PREVALENCE OF *ASPERGILLUS FUMIGATUS* ISOLATED FROM PATIENTS INDICATED FOR PATHOGENIC FUNGAL TESTING AT THE NATIONAL LUNG HOSPITAL IN 2023

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Objectives: To describe the prevalence of *Aspergillus fumigatus (A. fumigatus)* infection in patients indicated for pathogenic fungal testing at the National Lung Hospital in 2023.

Subjects and methods: Patients are assigned to undergo fungal testing at the National Lung Hospital in 2023. Cross-sectional descriptive study.

Results and conclusions: Of the 26,301 patients who were indicated for fungal testing, 817 (3.11%) of patients had positive fungal culture and identification results for *A. fumigatus*. Of which, 787 (96.33%) patients were only infected with *A. fumigatus* and 30 (3.67%) cases were co-infected with *A. fumigatus* with another fungal species. The proportion of men dominated 83.48%, women accounted for 16.52%. The median age of the patients was 65.19 ± 12.92. In which, the age group from 61 - 80 accounts for the largest proportion with 63.28%. The isolation rate of *A. fumigatus* in sputum specimens was mainly (71.4%), followed by bronchial fluid (25.4%), and other specimens accounted for a small proportion (< 1%). The isolation rate of *A. fumigatus* fungi in the departments of the National Lung Hospital was mainly found in the Respiratory Department (24.3%), ranked second in the Emergency Department (17.3%).

Keywords: *Aspergillus fumigatus (A. fumigatus)*, Prevalence, fungal test, Aspergillus, National Lung Hospital.

INTRODUCTION

Aspergillus fumigatus (A. fumigatus) is the most common etiology of fungal infections Aspergillus invasive aspergillosis[1], common in immunocompromised patients, including risk factors such as elderly patients, immunodeficiency diseases such as diabetes, long-term high-dose corticosteroid treatment, cancer, immunosuppressive drug treatment, organ transplantation,...[2]. Patients become infected by inhalation of spores A. fumigatus in the air. The mortality rate of the disease can be up to 35 - 55%, especially in immunocompromised patients if not treated promptly[3]. Every year, in the United States, there are more than 14,000 hospitalizations due to fungal infections Aspergillus invasive, costing more than $1.2 billion in treatment costs[4].

Vietnam is a country with the burden of tuberculosis (172,000 cases annually)[5] and high respiration, so our country has a fungal infection rate Aspergillus highly invasive. According to a study by Tra My et al. in 2020, it was estimated that the rate of fungal infection Aspergillus encroachment is 24/100,000 population[6]. However, the real burden is due to fungal infections Aspergillus Invasive is difficult to estimate because of the lack of comprehensive surveillance data because these diseases are not required to be reported, and there are still many undiagnosed cases of invasive fungal infections globally[7]. Moreover, symptoms of fungal infections Aspergillus are diverse, atypical and difficult to diagnose accurately[8,9]. While the treatment

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of fungal infections Aspergillus Hospitals also face many difficulties because there is not much data on the situation of sensitivity/resistance to antifungal drugs[10]. Therefore, knowing the ratio and some related factors will help managers, pharmacists, doctors and nurses improve the effectiveness of treatment. Sothat, we conduct research with the goal of describing infection rate *A. fumigatus* isolated on patients who were assigned for fungal testing at the National Lung Hospital in 2023.

SUBJECTS AND METHODS

Subjects: Patients are assigned to undergo fungal testing at the National Lung Hospital from January 2023 to December 2023.

Selection criteria: (1) The patient is prescribed a fungal test and has at least one of the risk factors including hypoleukemia (< 500 cells/mm^3); Organ transplantation, stem cell transplantation; Immunodeficiency due to corticosteroids, diabetes, HIV, COPD, cirrhosis; Or have clinical manifestations of suspected fungal infection or images on X-ray or CT with suspicious lesions. (2) The culture and identification results of the fungus were positive for *A. fumigatus*.

Exclusion criteria: Duplicate strains of fungi on the same patient (patients are taken from many types of specimens at the same time and have the same culture results); Patients who do not have complete medical records; the patient was transferred to the hospital or died before the results of the culture and identification of the fungus were available.

Methods: A retrospective study of medical examination records on the hospital management software of the Department of Microbiology and the National Standard Tuberculosis Laboratory (Vietba). Including personal information of the patient such as age, gender, department, type of medical specimen, culture results and fungal identification.

