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Clinical features of nursing and healthcare-associated pneumonia due to COVID-19

Naoyuki Miyashita a,*, Yasushi Nakamori b, Makoto Ogata a, Naoki Fukuda a, Akihisa Yamura a, Yoshihisa Ishiura c, Shosaku Nomura a

a First Department of Internal Medicine, Division of Respiratory Medicine, Infectious Disease and Allergology, Kansai Medical University, Japan
b Department of Emergency Medicine, Kansai Medical University Medical Center, Japan
c First Department of Internal Medicine, Division of Respiratory Medicine, Oncology and Allergology, Kansai Medical University Medical Center, Japan

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ABSTRACT

Introduction: The objective of this study was to clarify the clinical differences between nursing and healthcare-associated pneumonia (NHCAP) and community-acquired pneumonia (CAP) due to COVID-19. We also investigated the clinical characteristics to determine whether there is a difference between the variant and non-variant strain in patients with NHCAP due to COVID-19. In addition, we analyzed the clinical outcomes in NHCAP patients with mental disorders who were hospitalized in a medical institution for treatment of mental illness.

Methods: This study was conducted at five institutions and assessed a total of 836 patients with COVID-19 pneumonia (154 cases were classified as NHCAP and 335 had lineage B.1.1.7.). We compared the clinical features in patients with NHCAP between the non-B.1.1.7 group and B.1.1.7 group. The median age, frequency of comorbid illness, rates of intensive care unit stay, and mortality rate were significantly higher in patients with NHCAP than in those with CAP. Among the patients with NHCAP, the mortality rate was highest at 37.5% in patients with recent cancer treatment, followed by elderly or disabled patients receiving nursing care (24.3%), residents of care facilities (23.0%), patients receiving dialysis (13.6%), and patients in mental hospitals (9.4%).

Results: No differences in patient background, clinical findings, disease severity, or outcomes were observed in patients with NHCAP due to COVID-19. We also investigated the clinical characteristics to determine whether there is a difference between the variant and non-variant strain in patients with NHCAP due to COVID-19. In particular, we focused on elderly persons with mental disorders.

Conclusions: Our results demonstrated that there were many differences in the clinical characteristics between NHCAP patients and CAP patients due to COVID-19. It is necessary to consider the prevention and treatment content depending on the presence or absence of applicable criteria for NHCAP.

1. Introduction

Pneumonia including aspiration pneumonia is the third leading cause of mortality in Japan and most cases are elderly persons (>65 years old). A major feature of Japan is that there are high percentage of elderly persons. In line with the actual situation in Japan, the Japan Respiratory Society (JRS) guidelines defined a new pneumonia category as the nursing and healthcare-associated pneumonia (NHCAP) [1] separate from community-acquired pneumonia (CAP) [2]. To confirm the validity of the new category, many Japanese researchers have verified NHCAP and made the differences clear between NHCAP and CAP [3–8]. Median age and frequency of comorbid illness were significantly higher in patients with NHCAP than those with CAP. Several differences were also observed among four NHCAP subgroups.

Coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in 2019 [9]. Approximately 5–20% of patients with COVID-19 develop severe life-threatening pneumonia with respiratory failure [9]. SARS-CoV-2 causes frequent outbreaks in facilities such as welfare facilities for persons with disabilities, long-term care health facilities, and mental hospitals that meet the criteria for NHCAP. Elderly age and comorbid illness are relevant to both worse severity and fatal outcome in patients with COVID-19 [10]. In addition, several studies demonstrated increased risks of SARS-CoV-2 infection, disease severity, and mortality in persons with mental disorders [11–14].

The objective of this study was to clarify the clinical differences between NHCAP and CAP due to COVID-19. In particular, we focused on patient background, clinical findings, disease severity, and outcomes in patients with NHCAP.
determine whether there was a difference between variant and non-variant strains in patients with NHCAP due to COVID-19. In addition, we analyzed the clinical outcomes in NHCAP patients with mental disorders who hospitalized in a medical institution for the treatment of mental illness.

