

ANESTHETIC MANAGEMENT OF A PATIENT WITH PULMONARY ASPERGILLOMA UNDERGOING THORACOTOMY AND LOBECTOMY: A CASE REPORT

Adi Wibowo^{1*}, Juni Kurniawati²,

¹RSUD Prof Dr Margono Soekarjo, Purwokerto, Indonesia

²Department of Anesthesiology and Intensive Care, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia

ABSTRACT

Aspergillosis is most commonly caused by the fungus *Aspergillus fumigatus*. Aspergilloma (fungal ball), develops in post-tuberculous cavities. In many cases, the only therapeutic option is resection of the lung parenchyma colonized by the fungus. Despite this, postoperative care is associated with a relatively high risk of complications. We report a 35-year-old male patient with pulmonary aspergilloma. A right upper lobectomy was performed through thoracotomy using one-lung ventilation (OLV) with a double-lumen endotracheal tube (ETT) placed on the left side. Invasive monitoring included central venous catheter (CVC), arterial line, and EtCO₂ monitoring. Postoperatively, pain management and fast-track extubation were implemented. *Aspergillus fumigatus* spores are widespread in the environment, and hyphae are relatively frequently found in sputum samples. In many cases, diagnosis is based on radiological examination. Management of aspergilloma is complex and still controversial; surgical recommendations are only for patients in good general condition without significant comorbidities. General anesthesia with OLV is crucial for optimal lung visualization but may lead to pulmonary complications, particularly postoperatively. During ICU care, effective pain management is essential for patient comfort and timely extubation. Pneumonectomy should only be considered as a last resort due to its high mortality rate. Proper preoperative assessment, risk stratification, and postoperative counseling are critical. A multidisciplinary approach helps optimize patient care in the postoperative period, allowing for early detection and treatment of potentially fatal complications.

Keywords: Aspergilloma, One-Lung Ventilation, Anesthesia Management, Thoracotomy Pneumonectomy.

Corresponding author:

Adi Wibowo

RSUD Prof Dr Margono Soekarjo, Purwokerto

Jl dr Gumbreg No 1, Purwokerto, Kab. Banyumas

E-mail: wibowoadispan@gmail.com

INTRODUCTION

Pulmonary aspergillosis is a fungal infection caused by species of the genus *Aspergillus*, particularly *Aspergillus fumigatus*. Pulmonary aspergilloma is a clinical manifestation characterized by fungal colonization of a pulmonary cavity formed as a result of an underlying disease, most commonly pulmonary tuberculosis (TB). The colonization forms a mass resembling a fungal ball (fungus ball or mycetoma), consisting of fungal hyphae, fibrin, mucus, inflammatory cells, and other tissue components. This condition is frequently found in patients with a history of pulmonary TB, whether they are still recovering or have completed treatment (Rozaliyani et al., 2017; Brik et al., 2018).

The clinical manifestations of pulmonary aspergilloma vary, ranging from asymptomatic disease to recurrent or massive hemoptysis, which can be life-threatening. In patients with recurrent or massive hemoptysis, surgical lung resection may be considered definitive treatment. However, the decision to operate should take into account the extent of the lesion, the patient's general condition and pulmonary function, and the risk of perioperative complications. Patients with a history of pulmonary TB may have anatomical changes and impaired pulmonary function that increase the complexity of resection. Poor nutritional status may also be a consideration when determining surgical eligibility and planning postoperative recovery (Brik et al., 2018; Kasprzyk et al., 2017).

