

World Journal of *Virology*

World J Virol 2020 October 25; 9(4): 47-53



OPINION REVIEW

- 47 Management strategies in a thoracic surgery ward during COVID-19 pandemic: Experience from West China Hospital

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Editorial board member of *World Journal of Virology*, Dr. SeyedAlinaghi obtained his MD degree from Tehran University of Medical Sciences (TUMS; Iran) in 2006 and since has been working with the Iranian Research Center for HIV/AIDS. He was recognized by Iran's National Razi and Avicenna festivals in 2011, 2012 and 2014. Following award of his PhD in Epidemiology at TUMS, he became Assistant Professor. Through his research career, he has published 230 articles and 14 scientific books on different aspects of HIV/AIDS, and innovated a model of "Prison-based Active Health Services Provision". He served on the UNAIDS Program Coordinating Board for the "Ending tuberculosis and AIDS-a joint response in the era of the Sustainable Development Goals" meeting in 2018, and was awarded the Club Red Ribbon Award in 2016. (L-Editor: Filipodia)

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INDEXING/ABSTRACTING

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RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: Yan-Xia Xing; Production Department Director: Yun-Xiaojian Wu; Editorial Office Director: Jia-Ping Yan.

NAME OF JOURNAL

World Journal of Virology

ISSN

ISSN 2220-3249 (online)

LAUNCH DATE

February 12, 2012

FREQUENCY

Irregular

EDITORS-IN-CHIEF

Mahmoud El-Bendary, En-Qiang Chen

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/2220-3249/editorialboard.htm>

PUBLICATION DATE

October 25, 2020

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<https://www.wjgnet.com/bpg/gerinfo/240>

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<https://www.wjgnet.com/bpg/GerInfo/288>

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<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

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Management strategies in a thoracic surgery ward during COVID-19 pandemic: Experience from West China Hospital

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Conflict-of-interest statement: The authors declare that they have no conflicts of interest.

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Abstract

The coronavirus disease 2019 was first reported in Wuhan in December 2019 and then spread rapidly throughout the world. On March 11, 2020, the World Health Organization declared coronavirus disease 2019 a pandemic. In response to the pandemic, the management division of West China Hospital oversaw the implementation of hospital-wide emergency measures. In accordance with these measures, the hospital's thoracic surgery ward implemented a new management system by reformulating staff training plans, patient admission procedures, and other systems for managing the ward and protecting perioperative patients. Overall, the ward was successful in restoring normal working order, protecting all staff from occupational exposures, and ensuring the safety of inpatients and their families.

Key Words: COVID-19; Thoracic surgery; Thoracic surgery ward management; SARS-CoV-2; Epidemic prevention and control; Nosocomial infection

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Core Tip: This study describes a specific approach to preventing a coronavirus disease 2019 outbreak in the thoracic surgery ward at a hospital in West China. We believe that our study will make a significant contribution to the literature. It documents lessons learned in developing and deploying a system to protect staff and vulnerable inpatients

Manuscript source: Invited manuscript

Received: May 12, 2020

Peer-review started: May 12, 2020

First decision: July 25, 2020

Revised: August 3, 2020

Accepted: September 2, 2020

Article in press: September 2, 2020

Published online: October 25, 2020

P-Reviewer: Xiang HB

S-Editor: Zhang L

L-Editor: Wang TQ

P-Editor: Xing YX



during the unprecedented and highly challenging situation that has been the coronavirus disease 2019 pandemic.

