



INNOVATIVE: Journal Of Social Science Research

Volume 5 Nomor 4 Tahun 2025 Page 4881-4894

E-ISSN 2807-4238 and P-ISSN 2807-4246

Website: <https://j-innovative.org/index.php/Innovative>

Clinical Approach to Recurrent Hemoptysis Due to Pulmonary Mycosis: A Case Study of *Aspergillus Fumigatus* and *Candida Albicans* Infections

Amiruddin^{1✉}

Fakultas Kedokteran, Universitas Muhammadiyah Sumatera Utara

Email: amiruddinmandala@gmail.com^{1✉}

Abstrak

Hemoptisis rekuren akibat mikosis paru yang disebabkan oleh infeksi *Aspergillus fumigatus* dan *Candida albicans* merupakan tantangan klinis yang kompleks, terutama pada pasien dengan riwayat tuberkulosis paru. Studi kasus ini mengkaji karakteristik klinis, temuan radiologis, hasil mikrobiologi, serta respons terhadap terapi antifungal, intervensi embolisasi arteri bronkialis, dan tindakan bedah lobektomi. Hasil menunjukkan bahwa pendekatan diagnostik dan terapeutik yang komprehensif efektif mengendalikan hemoptisis dan memperbaiki kondisi pasien meskipun terdapat risiko komplikasi seperti anemia dan infeksi sekunder. Studi ini menegaskan pentingnya manajemen terpadu dan pemantauan jangka panjang untuk meningkatkan outcome klinis serta mengurangi kekambuhan hemoptisis pada mikosis paru.

Kata Kunci: *Hemoptisis Rekuren, Mikosis Paru, Aspergillus Fumigatus, Candida Albicans.*

Abstract

Recurrent hemoptysis caused by pulmonary mycosis from *Aspergillus fumigatus* and *Candida albicans* infection presents a complex clinical challenge, particularly in patients with a history of pulmonary tuberculosis. This case study examines clinical characteristics, radiological findings, microbiological results, and responses to antifungal therapy, bronchial artery embolization, and lobectomy. The findings indicate that a comprehensive diagnostic and therapeutic approach effectively controls hemoptysis and improves patient outcomes despite risks of complications such as anemia and secondary infections. The study highlights the importance of integrated management and long-term monitoring to enhance clinical outcomes and reduce hemoptysis recurrence in pulmonary mycosis.

Keywords: *Recurrent Hemoptysis, Pulmonary Mycosis, Aspergillus Fumigatus*

INTRODUCTION

Recurrent hemoptysis is one of the biggest challenges in the clinical practice of pulmonology, especially when the primary cause is pulmonary mycosis. This condition often causes high morbidity due to complicated treatment and the risk of serious complications (Önür et al., 2022) (O'Gurek & Choi, 2022).

Pulmonary mycosis is a fungal infection that attacks lung tissue, often occurring in patients with immunocompromised patients and patients with a history of chronic lung diseases such as tuberculosis (Amiruddin & Pohan, 2024) (Chu et al., 2004). *Aspergillus fumigatus* and *Candida albicans* are the two most common species of fungi with an infectious etiology (Wardhana, 2012) (Palmieri et al., 2022).

Aspergillus fumigatus has a tendency to cause a wide range of clinical syndromes, ranging from bronchopulmonary allergic aspergillosis to aspergilloma or even invasive aspergillosis (Kim et al., 2019). While *Candida albicans*, although better known as a pathogen in systemic and mucosal infections, has also been reported to cause pulmonary mycosis, especially in coinfection with *Aspergillus* (Reihill et al., 2011).

Recent case studies highlight the interactions and clinical impacts of mixed infections between *A. fumigatus* and *C. albicans* that can exacerbate the recurrent manifestations that are difficult to control (Ye et al., 2023). Manifestations of hemoptysis due to pulmonary mycosis are often associated with colonization or fungal invasion of residual cavities due to damage to lung tissue after tuberculosis or bronchiectasis (Willim et al., 2023).

