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CASE REPORT

Case Report: An immunocompromised, vaccine breakthrough COVID-19 patient with pneumonia [version 1; peer review: 2 approved with reservations, 1 not approved]

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Abstract

Background: The novel SARS-CoV-2 pandemic has inflicted a major blow on public health worldwide accounting for millions of deaths and subsequent socio-economic consequences. The main challenge for scientists and researchers has been to restrain transmission of the virus and prevent severe respiratory disease. Novel promising vaccines aim to fulfil these expectations, although new variants of the coronavirus have emerged. The present manuscript aims to add to the knowledge, through a case of an immunodeficient patient, who developed remarkably favorable recovery from SARS-CoV-2 pneumonia after having been fully vaccinated against the novel coronavirus.

Case presentation: An 82-year-old Caucasian male with a history of metastatic pancreatic cancer was admitted with signs and symptoms of pneumonia. Workup revealed a positive SARS-CoV-2 real time – polymerase chain reaction (RT-PCR) and further investigation identified a B.1.1.7 variant. The imaging essays showed extensive lung disease. Interestingly, the patient had already received the second dose of the BNT162b2 (Pfizer) vaccine against the new coronavirus 16 days prior. After having been treated with appropriate antiviral and antibacterial agents the patient showed significantly favorable recovery and no need for high oxygen flows and no complications presented. The patient was discharged after six days of hospitalization in good condition, with no need for supplementary oxygen at home.

Conclusions: Despite breakthrough cases, vaccination against COVID-19 is crucial for restraining the novel coronavirus. Further studies should be carried out in order to determine the optimal strategies for large-scale vaccination while minimizing the risk of further and faster evolution of the virus.

Open Peer Review

Approval Status

	1	2	3
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1. **Yulia Desheva** , Federal State Budgetary Scientific Institution, Saint Petersburg, Russian Federation
2. **Thomas Tsaganos** , National and Kapodistrian University of Athens (NKUA), Athens, Greece
3. **Erni Nelwan** , Universitas Indonesia and Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia

Any reports and responses or comments on the article can be found at the end of the article.

Keywords

COVID-19, vaccine breakthrough; efficacy; immunodeficiency, case report

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is responsible for approximately three million deaths, and subsequent vast financial and social burdens due to the current global pandemic.¹ The rapid and wide utilization of effective, and safe vaccines against SARS-CoV-2 infection and COVID-19 that act against viral infection, disease, transmission, and death is essential for the establishment of public health internationally.^{1,2} Multiple clinical trials aim to investigate the efficacy and safety of novel vaccines, although, the most crucial efficacy endpoint, which is protection against severe disease and death, is difficult to estimate.¹ With emphasis on the present efficacy endpoint, the present manuscript aims to add to the existing knowledge, while presenting the case of an immunodeficient patient, who developed remarkably favorable outcomes from SAR-CoV-2 pneumonia after having been fully vaccinated against the novel coronavirus.

Case report

An 82-year-old Caucasian male presented to the emergency room of our institution with malaise, fever (max temperature 38°C), and productive cough. The patient's vital signs were within normal range, his respiratory rate was 16/min and his mental status was normal. Clinical examination revealed reduced sounds and dry rales at lower auscultation. A laboratory workup was carried out. The complete blood count showed mild neutropenia (1450/ μ L, total white blood cells 3390/ μ L), D-Dimers 1260 mg/L and C-reactive protein 7,1 mg/L. Chest X-ray showed opacities in both lungs, especially in lower lobes consistent with the clinical findings (see [Figure 1](#) and [Figure 2](#)). A nasopharyngeal and pharyngeal swab were sent for SARS-CoV-2 antigen and real-time polymerase chain reaction testing, respectively, the results of which were positive. Further investigation identified a B.1.1.7 variant.