Anesthesiology perspective, thoracotomy and lobectomy for pulmonary aspergilloma present specific challenges, particularly in patients with limited pulmonary reserve. General anesthesia with one-lung ventilation (OLV) is required to collapse the lung being operated on and provide an adequate surgical field. However, OLV can cause ventilation-perfusion mismatch and hypoxemia due to increased intrapulmonary shunting. Particular attention is required during right-sided lung surgery, after positioning the patient laterally, and in patients with pre-existing pulmonary impairment. Preoperative assessment, selection of a lung-isolation device, protective ventilation settings, and monitoring of oxygenation and hemodynamics are therefore key components of anesthetic management during thoracic surgery (Campos *et al.*, 2006; Slinger, 2003). In addition to intraoperative challenges, anesthetic management includes preventing postoperative complications, particularly atelectasis, pneumonia, impaired gas exchange, and post-thoracotomy pain. Inadequately controlled pain can impede spontaneous ventilation, effective coughing, and early mobilization, thereby increasing the risk of respiratory complications. Anesthetic and multimodal analgesic strategies, assessment of readiness for extubation, and adequate postoperative monitoring are needed to support pulmonary recovery and reduce the need for prolonged mechanical ventilation (Ngo Nonga *et al.*, 2018; Rogers *et al.*, 2018; Slinger, 2003).

This case report describes and discusses the perioperative anesthetic management of a patient with right pulmonary aspergilloma who underwent thoracotomy and right upper lobectomy, with particular attention to preoperative risk assessment, OLV, intraoperative monitoring, and postoperative pain management and recovery strategies. This case is noteworthy because the patient's history of pulmonary TB and underweight status, with a body mass index (BMI) of 17.9 kg/m², were relevant to anesthetic planning and perioperative decision-making. The discussion aims to illustrate the application of thoracic anesthesia principles in a patient with pulmonary aspergilloma and the clinical considerations involved in minimizing respiratory complications during and after surgery.

RESEARCH METHOD

We report the case of a 35-year-old man diagnosed with right pulmonary aspergilloma, with fungal culture indicating *Aspergillus*. Non-contrast multislice computed tomography (MSCT) showed a solid mass in the right upper lobe. The patient underwent thoracotomy and right upper lobectomy. The patient's medical history revealed pulmonary TB approximately two years earlier, for which he had completed a six-month course of treatment. After completing treatment, he resumed his usual activities and worked as a mechanic in an auto repair shop. Approximately four months before presentation, he developed hemoptysis. He was then evaluated at a pulmonary outpatient clinic, where sputum testing and chest radiography were performed.

On physical examination, the patient appeared thin and weighed 50 kg. He was 167 cm tall, with a body mass index (BMI) of 17.9 kg/m² and a body surface area (BSA) of 1.54 m². No abnormalities were found on cardiac or pulmonary examination. His hemodynamic status was stable, with a blood pressure of 120/65 mmHg, heart rate of 76 beats/min, and SpO₂ of 99% on room air. Laboratory tests, chest radiography, and thoracic MSCT were performed. Chest radiography showed an infiltrate in the right upper lobe, with the heart size within normal limits (Figure 1). Electrocardiography (ECG) showed sinus rhythm with a heart rate of 80 beats/min (Figure 2).

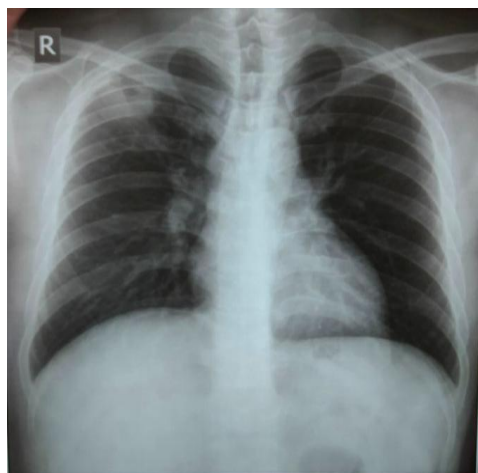


Figure 1. Chest radiograph (July 10, 2024).