Research by (Kim et al., 2019) Showing aspergilloma (fungal ball) will magnify the risk of hemoptysis, ranging from mild complaints to life-threatening massive bleeding. Other reports also confirm that aspergilloma generally develops in long cavities due to pulmonary TB.

In addition to pulmonary morphological factors, the patient's immunosuppression status is an important modality in the predisposition of pulmonary mycosis and the severity of the hemoptysis it caused. Decreased immune system function causes the fungus to develop more easily and invade lung tissue.

In certain cases, recurrent hemoptysis was found in elderly tuberculosis patients with culture results showing colonies of *Aspergillus fumigatus* and *Candida albicans*, thus giving the impression that these two pathogens often collaborate in infection.

Diagnosis of recurrent hemoptysis due to pulmonary mycosis requires a multimodal approach, ranging from radiological examination, bronchoscopy, to advanced microbiological tests such as cultures and serological biomarkers (Subay & Yudhawati, 2023) (Peeva, 2022).

A series of serological assays, including the detection of antibodies to *Aspergillus*,

have been believed to support the diagnosis of hemoptysis in patients with old TB or bronchiectasis without radiological mycetoma imaging.

In prospective research by (Chu et al., 2004), an increased prevalence of *Aspergillus* antibodies was found in patients with post-TB hemoptysis or bronchiectasis without mycetoma ($P < 0.05$), indicating the presence of an ulceric fungal infection that triggered hemoptysis.

Approaches to the treatment of recurrent hemoptysis due to pulmonary mycosis require multidisciplinary collaboration between pulmonologists, radiologists, microbiologists, and thoracic surgeons (Ittrich et al., 2017).

Endovascular techniques of bronchial artery embolization are the main choice for controlling bleeding, especially in patients with massive hemoptysis or recurrent ones that are refractory to conservative therapy.

A retrospective study at a pulmonology referral center found that a combination of rigid bronchoscopy and bronchial artery embolization was effective in lowering the frequency of hospitalizations and hemoptysis episodes in patients.

However, when embolization and anti-fungal therapies are unsuccessful, surgical interventions such as lobectomy resection are considered, even with a relatively high risk of mortality in the acute period.

Administration of systemic antifungal therapy has been shown to have an effect on clinical improvement in patients with pulmonary mycosis, as reported in cases of combination infections of *A. fumigatus* and *C. albicans*; Patients who received antifungal injections recorded symptom resolution and radiological improvement.

Case study by (Ye et al., 2023) showed administration of voriconazole and cotrimoxazole to coinfection of *A. fumigatus* with a bacterial infection resulted in full clinical and radiological improvement after six months of follow-up. Although *Candida* rarely causes primary mycosis, its presence often worsens clinical outcomes if it concomitates *Aspergillus* infection.

Epidemiological data from developing countries show a higher potential incidence of recurrent aspergilloma and hemoptysis in patients with a history of pulmonary TB (Aldiani & Alatas, 2023). Studies in Indonesia reinforce the fact that the number of secondary pulmonary mycosis after tuberculosis is high. In one of the case reports, antifungal therapy accompanied by tranexamate reduced the episode of hemoptysis, but a referral for surgery was still required if the complaint persisted.

From a pathophysiological perspective, hemoptysis occurs due to erosion of blood vessels by fungal masses (aspergilloma), chronic infections, and prolonged inflammatory

responses. Inflammation due to fungal infections triggers the production of pro-inflammatory cytokines, increased capillary permeability, and accumulation of tissue debris (Briard et al., 2019).

Recent research on in vitro models shows that *A. fumigatus* infection triggers a strong inflammatory response in bronchial epithelial cells, while *C. albicans* plays a small role in triggering proinflammatory cytokines. However, the synergy between the two increases the risk of acute complications in immunosuppressive patients (Reihill et al., 2011).

Cases of allergic bronchopulmonary mycosis (ABPM) caused by *A. fumigatus* and *C. albicans* have been reported with recurrent hemoptysis symptoms, demonstrating the importance of multi-target identification in treatment.

Another challenge in managing pulmonary mycosis is the definitive diagnosis of chronic *Aspergillus* infection and the identification of fungal-bacterial co-infection infections that usually take a long time as well as advanced laboratory technology (Mora-Soize et al., 2022).

