Medical Research Archives

ESMED
European Society of Medicine

OPEN ACCESS

Published: July 10, 2023

Citation: Gil MR, Keenan L, et al., 2023. Bacterial Pneumonia in Patients with Sars-Cov-2 Omicron Infection: A Case Series, Medical Research Archives, [online] 11(7). https://doi.org/10.18103/mra.v11i7.1.4011

DOI
https://doi.org/10.18103/mra.v11i7.1.4011

ISSN: 2375-1924

CASE REPORT

Bacterial Pneumonia in Patients with Sars-Cov-2 Omicron Infection: A Case Series

Ryan M Gil*, Lynn Keenan, Nathan Dean

University of Utah

*Correspondence: ryan.gil@hsc.utah.edu

ABSTRACT:
Recent SARS-coV-2 subvariants (BQ.1.1, BA.2, BA.4, BA.5, collectively referred to as Omicron) are adept at evading the immune system but tend to be less severe with fewer hospitalizations and deaths. The incidence of bacterial co-infection at time of admission for SARS-COV-2 related illness early in the COVID pandemic was low. In 2022 when few relatively healthy patients were being admitted, we report three patients found to have bacterial co-infection with pneumococcal and staphylococcal species at time of hospital admission. Varying practices abound, including use of procalcitonin as a screening tool for bacterial coinfection in patients with SARS-coV-2 infection despite a recommendation against this practice in recent pneumonia treatment guidelines. In our cases the use of procalcitonin did not lead to antibiotic delay, however we propose a clinical support rule that can be utilized in the Emergency Department to more accurately guide empiric use of antibiotics in this patient population.

Keywords: Streptococcal pneumonia, Sars-Cov2, Staphylococcus, MSSA, co-infection, bacteremia

Introduction:

Several strains of SARS-CoV-2 have been identified, each causing "waves" of infections, however vaccination and prior infections have recently blunted severity of illness with lower morbidity and mortality [1-3]. Early in the pandemic empiric antibiotic use was widespread, however the prevalence of bacterial co-infection was low at time of hospitalization [4]. The Infectious Disease Association of America (IDSA) recommended against use of empiric antibiotic for this reason [5]. However, it can be challenging to identify whether bacterial co-infection is present and missed bacterial coinfection can lead to severe consequences. The prevalence of co-infection varies considerably depending on the patient population, with some studies suggesting higher rates of co-infection in ICU patients [6]. A large retrospective study included patients admitted to an ICU with either SARS-CoV-2 or Influenza. The prevalence of co-infection was 9.7% vs 33.6% in the COVID and influenza groups respectively. Bacterial infection was most often diagnosed via tracheal aspirate obtained within 24 hours of intubation. Those who had bacterial coinfection with COVID had worse outcomes as compared to coinfection associated with Influenza [7]. Efforts to differentiate viral from bacterial pneumonia include the use of procalcitonin, an inflammatory marker that has been previously studied for antibiotic initiation in lower respiratory tract infections, with mixed results [8]. This tool has also been used in an attempt to identify co-infection in patients with either Influenza or COVID [7], but several factors limit its use in clinical practice. In this case series, we present three previously healthy patients with positive SARS-CoV-2 testing found to have bacterial co-infection causing severe pneumonia at time of hospital admission. We propose a clinical tool to be used in the Emergency Department or hospital wards that could more accurately identify bacterial co-infections in patients positive for SARS-coV-2 infection.

Methods:

We present a retrospective case series of three patients during 2022; all completed informed consent. Data was collected via chart review by the author (RG). All were confirmed to have SARS-CoV-2 by Polymerase Chain Reaction (PCR) detection of SARS-CoV-2 and bacterial co-infection with either a streptococcal urine antigen test, blood culture or fluid cultures. An arterial blood gas (ABG) was available in the third patient, allowing for accurate assessment of the PaO2:FiO2 (P/F) ratio, however in the first and second patient the P/F ratio was calculated utilizing the Ellis equation to calculate PaO2 from SpO2. This equation has shown adequate correlation with PaO2 measured from ABGs in a previous study [9]. All reported labs and imaging were obtained at time of hospital admission.

