Short Communication

Comparison of three prognostic and predictive scores in 10 patients with COVID-19 pneumonia caused by nosocomial infection

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ABSTRACT

Introduction: A nosocomial outbreak of coronavirus disease (COVID-19) occurred in the Toda Chuo Hospital in Toda City, Saitama Prefecture, Japan in December 2020. The purpose of this study was to compare the accuracy of three prognostic indices for predicting the outcome of COVID-19 in patents with COVID-19 pneumonia.
Patients and methods: Patients in the Department of Urology and Transplant Surgery at Toda Chuo General Hospital with nosocomially acquired COVID-19 confirmed by a positive polymerase chain reaction test were included in the study. We used the COVID-GRAM, International Severe Acute Respiratory and Emerging Infections Consortium's World Health Organization 4C Mortality Score, and COVID-19 Registry Japan to independently predict the prognoses of 10 patients and identify common prognostic factors. All three indices include age, dyspnea, and comorbidities as prognostic factors.
Results: Ten patients were included in the study, of which two patients died. According to the COVID-GRAM both patients were "high risk," whereas the 4C Mortality Score predicted "high risk" and "very high risk."
Conclusion: The prognostic scores of all three indices were useful for predicting illness severity.
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Comparación de tres puntuaciones pronósticas y predictivas en 10 pacientes con neumonía COVID-19 causada por infección nosocomial

RESUMEN

Objetivos: En diciembre de 2020 se produjo un brote nosocomial de enfermedad por coronavirus (COVID-19) en el Hospital General Toda Chuo de la ciudad de Toda, prefectura de Saitama, Japón. El propósito de este estudio fue comparar la exactitud de tres índices pronósticos para predecir el resultado de COVID-19 en pacientes con neumonía por COVID-19.
Métodos: Se incluyeron en el estudio pacientes del Departamento de Urología y Cirugía de Trasplantes del Hospital General Toda Chuo con COVID-19 adquirida por vía nosocomial confirmada por una prueba de reacción en cadena de la polimerasa positiva. Se utilizaron los índices COVID-GRAM, International Severe Acute Respiratory and Emerging Infections Consortium's World Health Organization 4C Mortality Score y COVID-19 Registry Japan para predecir de forma independiente el pronóstico de 10 pacientes e identificar factores pronósticos comunes. Los tres índices incluyen la edad, la disnea y las comorbilidades como factores pronósticos.
Resultados: Se incluyeron en el estudio 10 pacientes. Dos pacientes fallecieron. Según el COVID-GRAM ambos pacientes eran de "alto riesgo", mientras que el 4C Mortality Score predijo "alto riesgo" y "muy alto riesgo".
Conclusión: Las puntuaciones pronósticas de los tres índices fueron útiles para predecir la gravedad de la enfermedad.
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Introduction

Toda Chuo General Hospital is a 517-bed acute care general hospital in Toda City, Saitama Prefecture, with a dedicated ward for patients with coronavirus disease 2019 (COVID-19). On December 19, 2020, an infection was confirmed in one staff member, and simultaneously, six staff members and five patients were also confirmed to be infected. A cluster was consequently confirmed in the hospital, resulting in infections in 150 patients and 174 staff members, among which 45 deaths occurred. The outbreak occurred during the first wave of COVID-19 when no treatment was available. Ten cases of COVID-19 occurred in patients in our department during the outbreak. The purpose of this study was to compare the accuracies of three prognostic indices for predicting the outcome of COVID-19 in patents with COVID-19 pneumonia.

Materials and methods

Study cohort

Ten patients in the Department of Urology and Transplant Surgery at Toda Chuo General Hospital with a positive polymerase chain reaction test and a confirmed diagnosis of COVID-19 were included in the study. They were infected at the Toda Chuo General Hospital between December 19, 2020 and January 5, 2021.

