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## Clinical characteristics of emergency surgery patients infected with coronavirus disease 2019 (COVID-19) pneumonia in Wuhan, China

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### ABSTRACT

**Background:** We aimed to investigate clinical symptoms and epidemiologic features of emergency surgery patients infected with the 2019 novel coronavirus disease (COVID-19). More than 5 million people worldwide have been diagnosed with COVID-19 since December 2019 to the time of this publication. Thousands of emergency operations have been carried out since December 2019. To date, however, no literature has focused on the clinical symptoms of emergency surgery patients with COVID-19 pneumonia.

**Methods:** We conducted a retrospective cohort study of 164 emergency surgery patients with or without COVID-19 pneumonia in Zhongnan Hospital of Wuhan University in Wuhan, China, from January 1, 2020, to January 20, 2020. For this report, the final date of follow-up was February 5, 2020. The associated clinical, laboratory, epidemiologic, demographic, radiologic, and outcome data were collected and analyzed.

**Results:** Of the 164 emergency surgery patients, the median age was 41 years (interquartile range, 29–89), and 136 (82.9%) were women. The associated main clinical symptom included fever (93 [56.7%]), dry cough (56 [34.2%]), fatigue (86 [52.4%]), nausea (78 [47.6%]), and dizziness (77 [47%]). Of 54 emergency surgery patients infected with COVID-19, the median age was 46 years (interquartile range: 25–89), and 45 (83.3%) were women. The pathologic clinical symptoms investigated included fever (54 [100%]), fatigue (48 [88.9%]), nausea (52 [96.3%]), dizziness (46 [85.2%]), and dry cough (44 [81.5%]). The lymphopenia ( $0.37 \times 10^9/L$  [interquartile range: 0.23–0.65]) and increased C-reactive protein ( $24.7 \times 10^9/L$  [interquartile range: 13.57–38]) were observed. The preoperative fever and postoperative fever in emergency surgery patients with or without COVID-19 pneumonia were analyzed in this study. Of 54 emergency surgery patients with COVID-19, 15 (27.8%) showed preoperative fever, 54 (100%) had postoperative fever. Of 110 emergency surgery patients without COVID-19, 5 (4.5%) had preoperative fever, 31 (28.2%) patients had postoperative fever. In emergency surgery patients with COVID-19, the fever lasted more than 7 days, markedly exceeded the length of time non-COVID-19 patients experienced fever (approximately 3 days). Furthermore, 43 health care workers were exposed to emergency surgery patients with COVID-19 pneumonia and were infected with COVID-19 pneumonia.

**Conclusion:** In our study, the clinical symptoms of emergency surgery patients infected with COVID-19 displayed marked differences from those reporting common COVID-19 pneumonia. In addition, the health care workers were suspected to have been exposed to a great risk when caring for emergency surgery patients with COVID-19 pneumonia. Management guidelines of emergency surgery patients are described in this report.

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Jinpeng Li, Rongfen Gao, Gaosong Wu, Xiaolin Wu, and Zeming Liu contributed equally to this report. Jinpeng Li performed most of the study and participated in writing the original manuscript. Rongfen Gao supervised the study and was involved in writing the results and the discussion. Gaosong Wu and XW were involved in collecting original data and in writing the discussion. Hongjing Wang participated in the data analysis. XW proposed the original idea and design of the

study, supervised the study, and edited the manuscript. Jincao Chen provided intellectual input and was involved in writing the discussion. Zhenyu Pan participated in proposing original idea and writing the discussion.

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## Introduction

The 2019 novel coronavirus disease (COVID-19), a cluster of acute respiratory illnesses, emerged in Wuhan, Hubei Province, China, in December 2019.<sup>1–3</sup> More than 5 million people worldwide have been diagnosed with COVID-19 between December 2019 and the time of this publication. In this pandemic, China and other countries, including Japan, Korea, Italy, and Iran, experienced serious outbreaks.<sup>4</sup> A recent study reported that COVID-19 patients' clinical symptoms mainly include fever, dyspnea, nonproductive cough, fatigue, myalgia, normal or decreased leukocyte counts, and radiographic evidence of pneumonia.<sup>4</sup> Zhu et al<sup>5</sup> analyzed the full genome sequencing of COVID-19, a variant from the betacoronaviruses associated with Middle East respiratory syndrome (MERS) and human severe acute respiratory syndrome (SARS). Furthermore, the proven hospital-related transmission of COVID-19 pneumonia has been reported. Of 138 hospitalized COVID-19 pneumonia patients, 26% of patients were hospitalized in the intensive care unit, and the mortality was 4.3%.<sup>6</sup>

