

Perioperative challenges in managing a morbidly obese patient with COVID-19 undergoing an elective tracheostomy

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SUMMARY

Tracheostomy is an aerosol-generating procedure and performing it in patients with COVID-19 requiring mechanical ventilation raises significant concerns of infection risk to healthcare workers. We herein report a case of tracheostomy in a critically ill patient with severe COVID-19 acute respiratory distress syndrome. This article depicts the use of personal protective equipment, highlighting the common challenges it presents and ways to address them.

BACKGROUND

The WHO declared COVID-19 a pandemic in March 2020.¹ The high prevalence rate of COVID-19 in Malaysia has adversely impacted our healthcare system. In order to contain the spread of the virus, the Malaysian government has imposed standard operating procedures in various sectors including health. We, herein, report our valuable perioperative management in critically ill patient undergoing tracheostomy in the context of COVID-19 pandemic in Sabah, East Malaysia. The patient's course was complicated by respiratory failure requiring prolonged weaning. We highlight our experience of using personal protective equipment (PPE) and the challenges associated with it.

CASE PRESENTATION

A 40-year-old man who was morbidly obese (height 164 cm, actual body weight 128 kg, body mass index (BMI)=48 kg/m²) with a background history of well-controlled bronchial asthma presented to the hospital with shortness of breath following a 3-day history of cough and fever. He originated from a rural district in Sabah, East Malaysia, with multiple active COVID-19 clusters detected in the past 2 weeks prior to his presentation. Otherwise, he denied audible wheeze, chest pain, rhinorrhoea, anosmia and diarrhoea. On examination, he was alert but lethargic and tachypnoeic with a respiratory rate (RR) of 35 breaths per minute, blood pressure (BP) of 134/75 mm Hg, pulse rate of 105 beats per minute and oxygen saturation (SpO₂) of 82% on air. Auscultation revealed reduced breath sounds on both lungs without the presence of rhonchi or crackles. As part of the COVID-19 pandemic response in Malaysia, his nasopharyngeal swab (NPS) specimen was obtained and tested using real-time PCR. The result, unfortunately, was SARS-CoV-2 positive.

As a result, he was admitted to the intensive care unit (ICU) and started on high-flow nasal cannula (HFNC) therapy with an initial flow of 60 L/min and a fraction of inspired oxygen (FiO₂) of 0.6. Despite that, his condition continued to deteriorate as evidenced by the worsening type 1 respiratory failure and increasing HFNC settings up to a flow of 60 L/min and FiO₂ of 1.0. On day 2 of admission, he developed respiratory distress requiring emergency life-saving intubation. The team handling the patient donned adequate PPE, namely powered air purifying respirators (PAPR), one-piece coveralls, N95 respirators, rubber boots, triple-layered gloves, disposable aprons, face shields and goggles, for his intubation. Sufficient preoxygenation was performed followed by administration of intravenous fentanyl 2 mcg/kg, midazolam 0.2 mg/kg and suxamethonium 2 mg/kg via rapid sequence intubation with cricoid pressure. The endotracheal intubation was performed using a C-MAC video laryngoscope with a D-blade. Subsequently, a 7.5 mm sized cuffed polyvinylchloride endotracheal tube (ETT) was successfully inserted and anchored at 21 cm from the incisors. The patient's Cormack-Lehane Score was graded as I.

He was then mechanically ventilated using synchronised intermittent mandatory volume mode with a FiO₂ up to 1.0 and a positive end-expiratory pressure (PEEP) up to 14 cmH₂O. However, there was difficulty weaning him off of ventilation following his intubation. This was attributed to his concurrent severe COVID-19 acute respiratory distress syndrome. Fortunately, his clinical condition gradually improved and on day 12 of admission, the ventilator settings were reduced to FiO₂ 0.5 and PEEP 10 cmH₂O. His Glasgow Coma Scale (GCS) was E3VTM6 on dexmedetomidine infusion at 0.4 mcg/kg/hour and the haemodynamics were stable without any vasopressor support.

In anticipation of the need for prolonged mechanical ventilation and to facilitate early weaning, he was posted for an elective tracheostomy in the operating theatre. A high-risk consent was obtained from the patient, focusing on the anticipated difficulties in ventilation and oxygenation intraoperatively in addition to the risks of airway bleeding and aspiration.

INVESTIGATIONS

- ▶ NPS PCR for SARS-CoV-2 was positive.
- ▶ Initial chest X-ray showed bilateral consolidation opacities (figure 1).