Prognostic scoring

The COVID-GRAM, International Severe Acute Respiratory and Emerging Infections Consortium's (ISARIC) World Health Organization (WHO) 4C Mortality Score, and COVID-19 Registry Japan (COVIREGI-JP) were used as the prognostic scoring tools.

Ethics approval

This study was approved by the committee of Toda Chuo General Hospital Institutional Review Board (0542).

Statistical analysis

A simple descriptive analysis was conducted. In view of the small sample size, no inferential statistics or hypothesis testing were employed.

Results

The backgrounds of the 10 patients are shown in Table 1. Of the 10 patients, the COVID-GRAM score showed intermediate risk in four patients and high risk in six patients. The ISARIC WHO 4C Mortality Score showed intermediate risk in three patients, high risk in six patients, and very high risk in one patient. Nine patients in the COVIREGI-JP group were at a risk of requiring oxygen therapy (Table 2).

Of the ten study patients, two (Patients 2 and 10) died, and two (Patients 3 and 5) experienced severe outcomes. The COVID-GRAM

predicted Patient 3 to have intermediate risk, whereas the ISARIC WHO 4C Mortality Score predicted a high risk. Patient 5 was scored as high risk using both these prognostic tools. Patient 2 was also scored as high risk by both these tools, whereas Patient 10 was scored as high risk using the COVID-GRAM and very high risk using the ISARIC WHO 4C Mortality Score. Furthermore, six of the nine patients in the COVIREGI-JP group required supplemental oxygen.

Discussion

There are several prognostic factors for COVID-19. Currently, vaccination and new oral medications can prevent severe disease; however, at the time of this study, neither vaccination not oral medications were available. We compared the predictive accuracies of three prognostic factor indices, i.e., the COVID-GRAM, the ISARIC WHO 4C Mortality Score, and COVIREGI-JP.[1-3] Prognostic factors shared by all three indices included age, dyspnea, and comorbidities. Level of consciousness was common to the COVID-GRAM and the ISARIC WHO 4C Mortality Score, whereas sex was common to the ISARIC WHO 4C Mortality Score and COVIREGI-JP.

SARS-CoV-2 infection following kidney transplantation has been reported to be associated with a higher mortality rate (28%) than that in the general population or in patients older than 70 years.[4] Within our patients, Patient 3 had undergone a kidney transplantation and had a severe outcome. In the COVID-GRAM scale, high risk was more common due to the presence of malignancy. Within the 4C mortality scores, the proportion of high risk was high due to the high score due to age. The 4C Mortality Score was more accurate in predicting outcomes than the COVID-GRAM scale.

Patients with perioperative COVID-19 infections have a significantly higher risk of postoperative complications, especially in men older than 70 years.[5,6] Postoperative pulmonary complications occurred in half of the patients with COVID-19 infections diagnosed from within seven days pre-operation to 30 days post-operation and were associated with a high mortality rate.[5] Patient 5, a man aged over 70 years, experienced severe complications on the eighth postoperative day.

Patients 2 and 10 died. Patient 2 had a pelvic tumor of unknown origin with bone metastasis, and Patient 10 had a metastatic bladder tumor with uterine invasion and lung metastasis. Metastases may contribute to severe disease and death. Old age is the most important risk factor for severe disease, and in an analysis using COVIREGI-JP, the fatality rate was 3.9% in patients aged 60 years or older with no underlying disease and 12.8% in patients aged 60 years or older with underlying disease.[3,7] Although the number of cases in this study was small, the patients with underlying conditions, such as metastatic cancer and an immunosuppressed status, tended to develop more severe COVID-19 pneumonia. In addition, several meta-analyses have shown that men are at a higher risk of severe illness and death than women.[8] With the development of vaccination and treatment methods, new prognostic factors should be evaluated in the future.

In conclusion, all three prognostic scoring systems were useful for predicting illness severity.

Table 1
Patient characteristics.