2. Patients and methods

2.1. Study populations

The present study was conducted at five institutions (Kansai Medical University Hospital, Kansai Medical University Medical Center, Kansai Medical University Kori Hospital, Kansai Medical University Kuzu Hospital, and Kansai Medical University Temmabashi General Clinic) between February 2020 and June 2021. We enrolled adult patients diagnosed with NHCAP and CAP, defined in accordance with the JRS guidelines [1,2]. COVID-19 was diagnosed with positive reverse transcription polymerase chain reaction results from sputum or nasopharyngeal swab specimens in accordance with the protocol recommended by the National Institute of Infectious Diseases, Japan. From March 2021, a new lineage of SARS-CoV-2, named B.1.1.7 [15], had rapidly spread throughout Japan and reached almost 100% replacement by the B.1.1.7 variant in June 2021. Lineage B.1.1.7 includes multiple changes, including an N501Y (Asn501Tyr) substitution in the spike protein that enhances binding to the human ACE2 receptor, through which the virus entered the cell [16,17]. Thus, we analyzed the non-B.1.1.7 and B.1.1.7 groups separately.

The severity of pneumonia was evaluated using predictive rules via the A-DROP system proposed by the JRS guidelines: age over 70 years in male and over 75 years in female, dehydration, respiratory failure, orientation disturbance, and low blood pressure [2,18]. Informed consent was obtained from all patients, and the study protocol was approved by the Ethics Committee of Kansai Medical University (approval number 2020319).

2.2. Statistical analysis

Statistical analysis was performed using Stat View version 5.0. (SAS Institute Inc, Cary, NC, USA). The incidence of clinical findings was analyzed using Fisher’s Exact test. Continuous variables were compared using the Student’s t-test when variables were normally distributed, and the Mann–Whitney U test was used when variables were non-normally distributed.

3. Results

3.1. Patient characteristics

The data for a total of 836 patients (538 men and 298 women with a median age of 64 years) with COVID-19 pneumonia were analyzed. Of the 836 COVID-19 pneumonia patients, 335 had lineage B.1.1.7 and 154 cases were classified as NHCAP [1]. Of these, 79 (15.8%) cases were non-B.1.1.7 group and 75 (22.4%) cases were B.1.1.7 group, respectively (Table 1). Among the NHCAP criteria, there were no differences

| Table 1 | Background of patients with COVID-19 pneumonia in the non-B.1.1.7 and B.1.1.7 groups. |
|-----------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Characteristics | Non-B.1.1.7         | B.1.1.7             | p value             |
| Pneumonia classification | n = 501            | n = 335             |                      |
| Community acquired | 422                 | 260                 |                      |
| (84.2)             | (77.6)              |                      |
| Nursing and healthcare associated | 79                 | 75                  |                      |
| (15.8)             | (22.4)              |                      |
| NH_cap criteria    | n = 79             | n = 75              |                      |
| Group A: Pneumonia diagnosed in an resident of an extended care facility | 38                 | 38                  | 0.8720              |
| (48.1)             | (50.7)              |                      |
| Group B: Pneumonia diagnosed in a person who has been discharged from a hospital within the preceding 90 days | 3 (3.8)           | 2 (2.7)             | >0.9999             |
| Group C: Pneumonia diagnosed in an elderly or disabled person who is receiving nursing care | 40                 | 34                  | 0.5234              |
| with an Eastern Cooperative Oncology Group performance status of 3 or 4 | (50.6)             | (45.3)              |                      |
| Group D: Pneumonia diagnosed in a person who is receiving regular endovascular treatment as an outpatient (dialysis, antibiotic therapy, chemotherapy, immunosuppressant therapy) | 22                 | 22                  | 0.8601              |
| (27.8)             | (29.3)              |                      |

Data represent the numbers of patients and numbers in parentheses are percentages.