Citation: Lin L, Niu LL, Zheng E, Yuan Y, Ning N, Yang M. Management strategies in a thoracic surgery ward during COVID-19 pandemic: Experience from West China Hospital. *World J Virol* 2020; 9(4): 47-53

URL: <https://www.wjgnet.com/2220-3249/full/v9/i4/47.htm>

DOI: <https://dx.doi.org/10.5501/wjv.v9.i4.47>

INTRODUCTION

Shortly after the emergence of the novel coronavirus in Wuhan, Hubei Province, China in December 2019, other regions in China detected cases of the disease. Subsequently, the coronavirus disease-19 (COVID-19) epidemic spread throughout the world. On February 11, 2020, the International Committee on Taxonomy of Viruses officially named the virus the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)^[1], and the World Health Organization named the disease caused by the virus the COVID-19. Then, on March 11, 2020, the World Health Organization declared the epidemic a global pandemic. The total number of globally confirmed cases reached 2.2 million by April 19, 2020. According to published research^[2,3], the virus is a β -coronavirus, sharing up to 85% of its homology-based genes with a bat SARS-like coronavirus. The major sources of infection are confirmed COVID-19 patients, though asymptomatic patients can also be infection sources. The disease is highly contagious, and its main transmission routes include droplets and close person-to-person contact; there is also the possibility for aerosol transmission in closed environments. A retrospective study published by Zhongnan Hospital of Wuhan University reported that 41.3% (57/138) of patients diagnosed with COVID-19 had nosocomial infections from the early stages of the epidemic^[4].

The majority of thoracic surgery ward inpatients have malignant tumor diagnoses. These patients are usually immunocompromised and may be more vulnerable to viral infections, as postoperative respiratory rehabilitation training may increase the risk of viral transmission^[5]. SARS-CoV-2 infections may increase these patients' postoperative complications as well as their perioperative mortality. Therefore, it is extremely important to prevent outbreaks and the subsequent spread of COVID-19 in thoracic surgery wards. After the outbreak of COVID-19 in China, the West China Hospital (the authors' hospital) made it a top priority to prevent and control the disease, and quickly established a system to manage the COVID-19 outbreak. In accordance with this system^[6], the thoracic surgery department (the authors' department) constructed a detailed protocol for ward management, which included patient admission procedures, overseeing accompanying family members, and ward disinfection and isolation systems during the outbreak. As a result, the authors were able to restore working order in the ward, and they continued to treat inpatients in a timely fashion. Furthermore, no hospital-acquired infections occurred in the authors' ward. This paper describes the specific thoracic surgery ward management system in response to COVID-19.

STAFF TRAINING IN EPIDEMIC PREVENTION AND CONTROL

The authors' hospital implemented measures to train staff on the prevention, diagnosis, and treatment of COVID-19 through online courses, weekly video-conferences, and WeChat postings^[6]. Training covered basic knowledge about COVID-19 including its epidemiology, symptoms, diagnosis, and treatment. Staff were instructed on how to report COVID-19 cases and collect specimens as well as on disinfection, isolation, and self-protection. The department encouraged all staff to participate in the online discussions and complete the training and assessments. By acquiring the relevant knowledge and skills, the staff developed the capability to tackle the outbreak. According to Fu *et al*^[7], inconsistent protection standards and improper donning and removal of protective equipment are the key causes of medical staff occupational exposures. Therefore, the authors' department informed all staff on

these and other issues through online courses and periodic face-to-face training. Staff were trained to manage patient admissions, screen inpatients and their families for COVID-19, properly use protective equipment and so on. In addition, emergency preplans were developed and carried out based on the capabilities of the department, particularly for activities such as donning, removing, and disposing of protective equipment; reporting suspected/confirmed cases; and transporting infected patients. The director of the department was responsible for training doctors; the head nurse oversaw the nurse trainings; and the hospital's infection control nurse trained cleaning staff and others. These measures ensured that everyone could continue to perform their normal duties during the outbreak as well as effectively contribute to the prevention and control of COVID-19.

