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Case Report

Importance of respiratory airway management as well as psychological and rehabilitative treatments to COVID-19 patients

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ABSTRACT

The clinical therapy for severe 2019 coronavirus disease (i.e., COVID-19) sufferers is relatively challenging. Herein, the processes involving salvage of a critical COVID-19 patient were retrospectively analyzed. The condition of an obese female critical COVID-19 sufferer progressively worsened in the initial period after admission. According to her symptoms and examination reports, endotracheal intubation and mechanical ventilation were timely conducted and meanwhile high-dose sedatives and analgesics were administrated. In the later therapeutic phase, however, sedative and analgesic dosages were gradually reduced, and psychological and rehabilitative therapies were conducted, concomitantly with enhancement of airway care to facilitate sputum expectoration. Eventually, the endotracheal tube was feasibly removed after intubation for 18 days and subsequently replaced with noninvasive ventilation and a high-flow nasal cannula oxygen therapy. Intensive airway care alongside psychological and rehabilitative therapies can shorten the mechanical ventilation time and improve the prognosis of COVID-19 sufferers.

1. Introduction

The coronavirus disease 2019 (COVID-19) has been recently demonstrated to result from the novel coronavirus SARS-CoV-2 (or 2019-nCoV) infection [1-2]. COVID-19 is extremely contagious and characterized by respiratory diseases though clinically complex [3]. Nearly half of COVID-19 patients get dyspnea after infection for one week, and the critical patients will rapidly develop an acute respiratory distress syndrome (ARDS) [4]. Therefore, mechanically assisted ventilation, which can considerably improve the critical patients' respiratory efficiency, becomes an imperative means in the therapy. In addition, the critical patients are generally anxious and fearful [5,6] and thus large-dose sedatives, analgesics and even muscle relaxants are requisite. Hence, both assisted ventilation and proper psychological therapy are essential for these patients. In this report, a case of a critical COVID-19 patient who was initially subjected to mechanical ventilation and then to psychological and rehabilitative treatments and was finally ventilator-weaned is elaborated as follows.

2. Case presentation

2.1. General information

A 36-year-old woman got a fever on January 25th, 2020, without obvious inducements, and the highest body temperature reached 37.7 °C. Her clinical syndromes include cough, expectoration with a small amount of sticky sputum, and slight nasal congestion and rhinorrhea, but without fatigue, headache, nausea, vomiting, celialgia, diarrhea or muscle soreness. Two days later, she was admitted to Shenzhen Second People's Hospital, and the chest tests suggest a pulmonary infection; thus, a nucleic acid test of the pharynx swab for coronavirus 2019-nCoV was subsequently conducted in the centers for disease control (CDC). The positive result prompts the transfer to ××× Hospital on January 28 for further treatments. Although there is nothing special in her past history, one noteworthy event in the epidemiology is that the couple on January 18 picked up their mother and child, who both had got a fever.

2.2. Physical examination

Due to the positive nucleic acid test result, a further physical examination was conducted in ××× Hospital on admission. The results were

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as follows: height 160 cm, weight 80 kg, body mass index (BMI) 31.25, body temperature 37.7 °C, pulse 110 times/min, respiration rate 20 times/min, and blood pressure 138/94 mmHg; clear mind and good spirits; no rash; pharynx congestion; no swelling of the tonsil; thick breath sounds from both sides of the lungs; regular heart rhythm; inaudible pathological murmurs from the auscultatory valve areas; normal bowel sounds; no edema in the lower limbs.

Blood gas: pH 7.447, $PaCO_2$ 34.9 mmHg, and PaO_2 85.0 mmHg.

Blood routine: white blood cell count 6.51×10^9/L, lymphocyte count 1.77×10^9/L, neutrophil percentage 62.00%, platelet count 3.23×10^{11}/L, hemoglobin concentration 101 g/L, hypersensitivity C reactive protein 20.44 mg/L, and procalcitonin 0.063 μg/L.