Statistical analysis: Data is entered and cleaned on Excel 2010 software. Then conduct analysis on SPSS 26.0 software; statistics describing the use of frequency, percentage or average, and standard deviation for qualitative and quantitative variables; Tested by chi squared (X2), Fisher's Exact is used to understand the difference between qualitative and quantitative variables that have a statistically significant level of $p < 0.05$.

Research ethic: The study has been approved by the ethics committee of the Hanoi University of Public Health, according to Decision 024-300/DD-YTCC issued on June 21, 2024.

RESULTS

The study collected information from 26,301 patients who were indicated for fungal testing, of which 817 (3.11%) patients had positive fungal culture and identification results for *A. fumigatus*.

Table 1. Fungus positivity rate *Aspergillus fumigatus* (N = 817)

Isolated fungi	Number (n)	Percentage (%)
A. fumigatus	787	96.33
A. fumigatus and A. flavus	22	2.69
A. fumigatus and A. niger	7	0.86
A. fumigatus and T. marneffei	1	0.12

Remark: Of the 817 patients positive for *A. fumigatus*, 787 (96.33%) were infected with *A. fumigatus* alone and 30 (3.67%) were coinfected with *A. fumigatus* with another fungal species; of which, *A. fumigatus* coinfection with *A. flavus, A. niger* and *T. marneffei* accounted for 2.69, 0.86, and 0.12%, respectively (Table 1).

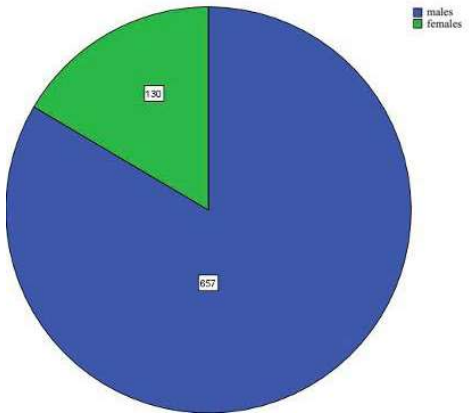


Figure 1. Gender characteristics (N = 787)

Remark: Of the total 787 patients infected with only *A. fumigatus*, the proportion of males accounted for 83.48% (657/787), females accounted for 16.52% (130/787) (Figure 1).

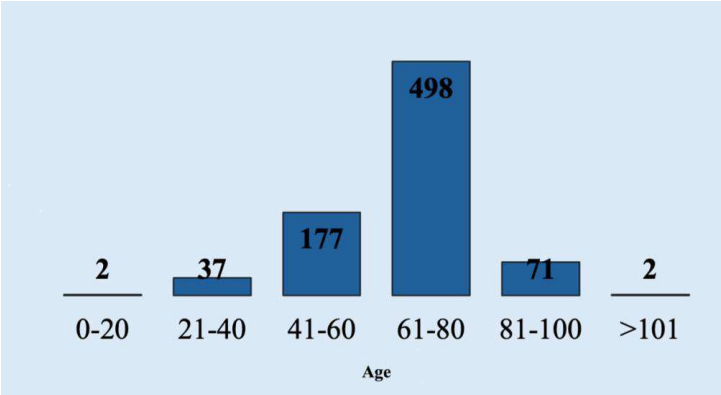
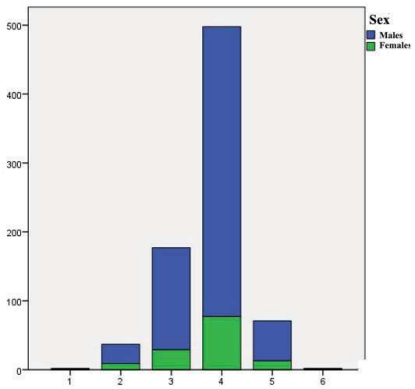


Figure 2. Age distribution of patients (N = 787)

Remark: The average age of 787 patients infected with only *A. fumigatus* was 65.19 ± 12.92. The youngest is 10 and the oldest is 104. Patients aged 67 and under account for at least 50% and patients aged 67 and over account for at least 50%. In which, the age group from 61-80 accounts for the largest proportion (498, 63.28%) (Figure 2).



Captions: 1 (< 20 years old), 2 (21 - 40 years old), 3 (41 - 60 years old), 4 (61 - 80 years old), 5 (81 - 100 years old) and 6 (>100 years old)

Figure 3. Gender classification by age group

Remark: Using Fisher's Exact test, p = 0.232 (p > 0.05). Thus, the difference between the positivity rate in age groups and sex is not statistically significant (Figure 3).

