

The Way a General Hospital Treated COVID-19 in Shenzhen, China & the Epidemiological and Clinical Characteristics of its Confirmed Patients

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Abstract

Objectives: To discuss the prevention and containment of COVID-19 at a general hospital in Shenzhen China; to analyze the epidemiological and clinical characteristics of its confirmed patients, which is intended to provide a model for other hospitals in COVID-19 management.

Methods: The General Hospital of Shenzhen University sets up 4 medical zones relative to the COVID-19 prevention and containment. In so doing, the suspected patients classified into different kind of ward receive different treatment (Classified and Separated Treatment). The epidemiological distribution and clinical characteristics of 28 confirmed cases in the hospital were analyzed.

Results: There are no medical personnel infected cases, no cross-infection among the patients in the hospital, and no misdiagnosis or missed diagnosis of COVID-19. The majority of cases in the group is from 15 to 60 years old, 25 cases had a definite travel history or close contact history in the epidemic area, and parents and spouses of the confirmed patients are the main contact groups. Fever and respiratory symptoms have a high proportion, 4 diarrhea and 4 asymptomatic cases. Additionally, the decrease of lymphocyte is observed in 8 cases. Chest CT scan shows viral pneumonia in 14 cases. All patients were confirmed by nucleic acid tests.

Conclusions: Classified and Separated Treatment facilitates management of COVID-19 in the general hospital. Relative to suspected patients in the general hospital, diagnosis matters more than treatment. Epidemiological history, lymphocyte count, and chest CT scan play an important role as the indicator in early diagnosis of COVID-19.

Introduction

Since COVID-19 broke out in December 2019, it has already rapidly spread to more than 200 countries and regions all over the world. According to World Health Organization), ^[1] as of 6 May 2020, 3,588,773 confirmed cases and 247,503 death cases have been reported at global range. Our understanding of this pandemic and prevention & containment measures have been continuously developed, and the spread of COVID-19 is overall controlled in China (just with some sporadic imported cases). However, some countries' situation is still grim. The General Hospital of Shenzhen University is one of the designated general hospitals for COVID-19 treatment in Shenzhen. At this hospital, patients are screened for COVID-19 suspected cases and well treated before being confirmed. The confirmed cases would be transferred to the infectious disease specialist hospital for further treatment. From January 2020 onwards, we have gradually set up a feasible plan of screening, prevention and containment which has been continuously improved given its obvious effectiveness. It is also expected to be a model for the general hospitals. The prevention and control experience of our hospital and the epidemiological and clinical characteristics of confirmed patients are introduced in this paper, aiming to provide some references for the prevention and control of COVID-19 in other hospitals.

Methods

The 4 medical zones set up by General Hospital of Shenzhen University for COVID-19 prevention and containment are respectively “fever clinic”, “quarantine observation room”, “quarantine ward” and “quarantine medical observation area outside the hospital”. The fever clinic is responsible for receiving patients who came to the hospital independently, patients from quarantine medical observation points and suspected patients assigned by the emergency center. The quarantine observation room is responsible for receiving suspected cases requiring no special treatment. Suspected patients requiring special treatment are admitted to the quarantine ward. The quarantine area outside the hospital is responsible for close contacts and the ones entering China from abroad who needed to be screened and checked assigned by the CDC. According to the diagnostic criteria,^[2] the confirmed cases examined by SARS-CoV-2 RNA detection, CT scan, peripheral venous blood examination, etc. would be sent to specialized hospitals of infectious diseases for treatment after diagnosis (Fig. 1). The data in this paper are from the diagnosis and treatment records of confirmed patients in General Hospital of Shenzhen University during the period of January 21, 2019 to April 20, 2020, including asymptomatic infected patients confirmed by SARS-CoV-2 RNA screening before resuming work and production.

Results

From January 21, 2019 to April 20, 2020, a total of 28 cases of COVID-19 were diagnosed and confirmed in General Hospital of Shenzhen University, including 4 cases in fever clinic, 3 cases in quarantine observation room(including 1 screening case of resuming work and production), 9 cases in the quarantine ward, 10 cases in the quarantine point outside the hospital, and 3 cases of resuming work and production. There was no infection among medical personnel, no cross-infection among the patients in the hospital, and no misdiagnosis or missed diagnosis of COVID-19.

