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Comparison of novel coronavirus pneumonia combined with left heart failure and heavy neocoronary pneumonia in highland snowy areas

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Abstract: This paper collects clinical data from a patient with novel coronavirus pneumonia combined with left heart failure and a patient with severe novel coronavirus pneumonia living in a highland area. We analyzed the difference between the clinical treatment of novel coronavirus pneumonia combined with left heart failure cardiogenic shock and the clinical treatment of severe novel coronavirus pneumonia. The results showed that patients with combined left heart failure presented with typical patchy shadows in both lungs, bilateral pleural effusion, increased BNP, and a minimum partial pressure of oxygen of 48 mmHg at rest, which was converted to negative nucleic acid after antiviral, oxygen therapy, and cardiac diuresis; patients with severe novel coronavirus pneumonia had hemoptysis, multilobar patchy shadows in both lungs, massive ground glass shadows, adjacent pleural adhesions, and no pleural fluid. After oxygen therapy, antiviral drugs and hormone therapy, the patient's SPO2 increased to more than 90%, the pulmonary ground glass shadow was absorbed, and the nucleic acid turned negative. Patients with high altitude severe novel coronavirus pneumonia compared to patients with novel coronavirus pneumonia combined with left heart failure because of more severe hypoxemia due to alveolar exudation, and novel coronavirus pneumonia combined with left heart failure aggravated the severity of the disease. The increased number of hematologic tests, imaging tests, rapid diagnosis and treatment early intervention can reduce mortality in patients with severe novel coronavirus pneumonia.

1. Introduction

Novel coronavirus pneumonia (NCP) is caused by the newly discovered 2019 novel coronavirus (2019-nCoV). According to the latest statistics from the Chinese Health Care Commission, as of

23:00 on November 10, 2020, more than 51.18 million confirmed cases and 1.26 million deaths have been reported globally, and the number of confirmed and suspected cases continues to increase, posing a huge challenge to health systems worldwide and a huge loss to economies worldwide. In Daofu County, with an average elevation of 3,245 meters, 73 cases of NCCP were diagnosed during this localized epidemic. Several of them were complicated by acute left heart failure resulting in significant aggravation of hypoxemia.[1] In this paper, by comparing the difference in clinical data between one patient with novel coronavirus pneumonia combined with left heart failure on the plateau and one patient with heavy new coronavirus pneumonia, and the related literature, we analyze and summarize the special features of new coronavirus pneumonia on the plateau in terms of diagnosis and treatment, aiming to help early diagnosis, early isolation, and early stratification of new coronavirus pneumonia in the prevention and control of high altitude areas The aim is to help the prevention and control of neo-crown pneumonia at high altitude to achieve early diagnosis, early isolation, early stratified treatment and prevent the development to critical illness.