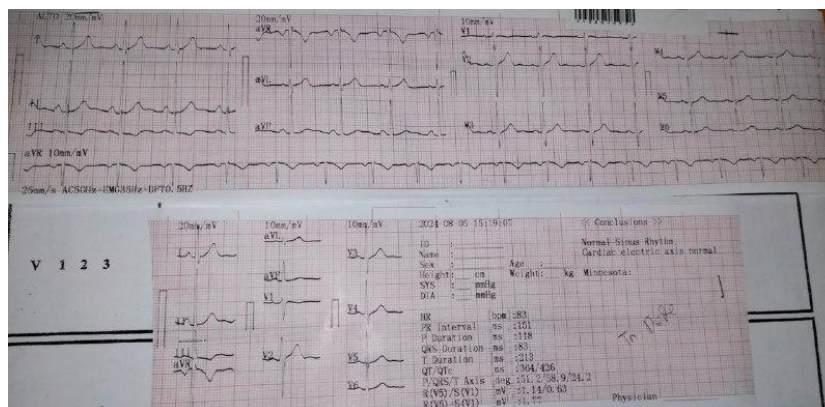


Figure 2. Electrocardiogram.

Non-contrast thoracic MSCT showed a suspected right pulmonary mass in segment 2, measuring 4.8×4.9 cm, with a surrounding pneumonic reaction and minimal infiltration into a small area of the adjacent lateral pleura. No right pleural effusion was observed, and the heart was normal in size.

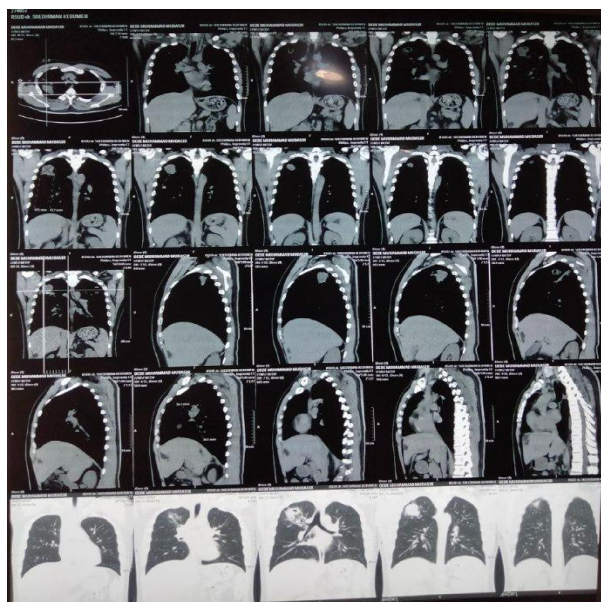


Figure 3. Thoracic MSCT scan.

The laboratory examination results indicated that all measured parameters were within normal limits, as presented in Table 1.

Table 1. Laboratory Test Results

Parameter	Result	Reference range
Leukocyte	6,4	$4,5 - 11,5 \times 10^3/\mu\text{L}$
Eritrocyte	4,0	$4,0 - 5,4 \times 10^6/\mu\text{L}$
Hemoglobin	13,2	12,0 – 15,0 g/dL
Hematokrit	40,3	35,0 – 49,0 %
Platelets	208	$150 - 450 \times 10^3/\mu\text{L}$
Albumin	4,22	3,97 – 4,94 g/dL
BUN	16	6,0 – 20,0 mg/dL
Creatinin	1,13	0.50 – 0.90 mg/dL
GDS	105	80 – 140
Na/K/Cl	135/4,3/100	136–145/3,5–5,1/98–107
PPT	10,7 (k 11)	14–15,8
APTT	31,1 (k 31,2)	31–40
INR	0,98	0,9–1,1
OT/PT	12,1/15,3	<32/<33
AGD	FiO ₂	21%
PH	7,44	7,35–7,45
PaO ₂	85	60–90
PaCO ₂	35	35–45
BE	-1	± 2
HCO ₃	21	22–27

Based on the history, physical examination, and investigations, the patient was classified as ASA physical status II. General anesthesia with OLV and invasive monitoring was planned.