DYNAMIC MANAGEMENT OF INPATIENT ADMISSION ACCORDING TO SURGICAL INDICATIONS

Taking into consideration the thoracic surgery specialty and patients who have been admitted to the department in the past, inpatients in the authors' department generally fall into one of three categories: Those requiring emergency operations, those needing limited operations, and those undergoing selective operations. Indications for emergency operations include spontaneous hemopneumothorax, esophageal rupture, open chest trauma, giant tracheal tumors, and other emergencies requiring immediate surgical treatment. Indications for limited operations include esophageal cancer, invasive lung cancer, thymic carcinoma, thoracic malignancies with rapid progression, and other conditions requiring surgical treatment in the near future. Indications for selective operations include benign esophageal or pulmonary diseases, pulmonary ground-glass opacities, mediastinal cysts and benign tumors, palmar hyperhidrosis, and other situations that allow for a more flexible scheduling of the surgical procedure.

In the early stages of the COVID-19 outbreak, the epidemiology, diagnosis, and treatment of the disease were unclear. Therefore, as part of a hospital-wide deployment, the authors' department stopped seeing outpatients and postponed limited and selective operations for one week. This gave us time to develop protocols and procedures to manage the epidemic as well as reserve the necessary protective equipment. After one week, those requiring limited operations could once again be admitted. Patients with more severe disease were prioritized, but those who lived outside Sichuan Province had their surgeries further postponed to reduce their risk of contracting COVID-19 *en route* to the hospital. At that point, the domestic epidemic was under control. In the authors' department, the admission of patients for elective operations returned to normal, and those who were waiting the longest times for their surgeries were the first to be admitted. However, all those seeking admission to the hospital were required to pass a three-step screening procedure^[6]. Prospective patients had to provide complete histories, first, when sending their admission notice; second, at the hospital admissions department; and third, in the surgical ward reception area. The histories documented any recent symptoms of cough, fatigue, diarrhea and so on in the prospective patient and his or her family members. A prospective patient also had to describe any recent travel and have his or her body temperature taken. Finally, after a chest computed tomography (CT) examination to exclude COVID-19 infection, the patient could be admitted into the hospital. These were the measures taken to prevent COVID-19 outbreaks in our medical institution.

Patients requiring emergency operations would undergo emergent treatment and history-taking at the same time based on the "screening while treating" principle. Then, after a chest CT examination and throat-swabbing nucleic acid test to exclude COVID-19 infection, patients in stable condition could be transferred to the inpatient ward. Patients in severe condition who could not undergo the screening test before their operations were reported to both the thoracic surgery department and hospital administration. The operating room and the department of anesthesiology were then contacted, and the patients were treated as confirmed COVID-19 cases during their emergency operations with every precaution taken. After the operation, the screening tests for COVID-19 were performed, and those without COVID-19 infection would be admitted to the authors' department. Otherwise, the patients would be admitted into the isolation ward of the infectious disease department.

STANDARDIZED WARD MANAGEMENT TO ENSURE THE SAFETY OF STAFF AND PATIENTS

Management of ward environment

Ward access was restricted under a 24-h closed management system. Access to the ward was possible only at two points, based on our ward's configuration. Staff at both access points were equipped with non-contact thermometers as well as the "Log Book for Recording Personnel Entrance and Exit". Staff took the temperatures and histories (*i.e.*, symptoms and epidemiology) of patients and families entering the ward for the first time. Upon leaving the ward, inpatients and family members were required to have their temperatures taken again and provide the reason for leaving and the destination. Temperatures would be taken again upon their return. Patients were allowed access to the ward by showing their wrist strap, while family members were required to present a companionship certificate. Other visitors and personnel were strictly prohibited from entering. Furthermore, only card-carrying employees were permitted to pass through the staff passageway; and body temperatures were taken there, as well. Our ward reserved an appropriate number of empty rooms for isolation of suspected patients in case of emergency.

Maintenance of the ward environment and disinfection of equipment were all in accordance with hospital requirements^[9]. For ventilation, the windows of the inpatient ward, medical staff office, and duty room would be opened at least twice a day for a minimum of one hour. The equipment surfaces in the nursing station, therapy room, dressing room, and ward were disinfected twice a day by wiping with an effective chlorine concentration of 1000 mg/L. Also twice per day, the ward floor and corridor passages were sprayed and cleaned using a wet disinfectant with an effective chlorine concentration of 1000 mg/L, and air disinfection machines were used to disinfect the therapy room and dressing room.