Kumar et al<sup>7</sup> reported that one patient died from SARS after liver transplantation. After this surgery, several health care workers and their family members were infected with SARS. Emergency surgery was believed to have been extremely dangerous during the Ebola epidemic in Africa.<sup>8</sup> Furthermore, Chen et al<sup>9</sup> reported the clinical characteristics of caesarean section patients with COVID-19 infection and denied the risk of vertical transmission. In addition, stringent infection control procedures for operations were established during the 2003 SARS epidemic to protect health care workers and to control intrahospital transmission. These procedures significantly decreased intrahospital transmission of SARS in the operating room complex.<sup>10,11</sup> Although these reports investigated the risk for the health care workers, who used recommended personal protective equipment, no reports to date have focused on the risk of emergency surgery patients (ESPs) with COVID-19 pneumonia. Our current study analyzed the clinical symptom of these patients perioperatively and postoperatively. Furthermore, we clearly describe the relative risk for health care workers in contact with ESPs who might have COVID-19 pneumonia.

## Methods

### Study design

Data regarding all postoperative patients with COVID-19 pneumonia were collected from Zhongnan Hospital of Wuhan

University, Wuhan, China, from January 1, 2020, to January 21, 2020. The final date of follow-up was February 5, 2020. All ESPs infected with COVID-19 were confirmed through the use of the World Health Organization interim guidance. Oral consent was given from patients in Zhongnan Hospital, Wuhan, Hubei Province, China. All 54 ESPs infected with COVID-19 were proven by the use of the quantitative real-time polymerase chain reaction (qRT-PCR) on samples from the respiratory tract. In addition, this research was confirmed by the institutional ethics committee of Zhongnan Hospital of Wuhan University (approval number 2020068).

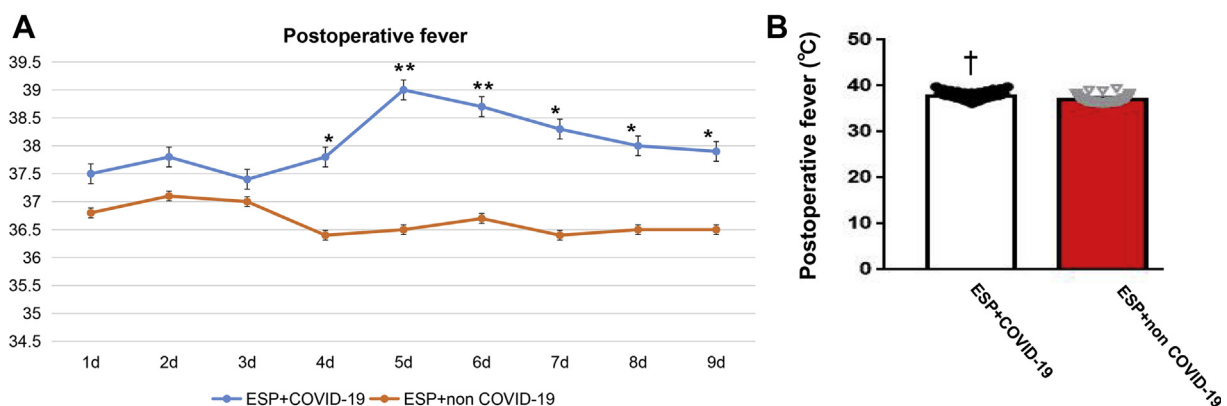
### Data collection

In this study, the clinical or epidemiologic records, chest computed tomography (CT) scans, and laboratory findings were obtained from the Information Center of Medical Service Zhongnan Hospital of Wuhan University. The data were reviewed by surgeons from the departments of neurosurgery, gynecology and obstetrics, and thyroid and breast surgery. All patients in our case series needed surgical intervention. The postoperative patients were transferred into their prospective departments. Patients with COVID-19 pneumonia were then transferred to the isolation ward. Collected throat swab samples were used to test for COVID-19 pneumonia following the Chinese Center for Disease Control and Prevention (CDC) recommended kit (Shanghai BioGerm Medical Technology Co, Shanghai, China) and the World Health Organization guidelines for qRT-PCR.<sup>9</sup>