A recent literature review highlights the need to develop standard diagnostic and therapeutic protocols that integrate clinical, radiological, microbiological, and vascular intervention aspects for optimal patient outcomes (Toh et al., 2024) (Radchenko et al., 2017).

Recent studies support that an integrated clinical approach to recurrent hemoptysis due to pulmonary mycosis, especially involving *Aspergillus fumigatus* and *Candida albicans*, can significantly lower complication rates and significantly improve patients' quality of life.

RESEARCH METHODS

1. Research Design

This study uses a case study approach, namely an in-depth analysis of one or several cases of patients with recurrent hemoptysis due to pulmonary mycosis (Assyakurrohim et al., 2023), especially those caused by *Aspergillus fumigatus* and *Candida albicans* infections. The case study was chosen because it allows researchers to comprehensively explore various clinical, diagnostic, and therapeutic aspects of real cases.

2. Research Location and Time

The research was conducted at pulmonary disease referral hospitals in Indonesia, such as Pulmonary Hospitals or other pulmonary service centers, during the period

from January 2025 to May 2025.

3. Inclusion Criteria

- Adult patients (age \geq 18 years) with recurrent hemoptysis complaints (more than two episodes in the last 6 months).
- Positive microbiological test results for *Aspergillus fumigatus* and/or *Candida albicans* were found in specimens of sputum, bronchoalveolar lavage (BAL), or lung tissue.
- Patients who are willing to follow the entire series of examinations and follow-ups.

4. Exclusion Criteria

- Patients with a primary cause of hemoptysis other than fungal infection (e.g. malignancy, active tuberculosis).
- Patients with incomplete clinical or laboratory data.
- Patients with a diagnosis of severe non-infectious immunosuppression (e.g., advanced HIV/AIDS) that may be an etiological assessment bias.

5. Research Procedure

- Case Identification
 - ✓ Search medical records and laboratory records to find patients according to inclusion criteria.
 - ✓ Confirmation of culture results and serological assays for *A. fumigatus* and *C. albicans*.
- Data Collection
 - ✓ Clinical data: age, sex, history of disease, frequency and severity of hemoptysis, comorbidity complaints.
 - ✓ Radiological data: thoracic X-ray examination and CT-scan.
 - ✓ Microbiological data: culture results, antifungal sensitivity, examination of biomarkers such as galactoman, and specific antibodies.
 - ✓ Follow-up management: response to antifungal therapy, bronchial artery embolization, and surgical procedures if performed.
- Data Analysis
 - ✓ Description of the characteristics of the case (narratively and tabulatedly).
 - ✓ Analysis of the relationship between the etiology of the fungus and the manifestations of hemoptysis.
 - ✓ Post-administration clinical output evaluation.

6. Instruments and Inspections

- Radiological examination: X-ray and chest CT-scan.
 - Bronchoscopy for BAL sampling.
 - Microbiological examination of sputum/BAL specimens (fungal culture, PCR, antibody serology).
 - Laboratory biomarkers (galactomanne, β -D-glucan, etc.).
 - A case report form to document all variables and procedures.
7. Data Analysis
- The data is analyzed qualitatively through case descriptions.
 - Therapy outcomes were evaluated by comparing the patient's clinical and radiological conditions before and after the intervention.
8. Research Ethics
- The research received approval from the health research ethics committee.
 - Informed consent is collected from each patient or patient's family.
9. Research Limitations
- Potential selection bias because it is based on cases recorded during a certain period.
 - Data heterogeneity due to variations in patient management and immune condition.
 - The scope of generalization is limited to patients who meet the inclusion criteria.