* Including overlapping cases.

between the two groups (Table 1). In Group A, 32 cases had mental disorders and who were hospitalized in a medical institution for the treatment of mental illness.

Tables 2 and 3 show the underlying conditions and clinical findings of NHCAP and CAP patients in the non-B.1.1.7 and B.1.1.7 groups at the first examination, respectively. Patients with NHCAP were significantly older than those with CAP (p < 0.0001), but the male/female ratio did not differ between NHCAP and CAP in both the non-B.1.1.7 and B.1.1.7 groups. Among co-morbid conditions, cerebrovascular disease, chronic renal disease, and neoplastic disease were significantly more frequent in patients with NHCAP compared with those with CAP in both groups. Among clinical signs and symptoms, many symptoms were less frequent in patients with NHCAP compared with those with CAP in both groups.

3.2. Pneumonia severity on admission

The severity on admission of NHCAP and CAP was assessed by means of the A-DROP systems of the JRS (Tables 2 and 3). The average A-DROP scores in patients with NHCAP were significantly higher than in patients with CAP in both non-B.1.1.7 and B.1.1.7 groups (non-B.1.1.7 group, CAP 0.95 ± 1.12 versus NHCAP 2.01 ± 0.79, p < 0.0001; B.1.1.7 group, CAP 1.31 ± 0.96 versus NHCAP 1.83 ± 0.82, p = 0.0122). Pneumonia severity was also evaluated using predictive rules with a 5-point scoring system for hospital-acquired pneumonia from the JRS I-ROAD (immunodeficiency, age, respiratory failure, orientation disturbance, and dehydration) [19]. The average I-ROAD scores in patients with NHCAP were also significantly higher than those of patients with CAP in both groups.

3.3. Clinical outcomes

Rates of intensive care unit (ICU) stay and in-hospital mortality were significantly higher in patients with NHCAP compared with those with CAP in both groups (Tables 2 and 3). In patients with NHCAP, these rates were similar in the non-B.1.1.7 and B.1.1.7 groups (ICU stay, non-B.1.1.7 group 60.8% versus B.1.1.7 group 61.3%, p > 0.9999; in-hospital mortality, non-B.1.1.7 group 19.0% versus B.1.1.7 group 21.3%, p = 0.8411). In contrast, in patients with CAP, these rates were higher in B.1.1.7 group than non-B.1.1.7 group (ICU stay, non-B.1.1.7
3.4. Differences in clinical characteristics among NHCAP subgroups

No clinical differences were observed in patients with NHCAP between the non-B.1.1.7 and B.1.1.7 groups. Thus, we performed a sub-analysis in four NHCAP subgroups (Group A to D) using all NHCAP patients. Several differences were observed among the four NHCAP subgroups (Table 4). NHCAP patients in Group C were significantly older than those in patients in Groups B and D ($p = 0.0001$). Rates of ICU stay were significantly higher in patients in Group D than patients in group 28.7% versus B.1.1.7 group 45.8%, $p < 0.0001$; in-hospital mortality, non-B.1.1.7 group 1.7% versus B.1.1.7 group 3.5%, $p = 0.1909$).

### Table 2

| Variables | Community-acquired pneumonia | Nursing and healthcare-associated pneumonia | $p$ value |
|-----------|-------------------------------|---------------------------------------------|-----------|
| No. of patients | 422 | 79 | 80 (70-85) |
| Median age (IQR), years | 62 (41-73) | 48 (31) | 0.8015 |
| No. (%) of patients with comorbid illnesses | Diabetes mellitus | 82 (19.4) | 21 (26.6) | 0.1717 |
| | Chronic lung disease | 45 (10.7) | 12 (15.2) | 0.2485 |
| | Chronic heart disease | 20 (4.7) | 20 (25.3) | <0.0001 |
| | Cerebrovascular disease | 15 (3.6) | 17 (21.5) | <0.0001 |
| | Chronic renal disease | 17 (4.0) | 15 (19.0) | <0.0001 |
| | Neoplastic disease | 17 (4.0) | 14 (17.7) | <0.0001 |
| | Chronic liver disease | 11 (2.6) | 4 (5.1) | 0.2723 |
| | Autoimmune disease | 13 (3.2) | 2 (2.5) | >0.9999 |