The throat swab samples from patients with COVID-19 pneumonia were collected and immediately indicated positive for 2019-nCoV RNA. Throat swab samples from infected patients were collected a minimum of three times. The steps used for the collection of the samples are based on Peng's report.<sup>6</sup> The RT-PCR assay was performed using a 2019-nCoV nucleic acid detection kit according to the manufacturer's protocol (Shanghai BioGerm Medical Technology Co). The RT-PCR assay was also performed according to Peng's report.<sup>6</sup>

### Statistical analysis

The data for fevers (Fig 1) were analyzed by the ANOVA followed by Tukey's analysis. One-way analysis of variance followed by Tukey's multiple comparison test was used to determine significance, which was defined as  $P < .05$ . The Mann-Whitney  $U$  test was used to analysis of median (interquartile range [IQR]). Categorical



**Fig 1.** Dynamic profile of postoperative fever in ESPs with or without the COVID-19 pneumonia infection. (A) The duration of postoperative fever between patients with the COVID-19 pneumonia infection and patients with no COVID-19 pneumonia infection. (B) The body temperature of ESPs with or with no COVID-19 pneumonia infection. The 2019 novel coronavirus disease was designated as COVID-19 here (\* $P < .05$ , † $P < .01$ ).

**Table 1**  
Clinical characteristics of ESP with or with no COVID-19 pneumonia

Clinical characteristics	Number (%)			P value
	Total (N = 164)	COVID-19 (N = 54)	Non-COVID-19 (N = 110)	
Age, median, (IQR), y	41 (29–89)	46 (25–89)	39 (29–87)	.023
Sex				
Male	28 (17.1)	9 (16.7)	19 (17.2)	.744
Female	136 (82.9)	45 (83.3)	91 (82.7)	
Epidemiologic History		yes		
Fever	93 (56.7)	54 (100)	39 (35.5)	< .0001
Preoperative fever	20 (12.2)	15 (27.8)	5 (4.5)	.0233
Postoperative fever	85 (51.8)	54 (100)	31 (28.2)	<.0001
Dry cough	56 (34.2)	44 (81.5)	12 (11)	<.0001
Fatigue	86 (52.4)	48 (88.9)	38 (34.5)	.82
Nausea	78 (47.6)	52 (96.3)	26 (23.6)	< .0001
Dizziness	77 (47.0)	46 (85.2)	31 (28.2)	< .0001
Dyspnea	20 (12.2)	11 (20.4)	9 (8.2)	.0342
Vomiting	18 (11.0)	6 (11.1)	12 (10.9)	.899
Headache	15 (9.1)	4 (7.4)	11 (10.0)	.639
Diarrhea	10 (6.1)	4 (7.4)	6 (5.5)	.771
Death	10	8	4	< .0001

ESPs, emergency surgery patients; COVID-19, 2019 novel coronavirus disease; IQR, interquartile range.

NOTE: P values indicate differences between ESPs infected with COVID-19 and those with no COVID-19.  $P < .05$  was considered statistically significant.

variables were expressed as number (%), median, or IQR and compared by the  $\chi^2$  test or the Fisher exact test between ESP with COVID-19 and non-COVID-19 groups. Statistical analysis was performed by SPSS v 25.0 (IBM Corp, Armonk, NY, USA).