Management of staff

All staff had to complete the "Basic Information Backup Record for Returning to Work", and those with suspicious symptoms or travel histories were required to suspend clinical work. Staff who returned to work would undergo daily body temperature monitoring by specially assigned personnel, and those who had not yet returned to work would monitor their body temperatures at home. All staff had to complete daily health reports so that administrators could stay informed about the health status of the hospital's front-line workers. Staff were required to wear surgical masks and hats at work and to maintain strict hand hygiene practices. When performing tracheotomies, sputum aspirations, and throat swabs, staff had to wear medical masks, goggles or face screens, rubber gloves, and disposable medical gowns. Staff were required to wear protective clothing when caring for patients with suspected COVID-19. Special personnel for the hospital and in each department supervised and enforced the personal protection practices, providing on-site feedback and corrections in case of insufficient or excessive protection. During work breaks, staff continued to observe the preventive regulations. Protective equipment used in the ward was not allowed in the duty room, nor were eating and group conversations. Staff were required to observe strict coughing and hand hygiene in all areas and to keep the duty room neat and ventilated.

Family member and companion management

Preoperative patients could not have a companion present unless they were minors or seniors or others incapable of self-care. These patients were allowed to have one companion. Postoperative patients could keep one fixed companion as determined by the attending doctor and nurses, and individuals with a recent history of fever or cough, or a positive epidemiological history could not serve as companions. Companion family members had to complete the same symptom and epidemiological screenings as patients. During a severe outbreak, nucleic acid tests or chest CT scans would also be needed. Each remaining family member had to use their own identity document card to apply for a companionship certificate. This was to facilitate the verification of the information and to signify acceptance of the department's unified management system. Companions were required to have their body temperatures taken and symptoms recorded three times per day. They were asked to wash their hands frequently and to wear masks throughout the hospital. It was forbidden for family members to gather for conversation, meals, or other purposes. If a patient's family member was found to have a fever or other positive signs, a monitor would take the family member to the fever clinic, where he or she would be overseen by the

clinic's supervising personnel.

Perioperative management of patients

During the epidemic, the following steps were taken as part of routine patient care: (1) After admission, patients were not allowed to enter or leave the department at will. Only after the primary nurse or doctor was informed could a patient leave the ward for an examination, accompanied by a central transport employee; (2) Patients needed to wear surgical masks throughout their hospitalizations^[10]. In the authors' department, some postoperative patients complained of dyspnea and feelings of suffocation while wearing masks; these symptoms were relieved after the patients were gently instructed to relax. It was reported that some postoperative patients on oxygen experienced a rise in oxygen saturation while wearing masks. This finding indicates a need for further studies on the pros and cons of wearing a mask after surgery and a mask's influence on breathing; (3) One-to-one bedside guidance was adopted to replace the original group health related education for patients and their companions in our ward. In addition to the conventional content, the guidance also included information on epidemic prevention. To reduce ineffective postoperative dry coughs, postoperative respiratory rehabilitation training techniques were emphasized, especially effective sputum expectoration^[11]. Patients were instructed to observe airway hygiene by covering their mouths and noses with tissues when coughing or sneezing, to implement hand hygiene after touching respiratory secretions, and to maintain a distance of one meter or more from others. Nursing staff were required to locate themselves behind the patient or with their own heads to other side when assisting the patient to finish nebulizer inhalation or produce sputum. Any expectorated sputum was wrapped in tissues and immediately discarded into a garbage bag, which was then tightly fastened. Moreover, patients and family members were required to keep an appropriate distance from one another; (4) Patient body temperatures were taken four times per day. In the case of fever, the doctor in charge was to be informed immediately. In this case, while attending to the patient's symptoms, a rapid screening would be performed. If the fever was not due to the primary lesion, a consultation would be scheduled with the respiratory department. The suspected patient would then be isolated in a single room and undergo a blood test, nucleic acid test, and chest CT to further screen for COVID-19; (5) Studies have suggested that panic is one of the most detrimental aspects caused by the acute stress response during epidemic outbreak^[12,13]. Along with concerns about surgical wounds and the illness itself, patients often suffer from severe generalized anxiety and depression, which can influence recovery. Therefore, patients should receive timely psychological evaluation and care upon admission. Doctors should communicate thoughtfully with patients if surgery or treatment needs to be delayed because of the pandemic. Patients with insomnia can take hypnotics in accordance with medical advice, and patients without companions can be instructed to connect with their families through cellphone or video chat to alleviate negative affect; and (6) After hospital discharge, patients would be instructed to protect themselves from COVID-19 through a healthy diet, exercise, and avoiding large social gatherings. Postoperative dressing changes and follow-up examinations could be completed at the nearest community hospital. Discharge follow-up could be done on the phone or *via* an internet platform.

