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ORIGINAL ARTICLE

Two-years surveillance of fungal contamination in three hospital departments in Campania Region

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Key words

Hospital • Environmental surveillance • Air and surfaces sampling • Aspergillus spp • Airborne fungal spores

Summary

A two-years (2003-2005) fungal environmental surveillance was carried out in three departments of a hospital in Campania region (Surgery, Intensive Care Unit, Obstetrics and Gynaecology). Four operating theatres rooms and their relative areas of service and support, 4 patient rooms of intensive care unit, 1 delivery room, 1 labour room and 1 nursery of Obstetrics and Gynaecology were checked. A total of 12,120 surfaces and 2,904 air samples were collected in 24 monthly determinations. A seasonal variation in the fungal development was observed, in particular the lowest level of air and surface fungi contamination was found in winter and autumn whereas it was higher in spring and summer. In this study 30 fungal species were identified and, among these, the most frequent specie isolated was the Aspergillus spp. The results show an air contamination, expressed in percentage of positive determinations for Aspergillus spp, and the other fungi in the following percentages: Obstetrics and Gynaecology (25% and 33,3%); Intensive Care Unit (17% and 25%); Surgery (12.5% and 21%). For surfaces contamination it was found: Obstetrics and Gynaecology (67% and 75%); Intensive Care Unit (63% and 71%); Surgery (58.3% and 67%). This study shows that in the departments observed environmental fungi contamination is always present and therefore it would be necessary to apply environmental surveillance procedure and monitor the effectiveness.

Introduction

Airborne fungal spores have been widely recognized as major allergens capable of causing asthma and allergic rhinitis as well as other diseases. The environmental fungi contamination is a high risk factor for the generation of opportunist pathologies [1, 2] especially in the hospitals where the concentration of people highly exposed is elevated (e.g. those receiving cytotoxic therapy for haematological malignancies or undergoing organ or haematopoietic stem cell transplantation and post operate). The main fungal genera responsible for these infections are: *Aspergillus* spp, *Fusarium* spp, *Scedosporium* spp and *Mucorales* [3, 4]. However, any filamentous fungus can be potentially pathogen [5, 6]. The inhalation of airborne Aspergillus spores, either directly or through intermediate nasopharyngeal colonization, is a direct cause of pulmonary infection in immunocompromised patients [7, 8]. The Aspergillus spores are widespread, since they originate from decaying vegetation and are spread over by the air [7, 8]. In some studies, there are evidences that also houses [9-11] and schools [12-16] are particularly exposed to such a contamination.
Possible sources of airborne nosocomial infection in hospital include ventilation or air-conditioning systems, decaying organic material, dust, ornamental plants, food, water and, particularly, building works in and nearby hospital [17, 18].
The aim of this study was an exploratory monitoring of possible fungi contamination in a hospital plexus, carried out by sampling several departments and their relative areas of service and support.

Materials and methods

Environmental sampling and frequency

The study lasted two years (February 2003-March 2005) with a monthly frequency of determination. For details about the number of air and surfaces samples obtained at each determination see Table I. The three departments investigated are: Surgery, Intensive Care Unit, Obstetrics and Gynaecology.
The total number of samples for all determinations and for each department is reported in Table II.

Environmental monitoring

Environmental contamination was monthly examined (during two-years surveillance) by surface and air sampling, according to the protocol described in Table I. A total of 12,120 surfaces samples were taken, using contact plate RODAC (55 mm) containing Sabouraud Chlo-

Tab. I. Environmental sampling of air and surfaces in the departments and number of samples in each site for each determination. Air sampling: 1,000 L per each site. Surfaces were sampled by contact plate RODAC.

Department	Environment/ Environment Number	Air sample Number per Environment	Surface sample Number per Environment
Surgery	infirmary/1	3 samples random	10 samples on: hand basin, walls, windows, trolley, door, furniture, shower
	Sterilization room/2	5 samples random	20 samples on: hand basin, walls, windows, door, furniture equipment
	Pre operating room/3	3 samples random	15 samples on: hand basin, walls, windows, door
	Operating room/3	6 samples random	25 samples on hand basin, walls, windows, door, trolley
	Awakening room/2	6 samples random	30 samples on bed, walls, windows, door, trolley furniture
Intensive Care Unit	emergency room/1	3 samples random	20 samples on: hand basin, walls, windows, door, furniture equipments, trolleys
	corridor/3	6 samples random	10 samples on: walls, windows, door, equipment,
	Patient room/3	6 samples random	30 samples on hand basin, walls, windows, door, furniture equipment, trolley, bed
Obstetrics and Gynaecology	Sterilization room 1	5 samples random	15 samples on: hand basin, walls, windows, door, furniture equipments, trolleys
	Pre operating room/1	3 samples random	25 samples on: hand basin, walls, windows, door
	Operating room/1	6 samples random	30 samples on: hand basin, walls, windows, door, trolleys
	Delivery room/1	6 samples random	20 samples on: hand basin, walls, windows, door, equipments
	Labour room/1	5 samples random	20 samples on: hand basin, walls, windows, door, furniture equipments, beds
	Nursery/1	5 samples random	25 samples on: hand basin, walls, windows, door, equipments

ramphenicol agar, in order to evaluate whether fungi spores were present. The floor, which is supposed to be the area of major contamination, was excluded. A total of 2,904 air samples were collected (1,000 L sampled at 200 L/min) using a SAS mod. Super 180 apparatus (International pbi Spa Milano) loaded with a 55 mm diameter Petri dish, containing the same medium of contact plate RODAC. Petri dishes were incubated at 37 °C and examined after 48-72 hours, counting the number of colony growth. The fungi species observed were identified by their macroscopic aspect and by microscopic aspect of their spores after lacto phenol cotton blue staining.