Results:

The first case is a previously healthy COVID vaccinated 39-year-old female with positive SARS-CoV-2 PCR. She had mild symptoms that progressed to include worsening fevers, chills, right-sided anterior chest pain and productive cough. In the Emergency Department (ED) she was tachycardic, tachypneic and hypoxemic on room air with oxygen saturation of 86%. See **Table 1** for labs and **Figure 1** for imaging. Thoracentesis removed 500cc with fluid cultures, blood cultures and a urinary strep antigen all positive for *Streptococcus pneumoniae*. She was discharged on prolonged antibiotics. She has since established care with pulmonology due to persistent symptoms of exertional dyspnea and chest pain that have been transiently responsive to antibiotics and steroids. She has also had an extensive workup including bronchoscopy and cryobiopsy with pathology demonstrating evidence of chronic scarring thought to be due to her prior pneumonia. Her symptoms have gradually improved.

The second case is a COVID vaccinated 56-year-old female with a prior history of gastric bypass, asthma, heart failure with preserved ejection fraction (HFpEF) and obesity (BMI 31) tested positive for SARS-CoV2 after presenting to the ED for progressive dyspnea. See **Table** 1 for labs. Micrologic workup was significant for blood cultures that grew methicillin sensitive *Staphylococcus aureus* (MSSA). Imaging showed multifocal ground glass opacities that progressed to cavitary pneumonia **(Figure 1)**. She was treated with prolonged antibiotics at discharge. She was re-admitted less than one month later with increasing dyspnea. Repeat imaging was concerning for an enlarging cavitary lesion and antibiotics were changed to continuous IV nafcillin and metronidazole. She was treated for an acute HFpEF exacerbation with oral furosemide. She has continued to endorse mental function changes as a result of her infection, however her respiratory symptoms have gradually improved.

The third case is an unvaccinated 45-year-old male with a past medical history of HTN, GERD, alcohol and opioid use disorder tested positive for SARS-CoV2 after four days of upper respiratory symptoms, fevers, emesis, weakness, chest pain and cough. In the emergency department, oxygen saturation was 75% on room air; he was intubated, and admitted to the intensive care unit. He also

received treatment for severe ARDS including paralysis and proning. See **Table 1** for labs and **Figure 1** for imaging. Infectious workup was significant for a positive streptococcal urine antigen. Blood and sputum cultures were negative. He was treated with remdesivir, dexamethasone, and antibiotics. While in the ICU, the patient had a cardiac event in which a ST elevation myocardial infarct was suspected. Coronary angiography did not show any vessel disease, however a transthoracic echocardiograph revealed global left ventricle hypokinesis and a left ventricular ejection fraction of 38%. This was felt to be due to stress cardiomyopathy. At time of discharge, he required supplemental O2 at a rate of 2L/min.

A.

B.

C.

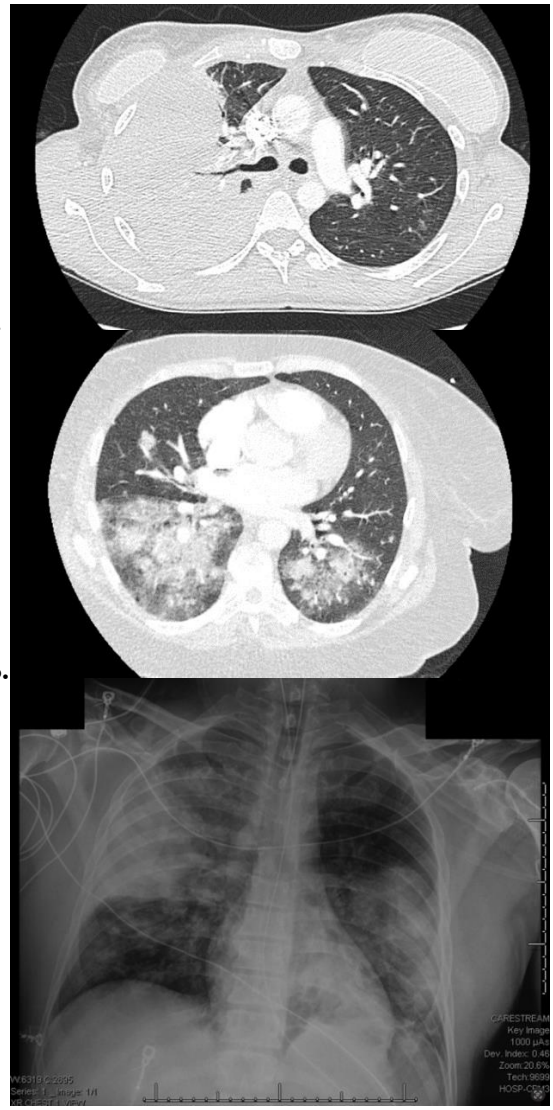

Figure 1: Initial chest imaging at time of admission to the hospital. **Panel A** CTPA shows a large pleural R sided pleural effusion with associated compressive atelectasis, patient 1. **Panel B** CTPA shows bilateral lower lobe consolidative and ground glass opacities, patient 2. **Panel C** CXR showing bilateral consolidations, patient 3.

