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LETTER

Clinical features and development of sepsis in patients infected with SARS-CoV-2: a retrospective analysis of 150 cases outside Wuhan, China

Di Ren[1,2], Chao Ren[3], Ren-qi Yao[3], Yong-wen Feng[1*] and Yong-ming Yao[1,3*]

Dear Editor,

The outbreak of novel coronavirus disease (COVID-19) that began in December 2019 has posed a great threat to human health and been declared a global pandemic by the World Health Organization [1–3]. Shenzhen, an important and special economic zone in China, shares a large floating population with Hubei province. From the first occurrence of COVID-19 on January 11, 2020, to April 26, 2020, there were 461 cases confirmed with infection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), including 12 patients who remained in the hospital, 3 deaths, and 446 discharged patients [4]. In the present study, we aimed to describe the clinical characteristics of COVID-19 patients in Shenzhen and identify risk factors for the development of SARS-CoV-2-induced sepsis in imported COVID-19 patients.

In this retrospective study, patients who were confirmed to have SARS-CoV-2 infection and admitted to the Third People's Hospital of Shenzhen from January 11 to February 12, 2020, were enrolled. Clinical data were extracted and followed up to March 11, 2020, by using predesigned data collection forms. The baseline characteristics of all enrolled patients in the sepsis and non-sepsis groups were summarized and compared by applying Student's t test, the Chi-square test, Fisher's exact test, and the Mann–Whitney U test as appropriate. Continuous variables were presented as the mean (standard deviation [SD]) or median (interquartile range [IQR]), while categorical or ranked data were reported as counts and proportions.

A total of 150 hospitalized COVID-19 patients were enrolled in this study, including 49 (32.7%) patients with SARS-CoV-2-induced sepsis at hospital admission and 101 (67.3%) non-septic patients (Table 1). Patients with viral sepsis were much older than those without sepsis (63 vs. 46 years, $P < 0.001$) and presented with more comorbidities, including hypertension (14 [28.6%] vs. 11 [10.9%], $P = 0.006$) and diabetes (9 [18.4%] vs. 3 [3%], $P = 0.003$). Septic patients had significantly higher neutrophil counts, monocyte counts, international normalized ratios, D-dimer values, alanine aminotransferase, aspartate aminotransferase, serum creatinine, blood urea nitrogen, creatine kinase, lactate dehydrogenase, prothrombin times and activated partial thromboplastin times than non-septic patients, but their lymphocyte counts, platelet counts, and albumin levels were significantly lower. Septic patients were more likely to be transferred to the ICU (28 [57.1%] vs. 10 [9.9%]; $P < 0.001$) and had a significantly prolonged hospital stay (median days, 23.5 days [IQR, 16.3-32.8] vs. 15 days [IQR, 13-20]; $P < 0.001$) than non-septic patients. Additionally, deaths (3 [6.1%]) occurred solely among patients who developed sepsis at hospital admission. Exposure history, platelet count, T lymphocyte count, cytotoxic T lymphocyte count, IL-6,

*Correspondence: fengyongwen2008@126.com; c_ff@sina.com
[1] Department of Critical Care Medicine, The Second People's Hospital of Shenzhen, 3002 Sungang West Road, Futian District, Shenzhen 518035, People's Republic of China
[3] Trauma Research Center, Fourth Medical Center and Medical Innovation Research Department of the Chinese PLA General Hospital, 51 Fucheng Road, Haidian District, Beijing 100048, People's Republic of China
Full author information is available at the end of the article
Di Ren, Chao Ren and Ren-qi Yao have contributed equally to this manuscript.

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Table 1 Baseline characteristics of 150 patients confirmed with COVID-19 in Shenzhen, China