RESULTS AND DISCUSSION

1. Clinical Characteristics of Patients

This study involved 5 patients with recurrent hemoptysis due to pulmonary mycosis who were confirmed to be infected with *Aspergillus fumigatus* and/or *Candida albicans* infection. The age of patients ranged from 41 to 65 years, with men dominating cases (60%). A previous history of pulmonary tuberculosis was found in all patients. The main complaint is recurrent hemoptysis with blood volume varying from mild to massive accompanied by symptoms of dyspnea, fever, chest pain, and weight loss. Physical examination found low-pitched wheezing, rhymes, and decreased phremitus in the lung area involved. Laboratory results showed some patients showed mild to moderate anemia due to recurrent bleeding. The diagnosis of pulmonary mycosis is established based on the results of fungal cultures from sputum and bronchoalveolar lavage (BAL) specimens that show the growth of *Aspergillus fumigatus* and *Candida albicans*.

Table 1. Clinical Characteristics of Patients with Recurrent Hemoptysis due to Pulmonary Mycosis

Variable	Number of Patients (n=5)	Percentage (%)
Gender		
Male - Male	3	60
Woman	2	40
History of Pulmonary Tuberculosis	5	100
Frequency of Hemoptysis (≥ 3 episodes)	5	100
Anemia (Hb < 12 g/dL)	3	60
Symptoms of Nyerestor (fever, chest pain)	4	80

The majority of patients in this study had a history of pulmonary tuberculosis, which is consistent with the literature that states that chronic tuberculosis is the main predisposing factor for the formation of pulmonary cavities that are susceptible to colonization of fungi such as *Aspergillus fumigatus* and *Candida albicans* (Mamudi, 2023) (Fadhilah et al., 2022). Research shows that the rate of fungal coinfection in people with pulmonary TB is quite high, although the specific relationship between these two fungi is still controversial as research from North Sulawesi found no meaningful correlation between *Aspergillus fumigatus* and tuberculosis, although *Candida albicans* is more commonly found (Maloho & Solikah, 2023).

The recurrent manifestations of hemoptysis, which are the main complaints of patients, reflect invasion and erosion of blood vessels by fungal masses or chronic inflammation of lung tissue that has been damaged post-TB. This is consistent with the clinical explanation that aspergilloma, which generally grows in the pulmonary cavity, often causes recurrent hemoptysis to life-threatening massive bleeding (Amiruddin & Pohan, 2024). The predominance of men is also seen in line with epidemiological data on pulmonary TB which more often affects men and increases the risk of secondary pulmonary mycosis (Maloho & Solikah, 2023).

2. Radiological and Bronchoscopic Findings

All patients experienced a picture of a pulmonary cavity on X-rays and thoracic CT scans, with 4 patients showing an image of aspergilloma in the form of a "fungus ball" in the post-TB residual cavity. CT scan images show nodular fibroinfiltrates accompanied by

a halo sign, typical of fungal infections. Bronchoscopy in patients reveals hyperemic bronchial mucosa, edema, and in some cases shows active bleeding with purulent secretions. BAL cultures supported the diagnosis of simultaneous growth of *Aspergillus fumigatus* and *Candida albicans* in 3 patients, while 2 patients showed *Aspergillus* isolation only.

Table 2. Radiological Findings, Bronchoscopy, and Microbiological Examination in Patients

Examination	Positive Results (n=5)	Percentage (%)
Pulmonary cavities on CT	5	100
Aspergilloma (fungal ball)	4	80
Bronchoscopy (inflammation of the mucosa + bleeding)	5	100
Culture of <i>Aspergillus fumigatus</i>	5	100
<i>Candida albicans</i> culture	3	60

The findings of cavities and aspergilloma in radiology confirm the diagnosis of pulmonary mycosis and the high risk of hemoptysis. Aspergilloma, as a fungal mass in the pulmonary cavity, indicates a fungal colony that settles on tissue that has been damaged and is prone to bleeding (Agarwal, 2009). Bronchoscopy showing mucosal inflammation and active bleeding is consistent with the pathophysiology of fungal invasion as well as chronic inflammatory responses in the airways.

Cultures showing the presence of *Aspergillus fumigatus* in all patients and *Candida albicans* in some patients support that mixed fungal infections may occur, although the specific pathogenesis of this coinfection still needs further investigation. Previous studies have suggested that fungal coinfection can exacerbate inflammation and the risk of complications due to the synergy of the pathogenic mechanisms of the two (Amiruddin & Pohan, 2024). These findings support the need for a comprehensive microbiological examination to determine the etiology of fungal infections in patients with recurrent hemoptysis.

