**Supplementary appendix**

This appendix has been provided by the authors to supplement readers with additional information about this work.

|  |  |  |
| --- | --- | --- |
| **Patient Status** | **Descriptor** | **Category** |
| **Ambulatory** | **No limitations on activities** | **1** |
| **Limitation of activities** | **2** |
| **Hospitalized, mild disease** | **Hospitalized, no oxygen therapy** | **3** |
| **Oxygen by mask or nasal prongs** | **4** |
| **Hospitalized, severe disease** | **Non-invasive ventilation or high-flow oxygen** | **5** |
| **Intubation and mechanical ventilation** | **6** |
| **Additional organ life support such as renal replacement therapy, and extracorporeal membrane oxygenation** | **7** |
| **Dead** | **Death** | **8** |

Table S1. Eight categories ordinal scale of the World Health Organization[1]

Table S2. Association of laboratory tests with unfavorable corticosteroid response according to time category

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Variables | Univariate | |  | Multivariable | |  |
|  |  | OR\* (95% CI) | p-value |  | aOR† (95% CI) | p-value |  |
| Total | WBC (10^3/uL) | 1.087 (1.011-1.167) | **<0.001** |  | 1.054 (0.972-1.142) | 0.200 |  |
|  | PLT (10^3/uL) | 0.997 (0.991-1.002) | 0.143 |  |  |  |  |
|  | Lymphocyte (%) | 0.937 (0.898-0.977) | **0.002** |  | 0.962 (0.922-1.003) | 0.070 |  |
|  | CRP (mg/L) | 1.016 (1.010-1.022) | **<0.001** |  | 1.015 (1.008-1.022) | **<0.001** |  |
|  | Albumin (g/dL) | 0.353 (0.210-0.592) | **<0.001** |  | 0.616 (0.357-1.063) | 0.082 |  |
|  | IL-6 (pg/mL) | 1.000 (0.999-1.001) | 0.775 |  |  |  |  |
|  | D-dimer (mcgFEU/mL) | 1.260 (0.965-1.646) | 0.090 |  |  |  |  |
|  | Procalcitonin (ng/mL) | 1.007 (0.973-1.042) | 0.692 |  |  |  |  |
| Category 0‡ | WBC (10^3/uL) | 1.057 (0.971-1.151) | 0.198 |  |  |  |  |
|  | PLT (10^3/uL) | 0.999 (0.994-1.003) | 0.545 |  |  |  |  |
|  | Lymphocyte (%) | 0.970 (0.923-1.020) | 0.234 |  |  |  |  |
|  | CRP (mg/L) | 1.013 (1.005-1.020) | **0.001** |  | 1.011 (1.001-1.021) | **0.038** |  |
|  | Albumin (g/dL) | 0.322 (0.160-0.646) | **0.001** |  | 0.342 (0.132-0.886) | **0.027** |  |
|  | IL-6 (pg/mL) | NA | NA |  |  |  |  |
|  | D-dimer (mcgFEU/mL) | 1.154 (0.935-1.426) | 0.183 |  |  |  |  |
|  | Procalcitonin (ng/mL) | 1.165 (0.993-1.366) | 0.061 |  |  |  |  |
| Category 1§ | WBC (10^3/uL) | 1.133 (1.018-1.261) | **0.022** |  | 1.107 (0.973-1.260) | 0.132 |  |
|  | PLT (10^3/uL) | 1.000 (0.995-1.005) | 0.926 |  |  |  |  |
|  | Lymphocyte (%) | 0.959 (0.922-0.998) | **0.038** |  | 0.987 (0.948-1.027) | 0.551 |  |
|  | CRP (mg/L) | 1.013 (1.00-1.020) | **<0.001** |  |  |  |  |
|  | Albumin (g/dL) | 0.343 (0.170-0.691) | 0.030 |  |  |  |  |
|  | IL-6 (pg/mL) | 0.999 (0.991-1.008) | 0.999 |  |  |  |  |
|  | D-dimer (mcgFEU/mL) | 1.748 (0.983-3.109) | 0.057 |  |  |  |  |
|  | Procalcitonin (ng/mL) | 1.283 (0.882-1.866) | 0.192 |  |  |  |  |
| Category 2‖ | WBC (10^3/uL) | 1.046 (0.940-1.164) | 0.406 |  |  |  |  |
|  | PLT (10^3/uL) | 0.994 (0.988-0.999) | **0.031** |  | 0.998 (0.991-1.004) | 0.433 |  |
|  | Lymphocyte (%) | 0.916 (0.864-0.970) | **0.003** |  | 0.914 (0.851-0.982) | **0.014** |  |
|  | CRP (mg/L) | 1.017 (1.009-1.024) | **<0.001** |  | 1.016 (1.007-1.025) | **<0.001** |  |
|  | Albumin (g/dL) | 0.299 (0.128-0.698) | **0.005** |  | 0.361 (0.107-1.219) | 0.101 |  |
|  | IL-6 (pg/mL) | 1.000 (0.996-1.004) | 0.878 |  |  |  |  |
|  | D-dimer (mcgFEU/mL) | 1.187 (0.227-6.204) | 0.839 |  |  |  |  |
|  | Procalcitonin (ng/mL) | 0.708 (0.077-6.505) | 0.761 |  |  |  |  |
| Category 3¶ | WBC (10^3/uL) | 1.026 (1.060-1.372) | **0.005** |  | 1.249 (1.052-1.482) | **0.011** |  |
|  | PLT (10^3/uL) | 0.995 (0.989-1.000) | 0.052 |  |  |  |  |
|  | Lymphocyte (%) | 0.82 (0.734-0.916) | **<0.001** |  | 0.857 (0.752-0.970) | **0.020** |  |
|  | CRP (mg/L) | 1.031 (1.013-1.046) | **<0.001** |  | 1.029 (1.009-1.049) | **0.005** |  |
|  | Albumin (g/dL) | 0.154 (0.049-0.477) | **0.001** |  | 0.266 (0.049-1.428) | 0.122 |  |
|  | IL-6 (pg/mL) | NA | NA |  |  |  |  |
|  | D-dimer (mcgFEU/mL) | 3.508 (0.417-29.504) | 0.248 |  |  |  |  |
|  | Procalcitonin (ng/mL) | 39.177 (0.771-1990.064) | 0.067 |  |  |  |  |