## Results

### Clinical characteristics of ESPs infected with COVID-19 pneumonia

We reviewed the data regarding 164 ESPs in Zhongnan Hospital of Wuhan from January 1, 2020, to January 21, 2020. Of these patients, the median age was 41 years (IQR, 29–89); 136 (82.9%) were women, 28 (17.1%) were men (Table 1). The number of women is high because many cesarean sections were performed during the period of our study. All ESPs infected with COVID-19 pneumonia had a history of close contact with others who had the virus (Table 1). Of the 164 ESPs, the common clinical symptoms at onset of illness included fever (93 [56.7%]), fatigue (86 [52.4%]), nausea (78 [47.6%]), dizziness (77 [47%]), dry cough (56 [34.2%]), dyspnea (20 [12.2%]), vomiting (18 [11%]), headache (15 [9.1%]) and diarrhea (10 [6.1%]) (Table 1).

When compared with non-COVID-19 patients ( $n = 110$ ), the ESPs infected with COVID-19 ( $n = 54$ ) showed more morbidity of fever (54 [100%]), dry cough (44 [81.5%]), fatigue (48 [88.9%]), nausea (52 [96.3%]) and dizziness (46 [85.2%]) (Table 1). We analyzed the preoperative fever and postoperative fever in ESPs with or with no COVID-19 pneumonia (Table 1). Of 93 (56.7%) ESPs with fever, 20 (12.2%) patients had fever preoperatively and 85 (51.8%) patients displayed fever postoperatively. Of 54 ESPs infected with COVID-19 pneumonia, 15 (27.8%) patients showed fever preoperatively and 54 (100%) had the postoperative fever postoperatively. Of 110 ESPs who did not have COVID-19, 5 (4.5%) patients had fever preoperatively, 31 (28.2%) patients had the fever postoperatively. These data suggested that more ESPs infected with COVID-19 displayed the clinical symptom of fever than patients who did not have COVID-19. Furthermore, we analyzed the duration of fever between them. The results showed that the fever in ESPs with COVID-19 lasted more than 7 days, markedly higher than the patients who did not have COVID-19 (approximately 3 days) (Fig 1, A). The level of fever in ESPs with COVID-19 was also higher than in patients who did not have COVID-19 (Fig 1, B). In addition, more clinical symptoms of dry cough, fatigue, nausea, and dizziness

were observed in ESPs infected with COVID-19 when compared with patients who did not have COVID-19. Of note, of 54 ESPs infected with COVID-19, the incidence of dry cough, fatigue, nausea, and dizziness in our study was higher than the reported common COVID-19 pneumonia cases.<sup>6,12</sup>

### Imaging features of ESP-infected COVID-19 pneumonia

For the most part in our research, ESPs originated from the following hospital departments: gynecology and obstetrics (72 [43.9%]), neurosurgery (16 [9.8%]), orthopedic surgery (15 [9.2%]), gastrointestinal surgery (20 [12.2%]), cardiothoracic surgery (8 [4.9%]), urologic surgery (9 [5.5%]), and hepatobiliary surgery (24 [14.6%]) (Table 2). Before operation, we tested ESPs for COVID-19 pneumonia by using chest CT scans and throat swabs of nucleic acid detection. Only 20% of patients were screened preoperatively. Of the ESPs, 80% were confirmed to have COVID-19 postoperatively. Of 54 ESPs with COVID-19, all displayed bilateral involvement of chest in the CT scan (Fig 2, A-C).

