

# Aerosol-generating procedures in thoracic surgery in the COVID-19 era in Malaysia

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## Abstract

**Background:** The Covid-19 pandemic has caused changes in the surgical treatment of non-Covid patients, especially in thoracic surgery because most procedures are aerosol generating. Hospital Kuala Lumpur, where thoracic procedures are performed, was badly affected. We describe our experience in performing aerosol generating procedures safely in thoracic surgery during the Covid-19 era.

**Methods:** Medical records of patients who underwent thoracic surgery from March 18, 2020 to May 17, 2020 were reviewed retrospectively. All patients undergoing thoracic surgery were tested for Covid-19 using the reverse transcriptase polymerase chain reaction method. Patients with malignancy were observed for 10 to 14 days in the ward after testing negative. The healthcare workers donned personal protective equipment for all the cases, and the number of healthcare workers in the operating room was limited to the minimum required.

**Results:** A total of 44 procedures were performed in 26 thoracic surgeries. All of these procedures were classified as aerosol generating, and the mean duration of the surgery was  $130 \pm 43$  minutes. None of the healthcare workers involved in the surgery were exposed or infected by Covid-19.

**Conclusion:** Covid-19 will be a threat for a long time and thoracic surgeons must continue to provide their services, despite having to deal with aerosol generating procedures, in the new normal. Covid-19 testing of all surgical candidates, using the reverse transcriptase polymerase chain reaction, donning full personal protective equipment for healthcare workers, and carefully planned procedures are among the measures suggested to prevent unnecessary Covid-19 exposure in thoracic surgery.

## Keywords

COVID-19, delivery of health care, Malaysia, thoracic surgical procedures

## Introduction

COVID-19, without a doubt, has become the current bane of humanity. First reported in December 2019 as an outbreak of pneumonia in Wuhan, China, the disease has spread like a raging wildfire to all four corners of the world. The World Health Organization named this new disease COVID-19 in February 2020, and on March 11, 2020, it was declared a global pandemic.<sup>1</sup> The disease is caused by a novel coronavirus, recently named SARS-CoV-2 by the International Committee of Taxonomy and of Viruses. Initially thought to be zoonotic, this virus has mutated and is currently spreading via human-to-human transmission. The main route of transmission is via respiratory droplets, contact, aerosol, and the digestive tract. Thus, thoracic

surgery is deemed high risk in this era because it entails direct contact with the aerodigestive tract.<sup>2,3</sup> To diagnose COVID-19, a reverse transcriptase polymerase chain reaction (RT-PCR) is the current gold-standard technique. In combination with RT-PCR, computed tomography (CT) of the thorax increases the sensitivity in diagnosing COVID-19.<sup>4,5</sup> In Asia, many countries have reduced the number of surgeries significantly,

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especially thoracic surgery.<sup>6</sup> In Malaysia, the Movement Control Order was enforced on March 18, 2020. Hospital Kuala Lumpur is in the heart of the city, designated as the “red zone”, with a high number of COVID-19 infections, and this has brought about a change in the surgical treatment of non-COVID-19 patients. Questions remain among healthcare workers (HCW) on how, where, and when to perform these surgeries. We describe our experience of performing aerosol generating procedures (AGP) safely in thoracic surgery during the COVID-19 era in a tertiary hospital gazetted as a hybrid COVID-19 hospital.

## Patients and methods

Medical records of patients who underwent thoracic surgery from March 18, 2020 to May 17, 2020 were reviewed retrospectively. Demographic data and the number of procedures performed were obtained. All patients who were scheduled to undergo surgery were tested for COVID-19 via oropharyngeal swab, using the RT-PCR method. Once the test was confirmed negative, the patients were posted for surgery.

All patients underwent contrast-enhanced CT of the thorax as part of the thoracic disease assessment. Bronchoscopy was performed to determine the position of a double-lumen tube for lung isolation in required cases. The number of HCW involved in the surgeries was kept to a minimum. All HCW were required to don full personal protective equipment (PPE); a minimum of a N95 mask, isolation gown with plastic apron, head cover/hood, shoe covers, goggles/face shield, disposable sterile gowns, and double-layered gloves. Donning and doffing procedures were carried out according to the hospital protocol.