Blood clotting function: plasma prothrombin time 10.2 s, prothrombin activity 192%, and the glycosylated hemoglobin 7.7% (via chromatography).

According to the chest computerized tomography (CT) (Fig. 1), (1) multiple lesions are extensively scattered in each pulmonary lobe, consistent with virus-induced pneumonia syndromes, and thus we consider that the patient has developed a bilateral pleuritis symptom; (2) a small amount of fluid can be observed in the heart-packed cavity.

Additionally, the results of the urine routine, liver and kidney functions, electrolyte, and blood lipid showed no abnormality.

Allowing for the above results, the treatments include isolation of the respiratory tract, interferon atomization, and administration of the anti-virus medicine favipiravir.

2.3. Therapeutic strategies

On February 1 (day 5 since admission), the patient still suffered recurrent fever, with the highest body temperature reaching 39 °C, and the chest CT (Fig. 2) indicates two points: (1) multiple lesions were scattered in the lobes of both lungs, in accordance with viral pneumonia syndromes, and the area and density of the lesions increased compared with those found on January 28; (2) the bilateral pleurisy was slighter than that found on January 28. Consequently, the therapy includes methylprednisolone (60 mg), gamma globulin (via intravenous drip) and moxifloxacin (via oral administration).

On February 4 (day 9 since admission), the patient's condition became worse, and hence she was given non-invasive ventilator (IPAP 16 cmH_2O, EPAP 7 cmH_2O, FiO_2 60%, and f 16 times/min).

On February 6, endotracheal intubation and mechanical ventilation were performed (A/C-PC mode, FIO_2 45%, PS 10 cmH_2O, PEEP 8 cmH_2O, f 14 times/min); meanwhile, administration of the anti-infective (i.e., piperacillin-tazobactam), sedatives (i.e., propofol and midazolam), analgesics (i.e., remifentanil and dexmedetomidine) and muscle relaxant (i.e., rocuronium bromide), lung protective ventilation as well as a prone-position therapy were comprehensively conducted.

On February 8, she still had a high fever and was then subjected to blood routine examination. Considering the results (white blood cell count 2.82×10^9/L, auxiliary T lymphocyte absolute count 256/μL), piperacillin-tazobactam was immediately replaced with meropenem to improve the anti-infection effect.

On February 11, the blood culture results verified the emergence of gram-positive streptococci, and thus the anti-bacterial drug Linezolid was added.

On February 17 the chest CT (not shown) showed that the distribution of lesions scattered on the right lung was marginally sparser than before and the oxygenation index increased, and hence we attempted reduction of the sedative dosages. In addition, she was given alprazolam for relieving the anxiety.

On February 19 (day 24 since admission), the chest CT (Fig. 3) shows that the pulmonary lesions increased and consolidation occurred. It is therefore barely feasible yet to wean the ventilator. As far as we know, several reasons are probably responsible for this failed weaning. (1) This patient progressively got stressed and depressed, based on a psychological assessment, as a result of comparatively overlong administration of sedatives; (1) pulmonary symptoms were undiminished yet, e.g., consolidation of the pulmonary lower parts was rather evident and an air bronchogram was observable, as indicated from the CT pictures (Fig. 3); and (3) the patient lacked physical exercises due to long-term lying down on the bed. Accordingly, the corresponding countermeasures were implemented. For example, extra addition of anti-anxiety medicine (e.g., flupentixol and melitracen tablets), continuous psychological counseling from psychologists, sedative discontinuation since February 2, discharging sputum assisted with mechanical vibration and percussion on the back), enhancement of exercise (including exercises for respiratory and limb muscles), et cetera. In doing so, the oxygenation index gradually rose and the ventilator parameters could be gradually lowered.