### Laboratory parameters in ESP-infected COVID-19 pneumonia

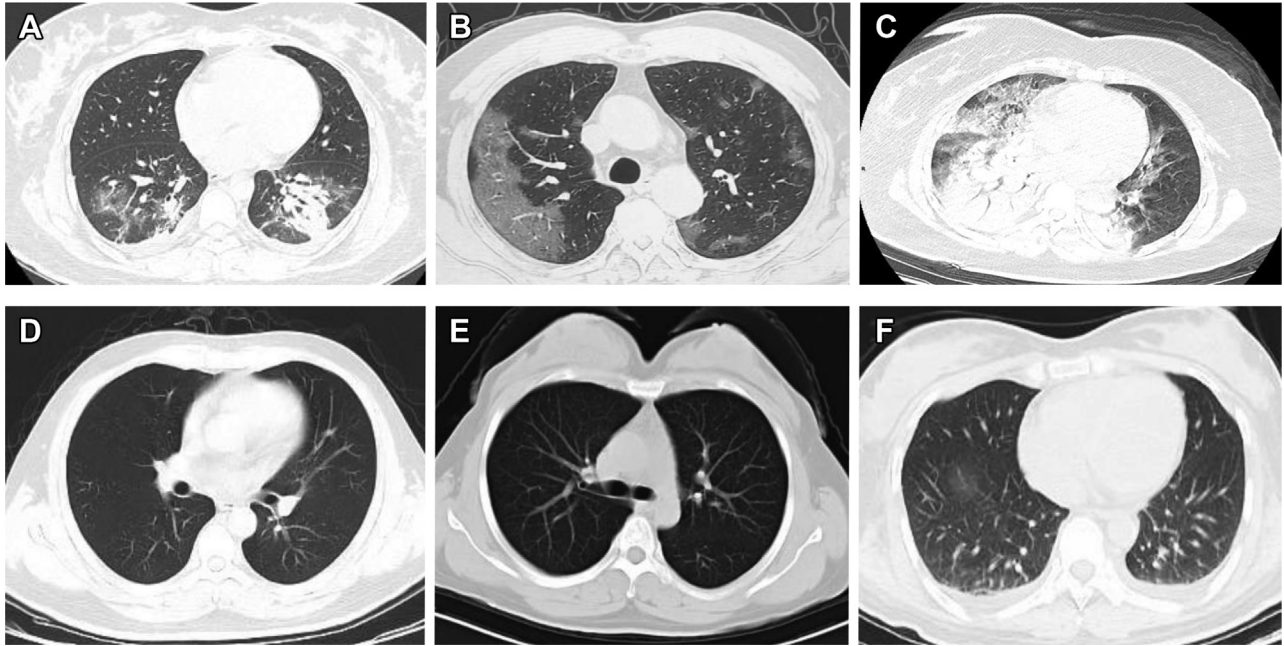
Patients' blood counts demonstrated the significant difference in the lymphocyte and C-reactive protein concentrations between ESPs infected with COVID-19 and patients who did not have COVID-19 pneumonia. We observed no significant difference in neutrophil, monocyte, alanine aminotransferase, aspartate aminotransferase,

**Table 2**  
Surgical intervention departments in ESPs with or with no COVID-19

Department	Number (%)	
	Total (N = 164)	COVID-19 (N = 54)
Gynecology and obstetrics	72 (43.9)	29 (53.7)
Neurosurgery	16 (9.8)	7 (13)
Orthopedic surgery	15 (9.2)	2 (3.7)
Gastrointestinal surgery	20 (12.2)	4 (7.4)
Cardiothoracic surgery	8 (4.9)	2 (3.7)
Urologic surgery	9 (5.5)	3 (5.6)
Hepatobiliary surgery	24 (14.6)	7 (13)

COVID-19, 2019 novel coronavirus disease.





**Fig 2.** Transverse chest CT images. (A-C) Chest CT images of ESPs with the COVID-19 infection who displayed marked ground glass opacity in both lungs. (D-F) Transverse chest CT images of ESPs with no COVID-19 infection. The 2019 novel coronavirus disease was designated as COVID-19 here (\**P* < .05, <sup>†</sup>*P* < .01).

**Table III**  
Laboratory findings of ESPs with or with no COVID-19 pneumonia

Item	Median (IQR)			<i>P</i> value
	Normal range	COVID-19	Non-COVID-19	
White blood cell count ( $\times 10^9$ cells/L)	3.5-9.5	7.4 (5.95–8.96)	9.13 (6.9–11.4)	.026
Red blood cell count ( $\times 10^{12}$ cells/L)	3.5-5.5	3.7 (3.2–4.2)	3.8 (3.5–4.2)	.612
Neutrophil count ( $\times 10^9$ cells/L)	1.8-6.3	6.24 (4.94–8.38)	6.8 (5.18–8.96)	.677
Lymphocyte count ( $\times 10^9$ cells/L)	1.1-3.2	0.37 (0.23–0.65)	1.4 (0.98–1.72)	< .0001
Monocyte count ( $\times 10^9$ cells/L)	0.1-0.6	0.44 (0.28–0.57)	0.52 (0.43–0.65)	.0102
C-reactive protein (mg/L)	0-8	24.7 (13.57–38)	7.85 (3.15–56)	.0314
ALT (U/L)	0-40	34 (12–71)	13 (9–20)	< .0001
AST (U/L)	0-40	29 (22–64)	20 (16–26)	< .0001
BUN (mmol/L)	2.9-7.5	5.53 (3.37–7.36)	3.7 (2.9–5.3)	.085
CREA (umol/L)	30-110	62.9 (48.2–71.9)	55.6 (47.8–71.7)	.483

ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; CREA, creatinine. *P* values indicate differences between ESPs infected with COVID-19 and those with no COVID-19.

blood urea nitrogen, and albumin-to-creatinine ratio (Table III). The ESPs infected with COVID-19 showed lymphopenia (0.37 [0.23–0.65]) and increased C-reactive protein (24.7 [13.57–38]). Of 110 ESPs who did not have COVID-19, almost all showed normal lymphocyte and C-reactive protein. These data are the same as the reported finding for COVID-19 pneumonia (Table III).<sup>12</sup>

**Hospital-related infection**

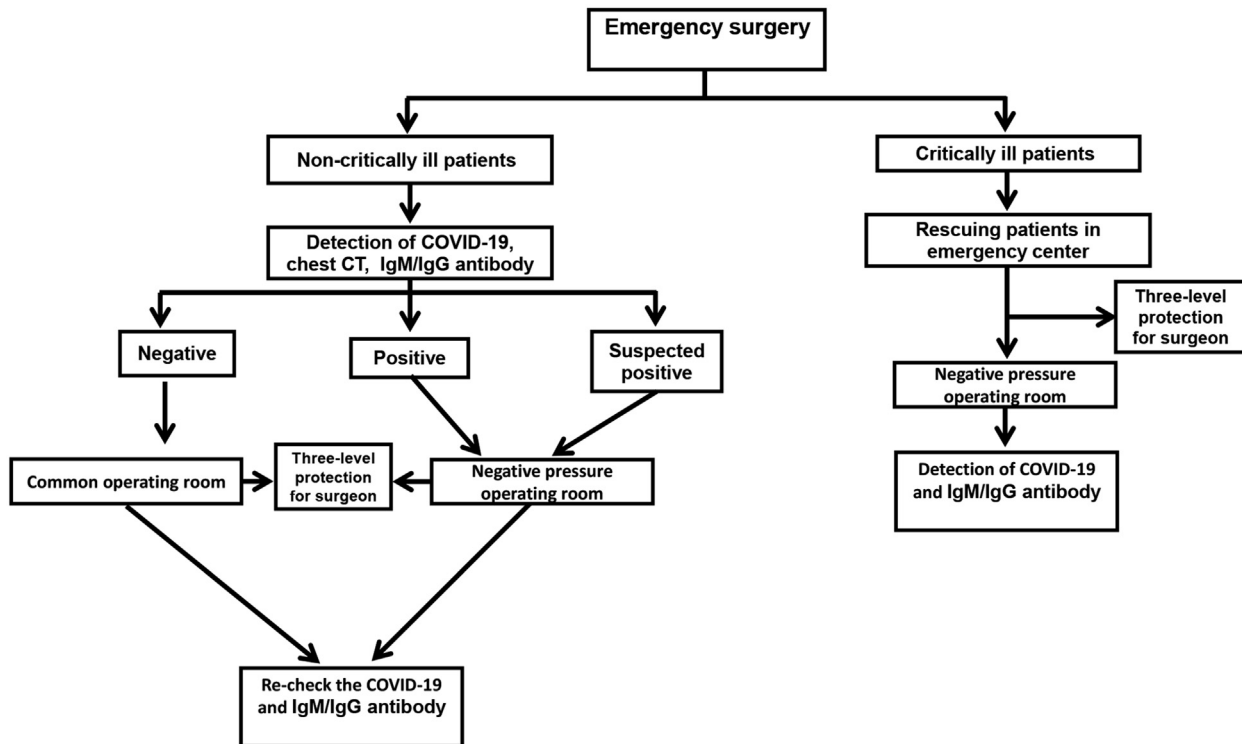
Of 164 ESPs, 54 were assumed to have been infected in the hospital after the emergency surgery. In addition, 43 health care workers were infected by being in contact with the ESPs infected with COVID-19. Of the 54 hospitalized patients, 29 (53.7%) were from obstetrics and gynecology, 7 (13%) patients were from hepatobiliary surgery, 4 (7.4%) patients were from gastrointestinal surgery, 7 (13%) patients were neurosurgery, 2 (3.7%) patients were from orthopedic surgery, and 3 (5.6%) patients were from urology surgery (Table II). Of 43 infected health care workers, most worked in the operating room (anesthesiologist and nurses) and associated