After discharge, the patients were reviewed in the clinic after 2 weeks. The patients and their family members were advised to look out for symptoms of COVID-19 infection, and to isolate themselves from others throughout the period.

## Results

A total of 26 thoracic surgeries were performed in the 3-month study period. The mean age of the patients was 40.5 years (Table 1). There were 12 (46%) males and 14 (54%) females. Eight (31%) patients had severe acute respiratory infection and were nursed in the intensive care unit preoperatively. The requirement for intensive care increased by 61% after surgery compared to before. In the 26 thoracic surgeries, 44 procedures were performed, most commonly, diagnostic bronchoscopy under sedation, followed by thoracotomy. All of the procedures performed were classified as AGP, and the mean duration of the surgery was

**Table 1.** Characteristics of 26 patients who underwent thoracic surgery.

Variable	No. of patients
Mean age, years [interquartile range]	40.5 [26.2–54.8]
Male	12 (46%)
Female	14 (54%)
Severe acute respiratory infection	8 (31%)
Emergency	20 (77%)
Semi-emergency	6 (23%)
Intensive care preoperatively	12 (46%)
Intensive care postoperatively	16 (61%)
Mean operative time (min)	130 ± 43

**Table 2.** Thoracic surgery procedures performed in 26 patients.

Procedure	No. of patients
Bronchoscopy	
Therapeutic (stenting)	2
Diagnostic	16
Thoracotomy	
Decortication	5
Lobectomy	3
Chest wall resection	3
Diaphragm repair	2
Video-assisted thoracoscopic surgery	
Bullectomy	2
Lobectomy	1
Wedge resection	1
Decortication	1
Sternotomy	1
Tracheal resection	2
Tracheostomy	3
Gastroesophageal surgery	2
Total no. of procedures	44

130 ± 43 min (Table 2). All of the patients who underwent surgery tested negative for COVID-19 by the RT-PCR technique. There was no mortality. Throughout the study period, none of the HCW was infected by COVID-19.

## Discussion

An RT-PCR test of an oropharyngeal swab for all the patients going for AGP is recommended by the 5th edition Guideline in the Management of COVID-19 in Surgery by the Malaysian Ministry of Health.<sup>7</sup> However, the sensitivity of the RT-PCR test has been reported to be around 70%, which means we may still have up to 30% false-negative results.<sup>4,5</sup> A study has shown that CT imaging of the thorax has a sensitivity of 98% in detecting COVID-19.<sup>5</sup> In our series, contrast-enhanced CT was performed for the primary disease assessment and also assisted in determining the

COVID-19 status in addition to the RT-PCR test. This allowed thoracic surgical procedures to be performed with a higher reassurance of COVID-19-negative status.

In view of the false-negative rate in RT-PCR COVID-19 testing, the safety of patients and HCW must be ensured even though the patient has tested negative. The patients were admitted before undergoing thoracic procedures and tested for COVID-19. Lung cancer patients planned for lobectomy were observed for 10 to 14 days (the incubation period) after testing negative for COVID-19 in the ward before surgery.<sup>2,3</sup> It was found that cancer patients who are COVID-19-positive and undergo surgery have up to a 20% risk of mortality.<sup>8</sup> If the patient tests positive, the procedure is postponed for 4 to 6 weeks and tests are repeated to ensure the absence of COVID-19.<sup>2,3</sup> In extreme emergencies, COVID-19 status cannot be determined immediately by the RT-PCR method. In these circumstances, an antigen rapid test kit can be used, and the result will be ready within an hour. With an unknown viral status, surgery can commence immediately in a COVID-19-designated operating room, and all HCW involved in the surgery must don full PPE.