On February 23 (day 28 since admission), the endotracheal tube was pulled out and substituted with noninvasive ventilation, which was

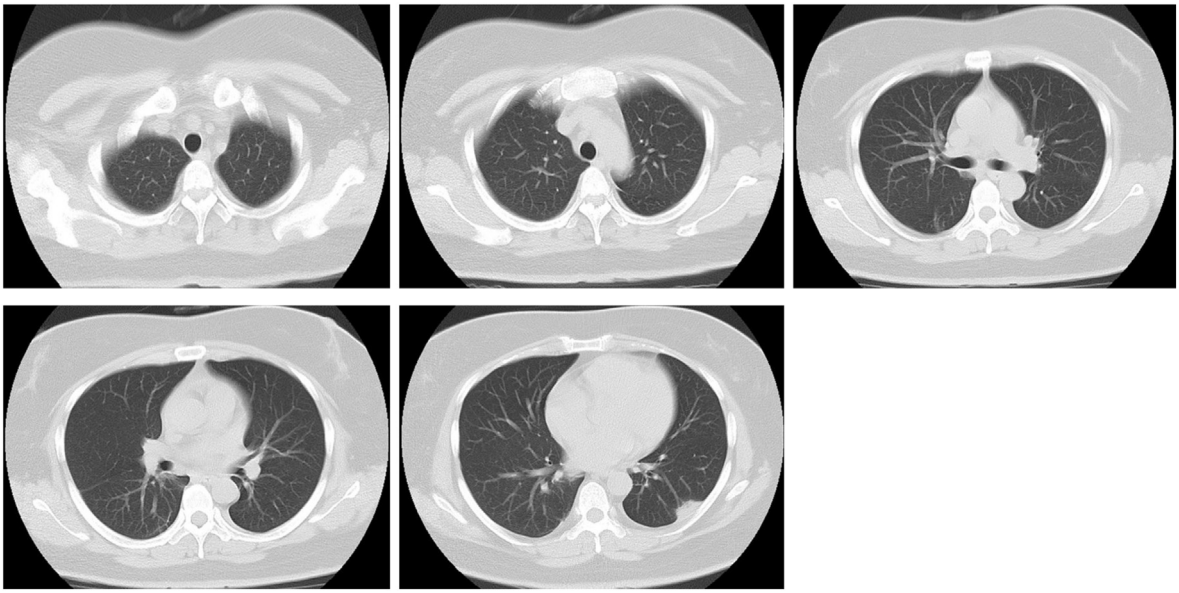

Fig. 1. Chest CT on January 28. Patchy ground-glass opacity is extensively scattered on the lungs.