surgery departments. All infected health care workers were in direct contact with the ESPs infected with COVID-19 in January. The number of health care workers who were infected after being in contact with ESPs infected with COVID-19 pneumonia significantly decreased after January 2020.

**Discussion**

In this research, we report on the potential risks posed by ESPs infected with COVID-19 pneumonia to clinicians and patients. Early in our experience SARS-CoV-2 nucleic acid testing was not available and computed tomography scans were not used to diagnosis COVID-19-related pneumonia; therefore, the diagnosis may not have been readily apparent. Here, we summarize the clinical symptoms of ESPs who are infected COVID-19 pneumonia.

- In 164 ESPs, 54 were diagnosed as having COVID-19 pneumonia after operation. The median age for ESPs was 46 y (IQR, 25–89),



**Fig 3.** Guide for emergency surgery during COVID-19. Patients in need of emergency surgery had to be tested for COVID-19; however, critically ill patients were resuscitated regardless of health care worker protective equipment. All patients who tested positive for or were suspected positive for COVID-19 or were critically ill were operated on in a negative pressure operating room. In addition, the surgeons performed surgery while using three-level protection. All patients were required to be retested for COVID-19 pneumonia after their operations.

136 (82.9%) patients were women and 28 (17.1%) patients were men.

- The fever in postoperative patients with COVID-19 pneumonia continued more than 7 days, more than common postoperative patients. In addition, for ESPs infected with COVID-19, 81.5% patients displayed cough, 88.9% patients showed fatigue, 96.3% had nausea, and 85.2% showed dizziness.
- All the ESPs infected with COVID-19 had the bilateral or unilateral ground-glass opacities in the lung CT.
- Routine blood tests indicated lymphopenia and increased C-reactive protein.
- They posed a strong insidious and infectious risk to clinicians.

Fever is the most common postoperative complication, including physiologic and pathologic pyrexia, observed in medical and surgical settings.<sup>13</sup> Normally, pathologic fever originates in postoperative infection.<sup>13</sup> Physiologic pyrexia is derived from digestion of necrosis material, characterized by short-term fever, slight fever, and early stage fever.<sup>14</sup> As we all know, slight fever is an important clinical symptom in the early stage of COVID-19 pneumonia. Chen et al<sup>9</sup> reported that 70% of patients' body temperatures fluctuated within the range of 36.5°C to 38.8°C, and the average of all of the patients' body temperatures was 38.3°C. Such an important phenomenon was also investigated recently. Although many researchers have demonstrated the existence of slight fever in patients with COVID-19 pneumonia and in postoperative patients, no difference has been identified. In our study, we analyzed 54 ESPs infected with COVID-19 pneumonia, including 29 patients who had undergone cesarean section, 7 patients having had neurosurgery, 4 patients having had gastrointestinal surgery, 2 patients having had orthopedic trauma surgery, 2 patients having had cardiothoracic surgery, 3 patients having had urologic surgery, and 7 patients having had hepatobiliary

surgery. All ESPs infected with COVID-19 displayed fever postoperatively and a body temperature range of 37.1°C to 39.6°C (duration of 1–2 weeks). Of 110 ESPs, 31 (28.2%) had a slight fever and a body temperature range of 36.3°C to 38.0°C (duration fewer than 4 days). Based on our data, we found different trends and durations of fever between ESPs with or without COVID-19 pneumonia. It is important to identify the COVID-19 pneumonia in postoperative patients. Also, we believe fever will be an early warning for ESPs infected with COVID-19 now and in the future.

