

A case of COVID-19 reinfection in the UK

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ABSTRACT

Protective immunity following COVID-19 infection is not yet fully understood. An understanding of COVID-19 reinfection will be key in guiding government and public health policy decisions in the coming months. This report describes two distinct infective episodes of COVID-19 occurring in the same individual, at the time of writing the first published case in the UK. In April 2020 a 25-year-old UK doctor exhibited classical COVID-19 symptoms, including fevers, headaches, and fatigue. A COVID-19 nucleic acid amplification test (NAAT) at the time returned negative. However, a follow-up antibody test in May 2020 returned positive. In October 2020 the same individual exhibited coryzal symptoms and headaches. He was COVID-19 NAAT tested and found to be positive. There was exposure to high viral load prior to reinfection. Overall the second infection was symptomatically milder, with a faster recovery. This evidence for reinfection poses challenges for public health and vaccination efforts to protect against the COVID-19 pandemic.

KEYWORDS: COVID-19, reinfection, UK, immunity, antibody

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Background

Protective, sustainable and long-lasting immunity following COVID-19 infection is uncertain, and the potential mechanisms that mediate it are not yet fully understood. An understanding of COVID-19 reinfection will be key in guiding government and public health policy decisions in the coming months. This report describes two distinct infective episodes of COVID-19 occurring in the same individual in the UK. At the time of writing there were only a few published reinfection cases worldwide.¹ To our knowledge there are no published cases of COVID-19 reinfection occurring in the UK.

Case presentation and management

In April 2020, a 25-year-old male UK doctor (Patient A) exhibited classical COVID-19 symptoms following extensive exposure in hospital environments. He had no prior symptoms and no immunodeficiency disorders. Symptoms included high-grade fevers and headaches of 3 days duration, followed by

severe fatigue lasting 3 weeks. A nasopharyngeal nucleic acid amplification test (NAAT) at the time returned negative. However, a follow-up antibody test in May 2020 revealed antibody presence, further evidencing an infection with COVID-19. In October 2020 Patient A exhibited new coryzal symptoms, 72 hours after contact with his female partner (Patient B) who had been exhibiting coryzal symptoms, fevers and fatigue. A COVID-19 NAAT returned positive 72 hours after onset for Patient B in October 2020. Patient B had no previous infection with COVID-19, with no prior positive NAAT or antibodies. Patient B did not have contact with Patient A during the time surrounding the April infective episode. Subsequently a COVID-19 NAAT for Patient A was completed, which returned positive. Given the lack of severity of Patient A's symptoms, prognosis was presumed to be good. The fatigue and coryzal symptoms were managed with rest at home and resolved over the following 4 days.

Discussion

The authors believe COVID-19 is the most likely diagnosis for both episodes in Patient A. Differentials would include influenza and other viral illnesses. In the October episode, symptoms commenced 72 hours following significant contact with a confirmed COVID-19 positive case, who was coryzal and febrile at the time of contact. A COVID-19 NAAT also returned positive during the October episode.

The April episode commenced during the first peak of the pandemic, when the individual had been working on COVID-19 positive wards extensively. The April episode also demonstrated hallmark COVID-19 symptoms, including pronounced fevers and fatigue extending over weeks. While the April NAAT returned negative, nasopharyngeal NAAT testing is only evidenced to be 70% sensitive.² Antibody testing is evidenced to be approximately 98.7% specific.³ The combination of classic clinical symptoms, followed by a positive antibody test, leads the authors to believe a false positive antibody test is vanishingly unlikely in this case. Furthermore, both episodes occurred outside of typical flu seasons and Patient A had received flu vaccination for the preceding season.

The second infection episode was symptomatically distinct from the first, with predominance of coryzal symptoms absent in the April episode, reduced fatigue and a faster recovery. The May 2020 positive antibody test would indicate a degree of adaptive immune response following the April 2020 infection.⁴

In this case, the absence of an antibody test, negative or positive, immediately prior to the second infection in Patient A limits the analysis of this case with regards to the presence of residual immunity at the time of reinfection. It is likely that the

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Table 1. Cases of reinfection with SARS-CoV-2

| Location | Sex | Age (years) | First infection (Ct) | Second infection (Ct) | Intervening period (days) | Antibody after first infection | Antibody after reinfection |
|---------------------------|--------|-------------|----------------------|-----------------------|---------------------------|--------------------------------|----------------------------|
| Hong Kong ⁹ | Male | 33 | Mild (N/A) | Asymptomatic (27) | 142 | Negative | IgG+ |
| Nevada, USA ¹⁰ | Male | 25 | Mild (35) | Hospitalised (35) | 48 | N/A | IgM+ and IgG+ |
| Belgium ¹¹ | Female | 51 | Mild (26–27) | Milder (33) | 93 | N/A | IgG+ |
| Ecuador ¹² | Male | 46 | Mild (37) | Worse (N/A) | 63 | IgM+ and IgG– | IgM+ and IgG+ |

Reproduced with permission from Iwasaki, 2020.¹ Data were obtained 14 September 2020 for reinfection cases confirmed by viral genome sequences. Ct = cycle threshold; N/A = not available.

antibodies pertaining to the initial immune response had either waned completely or provided partial protective immunity to the patient.

An antibody test in the weeks following October 2020 would be of equivocal value in understanding reinfection, since the second infection would likely prompt a discrete antibody response.

There is evidence in the literature that the COVID-19 immune response is variable and patient-specific with respect to the development of antibodies and to antibody persistence in serum over time. In considering the net protective effect of antibodies against a reinfection, the evidence is still inadequate and more research is warranted to clarify the interplay between the roles of adaptive and innate immunity.

The recent Icelandic humoral response study by Gudbjartsson *et al*⁵ concluded that antibody response was persistent within the 120-day timeframe used. However, there is evidence for modest decline in antibody titres after 120 days in the Icelandic data.

The recent paper by Iyer *et al*⁶ observed declining antibody titres over 90 days, with 'median times to seroreversion of 71 and 49 days following symptom onset'.

The findings in this case of a reinfection after 178 days are more in keeping with the conclusions of Iyer *et al*. However, the Icelandic data do not extend to the longer timeframe of our case, and therefore do not necessarily contradict an antibody decline and subsequent reinfection after 120 days.

The close contact with a positive case preceding the October 2020 reinfection could support an argument for the role of large viral load exposure in reinfection. There is existing evidence relating viral load to severity.⁷

Unfortunately genomic analysis was not available in either the April or the October episode. Without genomic analysis it is difficult to speculate around discrete strains of COVID-19 in this case, but evidence does exist for a variety of strains.⁸

This report adds to a growing body of evidence of COVID-19 reinfection, as described in Table 1.^{9–12}

Summary

This report documents the case of a UK doctor becoming reinfected with COVID-19 in October 2020, 178 days following first infection. The predominant early symptoms in the first episode were fevers and headaches, but the second episode was milder with coryzal symptoms predominant. An antibody response was present in the period between infective episodes. There

was exposure to high viral load prior to reinfection. The second infection was symptomatically milder, with a faster recovery. The evidence for reinfection poses challenges for public health and vaccination efforts to protect against the COVID-19 pandemic. ■

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