EFFECTS OF PREVENTION AND CONTROL

During the epidemic period from January 24, 2020 to April 19, 2020, 17 emergency patients and 569 regular patients were admitted to the authors' department. All patients completed epidemiological histories and chest CT examinations before entering the ward. We conducted 14 emergency operations and 469 elective operations, among which nine suspected cases of COVID-19 were identified (8 were admitted patients and 1 was a family companion of a patient). All nine suspected cases underwent complete COVID-19 screening to rule out infection.

CONCLUSION

The COVID-19 epidemic has introduced many challenges and problems to management and clinical practice in the thoracic surgery ward. The following are

some examples: (1) Owing to the pandemic, patients whose operations are postponed may miss opportunities to receive the best treatment. Therefore, the doctor in charge must determine the treatment order of patients based on the "disease first" principle, and the waiting times of patients seeking ordinary elective surgeries can be extended; (2) The symptoms and imaging features of many thoracic diseases are similar to those of mild COVID-19, making identification of COVID-19 more difficult in these patients. Therefore, it is imperative that these patients and their families be screened for epidemiological history before admission. Travel and contact histories should carefully consider regions with high numbers of confirmed cases or where cases are increasing rapidly. Those taking histories should also enquire about confirmed cases in patients' communities and workplaces; (3) Postoperative symptoms such as fever, cough, chest pain, and dyspnea could indicate the possibility of infection. The nurse in charge should actively communicate with the doctor, closely monitor examination results and disease changes in patients, and actively identify causes. When necessary, treatment can progress to multi-disciplinary collaborations and joint diagnoses; (4) Once a patient is suspected as having COVID-19, he or she should immediately be transferred to a single room for isolation and be attended to by special personnel. The department should then be closed; admissions and discharges should stop right away. All personnel should be isolated on the spot and prevented from resuming normal work until disease is excluded; and (5) To prevent an inpatient surge after the pandemic, which would likely increase risks, admissions to the department should be restored gradually, according to the risk level of the pandemic. All management plans and processes should be dynamically adjusted according to the current situation.

As key institutions in society for treatment and recovery, hospitals tend to house large numbers of patients, who are transported from one location to another in relatively closed environments^[4]. Hence, given the inpatient population's general susceptibility and the fact that COVID-19 is highly contagious through person-to-person transmission, hospital staff must pay attention to every level of epidemic prevention. In our experience, hospitals should initiate a "top-down" linked prevention and control mechanism. In this model, hospital administration plans the overall deployment, and then each department's managers construct specific protocols based on the unique features of their department. All on-duty hospital personnel must recognize the importance of epidemic prevention and be equipped with the proper screening skills and tools. Staff should be able to rapidly detect abnormalities and take prompt measures. By strictly applying the management strategies described above, the authors' department achieved the goal of "zero infection" for staff, patients, and family members while continuing to treat patients in a timely manner.

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