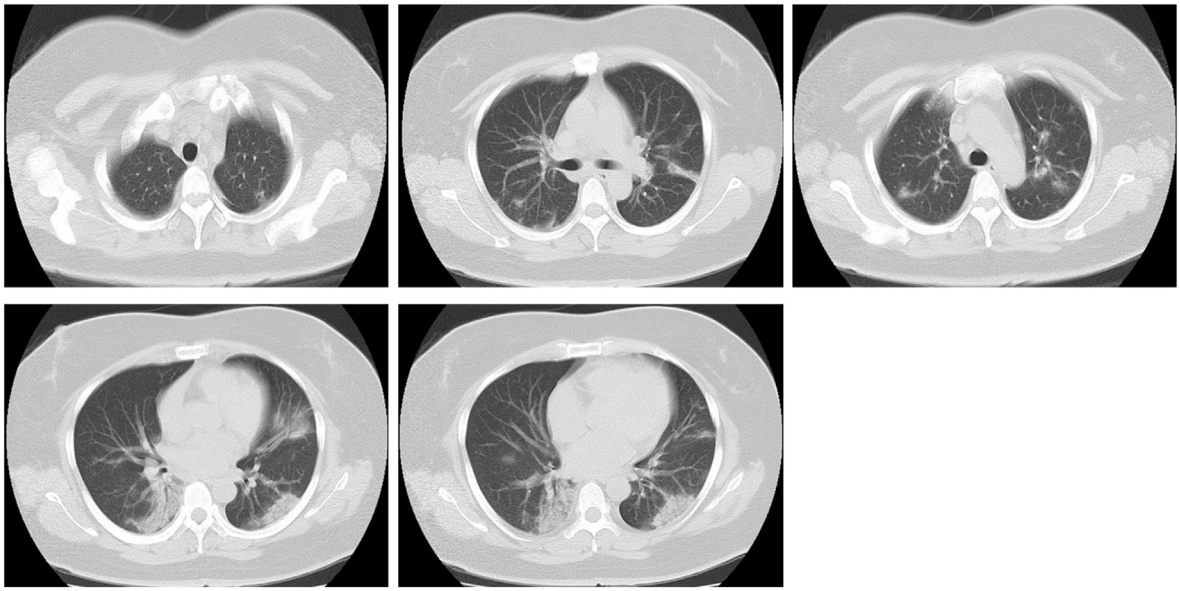

Fig. 2. Chest CT on February 1.

further replaced by a high-flow nasal cannula oxygen therapy after two days. The patient was discharged from ICU when her condition became steady.

3. Discussion and conclusions

The clinical therapy for severe COVID-19 patients is comparatively difficult and the salvage is somewhat strenuous and low-efficient. For example, the mortality rate of the 99 COVID-19 patients admitted to Wuhan Jinyintan Hospital in the early period is 11% [3], and the national mortality rate of COVID-19 patients is as high as 3.17% as of February 24, 2020 according to the Health Emergency Office [7].

The female patient in this case has a clear history of exposure to the 2019-nCoV-affected areas in × × ×. She is obese (BMI 32.03), whereas obesity is a high-risk factor for critical patients. Her clinical manifestations are fever and cough. The chest CT pictures obtained on the 5th day after admission show lesions in the pulmonary lower parts that are close to the pleura. The CT on the 9th day after admission indicates that pulmonary lesions increased further and that fusion and consolidation of lesions occurred in the pulmonary lower parts. As the patient's condition was getting worse, on the 14th day after admission intubation and mechanical ventilation were conducted, a large dose of sedation, analgesics and muscle medicine was given, the ARDS's lung protective ventilation strategy (including ventilation in prone position) was

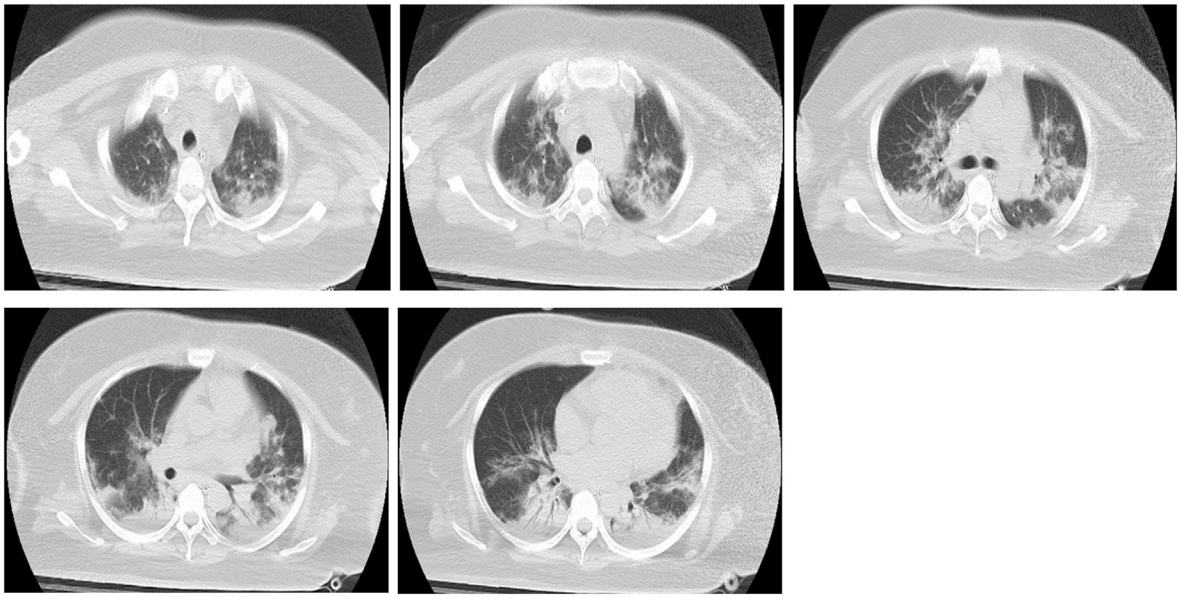

Fig. 3. Chest CT on February 17.