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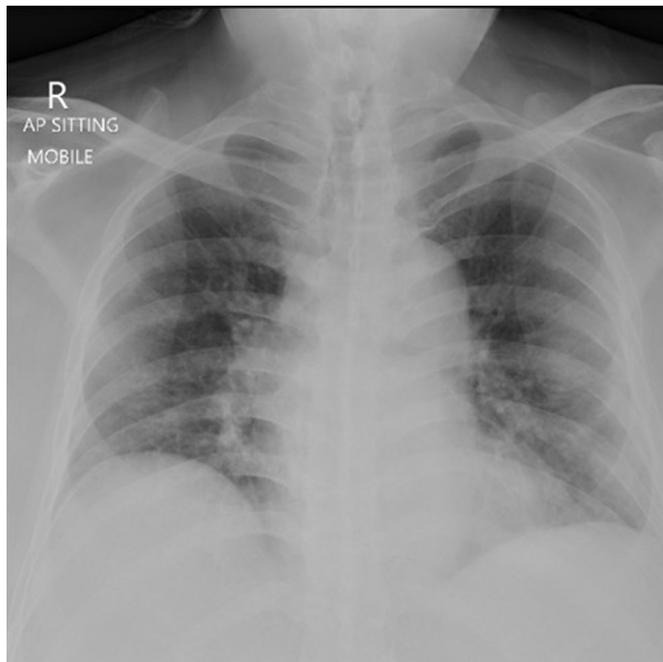


Figure 1 Initial chest X-ray showing bilateral consolidation opacities.

- ▶ High-resolution CT showed bilateral ground glass opacities centrally and peripherally in both lungs, suggestive of SARS-CoV-2 infection (figure 2).
- ▶ Preoperative blood investigations showed haemoglobin concentration 134 g/L, platelet count $296 \times 10^9/L$ and international normalised ratio 1.07.
- ▶ The serum electrolytes and liver function tests were within normal values.

TREATMENT

All involved healthcare workers (HCW) including two otorhinolaryngology (ORL) surgeons, two anaesthetists and four nurses wore mandatory PPE in the donning space. Furthermore, one

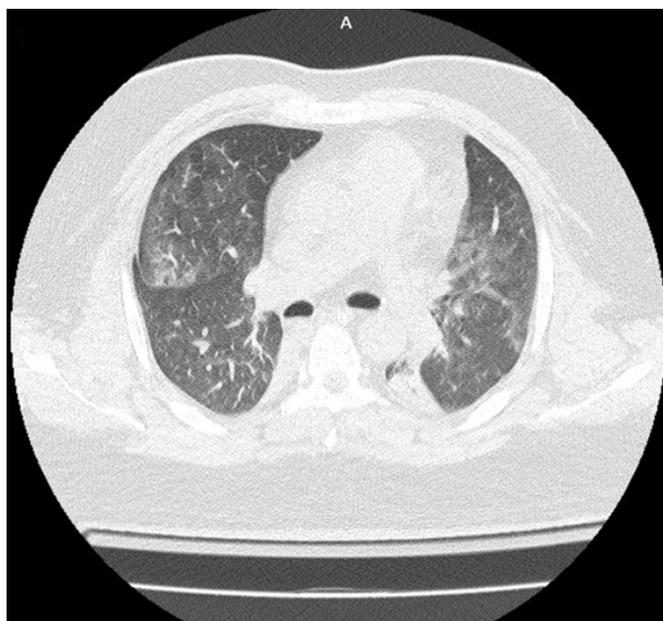


Figure 2 High-resolution CT showing ground glass opacities centrally and peripherally in both lungs. A, anterior view.

anaesthetic technician and one nurse were deployed in adjacent areas outside of the operating room (OR) and required to act as runners and support.

Before the surgery, the patient was kept nil by mouth for 6 hours and his last subcutaneous injection of heparin 5000 units was administered 12 hours ago. In the ICU, his central venous line on the right internal jugular vein was flushed to ensure patency. After that, he was paralysed with intravenous rocuronium 60 mg prior to transfer and dexmedetomidine infusion was slightly increased to 0.5 mcg/kg/hour to avoid risks of accidental extubation. The patient was then connected to a portable battery-powered multifunction monitor with a clear illuminated display consisting of HR, SpO₂, RR, non-invasive BP, invasive arterial BP and ECG. He was then manually bagged with oxygen flow rate at 10L/min with a rate of 14–20 breaths per minute, aiming of maintain SpO₂ of >95%. Other equipment such as portable syringe pumps, intravenous volumetric pumps, venous access equipment, intubation devices and emergency drugs (atropine and ephedrine) were also prepared in anticipation of the transport of a critically ill patient.

Following that, the patient was transported by two anaesthetists from the ICU to the positive pressure OR using a dedicated double-limb transport ventilator with a heat moisture exchanger filter in between the circuit and the ETT and a high-efficiency particulate air filter in between the ventilator and circuit. To achieve that, the patient and the anaesthetist had to go through the dedicated exit of ICU, open areas adjacent to the lifts reserved for HCW, the airlock and general areas in the OR complex.

