Journal of Community Hospital Internal Medicine Perspectives

Volume 12 | Issue 5 Article 22

2022

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William Gatenby
Georgetown University School of Medicine, wag40@georgetown.edu

Gifty Dominah
Johns Hopkins Medicine

Amrit Paudel
Medstar Franklin Square Medical Center

Nahar Saleh
Medstar Franklin Square Medical Center

Recommended Citation

Gatenby, William; Dominah, Gifty; Paudel, Amrit; and Saleh, Nahar (2022) "A Chronic Obstructive Pulmonary Disease Exacerbation Following the Administration of a COVID 19-Booster Vaccine: A Case Report," *Journal of Community Hospital Internal Medicine Perspectives*: Vol. 12: Iss. 5, Article 22.
DOI: 10.55729/2000-9666.1107
Available at: https://scholarlycommons.gbmc.org/jchimp/vol12/iss5/22

CASE REPORT

A Chronic Obstructive Pulmonary Disease Exacerbation Following the Administration of a COVID 19-Booster Vaccine: A Case Report

William Gatenby [a,*], Gifty Dominah [b], Amrit Paudel [c], Nahar Saleh [c]

[a] Georgetown University School of Medicine, United States
[b] Johns Hopkins Medicine, United States
[c] Medstar Franklin Square Medical Center, United States

Abstract

We present a case of a patient who presented to the emergency department with symptoms suggestive of a chronic obstructive pulmonary disease (COPD) exacerbation one day after receiving the BNT162b2 COVID-19 booster vaccine. Laboratory studies indicated she was in a state of inflammation, but not infection. Other potential triggers, including cardiac and viral etiologies, were ruled out. To our knowledge, this is the first documented case of a COPD exacerbation following the administration of the BNT162b2 COVID-19 vaccine.

Keywords: COVID-19 vaccine, Chronic obstructive pulmonary disease, COVID-19, BNT162b2 mRNA Covid-19 vaccine, Pulmonary disease, Internal medicine

1. Introduction

Since the emergence of the SARS COVID-19 virus numerous vaccines have been developed to combat it. New technologies utilizing mRNA were implemented, providing effective protection against the most severe forms of infection caused by the virus. The BNT162b2 (Pfizer/BioNTech) COVID-19 vaccine has a reported efficacy of 95% after two doses,[1] with a 3rd dose conferring even greater protection.[2] However, with this new vaccine technology came uncertainty about safety. Commonly, patients report headache, fever, and muscle aches following vaccine administration, with a 0.6% incidence rate of serious adverse events.[1] However, we are still observing and studying the mechanism of these vaccines and the effect they can have on different patient populations.

2. Case

A 75 year old African American woman presented to the Emergency Department (ED) complaining of shortness of breath and a cough producing white sputum for 2 days. The patient's son had been monitoring her oxygen status, which showed a drop in her oxygen saturation (SpO2) from her baseline of 95%−88%, prompting him to bring her to the ED. Upon arrival the patient had an SpO2 of 82% and a heart rate of 101 beats per minute. Notably, she was afebrile, with a temperature of 36.6 °C. On physical exam the patient was noted to be wheezing and breathing with difficulty.

She had a history of COPD treated with Symbicort (an inhaled corticosteroid), Spiriva (an inhaled muscarinic antagonist), and albuterol, and she was not on any home oxygen. Her additional past medical history included a diagnosis of paroxysmal atrial fibrillation on a direct oral anticoagulant, hypertension, hyperlipidemia, and obstructive sleep apnea.

When questioned, the patient denied any fevers, chills, nausea, vomiting, diarrhea, or sore throat. She also denied any recent contact or exposures to someone with COVID-19. She stated that she does not smoke, nor does anyone in her household, she

Received 9 May 2022; revised 7 September 2022; accepted 30 June 2022.
Available online 9 September 2022

* Corresponding author.
E-mail address: wag40@georgetown.edu (W. Gatenby), gifty.a.dominah@medstar.net (G. Dominah), amrit.paudel@medstar.net (A. Paudel), nahar.saleh@medstar.net (N. Saleh).

https://doi.org/10.55729/2000-9666.1107

Table 1. Infectious disease screening tests.

