

MYCETES CONTAMINATION IN HOSPITALS

Dallera M., Ottria G, Sartini M., Cristina M.L., Grimaldi M.* Perdelli F

Dipartimento di Scienze della Salute, Università degli Studi di Genova, Via Pastore 1, 16132 Genova.

* IST (Istituto Nazionale per la Ricerca sul Cancro), Largo Rosanna Benzi 10, 16132 Genova

Introduction

A large number of studies show that a variable percentage of hospital infections is carried by such mycetes as *Candida albicans* and different species belonging to the genus *Aspergillus*, *Cladosporium*, *Penicillium*, *Rhizopus*, etc.^{1,2,3}

The sanitary risk linked to an exposure to mycetes regards not only immunodepressed subjects, but also healthy individuals who may develop a hyperreactivity to the fungus allergen, with a possible onset of respiratory diseases (asthma, allergic alveolitis, etc.)

Scientific literature does not show any limit values nor reference values related to mycetes environmental concentrations in hospitals, although some authors propose for *aspergillus* a suspended mycotic charge in controlled contamination rooms lower than 5 cfu/m³.¹⁴

This research aims at pointing out the contamination degree in different kinds of hospital rooms, all equipped with air conditioning system, as well as the ability of such systems to reduce the mycotic contamination degree, and to find out which rooms show the highest risk, through an evaluation of the suspended mycotic charge.

Materials and methods

The microbiological features of different working environments in 10 hospitals have been studied. Each environment was monitored many times, during the course of the activities usually carried out in it.

1758 samplings were made in different kinds of rooms, all equipped with an air conditioning system with 2 to 25 v/h air changes: operating theatres, rooms (normal, protected, intensive care), laboratories and surgeries, kitchens, other working environments (sterilization, surgical instruments washing, pre- and post-anaesthesia rooms, offices, canteens, etc.) that will be defined as "other working environments".

For the sampling portable SAS (Surface Air System) SUPER 100 impactors were used, with RODAC plates containing selective nutritional medium for mycetes (Sabouraud with chloramphenicol).

An air volume of 500 litres was inhaled, and the sampling was carried out in the centre of the room, at a height of about 130 cm from the floor.

The plates were incubated at 25° and the reading was made after 4-6 days; the counting of the total mycetes was related to cfu/m³.

The suspected colonies were isolated using plates containing Sabouraud medium with chloramphenicol, incubated at 25°C and examined every day.

Afterwards mycetes were identified through both microscopic and macroscopic examining of each colony isolated.

For the statistical analysis of data, the following tests were used: Kruskal-Wallis test and Mann-Whitney U test.

Results

In the rooms examined the total suspended mycotic charge turned out to have an average value of 19 ± 19 cfu/m³ with a range between 1-120 cfu/m³.

As regards the data distribution, medians were equal to 5 cfu/m³ in operating theatres, 10 cfu/m³ in rooms, 14 cfu/m³ in other working environments, 20 cfu/m³ in surgeries/laboratories and 37 cfu/m³ in kitchens. (Table 1).

In surgeries/laboratories and in other working environments similar median and average values were found; that means a limited data dispersion.

As regards the other rooms, medians were below the average, due to a high data dispersion towards the highest values.

Table 1: Number of samplings, range, median and interquartile range (Q_L-Q_U) of the suspended mycotic charge (cfu/m³) found in the different kinds of rooms.

	Number of samplings	Range	Median	Q _L -Q _U
operating theatres	65	1-45	5	4-15
rooms	115	1-55	10	5-25
surgeries/laboratories	90	5-40	20	12-30
kitchens	30	5-120	37	24-46
Other working environments	105	1-70	14	1-25
total	405	1-120	14	5-25

The statistical analysis of data showed that the differences among the mycotic charge values (comparison between ranks) for the different kinds of rooms is highly significant (Kruskal-Wallis: $X^2=58,226$; $p<0,001$).

