

# Anaesthetic management in a patient requiring one lung ventilation during COVID-19 pandemic

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## SUMMARY

Placement of a double-lumen tube to achieve one lung ventilation is an aerosol-generating procedure. Performing it on a patient with COVID-19 will put healthcare workers at high risk of contracting the disease. We herein report a case of its use in a patient with traumatic diaphragmatic rupture, who was also suspected to have COVID-19. This article aims to highlight the issues, it presented and ways to address them as well as the perioperative impact of personal protective equipment.

## BACKGROUND

One lung ventilation (OLV) for the purpose of good surgical exposure and lung isolation can be achieved with a double-lumen tube (DLT). Due to inherent difficulties in the use of DLT, complications such as malpositioned tube and failure of unilateral isolation, are not uncommon. We, herein, report our invaluable experience dealing with the use of DLT in a patient with traumatic diaphragmatic rupture complicated with respiratory failure in the context of COVID-19 pandemic in Sabah, Malaysia. The patient, whose nasopharyngeal swab for real-time PCR (RT-PCR) was unknown prior to the emergency surgery, was initially treated as suspicious case of COVID-19. He successfully underwent an open left diaphragmatic repair with COVID-19 isolation precautions taken accordingly.

## CASE PRESENTATION

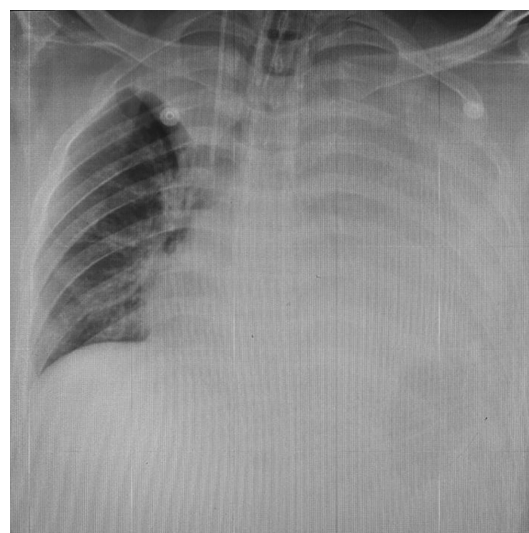
A 27-year-old healthy man (70 kg, 165 cm) sustained severe chest trauma in a motor vehicle accident under alcohol influence. The patient appeared intoxicated and had a Glasgow Coma Scale score of E4V4M5. He was very tachypnoeic with respiratory rate of 35 breaths per minute, blood pressure (BP) of 111/55 mm Hg, pulse rate of 97 beats per minute and oxygen saturation (SpO<sub>2</sub>) of 93% under room air. He was placed on a hard cervical collar in anticipation of cervical injury. Clinical examination showed reduced breath sounds and decreased resonance on percussion over the left chest. Bowel sounds were auscultated at the lower base of the left chest. Besides that, he sustained multiple superficial laceration wounds over his left chest and abdomen. Otherwise, he denied a history of fever, sore throat, cough and anosmia.

However, he developed sudden worsening respiratory distress and haemodynamic instability requiring emergency rapid sequence intubation. In view of the COVID-19 pandemic and unavailability of the patient's nasopharyngeal RT-PCR results due

to severe backlog, he was treated as a suspicious case of COVID-19. The emergency department team handling the patient donned personal protective equipment (PPE), namely coverall, goggles, N95 respirators and double-layered gloves, for his intubation. Adequate preoxygenation was performed followed by administration of intravenous fentanyl 2 µg/kg, intravenous propofol 2 mg/kg and intravenous suxamethonium 2 mg/kg along with application of cricoid pressure. Manual in-line stabilisation was applied with the hard cervical collar in situ and endotracheal intubation was conducted using a C-MAC video laryngoscope. A 7.0 mm sized cuffed polyvinylchloride (PVC) endotracheal tube (ETT) was anchored at 20 cm from incisor. The patient's Cormack Lehane (CL) score was graded as class 1.

## INVESTIGATIONS

- ▶ Chest X-ray (CXR) showed a complete whiteout of the left lung field with right mediastinal shift ([figure 1](#)).
- ▶ Focused assessment with sonography for trauma revealed free fluid at his pelvic region.
- ▶ A CT of the thorax showed a diaphragmatic opening measuring 6.6 cm in diameter with direct discontinuity seen at the left haemidiaphragm with herniation of the stomach, large bowel, spleen and part of the left liver lobe into the left haemithorax. In addition, there was collapse of the left upper and lower lobes. Left pneumothorax was present and associated with multiple fractures involving the sternum and



**Figure 1** CXR shows total whiteout of left haemithorax. CXR, chest X-ray.



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the left seventh rib. Otherwise, no ground glass opacification, consolidation, and pleural thickening were observed.