No. (%) of patients with the following clinical signs and symptoms

- History of fever: 351 (83.2) vs. 71 (89.9) | $p = 0.1773$
- Cough: 224 (53.1) vs. 29 (36.7) | $p = 0.0097$
- Fatigue: 152 (36.0) vs. 17 (21.5) | $p = 0.0135$
- Shortness of breath: 117 (27.7) vs. 21 (26.6) | $p = 0.8915$
- Sore throat: 93 (22.0) vs. 4 (5.1) | $p = 0.0002$
- Loss of taste: 47 (11.1) vs. 4 (5.1) | $p = 0.1089$
- Diarrhea: 41 (9.7) vs. 8 (10.1) | $p = 0.8389$
- Sputum production: 7 (1.7) vs. 351 (83.2) | $p = 0.0001$
- Runny nose: 35 (8.3) vs. 1 (1.3) | $p = 0.0029$
- Joint pain: 28 (6.6) vs. 0 | $p = 0.0134$
- Chest pain: 17 (4.0) vs. 0 | $p = 0.0013$
- Muscle ache: 16 (3.8) vs. 1 (1.3) | $p = 0.3315$
- Nausea or vomiting: 13 (3.1) vs. 4 (5.1) | $p = 0.3241$
- Abdominal pain: 5 (1.2) vs. 1 (1.3) | $p = >0.9999$

No. (%) of patients with each pneumonia severity score

- 0: 195 (46.2) vs. 56 (21.5) | $p = <0.0001$
- 1: 111 (26.3) vs. 18 (22.8) | $p = 0.5764$
- 2: 74 (17.5) vs. 36 (45.6) | $p = <0.0001$
- 3: 29 (6.9) vs. 23 (29.1) | $p = <0.0001$
- 4: 9 (2.1) vs. 0 | $p = 0.3665$
- 5: 4 (0.9) vs. 0 | $p = >0.9999$

No. (%) of patients with treatment

- Antibiotic therapy: 131 (31.0) vs. 60 (75.9) | $p = <0.0001$
- Antiviral therapy: 247 (58.5) vs. 77 (97.5) | $p = <0.0001$
- Glucocorticoid therapy: 183 (43.4) vs. 64 (81.0) | $p = <0.0001$

No. (%) of patients with respiratory care

- HFNC: 116 (27.5) vs. 18 (22.8) | $p = 0.410$
- IMV: 96 (22.7) vs. 38 (48.1) | $p = <0.0001$
- ECMO: 25 (5.9) vs. 10 (12.7) | $p = 0.049$

No. (%) of patients admitted to intensive care unit

- 0: 121 (28.7) vs. 48 (60.8) | $p = <0.0001$
- 1: 7 (1.7) vs. 15 (19.0) | $p = <0.0001$

### Table 3

| Variables | Community-acquired pneumonia | Nursing and healthcare-associated pneumonia | $p$ value |
|-----------|-------------------------------|---------------------------------------------|-----------|
| No. of patients | 260 | 75 | 72 (64-82) | $p = <0.0001$
| Median age (IQR), years | 62 (46-72) | 48 (31) | 45/30 | 0.1228 |

**Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages. HFNC, high flow nasal cannula. IMV, invasive mechanical ventilation. ECMO, extracorporeal membrane oxygen.**