DISCUSSION

Pulmonary aspergilloma is the colonization of a lung cavity by *Aspergillus*, with the cavity arising from an underlying disease, most commonly pulmonary TB. In this patient, a history of pulmonary TB approximately two years earlier and completion of a six-month treatment course were clinically relevant and supported the possibility of a post-tuberculous cavity serving as a site of fungal colonization. Culture identified *Aspergillus*, while thoracic MSCT showed a 4.8×4.9 cm mass in segment 2 of the right lung, with a surrounding pneumonic reaction and minimal infiltration into the lateral pleura. These findings, together with the patient's approximately four-month history of hemoptysis, informed clinical management (Brik *et al.*, 2008; Rozaliyani *et al.*, 2017).

Management of pulmonary aspergilloma requires balancing the benefits of disease control against the risks of surgery. Lung resection may provide definitive treatment, particularly in patients with recurrent or massive hemoptysis. However, the decision to operate should take into account the patient's general condition, pulmonary function, lesion extent, and the risk of postoperative complications. Kim *et al.* and the literature on surgical management of aspergilloma emphasize the importance of careful patient selection and preoperative risk assessment (Brik *et al.*, 2008; Kasprzyk *et al.*, 2017).

The patient was 35 years old, weighed 50 kg, and was 167 cm tall, with a BMI of 17.9 kg/m^2 . This indicates underweight status, which should be considered in perioperative planning, particularly in relation to physiological reserve, nutritional requirements, and postoperative recovery. Nevertheless, several preoperative findings supported proceeding with surgery: the patient was hemodynamically stable, had an SpO_2 of 99% on room air, had no significant abnormalities on cardiac or pulmonary examination, and had an arterial blood gas showing a PaO_2 of 85 mmHg and PaCO_2 of 35 mmHg on FiO_2 of 21%. Based on these findings, the patient was classified as ASA II and scheduled for general anesthesia with OLV and invasive monitoring.

The choice of lobectomy in this patient should be considered in the context of the lesion's location in the right upper lobe. In principle, an anatomical resection that preserves healthy lung tissue may be considered when the lesion's characteristics permit and adequate postoperative pulmonary function is anticipated. However, determining whether lobectomy was the most appropriate option for this patient also depends on pulmonary function testing, the extent of tissue involvement, and intraoperative findings. Spirometry, diffusing capacity, and predicted postoperative pulmonary function were not reported; therefore, the physiological suitability of lobectomy cannot be quantitatively assessed. Accordingly, low BMI alone is insufficient to conclude that lobectomy was either an ideal or an unsuitable choice.

Preoperative assessment is essential in patients undergoing lung resection to determine surgical suitability and develop an anesthetic plan. Assessment includes pulmonary history, physical examination, respiratory status, investigations, and an estimate of the patient's ability to maintain gas exchange during and after lung resection. Respiratory complications, including atelectasis, pneumonia, and respiratory failure, are major concerns in thoracic surgery. In this patient, the history of pulmonary TB and the

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mass in the right upper lobe were important considerations in planning intraoperative ventilation. Although the patient showed no clinically significant respiratory impairment before surgery, neither an SpO₂ of 99% on room air nor a PaO₂ of 85 mmHg on FiO₂ of 21% can, in isolation, predict oxygenation during OLV. Pulmonary function testing, particularly spirometry, FEV₁, FVC, and predicted postoperative pulmonary function, would provide additional information about the patient's respiratory reserve (Choi and Mazzone, 2015; Slinger, 2003)

In this procedure, OLV was planned to provide an optimal surgical field during right upper lobectomy. However, OLV can cause hypoxemia by increasing intrapulmonary shunting, as blood continues to flow through the non-ventilated lung. Lateral positioning and surgery on the right lung may also affect ventilation and perfusion during OLV (Slinger, 2003). In this case, OLV was planned using a left-sided double-lumen ETT. This device was selected to isolate the right lung and ventilate the left lung during surgery. Successful lung isolation should be confirmed after intubation and again after the patient is placed in the lateral position, because malposition may result in inadequate ventilation, impaired oxygenation, and a compromised surgical field (Campos *et al.*, 2006; Slinger, 2003).

