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CASE REPORT

Anaesthetic Management of One-Lung Ventilation Lower Lobectomy

M. Sethu Madhav[1], Vishnu Vardhan V.[2], Dinesh K.[3]
Ravi Madhusudhana[4], Mukesh S[5]

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ABSTRACT

One-lung ventilation (OLV) is routinely used to provide surgical exposure during thoracic procedures, but separation of the lungs can produce clinically important changes in oxygenation. We describe the perioperative anaesthetic management of a 76-year-old woman weighing 44 kg who underwent pulmonary lobectomy. A thoracic epidural was placed before induction, and lung isolation was achieved with a 28 Fr left-sided double-lumen tube. After initiation of OLV, oxygen saturation fell from 99% to 90%, with an arterial PaO_2 of 68 mmHg. Tube position was reassessed by fibreoptic bronchoscopy, inspired oxygen was increased to 1.0, recruitment of the dependent lung was performed, and PEEP was adjusted. CPAP of 5 cm H_2O was subsequently applied to the non-dependent lung. Oxygen saturation rose to 97% and PaO_2 to 118 mmHg, with no further desaturation. The operation lasted 310 minutes, with 520 mL blood loss and stable haemodynamics. Postoperative analgesia was provided through the thoracic epidural, and the patient had an uncomplicated recovery. This case illustrates the value of systematic assessment and stepwise intervention when hypoxaemia develops during OLV.

KEYWORDS:

• One-lung ventilation • Lobectomy • Double-lumen tube • Thoracic anaesthesia • Lung isolation • Thoracic epidural analgesia

AUTHOR'S AFFILIATION:

[1] Junior Resident, Department of Anesthesiology, Sri Devaraj Urs Medical College, SDUAHER, Kolar, Karnataka, India.
[2] Professor, Department of Anaesthesia, Sri Devaraj Urs Medical College, SDUAHER, Kolar, Karnataka, India.
[3] Professor, Department of Anesthesiology, Sri Devaraj Urs Medical College, SDUAHER, Kolar, Karnataka, India.
[4] Professor, Department of Anesthesiology, Sri Devaraj Urs Medical College, SDUAHER, Kolar, Karnataka, India.
[5] Senior Resident, Department of Anaesthesiology, Sri Devaraj Urs Medical College, SDUAHER, Kolar, Karnataka, India.

CORRESPONDING AUTHOR:

Vishnu Vardhan V., Professor, Department of Anaesthesia, Sri Devaraj Urs Medical College, SDUAHER, Kolar, Karnataka, India.

E-mail: voletivishnu@gmail.com

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INTRODUCTION

Thoracic operations often require separation of the lungs so that the operative field remains accessible and the opposite lung is protected. OLV provides this separation but alters the normal relationship between ventilation and pulmonary blood flow. Consequently, oxygenation, airway pressures and cardiovascular status need close observation throughout the procedure. A low tidal-volume strategy is particularly important when only one lung is ventilated, while correct positioning of the lung-isolation device must be confirmed and rechecked after patient repositioning. We present the anaesthetic course of an elderly patient undergoing lobectomy in whom a short episode of hypoxaemia during OLV was successfully treated with a structured sequence of interventions.

CASE REPORT

A 76-year-old woman, weighing 44 kg and 148 cm tall, was evaluated for pulmonary surgery. She had a two-month history of carcinoma associated with an ulcer over the lower gingivobuccal sulcus. She had chewed tobacco for approximately 40 years and had stopped two months before presentation. Hypertension had recently been diagnosed and was controlled with amlodipine 5 mg once daily. There was no reported diabetes mellitus, ischaemic heart disease or drug allergy.

