

Perioperative challenges in a morbidly obese former COVID-19 patient undergoing elective spine surgery

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SUMMARY

Anaesthesia for patients with severe lung fibrosis post COVID-19 infection requires special consideration. This is due to its propensity to cause perioperative anaesthetic catastrophe and possibility of cross infection among healthcare workers if not properly managed. This interesting article elaborates in detail the anaesthetic and surgical challenges in a morbidly obese patient who had a severe COVID-19 infection presenting for an elective spine surgery.

BACKGROUND

COVID-19 was declared a pandemic in March 2020.¹ Malaysia was not spared by this fatal virus infection, prompting the Ministry of Health to undertake proactive measures to ensure the safety of healthcare workers (HCWs). Patients who have had a COVID-19 infection may present a great challenge to anaesthetists during an elective surgery. Anticipated complications are difficult ventilation, oxygenation, barotrauma and possible COVID-19 cross infection among HCWs. This case report depicts a morbidly obese patient with a history of severe COVID-19 pneumonia 3 months ago, presenting for an elective posterior spinal instrumentation and fusion (PSIF) in prone position. We discuss in detail our perioperative challenges and techniques to maintain the safety of HCWs.

CASE PRESENTATION

A 51-year-old man (weight 95 kg, height 1.63 m and body mass index 35.8 kg/m²) with comorbidities of well-controlled hypertension, diabetes mellitus, and severe obstructive sleep apnoea (OSA) presented to our institution with low back pain for 1 month, which was associated with low-grade fever for 3 days. He denied any history of trauma, cough and fever. However, he gave a history of prolonged hospitalisation for 65 days due to severe COVID-19 infection. At that time, he required high-flow nasal cannula (HFNC) support of up to 60 L/min with fraction of inspired oxygen (FiO₂) of 70%. He had never been intubated nor ever required non-invasive ventilation. He spent 15 days in the intensive care unit (ICU) during the acute phase of his COVID-19 infection after which he was de-escalated to the general ward for further therapy and monitoring. The patient claimed that he did not develop any severe end-organ failure due to the COVID-19 apart from the severe pneumonia and uncontrolled hyperglycaemia due to prolonged steroid usage.

On clinical examination, the patient was alert and conscious with a pain score of 5 at his back. His blood pressure (BP), heart rate (HR), respiratory rate and oxygen saturation were 141/84 mm Hg, 117 beats/min, 22 breaths/min and 92% on room air, respectively. Chest auscultation revealed reduced breath sounds at the left lower zone with occasional crackles bilaterally. He had severe instability back pain, which neither allowed him to turn side to side nor sit up; hence, he developed stage 2 sacral sore. There were no motor or sensory deficits on his lower limbs. Airway assessment showed Mallampati score 3 with good neck flexion and extension. The thyromental distance was 6 cm.

In view of the instability pain and worsening sepsis, possibly from the lytic lesions from the fourth lumbar vertebra (L4), he was planned for an elective PSIF with transpedicular debridement in prone position. Unfortunately, intraoperative motor evoked potential and somatosensory evoked potential monitoring were not able to be performed due to the patient's financial constraint and complete lockdown of flight travelling in Malaysia at the height of COVID-19 pandemic. Intravenous cloxacillin was started immediately on detecting methicillin-sensitive *Staphylococcus aureus* (MSSA) bacteraemia.

INVESTIGATIONS

- ▶ Nasopharyngeal swab (NPS) reverse transcriptase PCR (RT-PCR) for SARS-CoV-2 was positive with a cycle threshold (Ct) value of 38.
- ▶ Serum IgM for SARS-CoV-2 was negative.
- ▶ Serum IgG for SARS-CoV-2 was positive.
- ▶ Chest X-ray showed bilateral patchy opacities with left lower zone consolidation.
- ▶ High-resolution CT (HRCT) of thorax and lungs showed persistent bilateral ground-glass opacities centrally and peripherally, highly suggestive of SARS-CoV-2 infection ([figure 1](#)).
- ▶ Serial erythrocyte sedimentary rate (ESR) was persistently elevated >120 mm/hour (normal values: 0–10 mm/hour) whereas C reactive protein (CRP) trend was high at 133 mg/L (normal values: <10 mg/L).
- ▶ Arterial blood gas (ABG) on room air showed compensated chronic respiratory acidosis.
- ▶ Full blood count showed haemoglobin at 91 g/L (normal values 12–15 g/dL), total white blood cells at 18×10⁹/L (normal values: 6–12×10⁹/L) and platelets at 402×10⁹/L (normal values: 150–450×10⁹/L).
- ▶ The prothrombin time was 12.8 s (normal values: 11–13.5 s), partial thromboplastin time



