are solely attributable to COVID-19. Therefore, diagnostic differentiation is essential, and ground-glass opacities (GGOs) must be evaluated in conjunction with other imaging findings, laboratory tests, and clinical features to reach a definitive diagnosis. Cytomegalovirus (CMV) pneumonia can be diagnosed by detecting the virus in serum and/or respiratory samples such as bronchoalveolar lavage (BAL) or tracheal aspiration. Quantitative real-time PCR (qRT-PCR) can be utilized to measure viral loads in blood and BAL fluid. Lung biopsy histopathology is considered the gold standard for diagnosing pulmonary CMV infections, with the presence of cytomegalovirus inclusion

bodies (owl+ACY-rsquo+ADs-s eye) in biopsy specimens being confirmatory of lung infection. However, the diagnostic yield of lung biopsy for diagnosing lung CMV infections can vary, and the study of CMV pneumonia in immunocompetent patients with GGOs on chest CT remains limited.+ADw-/p+AD4APA-/html+AD4-

### ***Research objectives***

This study aims to report a case of CMV pneumonia in an immunocompetent patient with GGOs on chest CT, to review the literature on the clinical, radiological, and laboratory features of CMV pneumonia in immunocompetent hosts, and to discuss the diagnostic workup and management of CMV pneumonia.

### ***Research methods***

+ADw-html+AD4APA-p+AD4-This study followed the PRISMA guidelines and aimed to identify case reports and case series studies related to pulmonary complications of CMV infection. The electronic database MEDLINE (PubMed) was searched in September and October 2022 without any publication date restrictions, and only studies written in English were included. The selection criteria were case reports or case series studies of pulmonary complications of CMV infection. The studies having other co-existing causes of pneumonia such as bacterial, parasitic or fungal infections in existing CMV pneumonia and those with other lung pathologies were excluded. Data extraction was performed on the characteristics of the subjects and the outcomes measured from each eligible study. The study selection process involved screening titles, abstracts, and full-length papers to filter out non-relevant studies. Finally, a table of extracted data on eligible studies was made to identify patterns. The patient case report presented in the article <sup>17</sup> was included in the study as it met the inclusion criteria. The patient was diagnosed with disseminated CMV infection and received ganciclovir therapy, resulting in complete recovery from symptoms and sustained undetectable viral load after 6 wk of treatment.+ADw-/p+AD4APA-/html+AD4-



### ***Research results***

The results of the study showed that out of 435 references retrieved, 45 case reports of pulmonary CMV infection were included after analyzing abstracts and full-length papers. All the included case reports were analyzed to measure and identify patterns to reach the conclusion. The majority of the patients (58%) were males, and more than half (55.6%) were in the age group of 16-45 years. Fever, dyspnea, and cough were the most common symptoms reported by patients, and respiratory distress was observed in 58% of them. A significant number of patients (64%) were found to be immunocompromised. Radiographic findings were reported in 71% of the patients, and blood/serum was the most commonly used method for serology testing. Immunohistochemistry was reported in 24% of the cases, and biopsy-histopathology was performed in 27% of the patients. The treatment was reported in 84% of the cases, with a high recovery rate of 89%. Unfortunately, the mortality rate was 9%, with four patients reported to have died. These findings suggest that pulmonary CMV infection is a serious respiratory illness that primarily affects immunocompromised individuals. It presents with typical symptoms of respiratory distress, fever, and cough, and radiographic findings can be useful in making a diagnosis. Blood/serum testing is the most commonly used diagnostic method, but immunohistochemistry and biopsy-histopathology may be necessary in some cases. With timely and appropriate treatment, the majority of patients recover, but the mortality rate is still significant. These results highlight the importance of early diagnosis and prompt treatment of pulmonary CMV infection, particularly in immunocompromised individuals, to improve outcomes and reduce mortality rates.

### ***Research conclusions***

+ADw-html+AD4APA-p+AD4-The study analyzed 45 cases of CMV-induced pneumonia and showed that CMV infection is more prevalent in immunocompromised patients. However, this case highlights that it can also occur in immunocompetent individuals. The prevalence of CMV-induced pneumonia may increase with age. The

clinical findings of most patients were fever, dyspnea, cough, and respiratory distress in both immunocompetent and immunocompromised patients. Radiological findings mostly showed bilateral diffuse pulmonary infiltrates and bilateral ground-glass opacities. Blood serology was positive for CMV, and antiviral treatment was given to the patients with a successful outcome. The recovery rate was 94% in immunocompetent patients and 86% in immunocompromised patients. Four deaths were reported, and three were among immunocompromised patients.