Once the patient reached the designated OR, his circuit was connected to the Philips IntelliSave AX700 general anaesthetic machine. When switching to a different ventilator, the gas flow was switched off and the ETT was clamped with forceps to reduce risks of aerosolisation. The patient was placed supine with his shoulders elevated and neck extended by putting a ramp on his back. General anaesthesia (GA) was induced with sevoflurane titrated to minimum alveolar concentration (MAC) of 1.2 and supplemented with intravenous morphine 8 mg. He was ventilated with FiO₂ 0.7 and PEEP 10 cmH₂O and the tidal volume and peak inspiratory pressure achieved were 360–420 mL and 28–29 cmH₂O, respectively. Nonetheless, our team of experienced ORL surgeons successfully performed the tracheostomy at the second tracheal ring despite their initial difficulties palpating and locating the trachea, due to the patient's thick and short neck. A size 7.0 mm cuffed tracheostomy tube with adjustable flange was inserted between the second and third tracheal rings on their first attempt. During the procedure, his SpO₂ was continuously monitored and maintained between 92% and 98% while BP and HR remained stable. The total blood loss was negligible.

The total duration of anaesthesia and surgery was 60 min and 45 min, respectively. Postoperatively, the patient was returned to the ICU following the isolation precautions as described above.

OUTCOME AND FOLLOW-UP

On postoperative day 1, he was tolerating pressure support ventilation mode with FiO₂ 0.4 and PEEP 8 cmH₂O without desaturation. From day 3 postoperatively onwards, he successfully underwent spontaneous breathing trials with incremental periods of prolonged tracheostomy mask with decremental oxygen percentages. On postoperative day 11, his tracheostomy was capped and thereafter the patient he was able to breathe comfortably with a 40% venturi mask. On the following day, his tracheostomy was successfully decannulated. Finally, he was discharged from the ICU on postoperative day 14, needing only

supplemental oxygen by nasal cannula. Altogether, he had spent 26 days in the ICU with improved lung functions and a GCS of E4V5M6 prior to his discharge.

DISCUSSION

This case report is extremely significant in several aspects. First, it details a surgical tracheostomy in a morbidly obese patient in a setting during the COVID-19 pandemic and the issues associated with it. Second, it demonstrates the importance of the use of PPE among HCW to prevent and control COVID-19 cross-infection transmission as well as the challenges it presents. Third, it describes the measures of facilitating the care of patients with known or suspected COVID-19 in a resource-limited hospital.

Hospital Queen Elizabeth in Sabah, East Malaysia, was built in 1957 and rebuilt in 2009 after which it was declared structurally unsafe. Our centre was designed for average patient loads, not COVID-19 pandemic. Therefore, certain measures were implemented to facilitate the care of patients with known or suspected COVID-19 needing surgery, while at the same time safeguarding HCW against infection.

First, prior to patient transfer, hospital security guards and attendants work together to clear the path between the ICU and the OR, ensuring designated routes are safe and clear to minimise risk of accidental contact with others. Second, apart from OR staff, HCW working in areas adjacent to the positive pressure OR are required to don adequate PPE in accordance with the guidelines set by the Ministry of Health (MOH) Malaysia.² Positive pressure is maintained in the OR relative to areas outside of it to prevent entry of common pathogens such as *Staphylococcus aureus* that could contaminate open wounds.³ However, this presents a risk of infection to the runners outside of the OR, hence necessitating the use of at least N95 masks. Third, areas that have been contaminated would be cleaned by dedicated staff using sodium dichloroisocyanurate 2000 parts per million. Specifically, all affected routes and the OR are immediately cleaned right after patient transfer. The cleaning process would be repeated for three times, allowing sufficient drying time in between each session. Fourth, dedicated doffing areas with assistants and guides displaying the correct sequence for doffing PPE have been established outside of the OR and the ICU. Studies had found that common errors such as incorrect doffing processes and lack of hand hygiene led a higher risk of COVID-19.^{4,5}

This case report also illustrates the detrimental effects caused by PPE on human operator performance. First, OR staff reported that the use of face masks, shields, goggles and multiple layers of gloves negatively affected their visibility, dexterity and performance of manual tasks. For example, the anaesthetists had struggled to palpate and cannulate the patient's veins whereas the surgeons had difficulties to visualise and palpate the trachea. Second, PPE use hampered situational awareness and verbal communication, causing OR staff to speak louder and thus, additional discomfort during the surgery. Third, a perceived low level of protection due to limited PAPR in our resource-limited setting contributed to increased stress and anxiety. Undoubtedly, the physical and emotional exhaustion due to PPE fatigue may lead to medical errors, especially in a prolonged surgery.