Values with statistical significance of p<0.05 were presented with bold type. Abbreviations: OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; WBC, white blood cell count; PLT, platelet count; CRP, c-reactive protein; IL-6, interleukin six; NA, not applicable

\* OR was calculated using a generalized estimating equation for all measurements involved or logistic regression analysis in categorical measurements.

† aOR was adjusted for age, sex, charlson comorbidity index, immune status, vaccination status, antiviral agent usage, and antibacterial agent usage.

‡ 0-2 days from the onset of symptoms

§ 3-5 days from the onset of symptoms

‖ 6-9 days from the onset of symptoms

¶ More than 10 days from the onset of symptoms

Table S3. The differences in laboratory values according to corticosteroid responsiveness

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Variables | Based on symptom | |  |
|  | Unfavorable\* | Favorable |  |
| Category 0† | WBC (10^3/uL) | 6.79 [4.977-10.36] | 6.23 [4.55-8.31] |  |
|  | PLT (10^3/uL) | 187.50 [141.25-251.75] | 194.00 [155.26-247.25] |  |
|  | Lymphocyte (%) | 15.90 [10.45-19.53] | 16.20 [10.80-22.08] |  |
|  | CRP (mg/L) | 71.20 [32.50-128.05] | 20.25 [8.00-47.65] |  |
|  | Albumin (g/dL) | 3.54±0.80 | 4.043±0.60 |  |
|  | IL-6 (pg/mL) | 100.05 [85.10-NA] | 17.70 [7.36-30.45] |  |
|  | D-dimer (mcgFEU/mL) | 0.63 [0.32-1.95] | 0.43 [0.23-0.93] |  |
|  | Procalcitonin (ng/mL) | 1.19 [0.44-10.69] | 0.12 [0.05-0.24] |  |
| Category 1‡ | WBC (10^3/uL) | 6.33 [4.84-9.80] | 5.31 [3.79-7.44] |  |
|  | PLT (10^3/uL) | 165.00 [101.00-244.00] | 173.00 [141.00-216.00] |  |
|  | Lymphocyte (%) | 13.15 [5-21.52] | 20.50 [13.25-31.05] |  |
|  | CRP (mg/L) | 72.00 [50.60-139.30] | 26.05 [7.70-59.53] |  |
|  | Albumin (g/dL) | 3.37±0.76 | 3.82±0.59 |  |
|  | IL-6 (pg/mL) | 73.4 | 26.10 [6.81-72.90] |  |
|  | D-dimer (mcgFEU/mL) | 1.07 [0.39-2.73] | 0.31 [0.20-0.61] |  |
|  | Procalcitonin (ng/mL) | 0.69 [0.45-3.49] | 0.11 [0.05-1.14] |  |
| Category 2§ | WBC (10^3/uL) | 7.33 [3.53-11.04] | 6.16 [4.51-8.37] |  |
|  | PLT (10^3/uL) | 153.00 [80.00-218.50] | 201.00 [147.00-264.00] |  |
|  | Lymphocyte (%) | 10.300 [7.00-21.50] | 19.60 [13.10-26.95] |  |
|  | CRP (mg/L) | 76.65 [47.60-435.52] | 16.40 [6.70-45.08] |  |
|  | Albumin (g/dL) | 3.19±0.71 | 3.58±0.51 |  |
|  | IL-6 (pg/mL) | 98.20 [70.40-NA] | 24.30 [13.88-71.87] |  |
|  | D-dimer (mcgFEU/mL) | 0.435 [0.35-0.70] | 0.41 [0.21-0.52] |  |
|  | Procalcitonin (ng/mL) | 0.24 [0.12-0.38] | 0.11 [0.03-0.17] |  |
| Category 3‖ | WBC (10^3/uL) | 9.54 [7.49-15.14] | 7.04 [5.45-9.43] |  |
|  | PLT (10^3/uL) | 99.00 [73.00-261.00] | 256 [195.75-319.25] |  |
|  | Lymphocyte (%) | 8.40 [3.90-12.70] | 19.00 [12.50-25.93] |  |
|  | CRP (mg/L) | 97.85 [58.1-202.10] | 15.90 [4.95-29.95] |  |
|  | Albumin (g/dL) | 2.89±0.72 | 3.48±0.47 |  |
|  | IL-6 (pg/mL) | NA | 33.79 [6.54-65.50] |  |
|  | D-dimer (mcgFEU/mL) | 0.755 [0.362-1.342] | 0.40 [0.29-0.70] |  |
|  | Procalcitonin (ng/mL) | 0.13 [0.09-0.75] | 0.07 [0.04-0.14] |  |