Discussion

Here we report three patients with severe bacterial pneumonia and positive SARS-coV-2 PCR at a time when severe hypoxemic respiratory failure in COVID patients has become uncommon. Two of the three patients had typical symptoms of a viral infection that acutely worsened leading up to their hospitalization, however one did not. Two met criteria for mild Acute Respiratory Distress Syndrome (ARDS) and had elevated procalcitonin levels, while the last patient met criteria for severe ARDS and did not have a procalcitonin level drawn during his admission. The use of procalcitonin has widespread clinical variability and remains a topic of controversy amongst hospital providers. Several industry funded studies promoted procalcitonin as a method to differentiate between viral and bacterial pneumonias, with an elevated procalcitonin level suggesting a bacterial process [10]. They suggested that procalcitonin levels >0.25 µg/L indicate a high likelihood of a bacterial process as compared to levels <0.1 µg/L [11]. However, other studies suggest no precise cut-off value exists that accurately delineates viral from bacterial infection [12]. The sensitivity and specificity of procalcitonin is variable amongst studies, making it an imperfect guide for antibiotic prescribing practices [13, 14]. Finally, a study from 2018 demonstrated the use of procalcitonin did not alter antibiotic-days in patients with suspected lower respiratory tract infections [8].

Because of the uncertainty associated with procalcitonin, the 2019 ATS/IDSA guidelines recommend against its use when determining need for antibiotic administration in patients with community-acquired pneumonia [15]. A recent retrospective study reviewed 2443 patients with SARS-CoV-2. 148 patients had bacterial co-infection at time of hospitalization. The mean procalcitonin level in this group was elevated (mean procalcitonin level 13.2ng/dL), however those with SARS-CoV-2 without co-infection also had elevated procalcitonin levels (mean 2ng/dL). Using a cutoff of 0.5ng/dL, the positive predictive value (PPV) of identifying a bacterial co-infection was 0.088, whereas the negative predictive value (NPV) was 0.95 [16]. It may be that procalcitonin is more useful in determining severity of an infectious or inflammatory process rather than in distinguishing viral from bacterial processes [17]. Fortunately, antibiotics were only delayed in one of our cases, and antibiotics were promptly initiated on admission to the ICU in the third.

Given the limited utility of procalcitonin, we propose a clinical support rule for empiric antibiotic therapy. If a patient tests positive for SARS-CoV-2 within the prior 7 days, we suggest the following

criteria to help guide empiric antibiotics: WBC count of <4.0 K/mcL or >11.0 K/mCL; absolute immature PMN greater or equal to 0.1 or if the sum of bands, metamyelocytes and myelocytes on manual differential is greater than or equal to 10%; consolidations or air bronchograms on imaging. If any of the above criteria suggest bacterial infection in patients with recent SARs-CoV-2 infection, empiric antibiotics per the 2019 pneumonia guidelines should be initiated [15]. All of our patients had a WBC that was consistent with the above rule. 2 patients also had a manual differential that demonstrated the presence of >10% bands. The third patient have a manual differential obtained. All had consolidations with air bronchograms on chest imaging. A larger study is required to validate this clinical tool and determine whether it also can be applied to patients with respiratory viral infections other than SARS-coV-2.

Conclusion

SARs-CoV-2 remains a common respiratory pathogen despite easing of illness severity. Natural immunity, vaccination, and ongoing viral mutations all have contributed to this phenomenon. Identification of bacterial co-infection remains challenging. Serologic markers have been used in an attempt to easily identify patients in whom antibiotics would benefit, however these serologic markers are imperfect. We report three cases of bacterial co-infection with SARs-CoV-2 that led to severe hypoxemic respiratory failure. Detection of a bacterial co-infection may be difficult and tools such as procalcitonin have poor sensitivity and specificity. We propose a clinical support rule to assist in this decision although this requires validation in additional patients.

Conflict of Interest: None

Table 1: Pertinent laboratory results at time of hospital admission.