2. Case studies

2.1. Patient Information

Case 1, 77-year-old female, 10 days ago, paroxysmal cough with white mucous sputum, generalized weakness, cardiac fatigue, chest tightness, no chills and fever, sore throat, dizziness, abdominal pain and diarrhea. Consciousness, loud breath sounds, dry rales and wet rales could be heard in both lungs, 2020-02-15 PCR results showed positive for novel coronavirus nucleic acid, blood count: leukocytes 3.1 x 109/L, lymphocyte percentage 10.8%, 2020-02-15 chest CT: infectious lesions in both lungs, diagnosis: highland novel coronavirus pneumonia (common type). Hypertension grade 3, heart failure, bilateral pleural effusion; old tuberculosis, drug-related liver injury. Treatment: (1) Monitoring: daily monitoring of respiratory rate, blood routine, finger oxygen saturation, oxygen concentration, urine routine, CRP, biochemical indexes (liver enzymes, electrolytes, etc.), coagulation function, arterial blood gas analysis every 3 days, chest CT review every 3-5 days, nasal catheter oxygen administration at 4 L/min; virus treatment: oral lopinavir/ritonavir 2 tablets (2 times/day for 5 d), ribavirin injection 500 mg once every 12 hours for 5 days, Bystolic 1 tablet once daily to lower blood pressure, doxorubicin 0.2 g three times daily, and aminoglutethimide injection 30 mg once every 12 hours. The patient was admitted with normal temperature, nasal catheter oxygen 4L/min, peripheral oxygen saturation of 93-96% in the first week, methylprednisolone was changed to 20mg (1 time/d) IV on Feb 15, 2020, considering that the patient's symptoms improved significantly, the hormone was stopped on Feb 17, 2020, and heart failure was treated with tachypnea and cetiran on Feb 16, 3 days later the patient's chest tightness and shortness of breath recovered compared with before. The patient recovered from chest tightness and shortness of breath 3 days later, and on 2020-02-20 chest CT: both lung lesions were better than before, no significant progress was seen. In the second week, the finger pulse oxygen saturation decreased to about 85-90%, and after oxygen therapy, the finger pulse oxygen saturation was over 93% in a calm state. On February 20, 2020, there was a drop in blood pressure, oliguria, vomiting, and abnormal liver function. Feb 21 symptoms better than before. 02/24/2020 chest CT: bilateral lung infectious lesions absorbed than before. 02/15/2020, 02/22/2020, 02/26/2020 novel coronavirus nucleic acid results negative. 02/28/2020 home.

Case 2, female, 39 years old, admitted to the hospital with "cough and sputum with fever for 2 days". 2 days ago there was no cause for cough, yellow-white sputum with fever , shortness of breath, no hemoptysis, clear consciousness, no cyanosis in the mouth and lips, respiratory sounds in both lungs were loud and wet rales could be heard. Chest CT: patchy shadows, massed glassy shadows, adhesions above two lung lobes and pleura. The diagnosis was highland novel

coronavirus pneumonia (heavy); electrolyte disturbance: hyponatremia. Respiratory rate, blood count, finger oxygen saturation, and oxygen concentration were monitored daily. Blood routine, urine routine, CRP, biochemical indexes (liver enzymes, cardiac enzymes, renal function, etc.), coagulation function, daily arterial blood tests were performed every 3 days. Viral treatment: lopinavir/ritonavir 2 tablets (2 times/d for 5 d) orally, ribavirin injection 500 mg Q12H, methylprednisolone 40 mg qd, doxorubicin 0.2 tid, amantadine Injection 30mg Q12H treatment, the patient's symptoms were cured, the chest CT was rechecked on February 11, there was absorption of exudate in both lungs compared to before, and he went home after 10 days of treatment.

2.2. Laboratory tests and imaging tests

Case 1 laboratory results (Table 1). Novel coronavirus nucleic acid test results (Table 2). High-resolution CT of the chest showed infectious lesions in both lungs (Figure 1). The laboratory results of case 2 are shown in (Table 3). High-resolution CT of the chest showed multilobar infectious lesions in both lungs (Figure 2). Novel coronavirus nucleic acid test results (Table 4).

Table 1: Results of the case 1 patient's laboratory examination (Note: "-" this item is not tested)

Indicators	Date		
	February 15th	February 20th	February 26th
Leukocyte count	3.1x109/L	3.2x109/L	4.5
Number of red blood cells	4.45x109/L	4.28x109/L	5.13
Hemoglobin concentration	142g/L	131g/L	140
Red blood cell pressure	43.5%	39.7%	40.3%
Percentage of lymphocytes	10.8%	16.2%	20%
Number of lymphocytes	0.4x109/L	0.5x109/L	1.5
Plasma prothrombin time	14.8	15.6	-
Partial activation of thromboplastin time	31.1	40.2	-
Fibrinogen	2.1	2.518	-
C-reactive protein	15.8mg/L	5.9	-
Calcitonin	0.1	0.1	0.1
Aspartate amino transaminase	14	10	10
Alanine aminotransferase	25	22	18
Glutamyl transpeptidase	154.66	122.9	80
Direct bilirubin	2.07	21.8umol/L	2.12
Indirect bilirubin	3.21	28.9umol/L	2.09
Urea nitrogen	3.82	7.96mmol/L	4.02
Creatinine	46.09	69.61umol/L	49.24
Potassium	4.82	3.45mmol/L	3.97
Sodium	137.4	121.8mmol/L	129.8
Chlorine	104..6	87.7mmol/L	96.4
Index Oxygen saturation	87-92%	90-94%	94-99
Oxygen partial pressure	58	48	60
Oxygenation index	360	300	370
B-type brain natriuretic peptide precursor	938pg/mL	233 pg/mL	322
24h urine output	900	3000	1400
Troponin I	< 0.01ng/ml	< 0.01ng/ml	< 0.01ng/ml