3.5. Characteristics in patients with mental disorders

Table 5 shows the underlying conditions and clinical findings in 32 patients with mental disorders who were hospitalized in a medical institution for the treatment of mental illness (22 schizophrenia, 4 mental retardation, 4 depressive disorders and 2 neurotic disorders), 122 patients with NHCAP excluding mental hospitals and 682 patients with CAP, respectively. Patients in mental hospitals were significantly grouped with CAP, respectively. Patients in mental hospitals were significantly lower than those in patients in Group A ($p = 0.011$) and C ($p = 0.0034$). Mortality rate were highest in Group C (24.3%), followed by Group D (20.5%), Group B (20.0%), and Group A (13.3%).
Clinical characteristics of patients with nursing and healthcare-associated pneumonia due to COVID-19 according to different groups.

| Variables | Group A | Group B | Group C | Group D |
|-----------|---------|---------|---------|---------|
| No. of patients | 76 | 5 | 74 | 44 |
| Median age (IQR), years | 77 (67-85) | 73 (65-79) | 82 (75-86) | 72 (64-80) |
| No. of males/females | 43/33 | 5/0 | 35/39 | 29/15 |
| No. (%) of patients with comorbid illnesses | 57 (75.0) | 5 | 62 (83.8) | 44 (100) |
| No. (%) of patients with each pneumonia severity score | | | | |
| No. (%) of patients with in-hospital mortality | | | | |
| No. (%) of patients admitted to intensive care unit | 35 (46.1) | 4 | 36 (48.6) | 34 (77.3) |
| No. (%) of patients with comorbid illnesses | 10 (13.2) | 1 | 18 (24.3) | 9 (20.5) |

Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages.

Excluding overlapping cases.

Younger than those with NHCAP (p < 0.0001), but similar to those with CAP. The frequency of comorbid illness in patients in mental hospitals was significantly lower than those with NHCAP (p < 0.0001), but the similar to those with CAP.

The average A-DROP scores in patients from mental hospitals were significantly higher than that in patients with CAP (Mental hospital 1.56 ± 0.83 versus CAP 1.02 ± 1.08, p = 0.0413). Rates of ICU stay in patients in mental hospitals were higher than that in patients with CAP (Mental hospital 53.1% versus CAP 35.2%), but these differences did not reach statistical significance. Rates of in-hospital mortality in patients from mental hospitals was significantly higher than that of patients with CAP (Mental hospital 9.4% versus CAP 2.3%, p = 0.0486).

### 4. Discussion

COVID-19 mainly occurs in the outpatient setting and CAP is more frequent than NHCAP among types of pneumonia. However, many outbreaks due to SARS-CoV-2 have occurred in nursing homes and mental hospitals, thereby meeting the criteria for NHCAP. The present results revealed differences in patient background, clinical findings, disease severity, and clinical outcomes between NHCAP and CAP due to COVID-19. The median age and frequency of comorbid illness, which are associated with greater severity of COVID-19 [10], were significantly higher in patients with NHCAP than those with CAP (p < 0.0001). Rates of ICU stay and in-hospital mortality were also significantly higher in patients with NHCAP than those with CAP. These differences were similar to previous reports that investigated the differences in NHCAP and CAP due to bacterial infection [3-8,20,21]. Our results also demonstrated that there were no differences in the clinical characteristics of patients with NHCAP between the non-B.1.1.7 group and B.1.1.7 group. Thus, giving priority for SARS-CoV-2 vaccination to elderly people and people with comorbid illnesses is thought to be reasonable. In fact, SARS-CoV-2 vaccination of people who met the NHCAP criteria was successful in the 5th wave of COVID-19 in Japan because number of severely ill patients and deaths due to COVID-19 in the elderly persons was markedly reduced [22].

Patients with mental disorders who are hospitalized in a medical institution for treatment of mental illness were included in NHCAP Group A. Our previous studies demonstrated that the pneumonia severity and mortality rate in patients in mental hospitals were lowest among the patients NHCAP and similar to those with CAP [20,21]. These findings may be related to the younger age and lower frequency of comorbid illnesses in patients in mental hospitals, as observed in this study. However, in the present study, the ICU stay and mortality rate were higher in patients in mental hospitals than those of patients with CAP (Table 5), as reported other studies [11-14]. Thus, it was appropriate to add patients with severe mental disorders to the vaccination priority program.