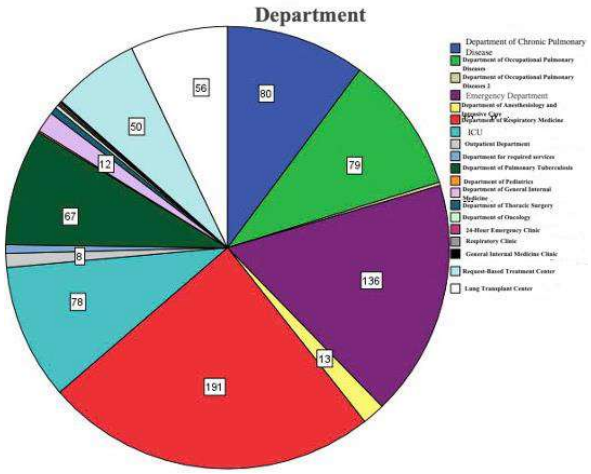


Figure 4. Isolation rate *Aspergillus fumigatus* in departments (N = 787)

Remark: The rate of isolation of *A. fumigatus* fungal etiology was highest in the Respiratory Department (191 cases with 24.3%), followed by the Emergency Department (136 cases with 17.3%), followed by the Department of Occupational Lung Diseases (81 cases with 10.3%), the Department of Chronic Lung Diseases (80 cases with 10.2%), Intensive Care Department (78 cases with 9.9%), Respiratory Tuberculosis Department (67 cases with 8.5%), Lung Transplant Center (56 cases with 7.1%) and On-Demand Treatment Center (50 cases with 6.4%). The remaining faculties have a lower rate (< 2%) (Figure 4).

Table 2. Isolation rate *Aspergillus fumigatus* by type of specimen (N = 787)

The changes of the loss attachment	Mean ± SD (mm)	p
Pleural fluid	4	0.5
Bronchial fluid	200	25.4
Sputum	562	71.4
Ganglion	1	0.1
Biopsy fragment	1	0.1
Organizational fragment	7	0.9
Pus	4	0.5
Pleural pus	5	0.6
Lung biopsy	3	0.4

Remark: The isolation rate of *A. fumigatus* in sputum specimens was mainly (562 cases accounted for 71.4%), followed by bronchial fluid (200 cases with 25.4%), while other specimens accounted for a small proportion (< 1%) (Table 2).

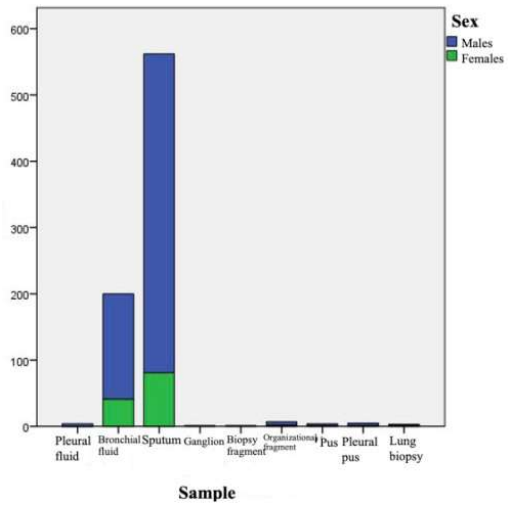


Figure 5. Gender classification by specimen type

Remark: Using Fisher's Exact assay, p = 0.008 showed a statistically significant difference in positivity rate across specimen types and sexes (p < 0.05) (Figure 5).

DISCUSSIONS

During the study period, 817 (3.11%) patients had positive fungal culture and identification results for *A. fumigatus* out of a total of 26,301 patients who were indicated for fungal testing. Of the 817 patients who tested positive for *A. fumigatus*, 787 (96.33%) were infected with *A. fumigatus* alone and 30 (3.67%) were coinfected with another fungal species. Because research is limited in that information on the patient's medical history, medication history, and clinical symptoms has not been collected, the study has not been able to analyze and evaluate the association with factors of cases of coinfection with *A. fumigatus*. Therefore, we only conducted an analysis on 787 patients with single infection with *A. fumigatus*.