A comparison among these values through the Mann-Whitney test confirmed some differences statistically significant for every kind of working environment, except for "other working environments" / operating theatres and "other working environments" / rooms (Tab. 2).

Table 2: Mann-Whitney test (Wilcoxon test of ranks sum) among the mycotic charge values found in the centre of the room in the different kinds of working environments.

	operating theatres	rooms	surgeries/laboratories	kitchens
other workplaces	n.s.	n.s.	***	***
kitchens	***	***	***	
surgeries/laboratories	***	***		
rooms	***			

*** $p < 0.001$

n.s.= not significant ($p > 0.05$)

The following pathological mycetes were found: *Aspergillus* spp., *Penicillium* spp, *Cladosporium* spp, *Rhizopus* spp; for each of them the suspended charge average value in the different kinds of rooms examined was calculated (Table III).

All the mycetes identified, except for the genus *Rhizopus* spp., showed a suspended charge average value that resulted higher in kitchens than in the other kinds of rooms.

Table 3: average suspended mycotic charge (cfu/m³) and standard deviation of the different kinds of mycetes found in the different working environments.

	aspergillus spp. (cfu/m ³)	penicillium spp. (cfu/m ³)	Cladosporium spp. (cfu/m ³)	Rhizopus spp. (cfu/m ³)
operating theatres	2 ± 0,3	1 ± 1,2	2 ± 1,7	1 ± 0,8
rooms	1 ± 2,3	4 ± 2,1	3 ± 1,9	1 ± 1,4
surgeries/laboratories	1 ± 0,5	3 ± 0,2	4 ± 1,8	3 ± 1,5
kitchens	5 ± 1,7	8 ± 2,4	5 ± 2,1	1 ± 2,1
other working environments	2 ± 1,5	2±1,4	2± 2,9	1±1,5
total	405	1-120	14	5-25

Discussion

The results found show a variable environment contamination of all the rooms examined, despite the presence of an air conditioning system.

As regards the monitored environments, the highest average value of global suspended mycotic charge was found in the kitchens, that make up an ideal environment for mycetes growth due to their microclimatic features (hot and damp) and to the various materials coming from the outside.

The mycotic charge values found in this research are certainly low if compared to values shown by scientific literature and related to other places.^{23, 24} So, as regards the risk of an onset of allergies, such concentrations do not seem to be a risk factor higher than the ones normally found in the domestic environment.

The mycetes environment contamination degree in hospitals may increase to coincide with different factors, including building works, microclimatic conditions, etc. As mycetes exposure may cause a wide range of sanitary consequences, it is necessary to make regular environment inspections, as well as a special monitoring during and after building works in the hospital, in order to evaluate the mycotic contamination degree and the infection risk degree in the patients and the staff, as the presence of an air conditioning system may not be enough to eliminate mycetes.

REFERENCES

1. Lajonchere JP, Fenilhade de Chauvin M. Contamination by aspergillosis: evaluation of preventive measures and monitoring of the environment. *Pathol Biol (Paris)* 1994; **42**: 718-729.
2. Faure O, Fricker-Hidalgo H, Lebeau B, Mallaret MR, Ambroise-Thomas P, Grillot R. Eight-year surveillance of environmental fungal contamination in hospital operating rooms and haematological units. *J Hosp Infect* 2002; **50**: 155-160.