The patient's medical history included pancreatic cancer with lung metastasis, prostate hyperplasia, and frequent RBC transfusions. His last chemotherapy session had taken place two weeks ago and he had received the second dose of the BNT162b2 (Pfizer) vaccine against COVID-19 16 days prior. Both doses had been administered without any complications. No symptoms indicative of acute infection (fever, chills, dyspnea, tachypnea, joint pain) were mentioned between the two doses. We preceded to admission of the patient for appropriate treatment. This included remdesivir 200 mg at first day of admission then 100 mg once daily, ceftriaxone 2 gr once daily, levofloxacin 500 mg once daily,

Figure 1-2. Computed tomography (CT) of the lungs of a vaccine breakthrough COVID-19 patient in axial projection taken after admission. The scan reveals ground glass opacities especially with onset of fibrotic lesions and concomitant vascular enlargement. CT findings suggest >50% extent of disease.

Figure 1-2. (continued)

N-acetylcysteine 600 mg bid p.os, inhaled agents (ipratropium and budesonide) and prophylactic dose of low-molecular-weight heparin (LMWH) enoxaparin 4000 once daily based on patient's weight. Supplementary oxygen was administered with nasal cannula at a flow rate of two to three liters per minute. Meanwhile a chest computed tomography (CT) was performed which was indicative of diffuse COVID-19 lesions (>50% extent). The patient was closely monitored however he did not manifest clinical deterioration or respiratory distress. No changes were made regarding the therapeutic interventions. The inflammatory markers and $\text{PaO}_2/\text{FiO}_2$ ratio remained stable and gradually ameliorated. No other complications were presented whatsoever (thromboembolism, disseminated intravascular coagulation, arrhythmia, shock, sepsis or ARDS). The patient was discharged after six days of hospitalization with no need for supplementary oxygen at home.

Discussion

The global pandemic of COVID-19 seems to constitute the most challenging pandemic of the 21st century.³ A strongly efficacious vaccine is fundamental and crucial for the prevention of morbidity and severe mortality.¹ Therefore, all clinically available vaccines against SARS-CoV-2 infection and COVID-19 are currently under evaluation through several multi-central clinical trials for their safety and efficacy.⁴

It is already documented that in comparison to unvaccinated patients, the probability of remaining asymptomatic after SARS-CoV-2 infection is lower among vaccinated persons at the period of more than 10 days after 1st dose of vaccine, and more than 0 days after 2nd dose.⁴

According to the study of Polack *et al.* (2020), between the first and the second dose, the Pfizer COVID-19 vaccine provided an efficacy of 52%, with an incidence of 39 cases of infection in the vaccinated group, in comparison to 82 cases from the placebo group. Meanwhile the integration of two doses of the BNT162b2 mRNA COVID-19 vaccine offered 95% protection against the virus in patients older than 16 years of age.²

Moreover, the study of Voysey *et al.* (2020) indicates that Oxford and AstraZeneca's COVID-19 vaccine (AZD1222), presents an efficacy of 62.1% after the integration of two standard doses.⁵ Interestingly, for the persons that received a lower first dose combined with a standard second dose, an efficacy of 90% was observed.⁵

Indeed, according to the literature there have been several documented cases of COVID-19 infections after vaccination.^{4,6} However, all the reported cases either remained asymptomatic or presented mild symptoms.⁴

Interestingly our patient's clinical course was remarkably favorable despite being immunodeficient. Herein it is implied that prior vaccination with BNT162b2 mRNA COVID-19 Vaccine had offered protection to some extent. This could be justified by the short period of hospitalization, the absence of septic and thromboembolic complications or severe respiratory distress, and finally by the fact that no high flow oxygen therapy was needed.

At this point we would like to address the issue of meticulous planning of vaccination campaigns. Given the rapid rate of COVID-19 evolution (presenting 1×10^{-3} mutations per genomic residue and year) alongside its genetic heterogeneity in every host, scientists are facing vaccination-driven virus evolution. As a result, even if massive vaccinations are implemented, there is still the risk of new infections by emerging variants. That is why authorities should take into consideration the epidemiological context of every country before vaccination campaigns are implemented.⁷

Conclusions

The current SARS-CoV-2 pandemic poses a real threat on public health due to the rapid and wide transmission of the virus. Despite the civil protection measures, the novel vaccines constitute a real game changer. To our knowledge this is the first reported vaccine breakthrough case with an extremely favorable clinical course indicating the efficacy of vaccination against COVID-19.

Data availability

All data underlying the results are available as part of the article and no additional source data are required.

Consent

Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient.