Pathogen Tested	Result
Adenovirus DNA	Not detected
Bordetella_pertussis	Not detected
Chlamydophila_pneumoniae	Not detected
Coronavirus_229E (not COVID-19)	Not detected
Coronavirus_HKU1 (not COVID-19)	Not detected
Coronavirus_NL63 (not COVID-19)	Not detected
Coronavirus_OC43 (not COVID-19)	Not detected
COVID19 (SARS-CoV-2)	Not detected
COVID-19/Coronavirus RNA PCR	Not detected
Human Metapneumovirus	Not detected
Human_Rhinovirus/Enterovirus	Not detected
Influenza A RNA PCR	Not detected
Influenza B RNA PCR	Not detected
Influenza_A	Not detected
Influenza A H1	Not detected
Influenza A H3	Not detected
Influenza A H1N1/pdm09	Not detected
Influenza_B	Not detected
Mycoplasma_pneumoniae	Not detected
Parainfluenza_1	Not detected
Parainfluenza_2	Not detected
Parainfluenza_3	Not detected
Parainfluenza_4	Not detected
Respiratory Syncytial_Virus	Not detected
RSV RNA PCR	Not detected
Bacterial Sputum Culture	Growth: Normal Upper Respiratory Flora

was not exposed to any chemical fumes or burnt substances, and there are no pets in her home. There had been no new medications adjustments either.

The only recent change that the patient or her son could identify was the administration of a Pfizer COVID 19 booster vaccine one day before her symptoms began. The patient had previously received the Johnson & Johnson COVID-19 vaccine 11 months prior.

Following her arrival to the ED, the patient was hypoxic requiring 3L of supplemental oxygen via nasal cannula. She was also prescribed prednisone, Duoneb (ipratropium bromide/albuterol combination medication) and a one time dose of doxycycline.

The patient tested negative for a variety of respiratory viruses including COVID-19 (Table 1). A bacterial sputum culture was performed as well, which after 3 days grew normal upper respiratory flora.

An EKG and cardiac enzymes were within normal limits. A chest radiograph (x-ray) demonstrated subtle patchy opacifications consistent with a COPD exacerbation, and no consolidations or pleural effusions. A normal cardiac silhouette was also observed.

Due to the severity of her symptoms she was admitted to the hospital for further observation and provided with supplemental oxygen, 40 mg prednisone and Duoneb daily, and her home medications.

Throughout her hospital stay she remained afebrile. Her laboratory values were significant for an elevated erythrocyte sedimentation rate and C-reactive protein, but a normal white blood cell count (Table 2).

She was slowly weaned off supplemental oxygen over the course of her 5 day hospitalization. On discharge some mild wheezing was appreciated during a physical exam, though decreased in severity compared to when she was admitted. The medical team recommended that she be evaluated by an outpatient pulmonologist to assess lung function, and she was sent home.

Table 2. Inflammatory and infectious laboratory values during hospitalization.

	Value on Admission	Value 1 day post admission	Value 2 days post admission	Units of Measure
WBC	10.0	8.6	6.8	k/uL
Neutrophil %	57.8	77.3	59.7	%
Lymphocyte %	22.9	11.4	19.1	%
Monocyte %	17.3	11.0	18.0	%
Eosinophil %	1.7	0.0	2.8	%
Basophil %	0.1	0.1	0.3	%
Neutrophil Absolute	5.8	6.6	4.0	k/uL
Lymphocyte Absolute	2.3	1.0	1.3	k/uL
Monocyte Absolute	1.7 H	0.9	1.2	k/uL
Eosinophil Absolute	0.2	0.0	0.2	k/uL
Basophil Absolute	0.0	0.0	0.0	k/uL
Imm Granulocyte %	0.2	0.2	0.1	%
Imm Granulocyte Absolute	0.02	0.02	0.01	k/uL
Erythrocyte Sedimentation Rate		73		mm/hr
C-Reactive Protein		58.49		mg/L

3. Discussion

This is a patient with a history of COPD who presented with symptoms of COPD exacerbation. Her improvement in symptoms following steroid and inhaled anti-inflammatory medications further strengthens this diagnosis. She also possessed an elevated erythrocyte sedimentation rate and C-reactive protein (Table 2), indicating a state of inflammation.