【Case】	1	2	3	4	5	6	7	8	9	10
Age	57	66	73	73	74	85	87	87	87	88
Sex	Man	Man	Woman	Man	Man	Man	Man	Woman	Man	Woman
Primary disease	Metastatic renal cell carcinoma	Pelvic tumor Multiple bone metastases of unknown primary cancer	After living donor kidney transplantation	Localized prostate cancer	Muscle-invasive bladder cancer	Non-muscle-invasive bladder cancer	Benign prostatic hyperplasia	Emphysematous pyelonephritis	Benign prostatic hyperplasia	Metastatic bladder tumor
Stage	cT1bN0M1	-	-	cT1cN0M0	cT1≧N0M0	cTaN0M0	-	-	-	cT4aN0M1b
Result	Mild	Dead	Severe	Mild	Severe	Moderate II	Mild	Moderate I	Mild	Dead

Table 2
Determination of the COVID-GRAM score, International Severe Acute Respiratory and Emerging Infections Consortium's (ISARIC) World Health Organization (WHO) 4C Mortality Score, and COVID-19 Registry Japan (COVIREGI-JP).

Patient:	1	2	3	4	5	6	7	8	9	10
Age	57	66	73	73	74	85	87	87	87	88
Number of comorbidities	1	4	2	1	4	4	2	3	0	5
Cancer history	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Radiographic abnormality	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Dyspnea	No	No	No	No	No	No	No	No	No	No
Hemoptysis	No	No	No	No	No	No	No	No	No	No
Unconsciousness	No	No	No	No	No	No	No	No	No	Yes
NLR	14	15	2	4	4	4	6	14	3	32
LDH	574	321	210	175	206	151	257	186	149	378
Total bilirubin	0.3	1.2	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1
COVID-GRAM Score	High	High	Intermediate	Intermediate	High	Intermediate	High	High	Intermediate	High
Age	2	4	6	6	6	7	7	7	7	7
Sex	1 (M)	1 (M)	0 (F)	1 (M)	1 (M)	1 (M)	1 (M)	0 (F)	1 (M)	0 (F)
Number of comorbidities	1	2	1	1	2	2	2	2	0	2
Respiratory rate, breaths/min	0	1	1	0	0	0	0	0	0	2
Peripheral oxygen saturation on room air	0	0	2	0	0	0	0	0	0	0
GCS	0	0	0	0	0	0	0	0	0	2
BUN	0	1	0	0	0	0	0	2	0	3
CRP	0	2	1	0	0	0	2	0	0	2
WHO 4C Mortality Score	4/ Intermediate	11/ High	11/ High	8/ Intermediate	9/ High	10/ High	12/ High	10/ High	8/ Intermediate	18/ Very high
Age	57/+1	66	73	73	74	85/+2	87/+2	87/+2	87/+2	88/+2
Sex	Man/+1	×	×	×	×	×	×	×	×	×
BMI	15.44	31.85/+2	17.04	23.08	19.63	22.32	··	19.65	21.97	15.8
CHF	×	0	0	0	0	0	0	0	0	0
Cerebrovascular disease	×	0	0	0	0	0	0	1	0	0
DM	×	0	2	0	2	2	0	2	0	0
Hypertension	×	2	0	0	2	0	2	0	0	2
Malignancy	0	×	×	×	×	×	×	×	×	×
Fever	2	4	4	0	4	4	4	4	4	4
Cough	1	1	1	0	0	0	0	0	0	0
SOB	2	4	4	0	0	0	0	0	0	0
Wheezing	0	×	×	×	×	×	×	×	×	×
Fatigue	1	×	×	×	×	×	×	×	×	×
COVIREGI-JP Score	8	13	11	0	8	6	6	7	6	8
Result	Mild	Dead	Severe	Mild	Severe	Moderate II	Mild	Moderate I	Mild	Dead

BUN, blood urea nitrogen; BMI, body mass index; CHF, congestive heart failure; CRP, C-reactive protein; DM, diabetes mellitus; GCS, Glasgow Coma Scale; LDH, lactate dehydrogenase; NLR, neutrophil-lymphocyte ratio SOB, shortness of breath

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