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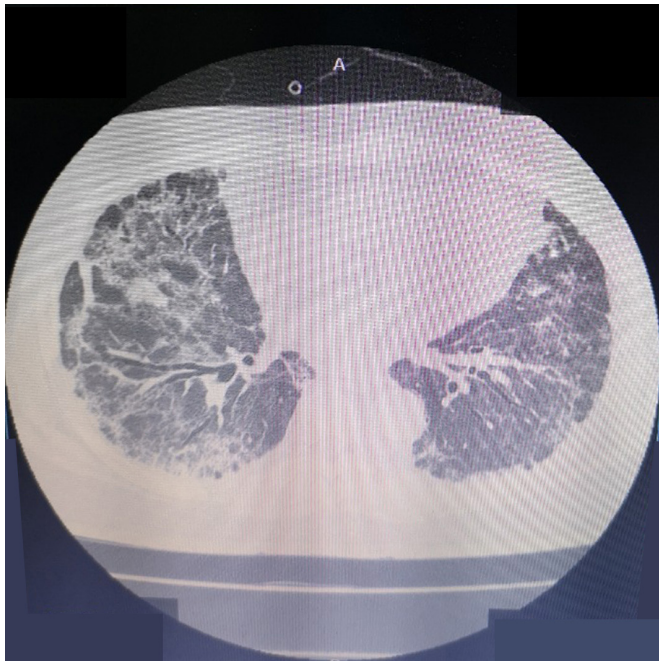


Figure 1 High-resolution CT of thorax showing persistent ground-glass opacities centrally and peripherally in both lungs.

was 32 s (normal values: 25–35 s), international normalised ratio was at 1.32 (normal values: <1.5).

- ▶ The D-dimer was less than 0.5 (normal) and fibrinogen was at 2.2 g/L (normal values: 2–4 g/L).
- ▶ Inflammatory biomarkers, such as ESR, CRP, procalcitonin and lactate dehydrogenase were within normal values.
- ▶ Serum ferritin was 172 $\mu\text{g/L}$ (normal values: 20–270 $\mu\text{g/L}$) and albumin was 3.8 g/dL (normal values: 3.5–5 g/dL).
- ▶ Blood culture and sensitivity (C&S) demonstrated MSSA. The organism was sensitive towards clindamycin, gentamicin, oxacillin, and trimethoprim.
- ▶ The bone C&S yielded MSSA, which was sensitive towards oxacillin and gentamicin.
- ▶ Echocardiogram did not reveal any vegetations on the leaflets of valves. The ejection fraction was 62%.
- ▶ CT thorax, abdomen and pelvis showed lytic destruction of superior end plate of L4 vertebra, likely representing osteomyelitic changes with spondylodiscitis. There were peripheral consolidations seen at both the right and left lungs, which suggested of postinfection fibrosis.
- ▶ MRI of spine showed L3–L4 spondylodiscitis with multi-level degenerated canal and foraminal stenosis ([figure 2](#)).
- ▶ Pulmonary function test (PFT) was not done due to temporary halt of non-essential hospital support in view of heavy COVID-19 load.

DIFFERENTIAL DIAGNOSIS

Possible differential diagnoses are tuberculosis (TB) of the spine due to him originating from a TB endemic district in Malaysia and constitutional symptoms of having low back pain with fever. Due to his age, there is a possibility of having spine malignancy.