### *Research perspectives*

Further studies can be conducted to compare the prevalence of CMV-induced pneumonia in different age groups and genders. More research can also be done to investigate the possible link between CMV infection and COVID-19. Additionally, future studies can be conducted to evaluate the effectiveness of antiviral therapy in preventing the development of severe CMV illness and to determine the optimal duration of treatment. Finally, more research is needed to explore the pathophysiology and immunology of CMV-induced pneumonia to better understand the mechanisms behind the more severe disease in immunocompromised patients.

### **ACKNOWLEDGEMENTS**

I would like to extend my sincere appreciation to the Acute Medicine MSc program at the University of South Wales for their invaluable assistance in our work. We acknowledge and commend the University of South Wales for their commitment to providing advanced problem-solving skills and life-long learning opportunities for healthcare professionals.

12%

SIMILARITY INDEX

PRIMARY SOURCES

1	Sonia M. Restrepo-Gualteros, Maria J. Gutierrez, Milena Villamil-Osorio, Maria A. Arroyo, Gustavo Nino. "Challenges and Clinical Implications of the Diagnosis of Cytomegalovirus Lung Infection in Children", Current Infectious Disease Reports, 2019 Crossref	104 words — 2%
2	<a href="http://www.ncbi.nlm.nih.gov">www.ncbi.nlm.nih.gov</a> Internet	62 words — 1%
3	<a href="http://www.oncotarget.com">www.oncotarget.com</a> Internet	58 words — 1%
4	<a href="http://link.springer.com">link.springer.com</a> Internet	53 words — 1%
5	<a href="http://doaj.org">doaj.org</a> Internet	50 words — 1%
6	<a href="http://www.uptodate.com">www.uptodate.com</a> Internet	31 words — 1%
7	<a href="http://www.researchgate.net">www.researchgate.net</a> Internet	25 words — 1%
8	Charles B Pasque, Alexander J Pappas, Chad A Cole Jr. "Intramedullary bone pedestal formation contributing to femoral shaft fracture nonunion: A case report	24 words — 1%

and review of the literature", World Journal of Orthopedics,  
2022

Crossref

- 
- 9 [mail.openaccesspub.org](mailto:openaccesspub.org) 18 words — < 1%  
Internet
- 
- 10 [www.science.gov](http://www.science.gov) 18 words — < 1%  
Internet
- 
- 11 Kewei Ma, Jieliang Chen. "Omicron XE emerges as SARS-CoV-2 keeps evolving", The Innovation, 2022 15 words — < 1%  
Crossref
- 
- 12 Steven E. Kossman, Mark A. Weiss. "Acute myelogenous leukemia after exposure to strontium - 89 for the treatment of adenocarcinoma of the prostate", Cancer, 2000 15 words — < 1%  
Crossref
- 
- 13 [www.semanticscholar.org](http://www.semanticscholar.org) 15 words — < 1%  
Internet
- 
- 14 [docksci.com](http://docksci.com) 14 words — < 1%  
Internet
- 
- 15 Ehsan Taherifard, Hamed Movahed, Sima Kiani Salmi, Ali Taherifard, Saeed Abdollahifard, Erfan Taherifard. "Cytomegalovirus coinfection in patients with severe acute respiratory syndrome coronavirus 2 infection: a systematic review of reported cases", Infectious Diseases, 2022 13 words — < 1%  
Crossref
- 
- 16 [dokumen.pub](http://dokumen.pub) 13 words — < 1%  
Internet

---

17 Amir Asharlous, Hassan Hashemi, Abbasali Yekta, Mohamadreza Aghamirsalim et al. "Topographic properties of the cornea in welders", European Journal of Ophthalmology, 2020 12 words — < 1%

Crossref

---

18 B Sanjay Harhangi, Tomas Menovsky, Hans A.L. Wurzer. "Hemothorax as a Complication after Anterior Cervical Discectomy: Case Report", Neurosurgery, 2005 12 words — < 1%

Crossref

---

19 www.ijbcp.com 12 words — < 1%

Internet

---

20 www.wjgnet.com 12 words — < 1%

Internet

---

EXCLUDE QUOTES ON

EXCLUDE SOURCES OFF

EXCLUDE BIBLIOGRAPHY ON

EXCLUDE MATCHES < 12 WORDS