Immunosuppressive state was thought to be a common phenomenon in postoperative patients<sup>6,15,16</sup> and will be susceptible to infect severe pneumonia and respiratory pathogens. Shantha et al<sup>17</sup> reported that cataract surgery was safe in patients who tested negative for the Ebola virus in ocular fluid specimens. In the Ebola epidemic in Africa, emergency surgery was believed to have been extremely dangerous.<sup>8</sup> In addition, during the 2003 SARS epidemic Kumar et al<sup>7</sup> reported that one patient died of SARS after liver transplantation, and as a result, several health care workers and their families were infected. Recent research analyzed the clinical characteristics of patients with COVID-19 infection undergoing cesarean section and denied the risk of vertical transmission. Although many cesarean sections have been performed during this pandemic, no reports have focused on perioperative or postoperative patients. Our study not only investigated the clinical manifestation in ESPs infected with COVID-19, including fever, cough, fatigue, nausea, dizziness, and so on, but also described countermeasures and potential risks for the health care workers. Of 54 ESPs infected with COVID-19, all showed longer and higher fever postoperatively. In addition, 81.5% of patients with cough, 88.9% of patients with fatigue, 96.3% of patients with nausea, and 85.2% of patients with dizziness were observed. These associated clinical characteristics demonstrated huge differences with reported cases

for common COVID-19. The reason may be from the effects of surgery and anesthesia. In addition, all showed multiple patchy ground-glass shadows in their lungs. These findings suggest that we can make the preliminary clinical diagnosis of COVID-19 pneumonia in the future for ESPs with COVID-19. From recent research of COVID-19 pneumonia patients, a total of 1,099 patients, only 43.8% had a fever,<sup>18</sup> less than our study of ESPs infected with COVID-19 (100% with fever); 56.4% showed the ground-glass opacity in the lung, less than in our study (100%); and 83.2% of them had lymphocytopenia, which was also less than in our investigation (100%). One reason for this may be the immunosuppressive state or postoperative stress response in patients. Furthermore, 7/54 (13%) mortality in our report, obviously higher than those reported cases in China, also proves our hypothesis.

Another focus of this research was to observe the huge risk to health care workers of ESPs infected with COVID-19 pneumonia. In the early stage of COVID-19 pneumonia, the research reported the characteristics of human transmission.<sup>4,18</sup> However, research did not focus ESPs in. In our study, we analyzed all ESPs (164 patients) from January 1, 2020, to January 21, 2020. The final date of follow-up was February 5, 2020, in our hospital. We found that these patients posed a great threat for health care workers by February 5. A total of 43 of health care workers, including surgeons, anesthesiologists, and associate nurses, were infected by ESPs. Of them, 2 were treated in the ICU because of the seriousness their illness. One reason for this spread of the virus is that incomplete preoperative examinations—especially the lack of CT scans of the lungs and of the nucleic acid detection of COVID-19 pneumonia—were carried out during that time. In addition, the lack of personal protective equipment items (N95 surgical masks and medical disposable medical chemical protective safety suits) and the lack of awareness of how contagious the virus is were critical causes for its spread. In addition, surgeons were not familiar with the virus and respiratory effects and, interestingly, no pulmonary or intensive care unit personnel were infected in the epidemic; thus, supporting our hypothesis. Our report aims to remind health care workers to take special precautions when caring for ESPs especially during this pandemic of the COVID-19 pneumonia.

Our study has its limitations. First, this study is limited by the short time of cases review (from January 1, 2020, to February 5, 2020). Second, the data regarding the number of health care workers infected with COVID-19 is incomplete. Third, we did not describe the management of ESPs when they are accepted for outpatient consultations. Here, we have included the guide for emergency surgery during COVID-19 from the Hubei Provincial Health Council (Fig 3). In this guide, all surgeons are reminded that they dress in three levels of protection when they care for ESPs (Fig 3).

In summary, ESPs infected with COVID-19 pneumonia pose a great threat to health care workers. This report describes the typical clinical symptoms of COVID-19 and the tests to confirm whether a patient has the virus, providing the steps necessary to identify ESPs

infected with COVID-19. We believe that this study offers helpful guidance to health care workers in hospitals.

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### Conflict of interest/Disclosure

The authors have no competing interests to disclose.

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