TREATMENT

In view of his severe underlying comorbidities, a high-risk consent for surgery was obtained, focusing on anticipated difficulties in intubation, ventilation and oxygenation. The patient was fasted for 8 hours prior to surgery. He was transported to

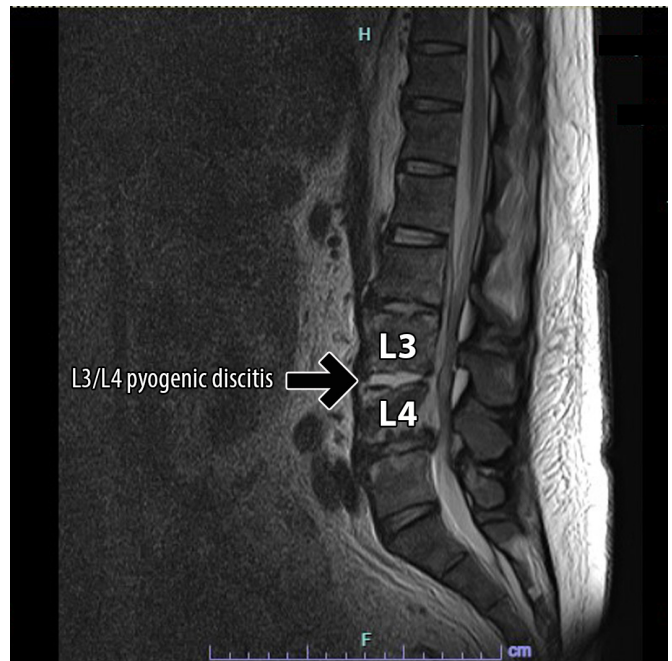


Figure 2 Sagittal MRI of spine showing lytic lesions at L3–L4 levels.

the operating theatre on nasal prong oxygen 2 L/min support and N95 mask. All HCWs involved in the surgery wore N95 masks, face shields, non-sterile gloves and disposable plastic apron when receiving the patient from the airlock. A proper biohazard signage was placed outside the operating room to limit the maximum number of HCWs to just 10 people at any one time.

The patient's 18 gauge cannula on the right dorsum was flushed to ensure its patency. The patient was put on ramped position with one pillow on his back. He was preoxygenated for 5 min with 100% oxygen at the flow of 15 L/min for denitrogenation. Induction of anaesthesia was performed using intravenous fentanyl 2 $\mu\text{g/kg}$, propofol 2 mg/kg and rocuronium 1 mg/kg with modified rapid sequence induction with direct laryngoscopy. A size 7.5 mm flexometallic endotracheal tube (ETT) was gently inserted and anchored at 21 cm. The Cormack-Lehane of the larynx was graded as 2b with cricoid pressure. After that, his right radial artery and femoral vein were cannulated for BP monitoring and central venous access, respectively.

Anaesthesia was maintained with FiO_2 of 50% and sevoflurane at minimum alveolar concentration of 1.0. The airway pressure (AP) and tidal volume (TV) generated under the synchronised intermittent mandatory ventilation (SIMV) mode were in the range of 29–34 cmH_2O and 450–520 mL, respectively, during supine position. The SpO_2 generated was 95%–97%. The patient was gently pronated, with care focused on the airway, eyes, neck, genitalia and limbs. The AP was elevated to 36–39 cmH_2O and TV generated was 390–420 mL with SpO_2 ranging between 94% and 96%. There were no excessive airway secretions, kinking of ETT or accidental endobronchial intubation during or after the change of position. We applied permissive hypercapnia with application of positive end expiratory pressure (PEEP) of 8–12 cmH_2O and low tidal volume of 4–6 mL/kg. ABG taken in the prone position with FiO_2 of 50% showed mixed compensating respiratory and metabolic acidosis with good oxygenation. Intraoperatively, the BP and HR range were 82–130/43–74 mm Hg and 72–96 beats/min, respectively. Permissive hypotension with the aim of mean arterial pressure of 70–80 mm Hg was allowed

to minimise blood loss for the spine surgery. Bleeding was estimated at 900 mL and the patient was transfused with 1 pint of packed cells. Intraoperative surgical finding noted unhealthy L3–L4 disc with copious amount of slough. The superior end plate of L4 and vertebral body was eroded. The L3–L4 disc was removed and unhealthy superior end plate of L4 was curetted through transforaminal approach. Bleeding from epidural veins and raw bone surfaces after curettage was secured with bipolar diathermy, thrombin and Gelfoam. The implant was then carefully inserted and secured safely without any complications.