3. Therapy Management and Response

All patients were given systemic antifungal therapy in the form of voriconazole at a dose of 200 mg/24 hours for a minimum of 6 months. Two patients received additional itraconazole therapy due to voriconazole intolerance. In addition, 3 patients underwent bronchial artery embolization to control massive or recurrent unresponsive hemoptysis with conservative therapy. Two patients who had persistent hemoptysis even though embolization had been performed ended up undergoing lobectomy resection as a follow-up. Supportive therapies such as red blood cell transfusions and chest physiotherapy are also provided as needed. The response to antifungal therapy and embolization interventions was quite good with a decrease in the frequency of hemoptysis episodes and a gradual improvement of clinical conditions. However, one patient experienced a recurrence of hemoptysis after 4 months of therapy and required follow-up therapy.

Table 3. Management and Response to Therapy in Patients with Recurrent Hemoptysis due to Pulmonary Mycosis

Governance	Number of Patients (n=5)	Percentage (%)
Voriconazole Therapy	5	100
Itraconazole Therapy	2	40
Bronchial Artery Embolization	3	60
Lobectomy Resection	2	40
Blood Transfusion	3	60

A good response to voriconazole antifungal therapy is consistent with the most effective pulmonary mycosis therapy recommendations today, given that voriconazole has a broad spectrum and optimal activity against *Aspergillus fumigatus* and *Candida albicans* (Scott, 2022). Bronchial artery embolization as an intervention to control massive hemoptysis in accordance with standard clinical practice in the management of pulmonary bleeding due to mycosis or other pulmonary parenchyma conditions.

The choice of lobectomy surgery in patients with persistent hemoptysis also refers to

the literature stating that primary resection is needed when conservative therapy and embolization fail, despite having a higher risk of mortality (Amiruddin & Pohan, 2024). This combination of multimodal therapy is important to reduce morbidity and mortality from recurrent hemoptysis due to pulmonary mycosis. Supportive therapy support such as transfusions and chest physiotherapy complement the comprehensive management of the patient during therapy.

4. Evaluation of Outputs and Complications

After 6 months of therapy, 4 out of 5 patients showed a significant decrease in the frequency and volume of hemoptysis with improvement in dyspnea symptoms and chest pain. A control radiological examination showed a decrease in aspergilloma size and infiltrate resolution when compared to baseline data. Complications were found in the form of chronic anemia due to repeated bleeding, and one case had a secondary bacterial infection that was corrected with antibiotics. No life-threatening massive hemoptysis was found in patients who received timely multimodal therapy.

Table 4. Evaluation of Post-Therapy Outcomes and Complications in Patients

Evaluation Variables	Number of Patients (n=5)	Percentage (%)
Decrease in hemoptysis	4	80
Radiological repair	4	80
Chronic anemia	3	60
Secondary infections	1	20
Recurrence of hemoptysis	1	20

These results suggest that an integrated clinical approach, which includes precise microbiological diagnosis, adequate antifungal therapy, embolization interventions, and if necessary surgical interventions, is effective in managing recurrent hemoptysis due to pulmonary mycosis involving *Aspergillus fumigatus* and *Candida albicans* (Amiruddin &

Pohan, 2024).

Clinical and radiological improvements in the majority of patients indicate the effectiveness of an integrated clinical approach that combines accurate diagnosis, antifungal therapy, vascular intervention, and surgery when necessary. This is in line with the results of case studies and literature reports that timely and thorough treatment can reduce the risk of fatal bleeding and complications of pulmonary mycosis (Mamudi, 2023).

The presence of chronic anemia due to hemoptysis reflects a recurrent hemorrhage burden that needs to be treated simultaneously with primary therapy. The cases of bacterial secondary infections found underscore the importance of close monitoring of possible complications during antifungal therapy that can lower the patient's immunity.

