South Afr J Anaesth Analg. 2025;31(4):126-129
https://doi.org/10.36303/SAJAA.3217

South Afr J Anaesth Analg
ISSN 2220-1181 EISSN 2220-1173

CASE REPORT

One-lung ventilation in vascular surgery for a patient with significant lung pathology – a case report

V Pather, T Louw

Department of Anaesthesia and Critical Care, Tygerberg Hospital, Stellenbosch University, South Africa
Corresponding author, email: *viantha.pather@gmail.com*

Summary

In South Africa, the prevalence of tuberculosis and human immunodeficiency virus (HIV) coinfection is one of the highest globally. This combination can have myriad clinical manifestations, posing a challenge to anaesthesiologists. This case report focuses on the anaesthetic management of an HIV-positive patient with previously treated pulmonary tuberculosis (PTB) complicated by fibrocavitary disease and subsequent right lung abscess. The patient presented to the theatre for an emergency right carotid-axillary bypass for multiple subclavian artery mycotic pseudoaneurysms.

Keywords: one-lung ventilation, lung pathology, vascular surgery

Case report

A 40-year-old known with HIV infection and post-PTB bronchiectasis, complicated by a right lung abscess, was referred from the base hospital for further management following an acute onset of weakness of the right hand and an episode of massive haemoptysis. Their medical history included PTB three years prior, which was treated, and HIV infection, with good antiretroviral therapy adherence since diagnosis. Baseline Duke Activity Status Index (DASI) 24.7 = 5.78 metabolic equivalent of tasks (METs), but with acute decompensation METs = 2.74. On initial assessment, the patient appeared acutely ill: heart rate of 145, blood pressure of 136/75, oxygen saturation of 97% on room air, and a respiratory rate of 28 breaths per minute.

Examination revealed bilateral finger clubbing and conjunctival pallor with a normal airway and body mass index (BMI). The patient presented with mild respiratory distress. The trachea was central, and decreased breath sounds were noted on the right side. No additional lung sounds were audible. Aside from the tachycardia and a diminished right radial pulse, the cardiovascular examination was unremarkable, with no signs of pulmonary hypertension. The rest of the systemic examination was unremarkable.

Arterial blood gas examination demonstrated respiratory alkalosis: pH 7.47, pCO_2 3.1 kPa, pO_2 10.7 kPa on room air, lactate 1.5, haemoglobin (Hb) 9.7 g/dl, and HCO_3 21 mmol/L. Preoperative laboratory investigations showed an initial Hb level of 3.4 g/dl at the base hospital after massive haemoptysis. This increased to 9.3 g/dl post-transfusion of four units of packed red blood cells (PRBC). The patient had a raised white cell count (WCC) of 24.18, platelet count of 545 (thrombocytosis), and C-reactive protein (CRP) of 338. The urea and electrolytes were within normal ranges. The initial International Normalised Ratio (INR) was 1.71. Sputum testing revealed a negative GeneXpert, and a positive culture of *Pseudomonas aeruginosa*. The electrocardiogram showed a sinus tachycardia with no features of right heart strain. Chest radiograph findings are demonstrated in Figure 1.

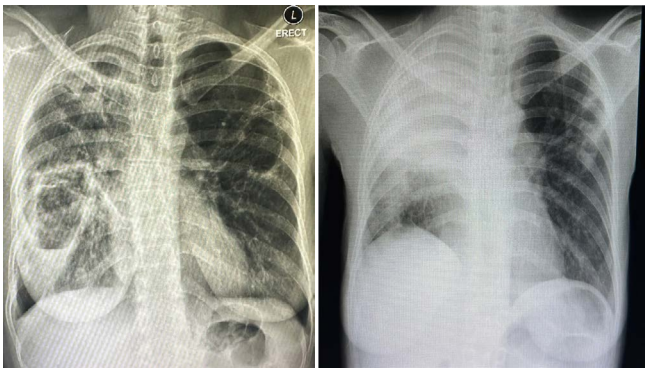

Figure 1: Chest radiograph three years ago with evidence of a right lung abscess and bronchiectasis (left), preoperative radiograph showing opacification of the right upper and middle lobe (right)

Computer tomography salient findings

Opacification of the right upper lobe with multiple areas of parenchymal necrosis. The large necrotic cavity in the posterior segment demonstrated possible recent internal haemorrhage. There was complete destruction of the right middle lobe with bronchiectasis. There were also two large, irregular, inferior-orientated focal outpouchings arising from the proximal right subclavian artery, with measurements of 20 × 16 × 25 mm and 18 × 17 × 20 mm, respectively, in keeping with arterial pseudoaneurysms.

Due to the episodes of massive haemoptysis and critical limb ischaemia of the right hand, the attending team decided to proceed with emergency surgery due to the risk of impending rupture of the pseudoaneurysms.

Anaesthetic considerations

Haemodynamic:

- Underlying sepsis (raised WCC, thrombocytosis, CRP, and INR).
- Pre-existing normochromic normocytic anaemia and raised INR with the risk of further bleeding from the surgery and/or haemoptysis that may warrant massive blood transfusion.