OUTCOME AND FOLLOW-UP

The patient was sent to the ICU for postoperative monitoring and resuscitation. He was sedated with infusion of dexmedetomidine, which was maintained in the range of 0.3–0.5 $\mu\text{g}/\text{kg}/\text{hour}$. The anaesthetic, surgical, nursing and ancillary teams who were involved in the surgery, were immediately assessed by the hospital's occupational safety and health administration (OSHA). Risk assessments were conducted, and a NPS RT-PCR were taken on the day of surgery itself. They were home quarantined for 9 days, after which another NPS RT-PCR was repeated. Fortunately, the entire team's RT-PCR was negative on both dates.

Our patient was safely extubated after 3 days of progressive weaning. The patient was able to ambulate with support and was discharged to home 3 days later. A repeated blood C&S did not reveal any MSSA bacteraemia. His antibiotics were changed to tablets and completed for 8 weeks according to guidance by the infectious disease team. A review in the spine clinic showed that the patient was able to ambulate well with no back pain and neurological deficits.

DISCUSSION

COVID-19 was first identified in November 2019 in Wuhan, China. It is caused by a single-stranded RNA virus known as SARS-CoV-2, which is spread by respiratory droplets that has an incubation period of 6–8 days.² Patients with SARS-CoV-2 infection may present with symptoms, such as fever, cough, sore throat, shortness of breath and diarrhoea.³ As approximately 50% of the patients with COVID-19 are asymptomatic, active case detections were conducted by screening close contacts via NPS for rapid test kits antigens or RT-PCR.⁴

In March 2020, the WHO had declared COVID-19 a pandemic, prompting governments across the globe to take strict actions to curb the spread of the deadly virus. Malaysia was severely affected by this virus, both economically and socially. A large amount of money was spent towards the healthcare system to ensure safety of HCWs and the public.

Clinically, COVID-19 infections can be classified into asymptomatic, mild, moderate, severe or critical.⁵ In our patient, he was in severe stage of COVID-19 infection as he presented with breathlessness and hypoxaemia with typical SARS-CoV-2 findings on the lungs HRCT on his first hospitalisation. He responded well to therapies instituted at our centre, which included HFNC 60 L/min, favipiravir, enoxaparin and dexamethasone, although taking a longer time to recover due to his underlying comorbidities of diabetes mellitus, severe OSA and obesity.

COVID-19 infection triggers a cytokine storm, which may cause severe life-threatening complications, such as acute respiratory distress syndrome (ARDS), acute renal failure, microvascular thrombosis, acute stroke, coagulopathy and deaths.^{6,7} It has been found that approximately 40% of patients with COVID-19 will develop ARDS, out of which, 20% of them

are severe.⁸ Severe COVID-19 pneumonia can further be complicated with pulmonary fibrosis in 30% of the discharged patients, especially in patients with multiple comorbidities and the elderly.^{8,9} The end points are poor lung compliance and ventilation–perfusion mismatch that can result poor oxygenation and hypoxaemia. These were present in our patient who has obesity and severe OSA, who developed persistent pulmonary fibrosis even after 2 months from his initial COVID-19 infection.

Patients who were infected with SARS-CoV-2 are at higher risks of developing severe perioperative cardiopulmonary complications and deaths. The American Society of Anaesthesiologists guided that patients who have had mild COVID-19 infection be allowed for an elective surgery at least 4 weeks after their symptoms have resolved.¹⁰ However, longer duration is needed for the patients who are immunocompromised or had been mechanically ventilated. In our centre, a patient's NPS RT-PCR will be conducted at least 3 days prior to the elective surgery. The RT-PCR Ct value plays an important role in determining the viral load and infectivity of the patient. The patient is deemed not infectious if the Ct values are >24 .¹¹ Lower Ct values are associated with increased disease severity and mortalities. Additional serum antibody testing, such as IgM and IgG, may be needed with the guidance of infectious disease experts.¹²

Despite this, HCWs should take extra precautions when dealing with former COVID-19 patients who undergo elective surgeries to prevent cross infections. Adequate history, physical examination, updated radiological and biochemical investigations should be obtained. These patients should be properly assessed for the presence of COVID-19-induced cardiomyopathies, respiratory failure, acute stroke, critical illness myopathies and deep vein thrombosis as sequelae of COVID-19.¹³ Thorough investigations with PFT, CT brain and echocardiogram are ideally indicated prior to anaesthesia. Patients who were on prolonged steroid therapy, as in our patient, may develop adrenal suppression and hyperglycaemia, thus necessitating the administration of intravenous hydrocortisone intraoperatively. Potential hepatic and renal dysfunction may occur from drug interactions with various antivirals and antipyretics.¹⁴

All HCWs should don adequate personal protective equipment (PPE), such as N95 face masks, face shields, plastic aprons and shoe covers, when dealing with these patients. Social distancing and good personal hygiene should be religiously practiced at all times. Although the precautions taken are not as tedious as with patients with active COVID-19 infections, these still present huge challenges to all HCWs involved. We used two heat and moisture exchanger filters—one connecting the patient's ETT to the circuit and another one from it to the anaesthetic machine. This was to ensure increased particles filtration and reduce exposing HCWs to possible contamination with airway secretions.