This case posed significant clinical challenges to us. Performing an aerosol-generating procedure such as tracheostomy on a patient with COVID-19 carries an extremely high risk of infection for HCW.⁶ Furthermore, the patient was morbidly obese (BMI 48 kg/m²) with a thick and short neck, making tracheostomy insertion extremely difficult.^{7,8} Increased tracheal mucosal

swelling due to prolonged intubation was also very likely and could complicate the creation of a false passage during tracheostomy.^{9,10} Besides that, simple considerations such as patient positioning and transfer became more complex due to his huge BMI.¹¹ The operation was also complicated by the fact that the patient was vulnerable to rapid desaturation due to the loss of PEEP and derecruitment during the procedure.¹²

These were the problems that we faced while wearing PPE and thus, a few strategies were implemented to allow us to quickly secure the patient's airway without jeopardising his care. First, two trained anaesthetists, with one of them being very experienced dealing with airway management in patients with COVID-19, were selected to provide highest standard of perioperative care to the patient. The patient was paralysed and adequately sedated with dexmedetomidine to prevent accidental extubation during transfer. In addition, dexmedetomidine is an excellent anxiolytic with stable hemodynamics.^{13,14} On top of that, the ability to maintain optimum ventilation and oxygenation using the Philips IntelliSave AX700 GA machine should be highly commended. Clearly, their skills proved effective as no episode of desaturation or haemodynamic instability occurred throughout the surgery, especially during the insertion of the flange tracheostomy tube.

Second, the team of ENT surgeons was led by a senior surgeon to reduce risk of complications and operative time. Undoubtedly, these measures put in place by us led to a safer surgery in a less optimal surgical environment. Third, two additional nurses were mobilised to the OR to help with moving and handling the patient so that injury to him or staff could be avoided. Ideally, the number of staff members should be kept at six, two anaesthetists, two surgeons and two nurses in accordance with the MOH guidelines.² Fourth, withholding the enteral feeding and the subcutaneous heparin certainly reduced perioperative risks of aspiration and bleeding, respectively.

We reported similar experiences of using PPE and the challenges associated with it in respective cases of double-lumen tube placement and emergency tracheostomy under local anaesthesia in patients with COVID-19.¹⁵⁻¹⁷ Lo *et al* also observed difficulties and complexities of PPE use during a surgical debridement for massive scalp myiasis.¹⁸ The reports agreed that while PPE protected against COVID-19, its use not only complicated technical procedures and resuscitation efforts but also aggravated physical and mental distress. Our experience of PPE use agrees with the results reported by Yáñez Benítez *et al* but Loibner *et al* provided contradictory findings.^{19,20} It is, however, important to note that the latter study was done with ventilated suits.

To tackle the physical and mental exhaustion among HCW, MOH Malaysia had taken a multipronged approach. At the national level, the ministry had instructed all private hospitals in the country to allocate beds for patients with COVID-19 in order to reduce the burden on public health personnel. Besides that, the government had so far recruited 8302 HCW on contract basis and implemented internal mobilisation of HCW to address the shortage of manpower in heavy-hit areas. Additionally, the ministry had supplemented the salaries of HCW with an allowance to compensate for the exposure to patients with COVID-19. Similarly, we had initiated various measures to address PPE fatigue at our centre. First, we had optimised the number of PAPR units in the ICU so that all of our HCW would have access to ventilated suits and thus, feel more comfortable despite being in PPE for long hours. Second, shift lengths were shortened with adequate opportunities for rest breaks during work shifts as we noted frequent yet shorter shifts were more tolerable. Third, free meals and refreshments were provided at

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times as a form of encouragement. Ultimately, we believe it is beneficial to create ergonomically designed PPE in this long-haul fight against COVID-19.

In summary, morbidly obese patients with severe SARS-coV-2 infections undergoing airway-related surgeries demand peculiar anaesthetic attention. Exhaustive efforts should be undertaken to prevent perioperative morbidity and mortalities to the patient and other HCW.

Patient's perspective

I am extremely grateful to the healthcare workers for providing me their best effort and care during my hospitalisation. Having suffering from a severe COVID-19 infection is as though a death sentence for me. This was in addition to the need for an elective tracheostomy on me to facilitate weaning. Being obese with severe COVID-19 infection possess a high risk of death during the surgery. I am glad to have survived this episode and will never forget this experience.

Learning points

- ▶ Safeguarding the safety and health of healthcare workers (HCW) must be given utmost priority in containing the COVID-19 pandemic.
- ▶ Performing tracheostomy in a morbidly obese patient with COVID-19 is extremely challenging.
- ▶ Personal protective equipment (PPE) fatigue is underestimated and often overlooked and thus, improvements must be made to current PPE design.
- ▶ Implementation of simulation-based training will better prepare HCW for patients with COVID-19, particularly in cases of emergency surgery in unstable patients.

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