Table 2: Case 1 results of 2019-nCoV nucleic acid detection

Test date	February 15th	February 22nd	February 24th	February 28th
Results	Negative	Negative	Negative	Negative

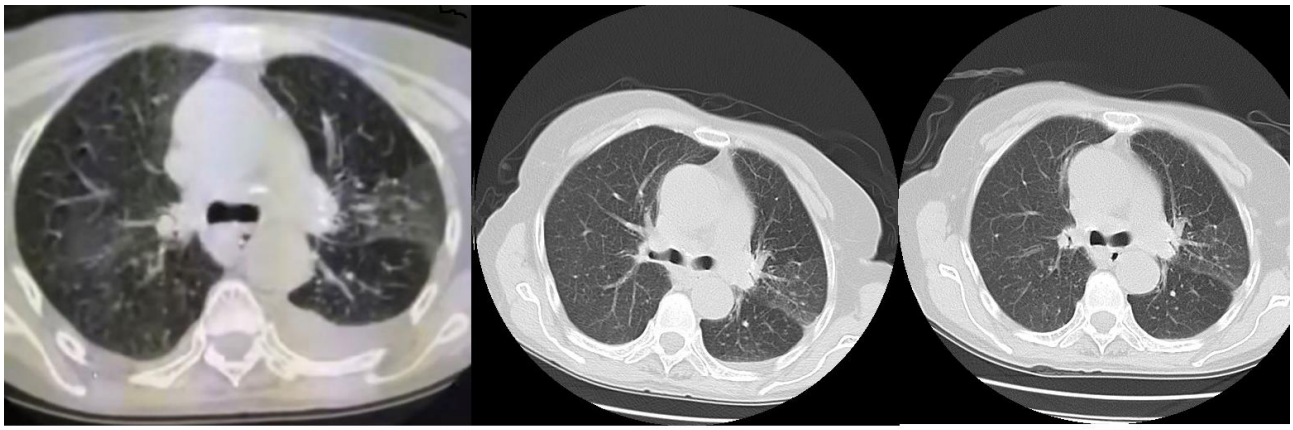

Figure 1: from left to right shows the lung CTs on February 15, 2020, February 20, 2020, and February 24, 2020

Table 3: Case 2 Results of the case 1 patient's laboratory examination

Leukocyte count	3.4x109/L
Number of red blood cells	5.29x109/L
Hemoglobin concentration	163g/L
Red blood cell pressure	49.3%
Percentage of lymphocytes	30.3%
Number of lymphocytes	1x109/L
Plasma prothrombin time	16
Partially activated thromboplastin time	28.8
Fibrinogen	1.942
C-reactive protein	<5mg/L
Calcitonin	<0.05
Aspartate amino transaminase	18
Alanine aminotransferase	25
Glutamyl transpeptidase	15.66
Direct bilirubin	3.39
Indirect bilirubin	4.36
Urea nitrogen	3.01
Creatinine	57.53
Potassium	3.98
Sodium	131.8
Chlorine	99.9
Index Oxygen saturation	80-85%
Oxygen partial pressure	45
Oxygenation index	183
B-type brain natriuretic peptide precursor	<50pg/mL
24h urine output	1500
Troponin I	< 0.01ng/ml