1.Epidemiological characteristics (Table 1)

Table 1
The Epidemical Distribution Characteristics of 28 Confirmed COVID-19 Patients in Shenzhen University General Hospital

Category	Distribution	n = 28
Population distribution	AGE(years older)	35; (0.75 ~ 78)
	≤14	5
	15 ~ 40	11
	41 ~ 60	5
	≥61	7
	Gender	
	Male	13
	Female	15
	Occupation	
	Preschooler	3
	Students	4
	Company employees	14
	Retired	7
	nationality	
Chinese	27	
Foreigner	1	
Regional distribution	Travel history of epidemic area	17
	Wuhan, Hubei	10
	Other parts of Hubei	5
	Others	2
	History of close contact	17
	Close contact and history of travel in affected areas	10
	Cluster disease	6
	Unknown epidemiological history	3
	Import cases	2
	Close contact group	

Category	Distribution	n = 28
	Parents	9
	Son and daughter	2
	Spouse	4
	Others	2
Time distribution	From Jan. to Feb. 2020	22
	Mild type	7
	Ordinary type	15
	From Mar. to Apr. 2020	6
	Asymptomatic	4
	Mild type	2
	Time from leaving the epidemic area to onset (day)	7; (0 ~ 20)
	Time of close contact to onset (day)	6; (0 ~ 14)

Population distribution: The amount of confirmed cases of male and female patients was basically closed. The distribution of age was 0.75-78 years old, with the median age of 35 years old. About the distribution of occupation, the majority were employees and Chinese patients, and none of the confirmed patients had serious chronic disease.

Spatial distribution: The travelling history or close contact history in the epidemic area remained a major epidemiological factor among confirmed patients. Wuhan, Hubei province was the most common epidemic area for confirmed patients. Besides, there were 3 cases with unknown epidemiological history and 2 cases imported from abroad. Most of the close contacts were diagnosed parents and spouses.

Time distribution: There were a total of 22 cases with mild and common symptoms from January to February in 2020, and 6 cases of asymptomatic infection and imported cases from abroad who screened for resuming work and production from March to April 2020. The time period from leaving the epidemic area or close contacting to the onset was respectively 0–20 and 0–14 days, with the median time of 7 and 6 days, respectively.

2.Clinical characteristics (Table 2)

Table 2
The Clinical characteristics of 28 Confirmed COVID-19 Patients in Shenzhen University
General Hospital

		n = 28
Symptoms	Fever (body temperature °C)	13; 37.9; (37.4 ~ 39)
	Cough	10
	Productive Coughing	6
	Fatigue	1
	Muscle soreness	2
	Headache	4
	Sore throat	7
	Diarrhea	4
	Asymptomatic	4
	Lab	Peripheral venous blood
WBC($\times 10^9/L$; Reference Values:3.50 ~ 9.50)		5.70; (2.84 ~ 10.19)
Increase		2
Decrease		4
Neutrophils($\times 10^9/L$; Reference Values:1.80 ~ 6.30)		3.37; (1.18 ~ 7.67)
Increase		2
Decrease		6
Lymphocyte($\times 10^9/L$; Reference Values:1.10 ~ 3.20)		1.71; (0.55 ~ 4.14)
Increase		1
Decrease		8
C-Reactive Protein(mg/L; Reference Values:0 ~ 10)		5.16; (0.40 ~ 27.51)
Increase	3	
Imaging	Chest X-Ray	
	Positive	1
	Negative	7
	Chest CT	

		n = 28
	Positive	14
	Negative	14
	Type of changes	
	Ground glass changes	14
	Consolidation	2
	Pleural effusion	1
	Location of changes	
	Left lung	5
	Right lung	2
	Both lung	7
Etiology	The initial SARS-CoV-2 RNA test	
	Positive(nasopharyngeal)	23
	Negative (oropharyngeal)	5
	The second SARS-CoV-2 RNA test	
	Positive (nasopharyngeal)	3
	Negative (nasopharyngeal)	2
	The third SARS-CoV-2 RNA test	
	Positive (nasopharyngeal)	2
	Negative	0
	SARS-CoV-2 RNA test in Anal swab	
	Positive (with diarrhea)	4
	Negative	0
Treatment	α -interferon	28
	Ribavirin	10
	Lopinavir/ritonavir	14
	Chinese medicine	28
	Antibiotics	3

	n = 28
Combination therapy	28

Symptoms: There were 24 cases of asymptomatic infection and 4 cases of asymptomatic patients; The main symptoms were fever, sore throat and dry cough, with the highest temperature of 39°C, most of which were below 38.5°C. Diarrhea occurred in 4 cases. Shortness of breath, headache and muscle pain were rarely observed.