Data are expressed as mean ± standard deviation or median [Q1-Q3] Abbreviations: OR, odds ratio; CI, confidence interval; WBC, white blood cell count; PLT, platelet count; CRP, c-reactive protein; IL-6, interleukin six; NA, not applicable

\*Unfavorable corticosteroid responsiveness was defined as either advancement of two or more of the eight-categories-ordinal scale established by WHO or no improvement from the initial 5th or worse category

†0-2 days from the onset of symptoms

‡3-5 days from the onset of symptoms

§6-9 days from the onset of symptoms

‖more than 10 days from the onset of symptoms

**Figure legends**

**Figure S1. Examples of artificial intelligence-generated abnormality scores incorporated in patients’ chest radiographs show the probability of the presence of abnormal lesions. (A) An 82-year-old male patient with unfavorable results (consolidation score, left 96%, consolidation score, right 96%, pleural effusion score, left 42%) (B) An 83-year-old female patient with the favorable response (pleural effusion score, left 72%)**

Abbreviations: Csn, consolidation; PEf, pleural effusion

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**Figure S2. Differences in artificial intelligence generated chest radiograph scores according to corticosteroid responsiveness and time category**

Abbreviations: CAT 0: category 0, 0-2 days from the onset of symptoms; CAT 1: category 1,3-5 days from the onset of symptoms; CAT 2: category 3, 6-9 days from the onset of symptoms; CAT 3, more than 10 days from the onset of symptoms

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**Figure S3. Association between consolidation score and unfavorable corticosteroid responsiveness according to the time category and subgroup**

a Adjusted odds ratio and 95% confidence interval of consolidation score in predicting corticosteroid responsiveness within each subgroup were calculated using multivariate logistic regression and adjusted for age, sex, Charlson comorbidity index, immune status, vaccination status, antiviral agent usage, and antibacterial agent usage

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; CAT 0: category 0, 0-2 days from the onset of symptoms; CAT 1: category 1,3-5 days from the onset of symptoms; CAT 2: category 3, 6-9 days from the onset of symptoms; CAT 3, more than 10 days from the onset of symptoms; CI, confidence interval

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**Figure S4. Association between pleural effusion score and unfavorable corticosteroid responsiveness according to the time category and subgroups**

a Adjusted odds ratio and 95% confidence interval of pleural effusion score in predicting corticosteroid responsiveness within each subgroup were calculated using multivariate logistic regression and adjusted for age, sex, Charlson comorbidity index, immune status, vaccination status, antiviral agent usage, and antibacterial agent usage

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; CAT 0: category 0, 0-2 days from the onset of symptoms; CAT 1: category 1,3-5 days from the onset of symptoms; CAT 2: category 3, 6-9 days from the onset of symptoms; CAT 3, more than 10 days from the onset of symptoms; CI, confidence interval

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