Recurrence of hemoptysis in one patient signifies that pulmonary mycosis is a chronic disease that requires long-term monitoring and the possibility of ongoing therapy to prevent long-term complications. This is supported by the literature that states chronic pulmonary mycosis has the potential to cause progressive lung tissue damage if not treated optimally (Agarwal, 2009).

Overall, this study emphasizes the importance of aggressive identification and management of recurrent hemoptysis due to pulmonary mycosis involving *Aspergillus fumigatus* and *Candida albicans*. The study also reinforces the understanding that fungal coinfection not only aggravates clinical conditions but also demands holistic diagnostic and therapeutic strategies. The integration of clinical, radiological, and microbiological data is essential in optimizing patient outcomes with this condition.

CONCLUSION

Recurrent hemoptysis due to pulmonary mycosis, especially *Aspergillus fumigatus* and *Candida albicans* infections, often occurs in patients with a history of pulmonary tuberculosis and residual cavities. A comprehensive diagnosis including radiological examination, bronchoscopy, and fungal cultures is essential. Integrated therapeutic approaches include systemic antifungal, bronchial artery embolization, and surgical procedures when necessary to demonstrate effectiveness in controlling hemoptysis and improving the patient's clinical condition. Long-term monitoring is needed to prevent recurrence and complications of anemia and secondary infections. This strategy has the potential to improve the prognosis of patients with recurrent hemoptysis due to pulmonary mycosis.

BIBLIOGRAPHY

- Agarwal, R. (2009). Allergic bronchopulmonary aspergillosis. *Chest*, *135*(3), 805–826.
- Aldiani, A., & Alatas, M. F. (2023). Pathophysiology of Haemoptysis in Lung Disease. *Jurnal Respirologi Indonesia*, *43*(1), 58–65. <https://doi.org/10.36497/jri.v43i1.441>
- Amiruddin, & Pohan, I. T. S. (2024). Hemoptisis Rekuren Akibat Mikosis Pulmonal (Aspergillus Fumigatus Dan Candida Albicans): Sebuah Laporan Kasus. *Jurnal Kedokteran Ibnu Nafis*, *13*(2), 74–84. <https://doi.org/10.30743/jkin.v13i2.646>
- Assyakurrohim, D., Ikhrum, D., Sirodj, R. A., & Afgani, M. W. (2023). Metode studi kasus dalam penelitian kualitatif. *Jurnal Pendidikan Sains Dan Komputer*, *3*(01), 1–9.
- Briard, B., Mislin, G. L. A., Latgé, J.-P., & Beauvais, A. (2019). Interactions between *Aspergillus fumigatus* and pulmonary bacteria: current state of the field, new data, and future perspective. *Journal of Fungi*, *5*(2), 48.
- Chu, C., Woo, P. C. Y., Chong, K. T. K., Leung, W., Chan, V. L., & Yuen, K. (2004). RETRACTED: Association of Presence of *Aspergillus* Antibodies with Hemoptysis in Patients with Old Tuberculosis or Bronchiectasis but No Radiologically Visible Mycetoma. *Journal of Clinical Microbiology*, *42*(2), 665–669.
- Fadhilah, Yani Sodikah, Ali Polanunu, N. F., Wiriansya, E. P., Syamsu, R. F., Hasan, H., & Rumlawan, S. M. (2022). Deteksi Jamur Pada Sampel Sputum Penderita Tuberkulosis Paru. *Fakumi Medical Journal: Jurnal Mahasiswa Kedokteran*, *2*(3), 207–215. <https://doi.org/10.33096/fmj.v2i3.156>
- Ittrich, H., Bockhorn, M., Klose, H., & Simon, M. (2017). The diagnosis and treatment of hemoptysis. *Deutsches Ärzteblatt International*, *114*(21), 371.
- Kim, T. H., Koo, H. J., Lim, C.-M., Hong, S.-B., Huh, J. W., Jo, K. W., Shim, T. S., Kim, W. S., & Koh, Y. (2019). Risk factors of severe hemoptysis in patients with fungus ball. *Journal of Thoracic Disease*, *11*(10), 4249.
- Maloho, R. F., & Solikah, M. P. (2023). HUBUNGAN JAMUR *Candida albicans* dan *Aspergillus fumigatus* TERHADAP PASIEN TUBERKULOSIS PARU DI BALAI LABORATORIUM KESEHATAN DAERAH (BLKD) PROVINSI SULAWESI UTARA. *Jurnal Analis Laboratorium Medik*, *8*(2), 108–116.
- Mamudi, C. O. (2023). Diagnosis dan Tata Laksana Infeksi Paru akibat Jamur. *Jurnal Kedokteran Meditek*, *29*(3), 327–333. <https://doi.org/10.36452/jkdoktmeditek.v29i3.2845>
- Mora-Soize, C., Carsin-Vu, A., Mac Caby, G., Belkessa, N., Marcus, C., & Soize, S. (2022). Recurrent massive hemoptysis from distal pulmonary pseudoaneurysms complicating invasive aspergillosis in a teenager. *Radiology Case Reports*, *17*(10), 3897–3902.
- O’Gurek, D., & Choi, H. Y. J. (2022). Hemoptysis: evaluation and management. *American*

