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Efficacy of Pfizer-BioNTech in SARS-CoV-2 Delta cluster

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A B S T R A C T

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) Sublineage B.1.617.2 or Delta, a variant that began circulating in India and is becoming dominant in the USA, has been responsible for significant morbidity and mortality. In May 2021, the Delta variant was upgraded to a variant of concern by international authorities. This article reports a cluster of Delta cases detected in Boston, Massachusetts, in May 2021 involving a recent traveller from India and subsequent transmission to two of three close contacts. All three close contacts experienced the same primary exposure events but differed in vaccination status. The two close contacts that eventually tested positive were unvaccinated. The other close contact had received one dose of the BNT162b (Pfizer-BioNTech) vaccine prior to exposure, and received their second dose 2 days after exposure. This case series illustrates the effectiveness of partial vaccination in blocking transmission of the Delta variant to vaccinated individuals under circumstances where the probability of transmission for unvaccinated individuals is high.

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Background

With the world in a race to vaccinate as many people as possible, concerns about vaccine efficacy have continued to arise, particularly related to variants of concern (VoC). The latest variant to be upgraded to a VoC was first discovered in India: B.1.617. This variant has three different subtypes including Delta or B.1.617.2, which has become the most reported lineage in India and has been responsible for a devastating second wave of infection in the country (Outbreak.info, 2021). This variant is defined by seven mutations in the spike protein, two of which – L452R and T478K – are suspected to increase transmissibility (Adam, 2021). Over recent months, the Delta variant has spread rapidly in the UK through travel-associated introductions and community transmission (Public Health England, 2021), and case numbers are increasing in the USA (Centers for Disease Control and Prevention, 2021). In total, 185 Delta cases have been reported in Massachusetts as of 1 July 2021, with the most recent case reported on 14 June 2021 (Outbreak.info, 2021).

There have been concerns about vaccine efficacy against the Delta variant. Recent studies have shown that antibodies from individuals vaccinated with BNT162b had reduced binding to the Delta variant (Bernal et al., 2021). Despite potentially reduced effectiveness in individuals, the BNT162b vaccine is still protective at the population level (Bernal et al., 2021). However, these studies did not investigate protection of vaccinated individuals compared with unvaccinated individuals in the same exposure event. The transmission cluster described in this article addresses this gap in understanding.

Methods

Biological investigation

Swabs of the anterior nares were self-collected into sterile saline at Boston University (BU) testing sites (Hamer et al., 2021). The BU Testing Laboratory reverse transcriptase polymerase chain reaction (RT-PCR) was used for initial diagnosis of COVID-19. Total RNA was extracted from leftover saline, and severe acute res-
piratory syndrome coronavirus-2 (SARS-CoV-2) genomic RNA was sequenced using amplification with the ARTIC v3 primer set. Raw sequences were aligned with the Wuhan-Hu-1 reference genome (GenBank accession no. MN908947.3). Genome coverage was assessed with SAMtools, and single nucleotide variants (SNVs) were called with LoFreq. Consensus sequences were assembled from SNV tables and the Wuhan-Hu-1 reference for nucleotides with >10 aligned reads. Pangolin was used for lineage assignment following consensus sequence assembly. A nasopharyngeal swab collected at a local Boston hospital was also analysed by RT-PCR.

**Epidemiological investigation**

Case investigation and contact tracing were conducted by BU contact tracers following an adapted version of the Centers for Disease Control and Prevention/Massachusetts Department of Public Health protocol (Hamer et al., 2021).

**Case presentation**

On 10 May 2021, the COVID-19 management team at BU, ‘Healthway’, received notification from Boston Public Health Commission reporting a 23-year-old BU-affiliated case who had tested positive outside of the BU surveillance network. The individual had recently travelled from India and developed a cough and sore throat 1 day after arrival in the USA. Upon case investigation and contact tracing, three individuals within the BU surveillance network were identified as close contacts and placed in close contact quarantine. Contacts with the initial case for all three individuals included two primary unmasked exposure events: a carpool drive and an indoor dining event. The four individuals were in a compact sedan vehicle with the windows closed for a total of 60 min. The indoor dining event lasted approximately 1 h and 40 min. The restaurant is located on the first floor of a large apartment complex. At the time, Massachusetts restaurants were required to separate tables by at least 6 feet, unless separated by walls or plexiglass dividers, and patrons were required to sit at a table (no standing room service) and order food during their visit. All patrons were held to a 90-min time limit. While the group was dining, the restaurant was not crowded and the four individuals sat at the back of the restaurant, away from the closed windows and closed main door, and were at least 10 feet from the nearest customer. Two of the three BU contacts, both unvaccinated, had positive SARS-CoV-2 PCR tests 5 and 7 days after these exposure events and were placed in isolation. One remained asymptomatic and one reported cough, headache, nasal congestion, sore throat, subjective fever and episodes of dizziness. The third individual remained asymptomatic and had negative SARS-CoV-2 PCR test results on days 1, 4, 8, 9 and 11 after exposure (Figure 1). The third contact had the same unmasked carpool drive and indoor dining event exposure, but had received one dose of the Pfizer-BioNTech vaccine 15 days prior to exposure, and received the second vac-
cine dose 2 days after exposure. During the carpool drive, this third contact sat in the rear driver-side seat while the index case sat in the front passenger seat. At the restaurant, the four individuals sat at a L-shaped table with three individuals sitting on the long side and one individual sitting on the short side. The index case sat in the furthest seat of the long part of the table. The partially vaccinated contact sat next to the index case in the middle of the long part of the table.

Anterior nares swab samples from the two individuals who tested positive for SARS-CoV-2 were sequenced to determine the infectious variant using an Artic-primer-based Amp-seq approach. Both samples returned high-quality sequences (aligned reads: 4.4E+7 and 7.4E+6; median coverage: 1.2E+5 and 1.5E+3). Pangoln-based sequence comparison identified both genomes as the Delta variant, consistent with Massachusetts Department of Public Health reporting that the index case was also infected with the Delta variant.

Discussion

This article reports three close contacts who all had the same unmasked carpool and indoor dining exposure to a Delta SARS-CoV-2 index case. The obvious differing factor was the mRNA partial vaccination status for one close contact. This contact tested negative with PCR testing five separate times up to 11 days after exposure, whereas the other two close contacts became infected. While this case series reviews one cluster of three individuals, and the vaccine response can be variable, the series does show promising evidence of vaccine protection after exposure to the Delta variant under extended close contact conditions that were sufficient to transmit the virus from the index case to two unvaccinated individuals.

In addition to vaccine protection, the importance of early and effective contact tracing, quarantine and isolation measures remain critical in controlling transmission. The identified close contacts were placed in quarantine prior to significant virus amplification (as measured by anterior-nares-based RT-PCR) and therefore blocked two potential transmission chains in the community.

Partial mRNA vaccination provided enough protection to prevent infection from a significant indoor, unmasked exposure and further spread of the Delta variant. Epidemiological investigation in combination with biological investigation enabled further analysis of the cluster’s impact. On a larger scale, mRNA vaccines could prove to prevent large clusters which were seen with other VoCs, including the Alpha variant. Vaccine outreach efforts should continue to be strengthened, and the ongoing collaboration between epidemiological and biological investigations should continue.

Conflict of interest statement

None declared.

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None.

Ethical approval

BU Charles River Campus Institutional Review Board determined that the case series (Protocol #6131X) meets the criteria for exemption in accordance with CFR 46.104(d) 4(ii).

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