For this patient, we had difficulties in palpating the veins and inserting the intravenous cannulas due to the thick adipose tissue and thin friable skin with multiple puncture marks due to previous hospitalisation. This was on top of the multi-layered gloves as well as encountering poor communication because of the face masks and shields. Yeap *et al* and Lo *et al* mentioned the difficulties encountered by HCWs due to thick gloves and powered air purified respirator when handling COVID-19 patients.^{15,16} Teah *et al* also concurred with the negative impact of PPE towards the performances of bronchoscopy and one lung ventilation.^{17,18} This was in addition to difficulties in intubation, ventilation and oxygenation due to

our patient's underlying lung condition. Extra manpower was needed to transport and pronate the patient intraoperatively, which increased the risks of cross infections.

Ventilation-wise, we had to carefully titrate our ventilator settings to achieve adequate oxygenation in prone position. As the patient had post-COVID-19 lung fibrosis, the lung compliance was significantly reduced, made worse by him being morbidly obese and the surgeons operating on his spine. We followed recommendations as per ARDS management protocols to avoid ventilator-induced lung injury. Our ventilator strategy was similar as Erbabacan *et al* who recommended low tidal volume strategy of 4–6 mL/kg body weight, lowest possible PEEP to prevent alveolar collapse and permissive hypercapnia with end tidal carbon dioxide ranging between 45–50 mm Hg.¹⁴ The aim was to prevent intraoperative hypoxaemia by achieving SpO₂ of >92% and partial pressure of oxygen of >60 mm Hg. We chose SIMV pressure control mode to carefully control the AP, TV and SpO₂ to avoid barotrauma. Postoperatively, we sedated the patient with dexmedetomidine, which possesses excellent anxiolytic and analgesic properties, which enable gradual weaning off the ventilator for an obese patient.^{19 20}

The operating spine surgeons had difficulties in visualising and palpating the spine anatomy with the thick gloves and face shield. Their tactile precision was reduced, especially during screw placement on the spine. Thus, they had to be alert and careful during the procedure so as not to cause injuries to the spinal cord. The surgeons also had difficulties in visualising bleeding from raw surgical areas. On top of that, all HCWs were psychologically impacted with fear of contracting COVID-19 perioperatively, despite the reassurances given. As a precaution, all staff involved in the surgery were assessed by the OSHA team, home quarantined and NPS RT-PCR was obtained, all of which yielded negative results fortunately.

In summary, former severe COVID-19 patients presenting for elective surgeries require significant considerations to ensure safety of HCWs. Anaesthetists must be clever in managing common pulmonary complications, such as difficult ventilation and oxygenation in this group of patients. More comprehensive measures should be tailored in obese patients who undergo anaesthesia.

Patient's perspective

I am grateful to the healthcare workers (HCWs) for taking good care of me during the spine surgery. Having a bad lung scarring after a severe COVID-19 infection is an awful experience, which I will never forget in my life. Most importantly, all HCWs took precautionary methods to ensure our safety and prevent cross infections.

Learning points

- ▶ Former COVID-19 patients undergoing elective surgeries demand special perioperative anaesthetic considerations.
- ▶ A minimum duration of 8 weeks is needed to safely undergo anaesthesia after recovery from a severe COVID-19 infection.
- ▶ Morbidly obese patients with severe lung fibrosis after COVID-19 infection are at increased risks of difficult resuscitation, ventilation and hypoxaemia, especially in prone position.
- ▶ Safe spine surgery is possible in former COVID-19 patients with adequate anaesthetic preparations.
- ▶ Healthcare workers should be vigilant and wear adequate personal protective equipment when handling former COVID-19 patients for anaesthesia.

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