Clinical Characteristics of Patients Who Contracted the SARS-CoV-2 Omicron Variant from an Outbreak in a Single Hospital

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Since the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) variant B.1.1.529 (omicron) was designated as a variant of concern (VOC) by the World Health Organization (WHO) on November 26, 2021, the omicron variant has spread worldwide including Korea as the dominant SARS-CoV-2.¹,² Among all VOCs, the omicron variant is the most heavily mutated, making its transmissibility increase and the effect of COVID-19 vaccines decrease.³ In the omicron wave in South Africa, different patterns of clinical characteristics and prognosis were observed, with younger patients being infected, fewer hospitalizations and pneumonia development, and a decrease in severity and mortality.⁴

From January 11, 2022 to January 25, 2022, 181 patients were infected with the SARS-CoV-2 omicron variant in a single hospital in Korea. The initial clinical characteristics were investigated through the COVID-19 basic investigation form. Outcomes were reviewed using medical records. The median age of the patients was 57 years (range 1–90), and 95 patients (52.5%) were male. None were re-infected with SARS-CoV-2, and 127 (70.2%) were fully vaccinated (boosted or within 6 months after second vaccination). Forty-two patients (23.2%) were asymptomatic. Among symptomatic patients, the frequency of symptoms was as follows: cough (37.0%), sore throat (33.7%), and fever (30.4%). In terms of disease severity, 168 (92.8%) patients did not require supplemental oxygen, 6 (3.3%) required low-flow oxygen, 5 (2.8%) required high-flow oxygen, and 2 (1.1%) died. Four of the five individuals who required high-flow oxygen and the two who died were not vaccinated. Most of the patients who contracted the SARS-CoV-2 omicron variant exhibited mild clinical features; however, severe clinical features including mortality were encountered among individuals who were not vaccinated.

Key Words: SARS-CoV-2, SARS-CoV-2 omicron variant, vaccination, outbreaks
lation or high flow oxygen, intubation and mechanical ventilation, ventilation with additional support, and death.\textsuperscript{5}

Descriptive statistic procedures were performed to analyze the cases. Categorical variables are presented as numbers and percentages, whereas continuous variables are presented as a median (range) or mean (standard variation). Ethics approval was obtained from the Institutional Review Board of Wonju Severance Christian Hospital (approval No. CR321189) and the need to obtain informed patient consent was waived.

In total, 143 patients were transferred to six dedicated hospitals, 20 patients to three community treatment centers, and 18 patients to their home. Among 181, 133 patients were infected during hospitalization: 81 hospitalized patients and 52 healthcare-workers. Forty-eight patients including 13 caregivers were infected outside the hospital by contact with those infected in the hospital (Fig. 1). The median age of the patients was 57 years (range 1–90). Ninety-five patients (52.5\%) were male. Regarding vaccination status, 127 were fully vaccinated (boosted or within 6 months after second vaccination), 13 were incompletely vaccinated, and 41 were not vaccinated (Table 1). Forty-two (23.2\%) patients were asymptomatic. Among 139 (76.8\%) symptomatic patients, 114 patients (63.0\%) complained of respiratory symptoms, and 41 patients (22.7\%) complained of extrapulmonary symptoms. Cough (37.0\%), sore throat (33.7\%), and fever (30.4\%) were frequently observed. Other symptoms are shown in Table 2. Pneumonia was observed on chest X-ray in 28 (29.5\%) of 95 patients who underwent chest X-ray on diagnosis. Among 67 without pneumonia on diagnosis, pneumonia developed upon hospitalization in 10 (14.9\%).

As for the disease severity, most patients (168, 92.8\%) did not require supplemental oxygen, while 13 patients required oxygen support: low-flow oxygen (6, 3.3\%) and high-flow oxygen (7, 3.9\%). Among them, 2 (1.1\%) cases were fatal. Two who died did not want a ventilator care, therefore, none was applied mechanical ventilation (Table 3). The two who died and four of the five who needed high-flow oxygen were never vaccinated. One who required high-flow oxygen was vaccinated more than 6 months ago.

The novel SARS-CoV-2 variant has unique biological factors, making it more contagious than other SARS-CoV-2 variants.\textsuperscript{6} In a short time, this variant affected many patients around the world. Omicron variants exhibit increased transmissibility, high receptor binding affinity, and escape from natural infection- or vaccine-induced immunity due to numerous mutations, particularly in the spike protein.\textsuperscript{3,7} According to several recent reports, the omicron mutation is estimated to infect people three to six times more than the delta strain.\textsuperscript{8} However, it is known that omicron mutation does not have a higher disease severity than other strains. According to one report on the clinical characteristics of the omicron variant, infections tend to elicit mild symptoms, such as fever, sore throat, and cough, more commonly than delta variant.\textsuperscript{9} Similarly, in our study, we found that most patients showed similar characteristics, such as fever, cough, sputum, and sore throat, consistent with recent findings from other countries.\textsuperscript{9,10}

The omicron variant has mainly been found to be responsible for mild infections, although deaths have occurred due to this outbreak. In this study, there were two deaths, and the overall mortality rate was not high at 1.1\% (2/181). However,
among only unvaccinated individuals, the mortality rate was 4.8% (2/42). According to several studies, vaccine effectiveness against symptomatic disease caused by the omicron variant is lower than that for the delta variant. After two doses, the effectiveness of the vaccine has been found to wane rapidly. However, boosters have been found to result in a significant increase in the protective effect against mild infections. Also, with the previous strains, vaccine effectiveness against severe disease, including hospitalization and death, was higher and maintained for a longer period, compared to mild disease. Based on experience with other variants, vaccine effectiveness against severe illness caused by omicron is likely higher than the estimate against symptomatic infections. For this reason, a current booster vaccination may help against omicron infection.