Laboratory examination: The oxygen saturation of finger blood in most of the cases was above 95%. The peripheral venous Leukocyte, neutrophil and lymphocyte counts were normal in most of the confirmed patients. And abnormal peripheral venous blood was mainly manifested by decreased Leukocyte and lymphocyte counts. The average CRP was 4.98 mg/L, within the normal range.

Imaging: The main manifestations were multiple patchy shadows and ground-glass attenuation, while consolidation and pleural effusion were rarely observed. Chest CT examination was performed in all 28 cases, among which, imaging manifestations related to COVID-19 were observed in 14 cases. Chest X - ray examination was performed before chest CT examination in 8 cases, and only 1 case showed positive in X - ray examination. The distribution of lesion types and ranges was shown in Table 2 in details.

Etiology: Most of the cases were confirmed by the positive detection of SARS-CoV-2 RNA for the first time. In some cases, the first two times of SARS-CoV-2 RNA detection were negative and were positive in the third time. Besides, all the positive results were manifested by nasopharyngeal sampling. The results of SARS-CoV-2 RNA detection in anal swabs of the patients with diarrhea were all positive.

Treatment: 4 cases of asymptomatic infection were inhaled with interferon atomization and treated orally with Chinese patent medicine. 10 cases with mild symptoms were treated with interferon atomization, ribavirin intravenous infusion, and Chinese patent medicine orally. 14 patients with mild symptoms were given interferon atomization, lopinavir/ritonavir orally, and Chinese patent medicine orally. Antibiotics were used in cases combined with bacterial infection. The distribution of therapeutic medicine was shown in Table 2.

Discussion

As a designated general hospital for the treatment of COVID-19 in Shenzhen, the General Hospital of Shenzhen University is responsible for the screening and treatment work of suspected cases. It differs from infectious diseases specialist hospitals in the following ways: 1. There are fewer medical personnel specialized in infectious diseases, and weaker professional and technical strength; 2. There is a lack of treatment areas for infectious cases, and limited reception for a large number of patients with severe infectious diseases; 3. The outpatient and inpatient population of in a general hospital are complex and prone to cross-infection. On the basis of the above characteristics, the prevention and treatment work of

our hospital was mainly focused on the confirming of suspected COVID-19 cases and the treatment of patients with mild and common symptoms before diagnosis. The diagnosis and treatment should be classified and separated reasonably according to the diagnosis and treatment process in Fig. 1, and each diagnosis and treatment area should be utilized efficiently to ensure that each suspected patient was individually under medical observation in a single room until diagnosis was ruled out. By now, a total of 28 cases of COVID-19 patients have been confirmed in our hospital, with everyone having been sent to the specialized hospitals of infectious diseases for further treatment. There was no infection among medical personnel, no cross-infection among the patients in the hospital, and no misdiagnosis or missed diagnosis of COVID-19, which had little impact on the diagnosis and treatment of the other patients in the hospital.

The population distribution of the patients in the group ranged from infants to the elderly, with a median age of 35 years old, which were mainly young adults aged 15 to 60 years old. Most of them were employees in the company who were always required to go on a business trip frequently to many places. No patients in this group were in combination with severe chronic diseases. Among the 28 confirmed cases, only one was imported from abroad, which was due to the epidemic prevention policy. The inbound flights were reduced and prevention and control measures were strengthened during the outbreak. 17 cases had a clear travel history in the epidemic areas, with Wuhan, Hubei province being the most, followed by the other regions of Hubei province, which was related to the fact that Wuhan had the most COVID-19 cases and the most severe epidemic status of COVID-19 in China. Different from the fact reported by Liaocheng Hospital of Infectious Disease that only 2 of the 26 cases there had travelling and living history in Wuhan,^[3] it was considered that this may be related to the fact that Shenzhen was one of the first-tier cities in China with a large population mobility. There were 10 cases of COVID-19 with travelling history and close contacts in the epidemic areas, and 7 cases with only close contact history, indicating the characteristics of human-to-human transmission of COVID-19, which was same with the human-to-human transmission pattern of COVID-19 in Wuhan reported earlier by Julien Riou on 30 January 2020.^[4] The majority of close contact group were parents and spouses, which indicated that COVID-19 might be easily transmitted among family members. Besides, all of the 6 clustered cases involved in this paper occurred in families, suggesting that home quarantine was one of the important means of COVID-19 prevention and control.^[5] And there was no severe case in this group, and most of them were patients with mild and common symptoms, which was related to the prevention and control of the General Hospital that only suspected cases were screened, while the severe cases were mainly treated in specialized hospitals of infectious diseases.