	Patient 1	Patient 2	Patient 3
CBC			
WBC, K/mcL	25.7	15.5	0.95
Hgb, g/dL	12.7	9.4	15.3
Plt, K/mcL	386	321	216
	15% bands	12% bands	N/a
Chemistry			
Na, mEq/L	124	135	128
BUN, mg/dL	44	17	22
Cr, mg/dL	1.24	0.61	1.14
Inflammatory markers			
D-dimer, mcg FEU/mL	3.39	1.68	1.88
LDH, U/L	499	247	N/a
Ferritin, ng/mL	1155	210	N/a
Procalcitonin, ng/mL	6.33	32.57	N/a
CRP, mg/dL	25.5	40.6	40.7
*P/F ratio**	266.7†	251.7†	76.4

Note: *P/F: Ratio of the partial pressure of oxygen in arterial blood and fraction of inspired oxygen. †Calculated using nonlinear computation utilizing SpO2.

References

1. Johnson, A.G., et al., *COVID-19 Incidence and Death Rates Among Unvaccinated and Fully Vaccinated Adults with and Without Booster Doses During Periods of Delta and Omicron Variant Emergence - 25 U.S. Jurisdictions, April 4-December 25, 2021*. MMWR Morb Mortal Wkly Rep, 2022. **71**(4): p. 132-138.
2. Strasser, Z.H., et al., *Estimates of SARS-CoV-2 Omicron BA.2 Subvariant Severity in New England*. JAMA Netw Open, 2022. **5**(10): p. e2238354.
3. Ulloa, A.C., et al., *Estimates of SARS-CoV-2 Omicron Variant Severity in Ontario, Canada*. JAMA, 2022. **327**(13): p. 1286-1288.
4. Vaughn, V.M., et al., *Empiric Antibacterial Therapy and Community-onset Bacterial Coinfection in Patients Hospitalized With Coronavirus Disease 2019 (COVID-19): A Multi-hospital Cohort Study*. Clin Infect Dis, 2021. **72**(10): p. e533-e541.
5. Bhimraj, A., et al., *Infectious Diseases Society of America Guidelines on the Treatment and Management of Patients with COVID-19*. Clin Infect Dis, 2022.
6. Kreitmann, L., et al., *Early bacterial co-infection in ARDS related to COVID-19*. Intensive Care Med, 2020. **46**(9): p. 1787-1789.
7. Rouzé, A., et al., *Early Bacterial Identification among Intubated Patients with COVID-19 or Influenza Pneumonia: A European Multicenter Comparative Clinical Trial*. Am J Respir Crit Care Med, 2021. **204**(5): p. 546-556.
8. Huang, D.T., et al., *Procalcitonin-Guided Use of Antibiotics for Lower Respiratory Tract Infection*. N Engl J Med, 2018. **379**(3): p. 236-249.
9. Brown, S.M., et al., *Nonlinear Imputation of Pao2/Fio2 From Spo2/Fio2 Among Patients With Acute Respiratory Distress Syndrome*. Chest, 2016. **150**(2): p. 307-13.
10. Schuetz, P., et al., *Procalcitonin to initiate or discontinue antibiotics in acute respiratory tract infections*. Cochrane Database Syst Rev, 2017. **10**(10): p. CD007498.
11. Christ-Crain, M., et al., *Procalcitonin guidance of antibiotic therapy in community-acquired pneumonia: a randomized trial*. Am J Respir Crit Care Med, 2006. **174**(1): p. 84-93.
12. Self, W.H., et al., *Procalcitonin as a Marker of Etiology in Adults Hospitalized With Community-Acquired Pneumonia*. Clin Infect Dis, 2018. **66**(10): p. 1640-1641.
13. Kamat, I.S., et al., *Low procalcitonin, community acquired pneumonia, and antibiotic therapy*. Lancet Infect Dis, 2018. **18**(5): p. 496-497.
14. Kamat, I.S., et al., *Procalcitonin to Distinguish Viral From Bacterial Pneumonia: A Systematic Review and Meta-analysis*. Clin Infect Dis, 2020. **70**(3): p. 538-542.
15. Metlay, J.P., 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 Respir Crit Care Med, 2019. **200**(7): p. e45-e67.
16. May, M., et al., *Limited Utility of Procalcitonin in Identifying Community-Associated Bacterial Infections in Patients Presenting with Coronavirus Disease 2019*. Antimicrob Agents Chemother, 2021. **65**(4).
17. Gautam, S., et al., *Severe respiratory viral infection induces procalcitonin in the absence of bacterial pneumonia*. Thorax, 2020. **75**(11): p. 974-981.