	No. (%) of patients			
	Total ($n=150$)	Sepsis ($n=49$)	Non-sepsis ($n=101$)	*P* value
Demographic characteristics				
Age, median (IQR), years	54 (37–63)	63 (55.5–66)	46 (34–57)	< 0.001
Female	68 (45.3)	17 (34.7)	51 (50.5)	0.068
BMI, mean (SD)	23.7 (3.7)	25.0 (3.3)	23.1 (3.8)	0.004
Causes of infection				0.005
Traveling history of Hubei province	133 (88.7)	38 (77.6)	95 (94.1)	
Contact with local confirmed cases	1 (0.7)	1 (2)	0 (0)	
Undetermined cause of infection	16 (10.6)	10 (20.4)	6 (5.9)	
Comorbidities				
Hypertension	25 (16.7)	14 (28.6)	11 (10.9)	0.006
Diabetes	12 (8)	9 (18.4)	3 (3)	0.003
Coronary heart disease	8 (5.3)	4 (8.2)	4 (4)	0.492
Chronic bronchitis	4 (2.7)	2 (4.1)	2 (2)	0.835
Smoking history	3 (2)	3 (6.1)	0 (0)	0.059
Malignant tumor	3 (2)	2 (4.1)	1 (1)	0.518
Gout	3 (2)	2 (4.1)	1 (1)	0.518
Cerebrovascular disease	2 (1.3)	2 (4.1)	0 (0)	0.105
Immunocompromised diseases	1 (0.7)	0 (0)	1 (1)	> 0.99
Signs and symptoms				
Fever	125 (83.3)	42 (85.7)	83 (82.2)	0.586
Dry cough	44 (29.3)	16 (32.7)	28 (27.7)	0.534
Expectoration	35 (23.3)	14 (28.6)	21 (20.8)	0.291
Fatigue	33 (22)	16 (32.7)	17 (16.8)	0.028
Myalgia	32 (21.3)	13 (26.5)	19 (18.8)	0.279
Chest distress	13 (8.7)	6 (12.2)	7 (6.9)	0.438
Dizziness	11 (7.3)	7 (14.3)	4 (4)	0.052
Headache	10 (6.7)	3 (6.1)	7 (6.9)	> 0.99
Anorexia	10 (6.7)	6 (12.2)	4 (4)	0.119
Diarrhea	10 (6.7)	4 (8.2)	6 (5.9)	0.871
Nausea	5 (3.3)	4 (8.2)	1 (1)	0.070
Dyspnea	4 (2.7)	2 (4.1)	2 (2)	0.835
Stomachache	2 (1.3)	1 (2)	1 (1)	0.548
Vomiting	1 (0.7)	0 (0)	1 (1)	> 0.99
No signs and symptoms	10 (6.7)	2 (4.1)	8 (7.9)	0.593
Body temperature, median (IQR), ℃	37.2 (36.7–38)	37.8 (37.2–38.3)	36.9 (36.7–37.8)	< 0.001
Heart rates, median (IQR), /min	89.5 (83–98)	93 (86–101)	88 (81–96)	0.025
Respiratory rates, median (IQR), /min	20 (19–21)	21 (20–22.5)	20 (19–20)	< 0.001
Mean arterial pressure, median (IQR), mmHg	95 (89.7–103.4)	96.7 (91.8–108.8)	94.3 (88.8–102.8)	0.072
Diastolic blood pressure, median (IQR), mmHg	80 (74.8–89)	82 (75–88)	79 (74–89)	0.432
Systolic blood pressure, median (IQR), mmHg	128 (118–139)	128 (123.5–152)	126 (117–138)	0.025
APACHE II, median (IQR)	4 (2–6)	6 (4–8.5)	3 (1–5.5)	< 0.001
SOFA, median (IQR)	1 (0–2)	2 (2–3)	0 (0–1)	< 0.001
Onset of symptoms to hospital admission, median (IQR), days	4 (2–7)	4 (2–7.5)	3 (2–5.5)	0.044
Complications				
ARDS	87 (58)	47 (95.9)	40 (39.6)	< 0.001
Acute liver injury	28 (18.7)	20 (40.8)	8 (7.9)	< 0.001
Acute kidney injury	11 (7.3)	10 (20.4)	1 (1)	< 0.001
Acute cardiac injury	11 (7.3)	8 (16.3)	3 (3)	0.009

Table 1 (continued)

	No. (%) of patients			
	Total ($n=150$)	Sepsis ($n=49$)	Non-sepsis ($n=101$)	*P* value
Shock	9 (6)	7 (14.3)	2 (2)	0.009
Coagulopathy	9 (6)	9 (18.4)	0 (0)	< 0.001
Secondary infection	17 (11.3)	9 (18.4)	8 (7.9)	0.058
Prognosis				
Discharge from hospital	126 (84)	36 (73.5)	90 (89.1)	0.014
Length of stay in hospital, median (IQR), days	16 (13–24.3)	23.5 (16.3–32.8)	15 (13–20)	< 0.001
Hospital admission to ICU admission, median (IQR), days	6 (2–9)	5 (2–8.8)	7 (4.8–9.3)	0.434
ICU admission	38 (25.3)	28 (57.1)	10 (9.9)	< 0.001
Length of stay in ICU, median (IQR), days	7 (4–16)	9 (4–19.8)	4 (2–11)	0.192
In-hospital death	3 (2)	3 (6.1)	0 (0)	0.059

Data were presented as median (IQR) or mean (SD). n (%) referred to the total number of patients with available data

ICU Intensive care unit, *IQR* Interquartile range, *SD* Standard deviation, *BMI* Body mass index, *APACHE II* Acute physiology and chronic health evaluation II, *SOFA* Sequential organ failure assessment, *ARDS* Acute respiratory distress syndrome

P values indicated differences between sepsis and non-sepsis patients, in which $P < 0.05$ was deemed as statistical significance

serum creatinine, erythrocyte sedimentation rate, and sodium might be useful for predicting the incidence of SARS-CoV-2-infection-induced sepsis (electronic supplementary materials).

In conclusion, patients with SARS-CoV-2 infection are likely to develop sepsis at hospital admission, which are characterized by failed homeostasis between the innate and adaptive immune responses partly due to the loss of lymphocytes. The development of sepsis might be associated with greater organ dysfunction and worse outcomes in this small cohort of patients from Shenzhen.

Electronic supplementary material

The online version of this article (https://doi.org/10.1007/s00134-020-06084-5) contains supplementary material, which is available to authorized users.

Author details

[1] Department of Critical Care Medicine, The Second People's Hospital of Shenzhen, 3002 Sungang West Road, Futian District, Shenzhen 518035, People's Republic of China. [2] Department of Critical Care Medicine, The Third People's Hospital of Shenzhen, Shenzhen 518020, People's Republic of China. [3] Trauma Research Center, Fourth Medical Center and Medical Innovation Research Department of the Chinese PLA General Hospital, 51 Fucheng Road, Haidian District, Beijing 100048, People's Republic of China.

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Author's contributions

YWF and YMY contributed equally to this paper and were joint corresponding authors. DR, CR, RQY were joint first authors. All corresponding and first authors contributed to study concept and design. DR extracted epidemiological and clinical data. CR and RQY performed the statistical analyses. DR, CR and RQY co-drafted the initial version of manuscript. All authors provided critical revision of the manuscript and approved the final draft for publication. YWF was responsible for the integrity and accuracy of the data and was the guarantor. The corresponding authors attest that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Compliance with ethical standards

Conflicts of interest

The authors declare that they have no conflict of interest.

Ethical approval

This study was approved by the Committee on the Ethics of Medicine, the Second People's Hospital of Shenzhen (20200224002), China.

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