The isolation rate is positive only for each fungus *A. fumigatus* in our study was higher than that of Vu Thi Vy et al. on patients diagnosed with invasive pulmonary infection at Bach Mai Hospital in 2021 (96.33% vs. 92.8%)[11]. Or this rate (96.33%) is also higher than other studies in the world, such as the study by Zhang et al. from 2019 to 2021 at Zhongshan Hospital in Shanghai, China on 105 patients diagnosed with aspergillosis. 112 isolates have been obtained Aspergillus, in which *A. fumigatus* accounting for 72.3% (81/112)[12]. Or according to a study Wang et al. and other study on patients with invasive aspergillosis at a hospital in Anhui, China from 2019 to 2021, the study isolated 156 strains Aspergillus, in which *A. fumigatus* 56.41%[13]. Or according to another study by Hsuan et al. at several hospitals in Taiwan from 2016 - 2020 from patients who were assigned mushroom culture, the results showed that *A. fumigatus* accounting for 99.2% (118/492)[14]. As well as a multicenter study in Australia and New Zealand from 2017 - 2020 in patients with invasive pulmonary fungal infection, the prevalence of infection *A. fumigatus* is 81%[15]. This discrepancy can be explained by a number of reasons, including 1) previous studies had some limitations because the time to collect samples was not year-round and the number of isolates was limited, on certain subjects, while our study was conducted on a large sample size, throughout (26,301 patients) and on all subjects (patients who are prescribed fungal tests); and 2) our study was conducted at the National Lung Hospital - a last line

hospital specializing in lung diseases, so the subjects had higher risk factors.

In total 787 patients were only infected *A. fumigatus*, most of the patients are men. The proportion of men accounted for 83.48%, women accounted for 16.52%. This rate is similar to previous studies abroad and Vietnam[11,16 - 18]. The median age of the 787 patients was 65.19 ± 12.92. The youngest is 10 and the oldest is 104. In which, the age group from 61 - 80 accounts for the largest proportion (498, 63.28%). The mean age in our study was similar to the mean age of the above studies (58, 60, 61 and 62 years). Moreover, from the results of the histogram, we divided 787 patients into 6 groups, including group 1 (< 20 years old), group 2 (21 - 40 years old), group 3 (41 - 60 years old), group 4 (61 - 80 years old), group 5 (81 - 100 years old) and group 6 (> 100 years old). The study used Fisher's Exact test and the results of the analysis showed that the difference between positivity rates in age groups and sex was not statistically significant ($p > 0.05$).

The isolation rate of *A. fumigatus* in the departments of the National Lung Hospital from January 2023 to December 2023 was mainly found in the Respiratory Department (24.3%), followed by the Emergency Department (17.3%), followed by the Department of Occupational Lung Diseases (10.3%), Chronic Lung Disease (10.2%) and Intensive Care (9.9%). While the Respiratory Tuberculosis Department (8.5%), the Lung Transplant Center (7.1%) and the On-Demand Treatment Center (6.4%). The remaining faculties have a lower rate (< 2%). This is completely appropriate and can be explained because most patients in the above departments have acquired diseases in the respiratory tract, accompanied by acquired underlying diseases such as diabetes, cirrhosis, heart failure, systemic diseases, and cancer,... The duration of the disease and/or prolonged treatment is a risk factor for fungal infections. In particular, the Respiratory Department is a place that focuses on treating respiratory diseases such as pneumonia, COPD, bronchial asthma, and alveolar dilation,... these are all chronic diseases, with a long treatment period, requiring the use of antibiotics and corticosteroids for a long time; The emergency department is a department that concentrates patients with severe patients, a history of prolonged antibiotic use or treatment at the lower level, subject to many intervention procedures; The Department of Chronic Lung Diseases, the Department of Occupational Lung Diseases is a department that focuses on patients with chronic diseases in the lungs, with many chronic lesions in the lungs such as caverns and pulmonary fibrosis,...

Of the 787 strains of mushrooms *A. fumigatus* selectable, isolated-rate *A. fumigatus* sputum is the main specimen and accounts for 71.4%, followed by bronchial fluid (25.4%), while other specimens account for a small proportion (< 1%). This rate is similar to studies in the world and Vietnam when the isolation rate is mainly from sputum specimens[11,16-18]. Furthermore, we conducted an analysis and the results showed a statistically significant difference in positivity rates across specimen types and sexes ($p < 0.05$).

CONCLUSIONS

Of the 26,301 patients who were indicated for fungal testing, 817 (3.11%) of patients had positive fungal culture and identification results for *A. fumigatus*. In which, the positivity rate for each *A. fumigatus* was 96.33% (787/817), and the coinfection rate of A. fumigatus with another fungus was 3.67% (30/817). Men dominated with 83.48%. The average age of patients was 65.19 ± 12.92, the age range was 61 - 80 mainly (63.28%). *A. fumigatus* isolated from sputum specimens was predominantly (71.4%), followed by bronchial fluid (25.4%).

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