However, this patient had no signs of infection. Her white blood cell count was within the normal range (Table 2), and she lacked any signs of pneumonia or infectious consolidation on her chest x-ray. Furthermore, she remained afebrile during her entire hospitalization. Common viral infections were ruled out with a negative respiratory viral panel (Table 1).

The patient's history is absent for potential triggers, as she denies any exposure to allergens, cigarette smoke, or other airway irritants.

We believe that it is likely that she had an inflammatory response to the BNT162b2 COVID-19 vaccine which triggered her COPD exacerbation. The timeline supports this, as her symptoms began only one day after receiving the vaccine. That she had already received a Johnson and Johnson COVID-19 vaccine and had no notable reaction does not preclude this as a possibility. The Johnson and Johnson vaccine utilizes a modified adenovirus to carry COVID-19 viral particles into a patient's cells, which then allows the immune system to recognize and fight COVID-19. The BNT162b2 COVID-19 vaccine works via a different mechanism, and therefore would be novel to the patient's immune system.[3]

As of now there is scant literature on interactions between the BNT162b2 and the Johnson and Johnson COVID-19 vaccine. The CDC does recommend an mRNA vaccine booster regardless of previous vaccine, which appears to be well tolerated in the vast majority of cases.[3]

There has been recent evidence that mRNA COVID-19 vaccines can instigate an inflammatory response similar to the case presented here. Durdevic et al. (2021) documented a 76 year old male who developed shortness of breath, respiratory wheezing, and fever one day after receiving the Moderna COVID-19 vaccine.[4] Similarly, their patient tested negative for viral infections, and his symptoms quickly improved following administration of prednisone and supplemental oxygen.[4]

Another case report was recently released by Steinberg et al. (2021), which presented a patient who developed a systemic inflammatory response following administration of the Moderna COVID-19 vaccine.[5] Their patient's symptoms also began one day after vaccination, and white blood cell count, urinalysis, and respiratory pathogen panel were all found to be unremarkable.[5] Interestingly, Steinberg et al. (2021) performed 18F-fluorodeoxyglucose PET/CT scans of thorax and abdominal lymph nodes in their patient, which demonstrated hypermetabolism in nodules closest to the site where the patient received their vaccine, as well as in the patient's spleen.[5] This indicates that both a local and a systemic inflammatory response was occurring, which in the absence of any other potential triggers points to the COVID-19 vaccine being the cause of the exacerbation.

4. Conclusion

We present a case of a patient who experienced a COPD exacerbation shortly after receiving the BNT162b2 COVID-19 booster vaccine. No other potential triggers for this exacerbation were identified in the patient history, laboratory studies, or imaging. Numerous reports of patients experiencing similar symptoms following receival of similar mRNA vaccines have been recently published, indicating a possible connection between these two events.[4,5] Although other reports of patients who experienced asthma or inflammatory symptoms after other COVID-19 vaccine formulations have been published, to our knowledge this is the first report of an exacerbation of COPD following the administration of a BNT162b2 COVID-19 booster vaccine. Though a causative link cannot be identified in this case, we believe that this patient's symptoms cannot be explained by any other mechanism. More research on the inflammatory response to mRNA vaccines is necessary, both to aid greater efficacy in COVID-19 vaccines and to ensure patient safety.

Notes on patient consent

All patient identifying information was removed from this manuscript.

Disclaimers

None.

Sources of support

None.

Financial Support

None.

Conflicts of interest

The authors have no conflicts of interest to declare.

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