Her preoperative investigations showed haemoglobin 12.4 g/dL, total leukocyte count 9140/mm^3, platelet count 2.1 lakh/mm^3 and serum creatinine 0.6 mg/dL; liver function tests were normal. Contrast-enhanced computed tomography of the chest identified a 2.0 × 1.7 × 2.0 cm lesion in the superior segment of the right lower lobe. Pulmonary function testing showed FEV1 78% of predicted, FVC 82% of predicted, an FEV1/FVC ratio of 0.75 and DLCO 70% of predicted. Electrocardiography showed sinus rhythm. Echocardiography demonstrated concentric left ventricular hypertrophy with an ejection fraction of 60%. She was classified as ASA Physical Status III.

Anaesthetic Plan and Preparation

General anaesthesia with surgical lung isolation was planned. The anaesthesia team prepared a difficult-airway cart, fibreoptic bronchoscope, a 28 Fr left-sided double-lumen tube, equipment for arterial and central venous access, a thoracic epidural set and emergency airway devices. Standard monitoring comprised ECG, pulse oximetry, non-invasive blood pressure, capnography and temperature. A right radial arterial catheter, a left femoral central venous catheter and a urinary catheter were also placed.

Before induction, an epidural catheter was inserted at T8–T9 using aseptic technique. The patient was preoxygenated with 100% oxygen for five minutes. Anaesthesia was induced intravenously with midazolam 2 mg, fentanyl 100 µg, propofol 100 mg and vecuronium 5 mg. After adequate neuromuscular relaxation, the trachea was intubated with a 28 Fr left-sided double-lumen tube. Position was assessed clinically by bilateral auscultation and then with fibreoptic bronchoscopy. The tube position was checked again after the patient was placed in the lateral position.

Intraoperative Management

Anaesthesia was maintained with an oxygen-air mixture, with FiO_2 adjusted between 0.6 and 1.0, isoflurane at 1 MAC and intermittent rocuronium. The thoracic epidural was used for analgesia with 0.125% bupivacaine and fentanyl. During two-lung ventilation, tidal volume was set at 6–8 mL/kg, respiratory rate at 12 breaths/minute and PEEP at 5 cm H_2O.

After placement of the thoracoscopic ports, the right lung was isolated and OLV commenced. Pressure-controlled ventilation was used, with a tidal volume of 4–6 mL/kg predicted body weight, respiratory rate of 16–18 breaths/minute, PEEP 5 cm H_2O and FiO_2 1.0.

About 30 minutes after OLV began, oxygen saturation declined from 99% to 90%. Arterial blood gas analysis showed a PaO_2 of 68 mmHg. The response was sequential rather than relying on a single intervention. Fibreoptic bronchoscopy was first used to exclude malposition of the double-lumen tube. FiO_2 was then maintained at 1.0, recruitment of the dependent lung was performed and PEEP was adjusted. CPAP of 5 cm H_2O was added to the non-dependent lung. Oxygen saturation subsequently increased to 97%, while PaO_2 improved to 118 mmHg. No additional desaturation episodes were reported.

The patient underwent right lower lobectomy (Figure 1) with mediastinal lymph-node dissection (Figure 2). The procedure lasted

310 minutes. Estimated blood loss was 520 mL, and 2300 mL of balanced crystalloid was administered. No blood transfusion was necessary, and haemodynamic variables remained stable.