performed, and anti-viral and anti-infection therapies were executed. On the 23th day after admission, the patient's oxygenation index increased to 228 (see Table S1 in Supplementary information for more details), indicating that the patient was getting better, and thus we gradually reduced the amount of sedative drugs and lowered the parameters of the ventilator. On the 25th day after admission, she exhibited anxiety, fear and serious human-machine confrontation. On the 27th day after admission, the chest CT results indicate that the pulmonary lesions were more sprawling than ever since the admission and even consolidated considerably and that an air bronchogram could be observed in the pulmonary middle area. Therefore, it is infeasible yet to wean the ventilator right then.

Nevertheless, allowing for the above problems, we actively tried discharging sputum aided with mechanical vibration and percussion on back; physically rehabilitative treatments were also entrusted; furthermore, the anti-anxiety medicine (i.e., flupentixol and melitracen tablets) was administrated, and psychological counseling was made concurrently. Consequently and expectedly, the patient's condition gradually improved; and on the 33th day after admission the ventilator was successfully withdrawn.

The experience of successfully rescuing this patient suggests two additional vital elements expect the common anti-virus and immune-enhancing therapies. (1) Respiratory airway care should be intensified. This patient is obese, and her thorax activities are thus restricted; more importantly, the chest CT on February 17 shows consolidation in the pulmonary lower parts but an obvious air bronchogram, suggesting that the respiratory airway might be blocked; furthermore, this hypothesis is consistent with the autopsy report [8] that a plethora of sticky secretions overflows from the alveoli in the pulmonary transection and some fibrous stripes are visible; in addition, the radiographically ground-glass opacity is compatible with the anatomically pulmonary gray-white lesions [8], implying that COVID-19 causes the inflammatory reactions featured mainly by damage in the deep airway and pulmonary alveoli. Hence, it is exceedingly critical to widen the congested respiratory airway in the later therapeutic processes to promote the expectoration of mucus. (2) Attention to the patient's psychological and physical rehabilitation in the later phase should also be paid. The COVID-19 patients are per se scared of the disease, and moreover, long-term high-dose use of sedative and analgesic medicine readily leads to delirium and restlessness once discontinuation; therefore, psychotropic drugs (e.g., alprazolam, flupentixol and melitracen tablets) should also be administrated besides bolstering psychological comfort. Additionally, the muscle disuse atrophy syndrome will readily appear if patients are bedridden for a long time, and thus timely rehabilitations, whether passive or active, can enhance their confidence and further increase the possibility of smoothly weaning the ventilator.

The therapeutic strategies for severe COVID-19 patients remain complex, probably due in large part to the complicated clinical symptoms. Nonetheless, in addition to actively protecting against 2019-nCoV and performing immunoregulation in the initial phase, airway management, which promotes the discharge of sputum in the small airway, and rehabilitative treatments are also crucial for weaning the ventilator.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2020.04.055.

Abbreviations

ARDS	acute respiratory distress syndrome
BMI	body mass index
CDC	centers for disease control
COVID-19	2019 coronavirus disease
CT	computerized tomography
ICU	intensive care unit

Authors' contributions

YJ took care of the patient, collected clinical data and drafted the manuscript; JC analyzed data and substantially revised the manuscript; FC, ZS and MP took care of the patient and collected clinical data; XL analyzed clinical data and revised the manuscript.

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Declaration of competing interest

The authors declare that they have no competing interests.

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