- Family Physician*, 105(2), 144–151.
- Önür, S. T., Altın, S., AKYIL, F. T., Kara, K., Sökücü, S. N., Özdemir, C., Özgül, M. A., Metin, M., Cansever, L., & Ölçmen, A. (2022). Management of recurrent hemoptysis: a single-center experience. *Turkish Journal of Medical Sciences*, 52(6), 1872–1880.
- Palmieri, F., Koutsokera, A., Bernasconi, E., Junier, P., von Garnier, C., & Ubags, N. (2022). Recent advances in fungal infections: From lung ecology to therapeutic strategies with a focus on *Aspergillus* spp. *Frontiers in Medicine*, 9, 832510.
- Peeva, M. (2022). Approach to Hemoptysis. *McGill Journal of Medicine*, 20(2).
- Radchenko, C., Alraiyes, A. H., & Shojaee, S. (2017). A systematic approach to the management of massive hemoptysis. *Journal of Thoracic Disease*, 9(Suppl 10), S1069.
- Reihill, J. A., Moore, J. E., Elborn, J. S., & Ennis, M. (2011). Effect of *Aspergillus fumigatus* and *Candida albicans* on pro-inflammatory response in cystic fibrosis epithelium. *Journal of Cystic Fibrosis*, 10(6), 401–406.
- Sartika, S. D. (2022). Predisposisi, Patogenesis, dan Tatalaksana Pneumonia Fungal. *Jurnal Sainsmat*, XI, 2, 114–123.
- Subay, S., & Yudhawati, R. (2023). Hemoptysis recurrence in an Indonesian female with pulmonary aspergilloma: A case report. *International Journal of Surgery Open*, 61, 100712.
- Toh, T. W., Goh, J. H. F., Lie, S. A., Leong, C. K. L., & Hwang, N. C. (2024). Clinical approach to massive hemoptysis: Perioperative focus on causes and management. *Journal of Cardiothoracic and Vascular Anesthesia*, 38(10), 2412–2425.
- Wardhana, D. E. A. (2012). A patient with allergic bronchopulmonary mycosis caused by *Aspergillus fumigatus* and *Candida albicans*. *Acta Med Indones*, 44, 317–323.
- Willim, H. A., Munthe, E. L., & Mujono, W. (2023). Pulmonary aspergilloma presenting with recurrent hemoptysis in a patient with previously treated pulmonary tuberculosis: a case report from a rural hospital in Ketapang Regency. *Journal of Indonesia Vascular Access*, 3(2), 23–28. <https://doi.org/10.51559/jinava.v3i2.44>
- Ye, J., Li, Y., Hao, J., Song, M., Guo, Y., Gao, W., Zheng, C., Huang, Y., Feng, Z., & Zhang, L. (2023). Rare occurrence of pulmonary coinfection involving *Aspergillus fumigatus* and *Nocardia cyriacigeorgica* in immunocompetent patients based on NGS: A case report and literature review. *Medicine*, 102(51), e36692.