- ▶ The CT of the neck was normal.
- ▶ His nasopharyngeal RT-PCR for SARS-CoV-2 was unavailable prior to the emergency surgery.

### DIFFERENTIAL DIAGNOSIS

The immediate provisional diagnosis was severe left traumatic diaphragmatic hernia with massive bowel herniation complicated with type 2 respiratory failure.

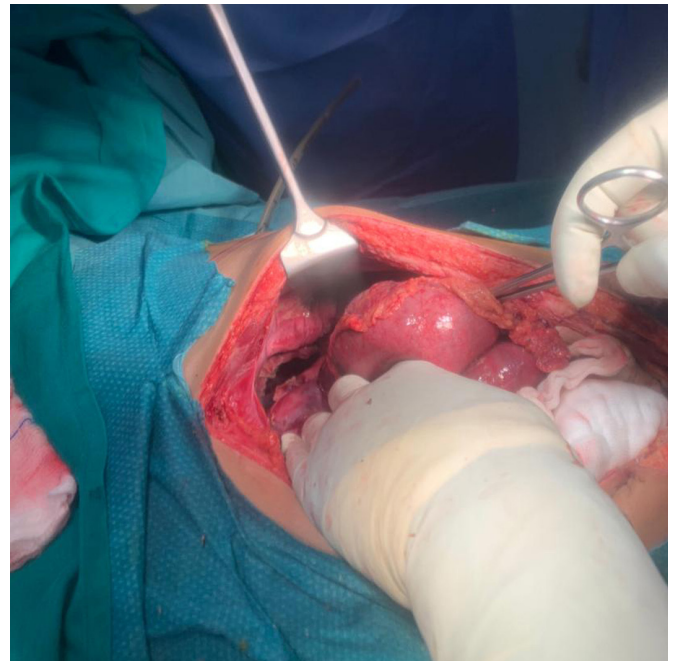
### TREATMENT

General anaesthesia with intravenous rocuronium 0.6 mg/kg and sevoflurane were administered. A central venous line was inserted into the right internal jugular vein for fluid and vasopressor administration. His right radial artery was cannulated for intra-arterial BP monitoring. Considering the patient's CL score of 1, his PVC ETT was carefully removed and changed to a left sided size 39 Fr Mallinckrodt DLT under direct laryngoscopy. The initial choice of using a 39 Fr DLT was based on our clinical experience as well as considering the patient's gender, weight and height. Furthermore, the airway exchange catheter was not available in our hospital. Unfortunately, the patient's three huge, buck teeth presented difficulties to inserting the size 39 DLT. We then changed to a smaller size 37 Fr DLT which was easily inserted into his airway. It was initially pushed deep until the DLT hit the carinal end. As we religiously percussed both lungs, the DLT was slowly pulled out 1 cm at a time, until the lungs were equally resonant with good chest rise visualised, while manual bagging with 100% oxygen. At this point, we anchored the DLT at 28 cm from the incisors.

Confirmation of placement and patency of the tracheal and bronchial cuffs were extremely challenging for us. First, we did not use fiberoptic bronchoscope (FOB) due to aerosol-generating procedure (AGP). Lung deflation was elicited via chest percussion during clamping of the bronchial lumen. This was further reconfirmed by direct visualisation of a successfully deflated left lung with the help of the surgeon during repair in supine position.

The patient's both lungs were initially ventilated with fraction of inspired oxygen (FiO<sub>2</sub>) 0.8. The tidal volume (TV) and Peak Inspiratory Pressure (PIP) achieved were 250–280 mL and 32–35 cmH<sub>2</sub>O, respectively. When the surgeon was repairing the left haemidiaphragm, OLV was commenced by clamping the bronchial cuff. Lung protective strategies, namely, low TV of 4–6 mL/kg, PEEP of 5–10 cm H<sub>2</sub>O and FiO<sub>2</sub> of 0.6–0.8 were employed during OLV, generating SpO<sub>2</sub> 95%–98%. A TV of 350–420 mL was generated on a PIP of 20–22 cm H<sub>2</sub>O after all abdominal content was completely removed from the left haemithorax. During the OLV, serial Arterial Blood Gases (ABG) tests did not show worsening respiratory failure with improved oxygenation.

The defect measuring 10 cm in diameter at the left haemidiaphragm, was successfully repaired using a mesh and following that, a 36 Fr sized chest drain was sited in the left pleural space (figure 2). Intraoperatively, the patient required norepinephrine infusion up to 1.2 µg/kg/min. In addition, he received a total of 4 L of crystalloids and colloids and four units of packed cells for an operative blood loss of 1.5 L. At the end of the operation, both lungs were ventilated, and the left lung was carefully reinflated under direct visualisation before closure of the abdominal wall. The DLT was then replaced with an 8.0 mm PVC ETT before the patient was admitted to the intensive care unit for further critical care management. The total duration of anaesthesia and surgery



**Figure 2** Abdominal organs herniating into the left haemithorax via the diaphragmatic defect.

was 150 min and 90 min, respectively. The dose of norepinephrine was progressively weaned off a day after the surgery. Subsequent postoperative CXRs showed resolved lung collapse and pneumothorax whereas ABG tests no longer indicated any metabolic or respiratory disturbances (figure 3). He was uneventfully extubated 2 days later and his COVID-19 PCR results returned as negative.