Within Group D, 16 patients were receiving regular endovascular treatment with anti-cancer drugs as an outpatient and 28 patients were receiving dialysis. A large Japanese cohort study demonstrated that patients with solid tumors or receiving dialysis experienced more-severe COVID-19 [10]. Among patients with NHCAP, the mortality rate was highest at 37.5% in patients with recent cancer treatment, followed by elderly or disabled people who were receiving nursing care with performance status scores of 3 or 4 (Group C, 24.3%), residents of an extended care facility or long-term care health facility (Group A, 23.0%), patients receiving dialysis (13.6%), and patients with mental disorders who were hospitalized in a medical institution for the treatment of mental illness (9.4%). Our previous study demonstrated that the mortality rate was higher in patients in Group A and C than Group D [20]. Chavez-MacGregor and colleagues found that patients with recent cancer treatment and COVID-19 had a significantly higher risk of adverse outcomes (odds ratio: death 1.74, ICU stay 1.69, and hospitalization 1.19), and patients with no recent cancer treatment had similar outcomes (odds ratio: death 1.35, ICU stay 1.08, and hospitalization 1.01).

### Table 5

Clinical characteristics of patients with two types of nursing and healthcare-associated pneumonia and community-acquired pneumonia due to COVID-19.

| Variables | Mental hospital | Nursing and healthcare-associated pneumonia (NHCAP) | Community-acquired pneumonia (CAP) | p value MH vs NHCAP | p value MH vs CAP |
|-----------|-----------------|-----------------------------|--------------------------------|---------------------|------------------|
| No. of patients | 32 | 122 | 682 | 0.0001 | 0.1563 |
| Median age (IQR), years | 65 (56-73) | 79 (70-84) | 62 (44-72) | 0.0001 | 0.1563 |
| No. of males/females | 22/10 | 71/51 | 445/237 | 0.3152 | 0.8495 |
| No. (%) of patients with comorbid illnesses | 12 (37.5) | 110 (90.2) | 367 (53.8) | <0.0001 | 0.1015 |
| No. (%) of patients with each pneumonia severity score | | | | |
| No. (%) of patients with in-hospital mortality | | | | |

Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages.

Excluding mental hospital.
outcomes to those without cancer [23]. However, the outcomes in patients with recent cancer treatment and COVID-19 are still controversial [24–27].

In this study, cases of pneumonia mixed with other microorganisms were excluded because small sample size. A systematic review and meta-analysis demonstrated the bacterial co-infection and secondary infection in patients with COVID-19 was observed in 3.5%–7% [28,29]. Our study demonstrated the bacterial co-infection with COVID-19 was observed in 2.1%. The prevalence rate of co-infection may differ according to pneumonia severity.

Our study had several limitations. The main purpose of this study was to clarify the differences between NHCAP and CAP due to COVID-19. In addition, we performed a subanalysis in four NHCAP subgroups (Groups A to D). Thus, sample size was small in each of the NHCAP subgroups. In particular, we were unable to evaluate Group B patients who has been discharged from a hospital within the preceding 90 days. Mortality rate may be affected in patients with recent cancer treatment, patients receiving dialysis, and patients in mental hospitals. Further studies with a larger sample size in each NHCAP subgroups are needed.

In conclusion, the median age, frequency of comorbid illness, rates of ICU stay, and mortality rate were significantly higher in patients with NHCAP than in those with CAP due to COVID-19. These findings were identical between the non-B.1.1.7 group and B.1.1.7 group. It is necessary to consider the prevention and treatment content depending on the presence or absence of applicable criteria for NHCAP.