It is important to emphasize that the risk of hypoxemia during OLV in this patient represents an anesthetic consideration, not a confirmed complication. The case report does not provide SpO₂ or PaO₂ values during OLV, actual ventilator settings, or documentation of intraoperative desaturation. Therefore, hypoxemia should be discussed as a potential risk based on the patient's preoperative status and the nature of the procedure, rather than as a confirmed clinical event. During thoracic surgery, hemodynamic and respiratory monitoring is essential to maintain patient stability under general anesthesia and OLV. In this case, invasive monitoring with an arterial line and a central venous catheter (CVC) was planned, in addition to electrocardiography and end-tidal carbon dioxide (EtCO₂) monitoring. These forms of monitoring are relevant during thoracotomy and lung resection because changes in patient position, intrathoracic manipulation, blood loss, and intrathoracic pressure can affect hemodynamics and gas exchange (Slinger, 2003).

An arterial line enables continuous blood pressure monitoring and allows arterial blood gas sampling, if required, to evaluate oxygenation, ventilation, and acid-base status during OLV. A CVC may be considered to provide vascular access and administer medications or fluids, particularly when significant blood loss or hemodynamic changes are anticipated. However, central venous pressure should not be used as the sole indicator of intravascular volume status or fluid responsiveness during thoracic surgery with an open chest (Slinger, 2003). EtCO₂ monitoring also helps assess ventilation during OLV. However, the relationship between EtCO₂ and PaCO₂ may change during one-lung ventilation because of altered ventilation-perfusion distribution and increased physiological dead space. EtCO₂ should therefore be interpreted in conjunction with the patient's clinical status and ventilator parameters, and with arterial blood gas results when available (Slinger, 2003).

The use of a left-sided double-lumen ETT for OLV in this patient was consistent with the need to isolate the right lung during lobectomy. Protective ventilation during OLV generally aims to maintain gas exchange while minimizing the risk of ventilator-induced lung injury. Tidal volume based on predicted body weight, airway pressure, PEEP, respiratory rate, and FiO₂ should be adjusted according to the patient's oxygenation and

hemodynamic response (Campos *et al.*, 2006; Slinger, 2003). Although these principles provide the basis for OLV management, assessing their specific application in this patient requires documentation of actual ventilator settings, SpO₂ during OLV, intraoperative arterial blood gas results, and hemodynamic measurements. Without these data, the adequacy of one-lung ventilation and intraoperative oxygenation stability cannot be objectively assessed.

Postoperative care following thoracotomy and lobectomy aims to maintain oxygenation, prevent respiratory complications, control pain, and support pulmonary recovery. In a patient with a history of pulmonary TB and a BMI of 17.9 kg/m², postoperative assessment should consider the ability to breathe spontaneously, cough effectively, maintain adequate oxygenation, and achieve sufficient analgesia. These considerations are important because post-thoracotomy pain can restrict chest wall expansion and ventilation, increasing the risk of hypoventilation, secretion retention, and atelectasis (Ngo Nonga *et al.*, 2018; Rogers *et al.*, 2018).

Multimodal pain management can reduce pain while minimizing the adverse effects of systemic analgesics. This approach may include systemic analgesics, regional anesthesia techniques, and opioids as clinically indicated. The choice of analgesia should take into account hemodynamic status, respiratory function, bleeding risk, and the patient's ability to mobilize and perform breathing exercises. In patients undergoing thoracotomy, adequate pain control supports effective coughing, deep breathing, and chest physiotherapy (Ngo Nonga *et al.*, 2018; Rogers *et al.*, 2018). In this case, postoperative pain management and planned early extubation were part of the anesthetic recovery strategy. However, the success of this approach should be evaluated using clinical documentation, including the analgesic methods actually administered, pain intensity, need for rescue analgesia, respiratory status, and actual time to extubation. Early extubation may be considered when the patient meets clinical criteria, including adequate consciousness, spontaneous ventilation, stable oxygenation and hemodynamics, and the ability to maintain the airway. The decision to extubate should be individualized and not based solely on a predetermined time target (Rogers *et al.*, 2018; Slinger, 2003).