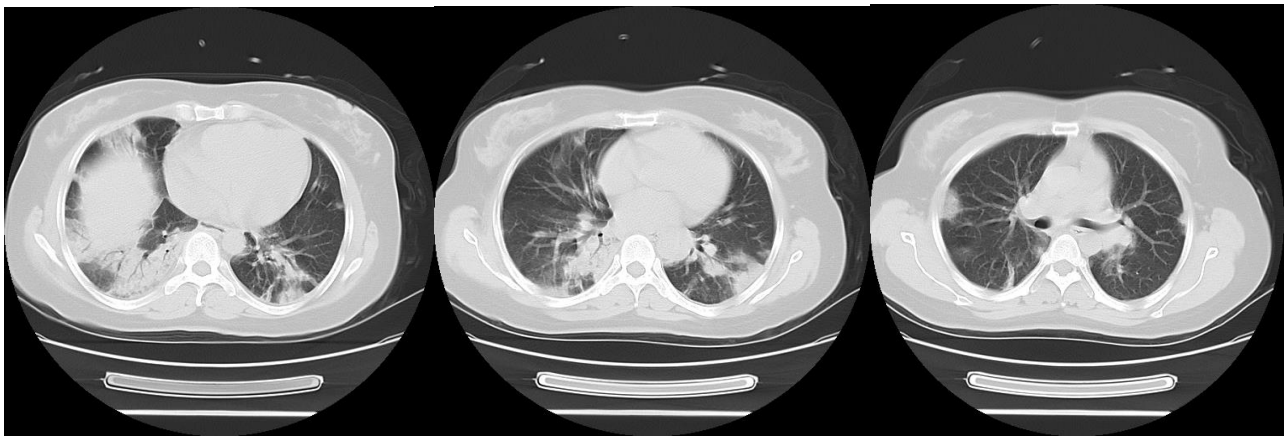

Figure 4: Patchy shadow and mass-like ground glass shadow with adjacent pleural adhesions were seen in multiple lobes of both lungs, and no pleural effusion was seen.

Table 4: Case 2 Results of 2019-nCoV nucleic acid detection

Test date	February 8th	February 15th	February 17th	February 20th
Results	masculine	Negative	Negative	Negative

3. Discussion

3.1 Highland severe novel coronavirus pneumonia or novel coronavirus pneumonia combined with cardiac insufficiency?

It was found that 2019-nCoV can enter human cells through its receptor angiotensin-converting enzyme II (ACE2), which is expressed in respiratory organs and in the esophagus, small intestine, and colon.[2] Patient 1 presented with hypoxemia and hypotension, but CT suggested progressive improvement of the pulmonary lesions after admission. Therefore, novel coronavirus pneumonia combined with cardiac insufficiency was considered based on (1) the diagnosis of novel coronavirus pneumonia, with reference to the Pneumonia Treatment Protocol for Novel Coronavirus Infection (Trial Version 6); (2) the presence of signs and symptoms of left heart insufficiency; and (3) cardiac structure, systolic and diastolic functional changes, and elevated natriuretic peptide in accordance with the 2018 Chinese Heart Failure Diagnostic Criteria for Left Heart Failure. Due to low-pressure hypoxia in highland areas, feasible methods to improve hypoxemia in heart failure patients include (1) using high inhaled oxygen concentration; (2) reducing oxygen consumption; (3) improving oxygen delivery; and (4) providing mechanical ventilation. The purpose of restrictive fluid resuscitation in this case of a patient with neocoronary pneumonia combined with cardiac insufficiency was to increase oxygen delivery (DO2) to meet the demand for tissue perfusion (urine output > 600/day, CVP 8--12, MAP > 65) by increasing cardiac output. However, rehydration therapy in plateau patients is prone to positive balance to aggravate respiratory and circulatory failure and induce acute pulmonary heart disease and plateau cerebral edema, so restrictive fluid management should be performed according to clinical symptoms and signs (the minimum fluid infusion that can meet therapeutic and organismal needs, and negative balance as much as possible). The author believes that bedside ultrasound and dynamic monitoring of BNP/NT-proBNP levels are the most convenient means of assessing volume resuscitation.

