CLINICAL VIGNETTE

A Case of Breakthrough COVID-19 Requiring Hospitalization

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Case Description

A 93-year-old woman with a past medical history of hypertension and neuropathy presented to the emergency department for acute hypoxic respiratory failure. She had a cough and shortness of breath for three days. The day of presentation, she felt weak and subsequently fell at her assisted living facility, which prompted additional evaluation. Her oxygen saturation was 85% and she was transferred to the emergency department.

At the emergency department, the patient required 3L O2 via nasal cannula. Chest x-ray showed infiltrates consistent with pneumonia. Labs included elevated D dimer 643 ng/ml, LDH 384 units/L, BNP 552 pg/mL, troponin 3.365 ng/mL, CRP 125.5 mg/L, and ferritin 552ng/mL. Due to her symptoms, the patient was tested for SARS-CoV-2, which returned positive. The patient had received her second dose of Pfizer vaccine two months prior to her presentation.

The patient was treated with remdesivir and intravenous dexamethasone over several days with gradual improvement in oxygen status. She was eventually discharged back to her assisted living facility at her baseline level of functioning.

Discussion

The efficacy of mRNA vaccines has been evaluated in randomized controlled studies.[1-3] These studies have shown high levels of efficacy in preventing COVID-19. However, despite these findings, there has been a small percentage of breakthrough cases amongst vaccinated individuals. The CDC defines a vaccine breakthrough case as "a person who tests SARS-CoV-2 RNA or antigen detected on a respiratory specimen collected ≥14 days after completing the primary series of a U.S. Food and Drug Administration (FDA)-authorized COVID-19 vaccine".[4]

The real-world efficacy has been reported as comparable to that seen in clinical trials.[5-6] As of April 30, 2021, 10,262 SARS-CoV-2 vaccine breakthrough infections have been reported in the United States.[7] Of the 10,262 breakthrough cases, 995 (10%) patients were hospitalized and 160 (2%) patients died.[7] Among the 995 hospitalized patients, 289 were asymptomatic or hospitalized for other reasons than COVID-19. Although the total number of breakthrough cases are likely under-reported as the numbers are based on voluntary reporting, the number of hospitalizations and deaths among vaccinated patients are less likely to be under-reported. The majority of breakthrough cases have not been clinically significant. The data the vaccines are meeting expectations in decreasing the rates and severity of infection, thereby decreasing the rates of hospitalizations and deaths.

Breakthrough infections are expected, given vaccine efficacy is less than 100%. Breakthrough infections will continue until the population immunity meets a threshold that further decreases transmission.[7] However, reaching this immunity threshold has remained elusive for multiple reasons, including vaccine hesitancy and lack of distribution. A systematic review and meta-analysis of twenty-eight studies from thirteen countries examined willingness to receive vaccine for COVID-19.[8] These twenty-eight studies used surveys to assess the percentage of people who would take the vaccine when it was available. The meta-analysis concluded that as the pandemic progressed the intent to vaccinate declined. In studies completed from March to May 2020, 79% of participants intended to vaccinate and 12% intended to refuse, whereas in studies done from June to October 2020, 60% intended to vaccinate and 20% intended to refuse. Another study surveyed nurses and found that 63% intended to be vaccinated.[9] A 60% vaccination rate is unlikely to reach the immunity threshold as some estimate 90% of Americans would need to be fully vaccinated.[10] This re-enforces the importance of continuing vaccination efforts and education in the United States, especially as restrictions are being lifted and continued misinformation surrounding the vaccines and COVID-19.

In addition, all countries need access to the vaccines. At this time, the majority of vaccines given have been in developed countries. In such an interconnected world, uncontrolled outbreaks in one part are a threat to all. Numerous variants have been identified, and the vaccines have been shown to still be effective thus far, albeit in some cases with reduced efficacy.[11] Timely vaccine distributions to countries that lack access can mitigate the risk of new variants against which the current vaccines lose all efficacy.

Nevertheless, the immune threshold may not be reached on a local or global level, making vaccination important for personal health.[10] Vaccines can mitigate the morbidity and mortality of COVID-19 infections. The individual benefits from the vaccines cannot be minimized. Even if the goal of herd immunity remains unachieved, the overall sentiment remains the same: continue to vaccinate as many as possible.

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