Postoperative monitoring should also include assessment for hypoxemia, secretion retention, atelectasis, pneumonia, and other respiratory complications. Chest physiotherapy, deep-breathing exercises, effective coughing, early mobilization, and oxygen support as needed are important components of recovery following lung resection (Ngo Nonga *et al.*, 2018; Rogers *et al.*, 2018). The postoperative recovery strategy in this case cannot be fully evaluated because the report does not provide detailed information on the actual time of extubation, oxygen requirements after extubation, postoperative radiological findings, pain intensity, or length of ICU stay. Therefore, successful fast-track extubation, the absence of atelectasis, and the absence of respiratory complications should be verified in the medical record before being reported as clinical outcomes.

CONCLUSION

Appropriate preoperative assessment to identify surgical risk factors is essential for achieving favorable postoperative outcomes. Anesthesiologists are responsible for using preoperative assessment to identify high-risk patients and guide perioperative planning, with particular attention to those at elevated risk in order to improve outcomes. The selection of anesthetic technique and hemodynamic monitoring during OLV are important

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in minimizing complications during thoracic surgery. A multidisciplinary team—including surgeons, anesthesiologists, and nurses—should coordinate care throughout the perioperative period, including during postoperative management in the intensive care unit or hospital ward.

REFERENCE

- Brik A, Salam AM, Kamal A, Sadek MA, Essa m, Sharawi M *et al.*, 2018. Surgical outcome of pulmonary aspergilloma. *European Journal of Cardio-thoracic Surgery* 2018; 34: 882-5.
- Campos JH, Hallam E, Van Natta T, et al. Devices for lung isolation used by anesthesiologists with limited thoracic experience: comparison of double-lumen endotracheal tube, Univent torque control blocker, and Arndt wire-guided endobronchial blocker. *Journal Anesthesiology*. 2006;104:261–266.
- Choi H, Mazzone P. Preoperative evaluation of the patient with lung cancer being considered for lung resection. *Curr Opin Anesthesiologi*. 2015;28(1):18–25.
- Garner, M., Brunswicker, A., Surgical management of pulmonary aspergilloma, *Shanghai Chest Journal*, vol 7, 2023.
- Kasprzyk, M., Pieczyński, K., Mania, K., Gabryel, P., Piwkowski, C., and Dyszkiewicz, W. Surgical treatment for pulmonary aspergilloma – early and long-term results, *Cardiothoracic anesthesia*. 2017 Jun; 14(2): 99–103.
- Ngo Nonga B, Bang GA, Jemea B, et al. Complex Pulmonary Aspergilloma: Surgical Challenges in a Third World Setting. *Surgical Respiratory Practice* 2018;2018:6570741.
- Park S, Mehrad B. Innate immunity to aspergillus species. *Clinical microbiology reviews*. 2019; 22(4): 535–551.
- Rogers L.J., Bleetman D., Messenger D.E., Joshi N.A., Wood L., Rasburn N.J., Batchelor T.J.P. The impact of enhanced recovery after surgery (ERAS) protocol compliance on morbidity from resection for primary lung cancer. *Journal Thoracic Cardiovascular Surg*. 2018;155:1843–1852. doi: 10.1016/j.jtcvs.2017.10.151.
- Rozaliyani, A., Jusuf A, Handayani, D., Syahrudin, E., Burhan E, Isbaniyah, F., 2017. *Mikosis paru. Pedoman nasional Untuk Diagnosis dan Penatalaksanaan di Indonesia*. PDPI. Jakarta. 2017.
- Shen C, Qiao G, Wang C, et al. Outcomes of surgery for different types of chronic pulmonary aspergillosis: results from a single-center, retrospective cohort study. *BMC Pulmonary Medicine* 2022;22:40
- Slinger, P., Erin, A., Sullivan, Anesthetic Management for Surgery of the Lungs and Mediastinum. *Hensley's Practical Approach to Cardiothoracic Anesthesia 6th*, 2019. 307-330