Figure 1: Collapsed lung following isolation with a double-lumen tube

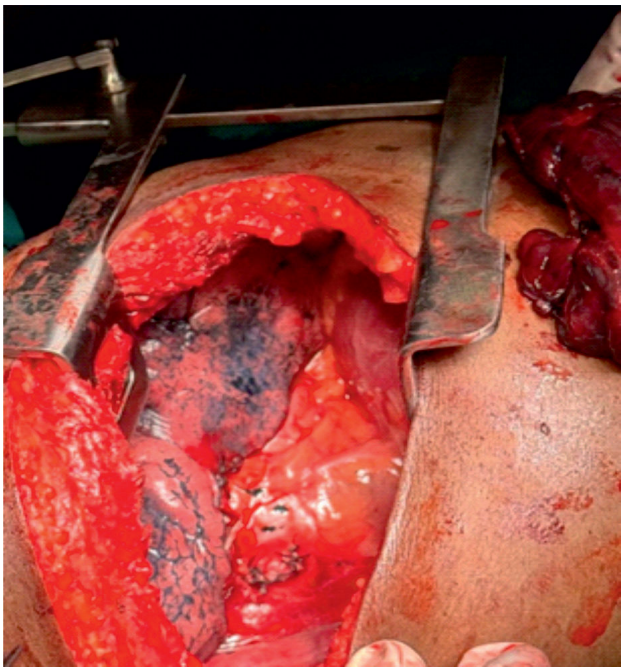


Figure 2: Resected lung before closure

Emergence and Postoperative Management

At the end of surgery, ventilation of both lungs was restored and recruitment was performed. Bronchoscopy confirmed satisfactory lung expansion. Neuromuscular blockade was antagonised with neostigmine 2.5 mg and glycopyrrolate 0.4 mg intravenously. Extubation was undertaken after standard clinical criteria had been met.

Postoperative analgesia continued through the thoracic epidural using 0.125% bupivacaine with fentanyl 2 µg/mL. Pain scores remained below 3/10 during the first 48 hours. She was observed in the thoracic intensive care unit for 24 hours. There was no documented reintubation, pneumonia, prolonged air leak or arrhythmia. She was discharged on postoperative day seven. Histopathological examination showed lung adenocarcinoma with tumour-free margins.

DISCUSSION

OLV changes pulmonary perfusion and ventilation because one lung is deliberately excluded from ventilation while it may continue to receive blood flow. The resulting shunt and ventilation–perfusion imbalance can reduce arterial oxygenation. Hypoxic pulmonary vasoconstriction limits, but does not completely eliminate, perfusion of the non-ventilated lung. Accordingly, safe thoracic anaesthesia depends on reliable lung isolation, continuous assessment of oxygenation and circulation, protective ventilation of the dependent lung and an effective plan for postoperative analgesia.

In this patient, the episode of hypoxaemia developed approximately half an hour after OLV was established. The first priority was to confirm that the double-lumen tube had not moved, making fibreoptic bronchoscopy an important diagnostic step. Increasing inspired oxygen, recruiting the dependent lung and adjusting PEEP were then used to improve oxygenation. Because the saturation remained a concern, 5 cm H_2O CPAP was applied to the non-dependent lung. The subsequent rise in PaO_2 from 68 to 118 mmHg and saturation to 97% suggests a favourable response to this combined approach.[2]

Ventilation during OLV was deliberately delivered with smaller tidal volumes than during two-lung ventilation.[1] This approach is intended to reduce excessive alveolar stretch in the ventilated lung. The patient's lateral position also made repeated assessment of the isolation device important, which is why bronchoscopic confirmation was

performed both after intubation and following positioning.[3]

Regional analgesia was incorporated into the perioperative plan through a thoracic epidural placed before induction. Adequate analgesia is particularly relevant after thoracic surgery because pain can limit effective respiratory effort and coughing. In this case, postoperative pain scores remained low during the first two days, and the recorded recovery was uncomplicated.

The case therefore emphasises that hypoxaemia during OLV should be approached methodically. Device position, ventilator settings and recruitment should be reassessed before progressing to additional measures such as CPAP to the non-dependent lung. Close haemodynamic observation and postoperative surveillance are equally important, particularly in an elderly patient classified as ASA III.[4]

CONCLUSION

Successful anaesthetic management for OLV depends on preparation, dependable lung isolation, protective ventilation and continuous monitoring.[5] When oxygenation deteriorates, a structured sequence beginning with verification of the double-lumen tube and optimisation of the ventilated lung can identify and correct reversible causes. In this case, recruitment, PEEP optimisation and CPAP to the non-dependent lung restored oxygenation without further intraoperative desaturation.[6] Thoracic epidural analgesia also contributed to satisfactory postoperative pain control.[7]

Conflict of Interest: Nil.

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