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Erni Nelwan

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In this case, I am not sure if we can say within 16 days of vaccination of Pfizer vaccine, it is sufficient enough to said "a breakthrough" of COVID-19. Among elderly potential the increase of antibody after vaccination is delay. The actual scenario may be the patient had an infection just before the antibody is high enough to protect him.

One important data to convince reader is actually if the level of antibody was measured against covid-19

If the patient had an history of lung metastasis and also could probably the hyper-coagulation state due to his primer illness, therefore a more detail information on the previous lab result or imaging is interesting to compare as part of the analysis of the case

Is the background of the case's history and progression described in sufficient detail?

No

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?

No

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?

Partly

Is the case presented with sufficient detail to be useful for other practitioners?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Tropical medicine and infectious diseases, immunology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 01 February 2022

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In this case report article, the authors present a male old patient with history of metastatic pancreatic cancer under current chemotherapy treatment who suffered from COVID-19 two weeks after his last chemotherapy and 16 days after his vaccination with the second dose of Pfizer vaccine. The patient was hospitalized with a remarkably mild clinical course, uncomplicated and without increased oxygen needs, who received both antiviral and antimicrobial treatment and prophylactic LMWH. They disclose that his mild disease and favorable outcome was attributed to the vaccination against COVID-19, despite being immunodeficient, and conclude that vaccines are real game changer in the fight against SARS-CoV-2.

This article is interesting, since it is one of the few presenting the protective role of vaccines against COVID-19 in immunodeficient patients. The presented case is helpful for clinicians, in order to urge their patients, especially immunodeficient ones, to get vaccinated promptly. This article merits careful examination in the era of pandemic that we all live.

The paper falls within the scope of the journal. There is a major issue with the rationale behind the paper. It can be hypothesized that vaccination contributed to the mild clinical course of the patient, but it cannot be proved that vaccination protected the patient against severe disease. The language in the manuscript is of superior quality; no ethical issues can be raised. In my opinion, the case report is also lacking in the justification of the treatment selected. The claims in discussion and conclusion are partly supported by the presented disease course.

Technically, the manuscript is very well written: the abstract is informative and the language used is high quality; the structure of the article is robust and helpful in the presentation of the findings and the manuscript is ordered in a meaningful way; in addition, the discussion has adequate length and conveys the messages of the authors; however, the limitations of the case report are not properly identified. The objective is clearly stated; the references strictly adhere to the

guidelines of the journal. Lastly, the authors relate their study to previous studies (and also describe how their study is in line with previous ones) and explain the impact of their study and its contribution to current scientific knowledge. There is one minor issue that the authors should address regarding their study.

Major Comments:

1. The authors' claim that vaccination of the patient against COVID-19 was protective against severe disease is unjustified. A few studies and extensive clinical experience have indicated that immunosuppressed patients frequently do not respond satisfactorily in the vaccines against COVID-19. In addition, the fact that vaccination was followed by chemotherapy two days afterwards further hinders the response of the host to the vaccine. Therefore, the authors should properly identify this limitation of their study in the discussion and conclusion sections.
2. There is no justification for the selection of the antimicrobial regimen. C-reactive protein was not markedly elevated and only ceftriaxone would have sufficed.

Minor Comments:

1. The authors should discuss (and emphasize) that their case is only one (among many immunodeficient patients) who had a mild clinical course and favorable outcome and that their findings should be confirmed in the setting of a clinical study.

Is the background of the case's history and progression described in sufficient detail?

Yes

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?

Partly

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?

Yes

Is the case presented with sufficient detail to be useful for other practitioners?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Infectious Diseases, Sepsis

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 23 September 2021

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Yulia Desheva

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The authors' conclusions that the outcome of the disease is associated with vaccination are unfounded. The fact that the absence of septic and thromboembolic complications or severe respiratory distress, and finally by the fact that no high flow oxygen therapy was needed may not be the result of vaccination, it is not supported by anything other than a sequence of events. It is known that "after something" does not mean "as a result of something", you need to provide evidence.

Is the background of the case's history and progression described in sufficient detail?

No

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?

Partly

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?

No

Is the case presented with sufficient detail to be useful for other practitioners?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Infectious diseases, virology, immunology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

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