### OUTCOME AND FOLLOW-UP

At 2 weeks postoperatively in the clinic, the patient was well and complied to regular follow-up with our centre since his discharge from the hospital.

### DISCUSSION

The COVID-19 pandemic that began in Wuhan, China in December 2019 was declared a global emergency by WHO in March 2020.<sup>1</sup> In Malaysia, the first COVID-19 case was detected on 25 January 2020, and as of 28 November 2020, there were 63 176 COVID-19 cases including 354 deaths.<sup>2</sup> Given the high transmissibility of COVID-19 and absence of a vaccine, the Ministry of Health Malaysia has implemented strict guidelines to prevent and control COVID-19 infections in healthcare settings.

This case report is very significant in several aspects. First, it depicts the use of DLT in a setting during the COVID-19 pandemic and the issues associated with it. Second, it highlights the importance of the use of PPE to minimise COVID-19 transmission among health care workers (HCW) and the challenges it presents.

Our patient sustained severe diaphragmatic rupture complicated by abdominal organ herniation into the left haemithorax, requiring OLV for optimum surgical exposure. The successful placement of the DLT was confirmed clinically without the use of FOB, despite strong evidence supporting the routine use of it as diagnostic and troubleshooting tool.<sup>3 4</sup> Fortunately, this open surgical repair was conducted entirely in supine position, thus not much of patient repositioning required. Inoue *et al* reported 1.0 cm of movement can cause DLT malpositioning,



**Figure 3** Postoperative CXR showing resolved left pneumothorax and collapse. CXR, chest X-ray.

jeopardising OLV.<sup>5</sup> However, performing an AGP such as FOB on a COVID-19 patient carries an extremely high risk of transmission to HCW.<sup>6–8</sup> Furthermore, the patient was haemodynamically unstable requiring high-dose norepinephrine support and high ventilator settings, thus aggravating his condition if bronchoscopy was done. We were walking on thin ice—to secure the patient’s airway, minimise further deterioration and protect the safety of HCW. A few core strategies were put in place to overcome our challenges. First, a very experienced anaesthetist was selected to provide anticipatory vigilance to appropriate perioperative care. His vast skills proved effective as complications related to DLT use and repeated intubations were avoided. Second, lung-protective ventilation strategies were

### Patient’s perspective

I am happy and thankful that I survived the mysterious ordeal of having a great trauma which was complicated by almost all of the abdominal organs went into my left thorax. What is more traumatising was the challenge posed onto myself and the operating theatre staffs and doctors during COVID-19 pandemic. I would like to share my ordeal and experience with the rest of the world.

### Learning points

- ▶ Anaesthetists must possess a full range of technical clinical skills for good airway management including insertion of double-lumen tube (DLT), concept of one lung ventilation and its associated complications.
- ▶ Safety of HCWs must be safeguarded first and foremost to prevent COVID-19 contagion among themselves.
- ▶ Performing DLT insertion for lung separation is extremely challenging during COVID-19 pandemic.

used to prevent further lung injury.<sup>9</sup> Third, a seasoned surgeon was leading the surgery to reduce operation time and minimise complications. Undoubtedly, these steps had helped us to ensure a successful surgery in a safe environment.

This case report also demonstrates the impact of PPE on human task performance. First, OT staff, particularly the surgeons, reported that PPE hampered their performance of manual tasks due to the use of face masks, shields, and goggles as well as the double and sometimes triple gloving. Worst of all, the anaesthetist had difficulty to clearly hear the dullness of lungs percussion to confirm a totally deflated lung. This was on top of the beeping sounds of mechanical ventilators and people around talking loudly. We had to rely on the surgeon to check on the left lung once the bowels were removed. Second, fogging of the eye protectors impaired visibility. Third, it was asserted that PPE use affected verbal communication and situational awareness, forcing OT staff to speak louder. Fourth, physical discomfort and a perceived lack of protection due to limited ventilated PPE such as powered air-purifying respirator in our resource-limited facility contributed to unnecessary stress and anxiety. Irrefutably, PPE use can cause increased fatigue in a prolonged emergency setting, influencing clinical judgement.

Our experience of PPE use is consistent with the findings described by Yáñez Benítez *et al.*<sup>10</sup> On the contrary, Loibner *et al* described no impact of performance with PPE use; however, the study was done with ventilated suits.<sup>11</sup> We believe there is a growing need to improve PPE designs to make them more user-friendly and comfortable in preparation for a long-haul fight against COVID-19.

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