Results

As reported in Table III the fungal contamination more frequently found was *Aspergillus* spp. The minimum average value in the air was 2.5 cfu/m^3 in the Surgery and the maximum 3.8 cfu/m^3 in the Obstetrics and Gynaecology department, whereas for the other species a minimum of 4.5 cfu/m^3 was found in the Intensive Care Unit and a maximum average value of 5.1 cfu/m^3 in the Obstetrics and Gynaecology.

The following species were identified: *Mucorales* spp, *Pennicillium* spp, *Paecilomices* spp, *Fusarium* spp, *Epicoccum* spp, whereas *Chaetonium* spp and *Cephalosporium* spp were only occasionally found.

Tab. II. Total number of samples for all determinations and for each department.

Determination numbers = 24	Department						Total samples	
	Surgery		Intensive Care Unit		Obstetrics and Gynaecology			
	Air	Surf.	Air	Surf.	Air	Surf.	Air	Surf.
	1,248	5,520	936	3,360	720	3,240	2,904	12,120

With regard to the surfaces analyzed *Aspergillus* spp was found with a minimum value of 7.7 cfu/Petri dish in the Surgery and a maximum value of 9.2 cfu/Petri dish in the Obstetrics and Gynaecology. In the department of Obstetrics and Gynaecology Aspergillus contamination was localized particularly on the equipments, on the walls and windows, whereas in other departments it was found to be diffused on all the surfaces sampled. The other species identified, with a minimum value of 10.5 cfu/Petri dish in the Surgery and a maximum value of 14.3 cfu/Petri dish in the Obstetrics and Gynaecology, are the following: *Mucorales* spp, *Pennicillium* spp, *Paecilomices* spp, *Fusarium* spp, *Epicoccum* spp, *Chaetonium* spp and *Cephalosporium* spp, whose contamination was found to be diffused on all the surfaces investigated. *Paecilomices* spp, *Mucorales* spp and *Pennicillium* spp, were prevalent on the tops of the furniture and over the equipments, compared with other species which, instead, were prevalent on the other surfaces. *Trichoderma* spp was only occasionally found on the headboards and *Candida* spp on the hand basins.

Discussion

The pulmonary infection as complication in hospitalized patients, is very frequent. This possibility is more dangerous in immunocompromised patients [2]. Normally there is no specific investigation about the causes of these infections, that very often are due to environmental fungi contamination.

In this work we performed a long period monitoring of hospital environments in a health care district of the Campania region and analyzed the presence of fungi spores on the surfaces and in the air.

Air and surfaces monitoring shows a fungi contamination, that even if do not associated to infection cases of such an origin in this hospital plexus, to our knowledge, represents a high risk factor both for patients and for hospital employers. The lack of a filtering system capable of an high grade purification, together with non pressurized environment plays a crucial role in the fungal contamination.

Therefore a valid prevention of fungi infection risk would be the installation, in these environments, of adequate air purification systems and to monitor their efficiency so that spores fungi accumulation on the surfaces would be prevented [3, 19-21].

This study shows an high air fungi contamination in all the departments investigated, mostly in the Obstetrics and Gynaecology where we found the maximum frequency of positive determinations and the highest average values of both Aspergillus' spores and other fungi. The presence in the air of Aspergillus' spores in the concentrations observed is a high risk factor for Invasive Apergillosis (IA) [1]. With regard to the surfaces contamination there is evidence of a higher percentage of positive determinations compared with the results of air determinations in all the departments investigated. This phenomenon can be connected with dust accumulation, that favours the deposit of pathogenic fungi spores [22], and which is probably due to a non frequent or insufficient environment cleaning [2]. Among the surfaces detected the ones that show major contamination are furniture tops and top surfaces of big equipments (refrigerators, sterilization apparatus, heaters,

Tab. III. Cumulative rates of fungi contamination of air and surfaces during the study period (2003-2005). For each department, the total number and percentage of positive determination during the study period are indicated in the upper raw. Average and range of fungal contamination for Aspergillus and other fungi are given in cfu/m³ for air and in cfu/Petri dish for surfaces, in the lower raw.

Department	Air 24 determination		Surfaces 24 determination	
	Aspergillus	Other Fungi	Aspergillus	Other Fungi
Surgery	3 12.5%	5 21%	14 58.3%	16 67%
	2.5 (2-9)	4.9 (3-15)	7.7 (3-20)	10.5 (8-25)
Intensive care unit	4 17%	6 25%	15 63%	17 71%
	3.4 (2-11)	4.5 (4-20)	8.8 (4-16)	12.1 (3-20)
Obstetrics and Gynaecology	6 25%	8 33.3%	16 67%	18 75%
	3.8 (1-10)	5.1 (4-18)	9.2 (4-35)	14.3 (5-40)

etc.) where dust accumulation is easier to occur [23, 24]. The species of fungi found on the surfaces are closely correlated with the ones found in the air; the department with major surfaces contamination being Obstetrics and Gynaecology.
In conclusion, in all the departments object of our study, an environmental fungi contamination was found, both in the air and on the surfaces, with small variation between them.

These results underline the importance of environmental surveillance and the need of cleaning procedures that can prevent fungal contamination in hospital departments. An immediate action of prevention and a specific training to the cleaning staff, by means of programmes of education and application of infection control procedure as well as corrective measure of cleaning in contaminated rooms, will certainly have a positive effect directly detectable in the environment.

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