Ethical approval and consent to participate

The study protocol was approved by the Ethics Committee at Kansai Medical University and all participating facilities. Informed consent was obtained from all individual participants in the study.

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Author’s contributions

All the authors conceived the study, participated in its design and coordination, and collected and managed the data, including quality control. NM, YN and SN drafted the manuscript, and all authors contributed substantially to its revision. All the authors read and approved the final manuscript.

Availability of data and materials

The data will not be shared because of participant confidentiality.

Consent for publication

Not applicable.

Declaration of competing interest

The authors declare that they have no competing interests.

References

[1] Kohno S, Imamura Y, Shindo Y, Seki M, Ishida T, Teramoto S, et al. Clinical practice guidelines for nursing- and healthcare-associated pneumonia (NHCAP) (complete translation). Respir Investig 2013;51:103–26.
[2] Committee for The Japanese Respiratory Society guidelines for the management of respiratory infections. Guidelines for the management of community acquired pneumonia in adults, revised edition. Respirioplogy 2006;11(Suppl 3):S79–133.
[3] Ishida T, Tachibana H, Ito A, Yoshiba H, Arita M, Hashimoto T. Clinical characteristics of nursing and healthcare-associated pneumonia: a Japanese variant of healthcare-associated pneumonia. Intern Med 2012;51:2537–44.
[4] Fukuyama H, Yamashiro S, Tamaki H, Kishaba T. A prospective comparison of nursing- and healthcare-associated pneumonia (NHCAP) with community-acquired pneumonia (CAP). J Infect Chemother 2013;19:719–26.
[5] Kaku N, Nagashima S, Fukuda M, Takatani H, Fukuda M, Hashiguchi K, et al. The definition of healthcare-associated pneumonia (HCAP) is insufficient for the medical environment in Japan: a comparison of HCAP and nursing and healthcare-associated pneumonia (NHCAP). J Infect Chemother 2013;19:70–6.
[6] Nakagawa N, Saito Y, Sasaki M, Tsuda Y, Mochizuki H, Takahashi H. Comparison of clinical profile in elderly patients with nursing and healthcare-associated pneumonia, and those with community-acquired pneumonia. Geriatr Gerontol Int 2014;14:362–71.
[7] Oshitani Y, Nagai H, Matsui H, Aoshima M. Reevaluation of the Japanese guideline for healthcare-associated pneumonia in a medium-size community hospital in Japan. J Infection Chemother 2014;20:259–67.
[8] UmeKI K, Tomitaka I, Yasuda C, Iwata A, Yoshioka D, Ishii H, et al. Clinical features of healthcare-associated pneumonia (HCAP) in Japanese community hospital: comparisons among nursing home-acquired pneumonia (NHPA), HCAP other than NHAP, and community-acquired pneumonia. Respirology 2011;16:856–61.
[9] Cevik M, Kupplali K, Kindrachuk J, Periris M. Virollogy, transmission, and pathogenesis of SARS-CoV-2. BMJ 2020;371:m3862.
[10] Terada M, Ohtsu H, Saito S, Hayakawa K, Tszuki K, Azai Y, et al. Risk factors for severity on admission and the disease progression during hospitalization in a large cohort of patients with COVID-19 in Japan. BMJ Open 2021;11:e047007.
[11] Wang Q, Xu R, Volkov. Increased risk of COVID-19 infection and mortality in people with mental disorders: analysis from electronic health records in the United States. World Psychiatry 2021;20:124–30.
[12] Taquet M, Luciano S, Geddes JR, Harrison PJ. Bidirectional associations between COVID-19 and psychiatric disorders: retrospective cohort studies of 66254 COVID-19 cases in the USA. Lancet Psychiatry 2021;8:336–40.