The time period from leaving the epidemic area to the attack and the time period from close contacting to the attack were analyzed as 0–20 days and 0–14 days in this paper, respectively. Therefore, we required that people with travel and close contact history in the epidemic areas should be quarantined for at least 14 days. With the development of the outbreak, the improvement of prevention and control measures and treatment experience, the amount of cases dropped from 22 during January - February, 2020 to 6 during March- April, 2020, with a trend from common cases to asymptomatic cases, which reflected the results

of the previous prevention and control work and suggested that the focus of prevention and control should be transferred to asymptomatic infected cases. Therefore, it is one of the important prevention and control measures to identify infected cases by improving the detection capacity of SARS-CoV-2 RNA.

The first symptom of nearly half of the patients in the group was fever, and high fever was rare. Others were mainly respiratory symptoms, and diarrhea symptoms in a few cases. No specific symptoms of COVID-19 were observed, making it difficult to differentiate from the influenza.^[6] there was no abnormality in the count of Leukocyte, neutrophil and lymphocyte in 12 patients during peripheral venous blood examination. Among the cases with abnormal counts of blood cell (CBC), 8 showed a reduction in lymphocyte count—more than that of Leukocyte and neutrophil, which indicated that reduced lymphocyte counts might be of great significance in the diagnosis of COVID-19.^[7] All the 28 cases in the group underwent chest CT examination, among which 14 were positive, mainly manifesting by ground-glass opacity, with more cases of disease in both lungs than that in single lung. In this group, 8 cases underwent chest X-ray examination before CT examination, but only one of them showed positive manifestations with the finding that positive imaging performances were often prior to the etiological diagnosis.

Therefore, for suspected cases—especially those with no evidence of etiology, it is always impossible to comprehensively and objectively evaluate the lung condition through chest X-ray examination, which may result in misdiagnosis and further affect the treatment and epidemic prevention. In summary, chest CT examination in early stage is relatively reliable and may reduce the rate of missed diagnosis.^[8] In this group, 23 cases were confirmed by the first nasopharyngeal sampling of SARS-CoV-2 RNA detection, and the sampling site of the remaining 5 cases who was tested negative for the first time was oropharyngeal, among them, 3 patients were confirmed by the second nasopharyngeal sampling, and 2 patients were confirmed by the third nasopharyngeal sampling. The result of first SARS-CoV-2 RNA detection was false-negative in 5 cases. It was considered be related to the following factors: 1. The amount of viral load in the patient is not enough to be detected during the course of the disease. 2. The collection site of respiratory secretions: it has been reported^[9] that the detection rate of SARS-CoV-2 RNA in oropharyngeal sampling is lower than that in nasopharyngeal sampling, which may possibly due to effect of the environment of nasopharynx and oropharynx on SARS-CoV-2 RNA. Meanwhile, the tolerance of the patients results in a longer stay of the swab in the nasopharynx than in the oropharynx. In addition, oropharyngeal sampling is more likely to result in droplet spatter and lead to the occupational exposure. 3. It is related to the technical level, test method, kit, specimen preservation and transportation of the samplers. In summary, for suspected cases, the results of SARS-CoV-2 RNA sampled from a single sample, a single site and a single specimen are not reliable, and nucleic acid testing of multiple times, multiple sites and multiple specimens is required for etiological diagnosis. 4 patients in this group performed diarrhea and SARS-CoV-2 RNA was detected in feces, indicating that the gastrointestinal tract might be a potential route of COVID-19 infection, and this disease was likely to be transmitted through fecal-mouth.^[10] However, further studies are needed to determine whether COVID-19 patients without the symptom of diarrhea can be confirmed by fecal samples. Moreover, all cases in this group were treated

with α -interferon atomized inhalation and Chinese patent medicine orally before diagnosis, due to the facts that the confirmed patients were not symptomatic and were treated before getting confirmed, antiviral medicine and other treatments were not widely used.