3.2 Early identification of patients with high altitude critical illness

High altitude is a life-threatening area, and long-distance transportation on frozen highland roads

increases the risk. Patient 1 was admitted with transient respiratory distress, persistent decreased peripheral oxygen saturation (SpO2) (≤0.85), advanced age and underlying disease, decreased lymphocyte count, increased D-dimer and decreased albumin, aggravated left heart failure with cardiogenic shock, electrolyte disturbances, liver function impairment, increased CRP, and other critical warnings, suggesting the need for early transport. However, the case was admitted to the hospital already showing diffuse lesions in both lungs, and the estimated duration of the disease was more than 7-14 days. If the lesions do not increase, the patient may show an early inflection point toward improvement, and the risk of transport can be avoided. Patient 2 had improved SPO2 to about 90% after treatment, and shortness of breath improved with activity, which may be related to the patient being a plateau Tibetan for generations and tolerating low oxygen.[3]

3.3 Highland New Coronary Pneumonia Hypoxemia Graded Respiratory Support Prognosis

(1) PaO2/FiO2 at 200-300 mmHg after altitude correction, 1) should receive nasal cannula or mask oxygenation and promptly assess whether respiratory distress and/or hypoxemia is resolved. 2) Transnasal high-flow oxygen therapy (HFNC): when the patient receives nasal cannula or mask oxygenation for 2 hours without improvement of respiratory distress and/or hypoxemia, transnasal high-flow oxygen therapy should be used. After 2 hours of the above high-flow oxygen therapy support, if the oxygenation index does not improve or deteriorates further, non-invasive mechanical ventilation (NIV) or invasive mechanical ventilation should be changed.

(2) PaO2/FiO2 after altitude correction is 150-200 mmHg. NIV therapy is preferred. Such patients have a high failure rate for treatment with noninvasive mechanical ventilation and should be monitored closely. If the condition does not improve or even worsens in a short time (1-2 h), tracheal intubation and invasive mechanical ventilation should be performed promptly.

(3) If PaO2/FiO2 is <100 mmHg after altitude correction, invasive mechanical ventilation combined with pulmonary retension and prone ventilation should be used. If the condition improves after treatment, i.e., PaO2/FiO2 is >200 mmHg after altitude correction, and the patient is conscious and circulatory stable, the evaluation and withdrawal procedure can be considered.[4]

3.4 Highland antiviral

Studies have reported that the incubation period of viral infection leading to pneumonia is estimated to be more than 7-14 d. In this case, antiviral therapy was tried because it was within 10 days of onset, and patient 1 was discontinued from lopinavir/ritonavir and ribavirin successively because of anorexia, vomiting, and abnormal liver function. However, the nucleic acid turned negative faster and did not regain positive, probably coronavirus is sensitive to highland UV and heat, and lipid solvents such as 56℃ for 30min, ether, 75% ethanol, chlorine-containing disinfectants, peroxyacetic acid and chloroform can effectively extinguish the virus related. It has been found clinically that SARS-CoV-2 nucleic acid results can show a significant mismatch with the clinical symptoms and imaging findings of patients. Whether this is related to the means of detection, the time window of sampling, and the need to select different samples for different stages of disease remains to be seen.[5]

4. Conclusions

Highland NCP is an emerging infectious disease, and its clinical symptoms are highlighted by hypoxemia. The revised version of the Novel Coronavirus Pneumonia Treatment Protocol (Trial Version 7) standardizes the diagnosis of hypoxemia in plateau NCP, but it is still necessary to distinguish severe NCP from NCP combined with cardiac insufficiency. In addition, early

identification and early transport of critically ill patients emphasizes close monitoring. In addition to daily assessment of vital signs, consciousness, circulation, and oxygenation, regular blood tests (blood gas analysis 1-3 times/d) and pulmonary CT examinations (2-3 d/time) and, if necessary, bedside ultrasound monitoring of lung lesion development and changes in cardiac function (1 time/d) can improve early warning of critical illness in plateau neointimal pneumonia and effectively take early critical treatment measures and reduce mortality.

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