[13] Jeon H-L, Kwon JS, Park S-H, Shin J-Y. Association of mental disorders with SARS-CoV-2 infection and severe health outcomes: nationwide cohort study. Br J Psychiatry 2021;21:1–8.
[14] Nemani K, Li C, Olifon M, Blesing EM, Razavian N, Chen J, et al. Association of psychiatric disorders with mortality among patients with COVID-19. JAMA Psychiatry 2021;78:380–6.
[15] Rambaut A, Loman N, Pybus O, Barclay W, Barrett J, Carabelli A, et al. Preliminary genomic characterisation of an emergent SARS-CoV-2 lineage in the UK defined by a novel set of spike mutations. Virological 2020. https://virological.org/t/preliminary-genomic-characterisation-of-an-emergent-sars-cov-2-lineage-in-the-uk-defined-by-a-novel-set-of-spike-mutations/565.
[16] Wije J. COVID-19: new coronavirus variant is identified in UK. BMJ 2020;371:m4857.
[17] Frampton D, Rampling T, Cross A, Bailey H, Heaney J, Byott M, et al. Genomic characteristics and clinical effect of the emergent SARS-CoV-2 B.1.1.7 lineage in London, UK: a whole-genome sequencing and hospital-based cohort study. Lancet Infect Dis 2021. https://doi.org/10.1016/S1473-3099(21)00170-5.
[18] Koizumi T, Tsukada H, Ito K, Shibata S, Hokari S, Tetsuka T, et al. A-DROP system for prognostication of NHAP inpatients. J Infect Chemother 2017;23:523–30.
[19] The committee for the Japanese Respiratory Society guidelines in management of respiratory infections. The Japanese Respiratory Society guideline for the management of hospital-acquired pneumonia in adults in 2008. Respirology 2009;14: S1–71.
[20] Miyashita N, Kawai Y, Akaike Y, Yamaguchi T, Ouchi K, Hayashi T, et al. Clinical features and the role of atypical pathogens in nursing and healthcare-associated pneumonia (NHCAP): differences between teaching university hospital and community hospital. Intern Med 2012;51:585–94.
[21] Miyashita N, Kawai Y, Imamura N, Tanaka T, Akaike H, Teranishi H, et al. Detection failure rate of chest radiography for the identification of nursing and healthcare-care-associated pneumonia. J Infect Chemother 2015;21:692–6.
[22] Ministry of health, labour and welfare, 50th Advisory board of countermeasures for COVID-19 infection. https://www mhwb gov. jp/content/10900000/000826597. pdf.
[23] Chavez-MacGregor M, Lei X, Zhao H, Scheet P, Giordano SH. Evaluation of COVID-19 mortality and adverse outcomes in US patients with or without cancer. JAMA Oncol 2021 Oct 28.
[24] Zhang L, Zhu F, Xie L, Wang C, Wang J, Chen R, et al. Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China. Ann Oncol 2020;31:894–901.
[25] Liang W, Guan W, Chen R, Wang W, Li J, Xu K, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. Lancet Oncol 2020;21:335–7.
[26] Lee L, Zaiyer J-B, Angelis V, Arnold R, Bishot V, Campton NA, et al. COVID-19 mortality in patients with cancer on chemotherapy or other anticancer treatments: a prospective cohort study. Lancet 2020;395:1919–26.
[27] Luo J, Rizvi H, Egger JV, Preeshagul IR, Wolchok JD, Hellmann MD. Correction: impact of PD-1 blockade on severity of COVID-19 in patients with lung cancers. Cancer Discov 2021;11:520.
[28] Langford BJ, So M, Raybardhan S, Leung V, Westwood D, MacFadden DR, et al. Correction: PD-1 blockade on severity of COVID-19 in patients with lung cancers. Cancer Discov 2021;11:520.
[29] Frampton D, Rampling T, Cross A, Bailey H, Heaney J, Byott M, et al. Genomic characteristics and clinical effect of the emergent SARS-CoV-2 B.1.1.7 lineage in London, UK: a whole-genome sequencing and hospital-based cohort study. Lancet Infect Dis 2021. https://doi.org/10.1016/S1473-3099(21)00170-5.