Conclusions

For the prevention and control of COVID-19 in general hospitals, the diagnosis and treatment process should be optimized, the prevention and control of COVID-19 should be done in different sections, and the COVID-19 patients should be treated in different areas, as as to make efficient use of each diagnosis area, and ensure that suspected patients are individually quarantined in single rooms for medical observation until diagnosis is ruled out. the focus of prevention and control work should be transferred in time according to the development of the epidemic. In the early stage of the epidemic, the diagnosis and treatment of ordinary and mild patients should be given priority, and in the later stage, the control of asymptomatic infected persons should be given priority. The diagnosis and treatment of common and mild patients should be given priority at the early stage of the epidemic, and in the later stage, we need to give priority to the management and control of asymptomatic infected cases. Young adults having a history of travel and close contact with suspected patients in epidemic areas should be the focus group for COVID-19 management in general hospitals. And diagnosis is more important than treatment for the diagnosis and treatment of suspected patients; In addition, as there are many factors affecting the results of nucleic acid detection of SARS-CoV-2 RNA, epidemiological history, the count of peripheral blood lymphocyte and chest CT scan can be used as important indicators for the diagnosis of COVID-19 at the early stage.

Declarations

Ethical Approval and Consent to participate

The study was approved by the Ethics Committee of the General Hospital of Shenzhen University and followed guidelines from the 1964 Helsinki Declaration, in which each patient signed an informed consent.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no competing interests to declare.

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Authors' contributions

YZ, WH and JL conceived and designed the study. LY and QZT were responsible for data collection and statistics. The contribution of ZRR, MQH and MH was the clinical management of patients. YZ wrote the paper. YZ and LY reviewed and edited the manuscript. All authors read and approved the final manuscript.

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Figures

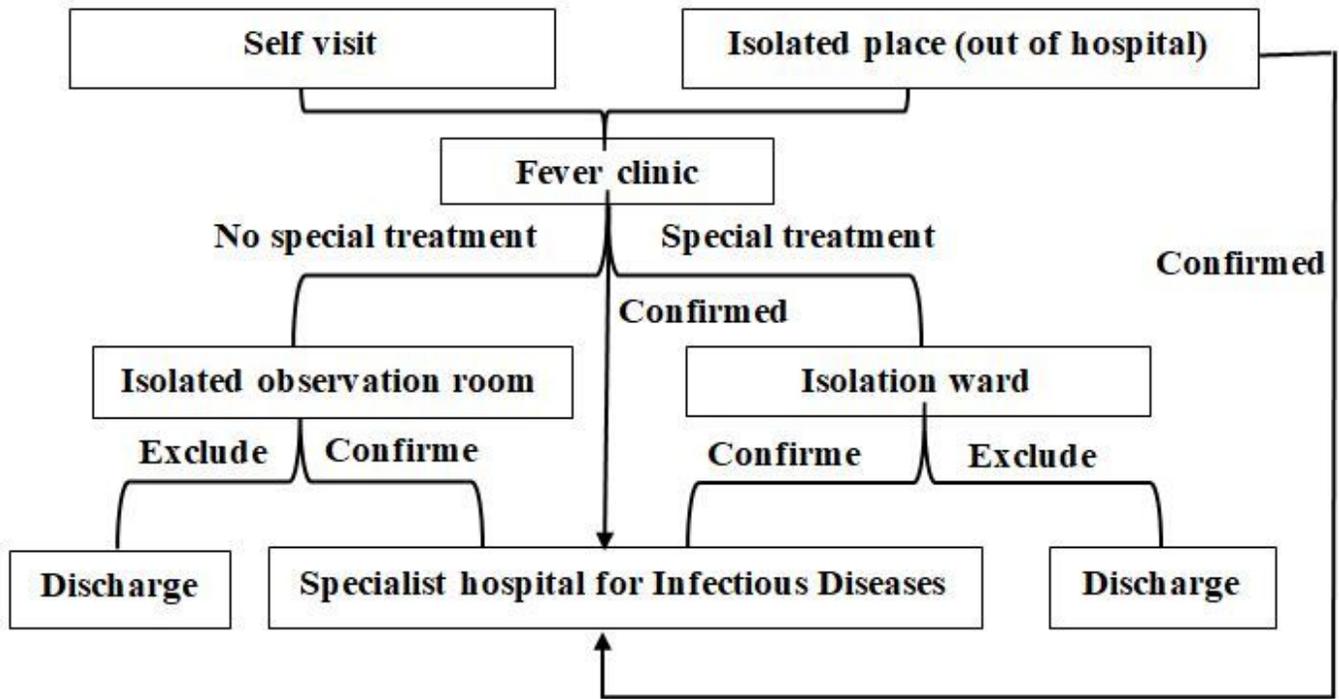


Figure 1

Procedures for diagnosis and treatment of suspected patients