3. Fox BC, Chamberlin L, Kulich P, Rae EJ, Webster LR. Heavy contamination of operating room air by *Penicillium* species: identification of the source and attempts at decontamination. *Am J Infect Control* 1990; **18**: 300-306.
4. Boyd RF. Malattie da funghi. In: Boyd RF, Eds. *Microbiologia generale*, 1st edn. Palermo: Medical Books 1987; 801-818
5. Ampel NM. Emerging disease issues and fungal pathogens associated with HIV infection. *Emerg Infect Dis* 1996; **2**: 109-116.
6. Sangeorzan JA, Bradley SF, He X, Zarins LT, et al. Epidemiology of oral candidiasis in HIV-infected patients: colonization, infection, treatment and emergence of fluconazole resistance. *Am J Med* 1994; **97**: 339-346.
7. Powderly WG, Robinson K, Keath EJ. Molecular epidemiology of recurrent oral candidiasis in human immunodeficiency virus-positive patients: evidence for two patterns of recurrence. *J Infect Dis* 1993; **168**: 463-466.
8. Martinez – Marcos F, Cisneros J, Gentil M, Algarra G, Pereira P, Aznar J, Pachon J. Prospective study of renal transplant infections in 50 consecutive patients. *Eur J Clin Microbiol Infect Dis* 1994; **13**: 1023-1028.
9. Grossi P, Farina C, Fiocchi R, Dalla Gasperina D. Prevalence and outcome of invasive infections in 1,963 thoracic organ transplant recipients: a multicenter retrospective study. Italian Study Group of Fungal Infections in Thoracic Organ Transplant Recipients. *Transplantation* 2000;**70**:112-116.
10. Kontoyiannis DP, Bodey GP. Invasive aspergillosis in 2002: an update. *Eur J Clin Microbiol Infect Dis* 2002; **21**: 161-172.
11. Cross S. Mould spores: the unusual suspects in hay fever. *Community nurse* 1997; **3**: 25-26.
12. Kurup VP, Grunig G. Animal models of allergic bronchopulmonary aspergillosis. *Mycopathologia* 2002; **153**: 165-177.
13. Kanny G, Becker S, De Hauteclocque C, Moneret-Vautrin DA. Airborne eczema due to mould allergy. *Contact Dermatitis* 1996; **35**: 378.
14. Morris G, Kokki MH, Anderson K, Richardson MD. Sampling of *Aspergillus* spores in air. *J Hosp Infect* 2000; **44**: 81-92.
15. Panagopoulou P, Filioti J, Petrikkos G et al. Environmental surveillance of filamentous fungi in three tertiary care hospitals in Greece. *J Hosp Infect* 2002; **52**: 185-191.
16. Rainer J, Peintner U, Poder R. Biodiversity and concentration of airborne fungi in a hospital environment. *Mycopathologia* 2001; **149**: 87-97.
17. Tormo Molina R, Gonzalo Garijo M, Munoz Rodriguez A, Silva Palacios I. Pollen and spores in the air of a hospital out-patient ward. *Allergol Immunopathol* 2002; **30**: 232-238.

18. Hussein HS, Brasel JM. Toxicity, metabolism, and impact of mycotoxins on humans and animals. *Toxicology* 2001; **167**: 101-134.
19. Bullerman LB, Ryu D, Jackson LS. Stability of fumonisins in food processing. *Adv Exp Med Biol* 2002; **504**: 195-204.
20. Krämer J, Cantoni C. Muffe micotossinogene. In: Krämer J, Cantoni C, Eds. *Alimenti. Microbiologia e igiene*. 2nd edn. Milano: OEMF spa 1994; 54-63.
21. Bhatnagar D, Yu J, Ehrlich KC. Toxins of filamentous fungi. *Chem Immunol* 2002; **81**: 167-206.
22. Loudon KW, Coke AP, Burnie JP, Shaw AJ, Oppenheim BA, Morris CQ. Kitchens as a source of *Aspergillus niger* infection. *J Hosp Infect* 1996; **32**: 191-198.
23. Gorny RL, Dutkiewicz J. Bacterial and fungal aerosols in indoor environment in Central and Eastern European countries. *Ann Agric Environ Med* 2002; **9**: 17-23.
24. Dharmage S, Bailey M, Raven J et al. Prevalence and residential determinants of fungi within homes in Melbourne, Australia. *Clin Exp Allergy* 1999; **29**: 1481-1489.