Aerosolized droplets can travel more than a meter and stay air borne for up to 3 hours, hence all AGP require meticulous planning to ensure the safety of the patient and the HCW.<sup>5</sup> Aerosol generated by a cough differs from the aerosol generated while operating for a prolonged period of tracheal surgery.<sup>9</sup> AGP can create high viral loads, influenced by factors such as the use of

motorized instruments, ultrasonic energy devices, diathermy, and prolonged duration of handling tissues near the nasopharynx, throat, and respiratory tract. Procedures such as tracheotomy or tracheostomy, pleural decortication, lung resections, and sternotomy fall under the category of high-risk AGP.<sup>2,9</sup> The risk of COVID-19 infection for HCW performing these procedures is not well understood, however, it was found that even asymptomatic patients with a high viral load in the upper respiratory tract can transmit the disease during the procedure.<sup>10</sup> In view of these risks, bronchoscopy, tracheostomy, cross-field ventilation, and sputum suction through an endotracheal tube should be avoided as much as possible.<sup>11</sup> If needed for emergency purposes, protective garments must be worn. The number of HCW involved in the procedures should be limited to the minimum required (Figure 1). The operating team should not enter until induction of anesthesia is completed.

Full PPE consist of at least a N95 mask, isolation gown with plastic apron, head cover/hood, shoe covers, goggles/face shield, disposable sterile gown, and double-layered gloves. This is recommended for thoracic surgery.<sup>1-3,9</sup> A powered air-purifying respirator can be used if available. Enhanced PPE is encouraged for high-risk AGP and this is determined by the filtering capacity of the mask.<sup>9</sup> In our practise, we utilize a 3M half-mask respirator with a p100 filter and the first layer of a water repellent gown with a hood is followed by a sterile disposable gown. Shoe covers are worn (Figure 2). A powered air-purifying respirator is not utilized for non-COVID-19 patients in our center.



**Figure 1.** Video-assisted thoracoscopic surgery being performed in a non-COVID-19 patient. Healthcare workers in the operating room must don full personal protective equipment and keep to a minimum number.



**Figure 2.** Healthcare worker with full personal protective equipment and a 3M half-mask respirator with a p100 filter.

Donning and doffing briefings were given to all HCW involved to minimize PPE breaches and exposure. Only symptomatic HCW or those with direct contact with COVID-19 patients, i.e., a breach in PPE, are tested. Adherence to these protocols has enabled us to perform high-risk thoracic procedures without any HCW being infected by COVID-19.

High-risk category patients are those with diabetes, chronic kidney disease or end-stage kidney disease on hemodialysis, elderly patients, and those with underlying malignancies on chemotherapy.<sup>8</sup> Surgery is best avoided in these patients. They carry higher chance of being infected by COVID-19 and fare less well.<sup>3,8</sup> In semi-emergency cases, the patients need to have tested negative for COVID-19 before surgery. If tested

positive, surgery should be delayed for at least 4 to 6 weeks after symptom resolution.<sup>8</sup>

There is no evidence that a video-assisted thoracoscopic approach carries less chance of exposure to COVID-19 compared to a thoracotomy.<sup>2,11</sup> In our center, no CO<sub>2</sub> is used to create pneumothorax for video-assisted thoracoscopic surgery because most are performed by a uniportal approach with lung isolation. Insufflation of CO<sub>2</sub> is known to increase the risk of aerosolization in laparoscopic procedures, thus it is not recommended.<sup>12</sup> With appropriate testing, identification of high-risk AGP, and use of suitable PPE, none of our HCW involved in the procedures was affected by COVID-19. In this pandemic period, one must not take the risk of exposure lightly, especially when dealing with procedures that may produce a high viral load. We are fortunate that none of the COVID-19 positive patients in our center required lung resection, hence, we have no experience in dealing with such patients.

After discharged from the hospital, the patients were followed up at 2 weeks. During the first follow-up, screening to assess for COVID-19 symptoms was conducted in the form of a questionnaire. Chest radiography and a full blood count were obtained. None of the patients was discharged home with a chest drain, to reduce risk of exposure.<sup>11</sup> In our series, none of the patients was affected by COVID-19 during the follow-up period.

There are no established protocols to follow when performing thoracic surgery during the COVID-19 era at the time of writing, but by adhering strictly to the guidelines available, we managed to perform surgery in non-COVID-19 patients safely. COVID-19 will be a threat for a long time, and thoracic surgeons must continue to provide their services, despite having to deal with AGP, in the new normal. Based on our experience, we suggest the measures described above be adhered to while performing thoracic surgeries and AGP during the COVID-19 era.

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