- Maintenance of cerebral perfusion during carotid cross-clamping: mean arterial pressure (MAP) > 80. The use of non-invasive monitoring, such as near-infrared spectroscopy, is a useful technique and is advised; however, in this case, MAP targets were used.

Difficulty with ventilation:

- Significant pre-existing bilateral lung pathology (right > left).
- Increased risk for significant dead space ventilation (cystic lung changes).
- Potential for lung abscess rupture/further haemoptysis and left lung soiling.

Management of ventilation:

- One-lung ventilation (OLV) was needed.
- Postoperative respiratory support.

Occupational exposure:

- Previous tuberculosis, concurrent lung pathology.
- Personal protective equipment (PPE) for all staff.

Anaesthetic plan carried out

Preoperative:

- Fluid status optimised.
- INR corrected to 1.01 with six units of fresh frozen plasma.
- Hb optimisation with two units of PRBC ordered for the theatre.
- Extensive counselling of the patient regarding anaesthetic and surgical risks.
- Intravenous antibiotic therapy (meropenem).
- Postoperative cardiothoracic intensive care unit (ICU) bed reserved.

Intraoperative:

- On arrival at the theatre, all infection control precautions were maintained with PPE.
- World Health Organization (WHO) checklist performed.

Monitors and lines placed:

- Standard I and II American Society of Anesthesiologists (ASA) monitoring.
- 16 G intravenous access (left antecubital fossa).
- Awake invasive arterial blood pressure line (left radial artery).
- Once asleep, ultrasound-guided central venous line (left internal jugular).

Anxiolysis:

- Midazolam and fentanyl were administered.

Induction:

- General anaesthesia was performed, and no haemodynamic instability was noted.
- Pre-oxygenated with 100% oxygen for three minutes.
- Gas induction with 8% sevoflurane in 100% oxygen and ketamine 2 mg/kg maintained spontaneous ventilation, and the cords were sprayed with 2% lignocaine. Due to the risk of coughing, the decision was made to paralyse and intubate (rocuronium 1 mg/kg).

Airway intervention:

- Plan A: Direct laryngoscopy and intubation with a single lumen size 7.5 endotracheal tube was performed, followed by placing a right bronchial blocker. Once the tube was placed, a prophylactic bronchospasm mix was administered. However, the bronchial blocker would not advance into the right bronchus, so the decision was made to move to Plan B.
- Plan B: A size 37 left double-lumen tube (DLT) was placed. Its position was confirmed clinically and with a fibreoptic scope. The right lung was isolated from the start.

Maintenance:

- Isoflurane.

Analgesia:

- Multimodal analgesia.

Haemodynamic targets:

- Phenylephrine titrated to MAP ≥ 65 mmHg, except when carotid clamp on MAP maintained ≥ 80 mmHg. No carotid artery pressure was monitored.
- Two units of PRBC were administered to maintain Hb > 8 g/dl.

Ventilation strategy

Lung-protective ventilation and permissive hypercapnia pressure-controlled ventilation were used, with peak pressures < 25 cmH_2O, tidal volume (TV) 220–250 ml, positive end-expiratory pressure (PEEP) 5 cmH_2O, and FiO_2 40%. The patient coped well and did not need any troubleshooting on OLV.

Surgery

Figure 2 shows the open, right carotid-axillary bypass with a left, deep femoral vein graft. A right supraclavicular, infraclavicular incision was done to access the right brachiocephalic, proximal common carotid, proximal subclavian, and axillary arteries. Heparin was given before artery clamping, and the activated clotting time was kept at around 200. The left femoral vein was reversed, and anastomosis was performed on the proximal common carotid artery. The aneurysm sac was closed with the graft lying over it. Postoperatively, the right radial and left foot pulses were present.

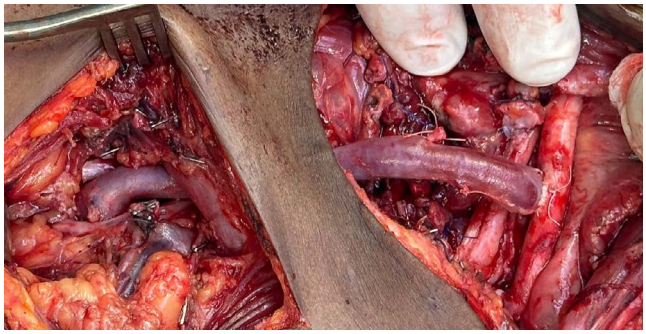

Figure 2: Carotid-axillary bypass

Emergence

The patient was extubated uneventfully. They were drowsy but rousable. Repeat arterial blood gas showed CO_2 retention (pCO_2 11.7 kPa), a respiratory rate of 26 bpm, and PaO_2 15.3 kPa on 40% FiO_2. No neurological deficits were noted. The patient was transported to the ICU for postoperative respiratory support. There was no need for continued inotropic or vasopressor support.

Follow-up

The patient did well in the ICU and remained extubated throughout their stay without requiring invasive ventilation. During the ICU stay, the patient experienced intermittent episodes of minor haemoptysis, attributed to structural lung disease, which was managed expectantly. No further massive haemoptysis was noted.