Table 1. Demographics and Baseline Characteristics of 181 Patients Who Contracted the SARS-CoV-2 B.1.1.529 (Omicron) Variant

| Characteristics                      | No. (%) of patients |
|--------------------------------------|---------------------|
| Age groups, yr                       |                     |
| –17                                  | 7 (3.9)             |
| 18–50                                | 63 (34.8)           |
| 51–64                                | 53 (29.3)           |
| 65–79                                | 42 (23.2)           |
| 80–                                  | 15 (8.3)            |
| Sex                                   |                     |
| Male                                 | 86 (47.5)           |
| Female                               | 95 (52.5)           |
| Identity                              |                     |
| Healthcare worker                    | 52 (28.7)           |
| Hospitalized patients                | 81 (44.8)           |
| Caregiver                            | 13 (7.2)            |
| Others                               | 35 (19.3)           |
| COVID-19 vaccination status          |                     |
| Unvaccinated                         | 41 (22.7)           |
| Partially (1-dose) vaccinated        | 5 (2.8)             |
| Fully (2-dose) vaccinated, more than 6 months ago | 8 (4.4) |
| Fully (2-dose) vaccinated within 6 months | 47 (26.0) |
| Boosted                              | 80 (44.2)           |
| Underlying disease                   |                     |
| No                                   | 86 (47.5)           |
| Yes                                  | 95 (52.5)           |
| Cerebrovascular diseases             | 55 (30.4)           |
| Diabetes mellitus                    | 25 (13.8)           |
| Chronic heart diseases               | 13 (7.2)            |
| Chronic pulmonary disease            | 3 (1.7)             |
| Chronic liver disease                | 3 (1.7)             |
| Chronic renal diseases               | 1 (0.6)             |
| Solid organ tumor                    | 2 (1.1)             |
| Organ transplantation                | 1 (0.6)             |

Table 2. Clinical Features of the Patients Who Contracted the SARS-CoV-2 B.1.1.529 (Omicron) Variant

| Characteristics                      | No. (%) of patients |
|--------------------------------------|---------------------|
| Symptoms                             |                     |
| Asymptomatic                         | 42 (23.2)           |
| Symptomatic                          | 139 (76.8)          |
| Initial presenting symptoms          |                     |
| Fever                                | 55 (30.4)           |
| Respiratory symptoms                 | 114 (63.0)          |
| Cough                                | 67 (37.0)           |
| Rhinorrhea                           | 16 (8.8)            |
| Sputum                               | 49 (27.1)           |
| Sore throat                          | 61 (33.7)           |
| Dyspnea                              | 1 (0.6)             |
| Extrapulmonary symptoms              |                     |
| Myalgia                              | 11 (6.1)            |
| Headache                             | 20 (11.0)           |
| Chills                               | 18 (9.9)            |
| Loss of smell                        | 3 (1.7)             |
| Dizziness                            | 7 (3.9)             |
| Diarrhea                             | 2 (1.1)             |
| Nausea                               | 1 (0.6)             |
| RT-PCR Ct value, nasopharyngeal swab on diagnosis,* mean (SD, range) |         |
| RdRp gene                            | 23.90 (5.85, 12.61–37.74) |
| E gene                               | 23.85 (6.21, 12.41–37.49) |
| Presence of pneumonia for 95 patients upon diagnosis | 28/95 (29.5) |
| Development of pneumonia upon hospitalization | 10/67 (14.9) |
| Clinical status                      |                     |
| Initial                              |                     |
| No oxygen                            | 176 (97.2)          |
| Oxygen by mask or nasal cannula      | 5 (2.8)             |
| Aggravated clinical status           | 9 (5.0)             |
| Oxygen by mask or nasal cannula      | 2/9                 |
| High-flow oxygen or non-invasive ventilation | 5/9                   |
| Death                                | 2/9                 |

Table 3. Disease Severity of Patients Who Contracted the SARS-CoV-2 B.1.1.529 (Omicron) Variant according to Vaccination Status

| Vaccine status (n=181) | No oxygen | Low-flow oxygen | High-flow oxygen | Death |
|------------------------|-----------|-----------------|------------------|-------|
| Unvaccinated (42)      | 33 (78.6) | 3 (7.1)         | 4 (9.5)          | 2 (4.8) |
| Partially vaccinated, single dose (5) | 4 (80.0) | 1 (20.0)        | 0 (0.0)          | 0 (0.0) |
| Fully, 2-dose vaccinated more than 6 months ago (8) | 6 (75.0) | 1 (12.5)        | 1 (12.5)         | 0 (0.0) |
| Fully, 2-dose vaccinated within 6 months (47) | 46 (97.9) | 1 (2.1)         | 0 (0.0)          | 0 (0.0) |
| Boosted (79)           | 79 (100.0)| 0 (0.0)         | 0 (0.0)          | 0 (0.0) |

*173 patients; †Among 95 patients who could be assessed.
This study has several limitations. We could not analyze the specific treatment applied to each patient. In addition, image studies, such as chest X-ray or computed tomography could not be performed for all patients, so it was impossible to confirm whether pneumonia progressed. Nevertheless, our study has an advantage in that we examined various age groups from an outbreak occurring in a single institution, compared to the recent studies limited to relatively young age groups.

In conclusion, the most of patients who contracted SARS-CoV-2 omicron variant exhibited mild clinical features, however, the severe clinical features including mortality could be showed among whom did not vaccinated.

**AUTHOR CONTRIBUTIONS**

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