After 12 days, the patient was discharged to the ward and could mobilise without assistance after intensive physiotherapy. Subsequently, the patient was diagnosed with pulmonary aspergillosis requiring antifungal therapy, resulting in a prolonged hospital stay. After three months, the patient was discharged home with no functional limitations.

Discussion

The above case is a scenario of needing OLV for non-thoracic surgery due to complications of HIV and previous PTB coinfection. According to the WHO, people infected with HIV are 14 times more likely to develop TB-related illnesses.[1] A study by Kubjane et al.[2] stated that between 1990 and 2019, 8.8 million South Africans contracted TB, and 2.1 million patients died from it. HIV was directly related to 55% of TB cases (4.8 million) and 69% of TB deaths (1.4 million).

PTB has a high prevalence in South Africa, and its complications (acute and chronic) may be present in patients presenting for procedures requiring anaesthetic intervention. These may include massive haemoptysis, empyema, and bronchopleural fistula. In this case, OLV was indicated to reduce the risk of left-sided lung contamination from the potential lung abscess rupture/haemoptysis. Table I summarises the indications for OLV. Three different OLV techniques are commonly used: DLT placement, bronchial blockers, and single-lumen tube advancement.

Main concerns with OLV during this case

1. Hypoxaemia is the most common side effect of OLV that may require active management intraoperatively. In this case, hypoxaemia was not a problem, most likely due to the chronicity of the lung disease with adequate chronic compensatory mechanisms. It is important to know the risk factors for developing hypoxaemia during OLV which include:[4]
   - Right-sided surgery with left-lung ventilation.
   - Preoperative ventilation-perfusion(V/Q) scan demonstrating a high percentage of ventilation/perfusion to the operative lung.
   - Normal spirometry preoperatively.
   - Low partial pressure of arterial oxygen during two-lung ventilation in lateral decubitus position.
   - BMI > 30 kg/m^2.
   - Previous lobectomy and contralateral lung collapse surgery.
2. Acute lung injury. In this patient, the risk was high due to the presence of significant pre-existing pulmonary disease. Suggested strategies and targets as part of lung-protective ventilation:[3]
   - Maintain as low as acceptable FiO_2.
   - Keep tidal volumes low (4–6 ml/kg predicted body weight (BW)).
   - Peak pressure < 35 cmH_2O.
   - Optimal individualised PEEP versus standardised PEEP 5–8 cmH_2O (except in chronic obstructive pulmonary disease, then limit the use of PEEP).
   - Frequent recruitment manoeuvres.
   - Permissive hypercapnia.
3. Hypercarbia is a concern due to the increased dead space ventilation and intraoperative permissive hypercapnia. The patient's emergence was slightly prolonged due to the CO_2 narcosis, but the central venous pressure remained normal, and they developed no haemodynamic instability or arrhythmias.

Table I: Indications for one-lung ventilation[3]

Absolute	Relative
To prevent damage or contamination of the healthy lung: • Lung abscess and pulmonary haemorrhage.	To improve surgical access (strong): • Thoracic aortic aneurysm. • Pneumonectomy. • Lung volume reduction surgery. • Minimally invasive cardiac surgery. • Upper lobectomy. • Video-assisted thoracoscopic surgery.
To control the distribution of ventilation: • Bronchopleural fistula, major cyst or bulla, traumatic bronchial disruption. To facilitate single-lung lavage: • Cystic fibrosis, pulmonary alveolar proteinosis.	To improve surgical access (weaker): • Oesophageal surgery. • Middle and lower lobectomy. • Mediastinal mass reduction.

Conclusion

Patients may present with comorbid diseases that can pose an anaesthetic management challenge. Thorough planning reduces unexpected intraoperative complications. In this case, knowledge of lung isolation methods and complications of OLV contributed to a satisfactory perioperative course.

Conflict of interest

The authors declare no conflict of interest.

Funding source

None.

Ethical approval

Written, informed consent was obtained from the patient to report and publish the case. Ethical approval was obtained from the Stellenbosch University Human Research Ethics Committee (reference: C24/07/024).

ORCID

V Pather https://orcid.org/0009-0006-0423-2900
T Louw https://orcid.org/0000-0003-0454-9335

References

1. who.int [Internet]. WHO launches updated guidance on HIV-associated TB. Geneva: World Health Organization; 2024. Available from: https://www.who.int/news/item/16-05-2024-who-launches-updated-guidance-on-hiv-associated-tb. Accessed 27 July 2024.
2. Kubjane M, Osman M, Boulle A, Johnson LF. The impact of HIV and tuberculosis interventions on South African adult tuberculosis trends, 1990-2019: a mathematical modeling analysis. Int J Infect Dis. 2022;122:811-9. https://doi.org/10.1016/j.ijid.2022.07.047.
3. Ashok V, Francis J. A practical approach to adult one-lung ventilation. BJA Educ. 2018;18(3):69-74. https://doi.org/10.1016/j.bjae.2017.11.007.
4. Campos JH, Feider A. Hypoxia during one-lung ventilation-a review and update. J Cardiothorac Vasc Anesth. 2018;32(5):2330-8. https://doi.org/10.1053/j.jvca.2017.12.026.