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Punctual fungal monitoring of environment surfaces in an intensive care unit

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Abstract:

Nosocomial fungal infections could arise from exposure to spores or filamentous fungi existing in the hospital environment.

The present study aimed to investigate the quality of surfaces in an intensive care unit, to ascertain their potential contribution to fungal infection in the hospital.

In the morning of May 28, 2017 punctual samples were taken from surfaces by moistened sterile swabs and were inoculated on Sabouraud dextrose agar and Malt extract agar.

Qualitative evaluation of moulds was based on the microscopic view and morphological features of colonies; identification of yeasts was based on routine biochemical tests (Auxacolor® -Bio-Rad).

Out of 100 samples taken from surfaces, 24 (24%) were positive for fungal presence, divided into moulds (75%) and yeasts (25%), the identified strains belonged to 9 genera, most frequently to *Aspergillus*, *Candida*, *Mucor*, *Cladosporium*, *Penicillium* and *Trichosporon*, the most predominant fungi encountered is *Aspergillus niger* (25%).

In conclusion, to achieve our professional service and provide a safe environment for patients, punctual fungal monitoring needs to be done consistently.

Key words: intensive care unit; fungi; *Aspergillus*; *Candida*; nosocomial; surface

Introduction:

Intensive care unit (ICU) are specialized divisions of a hospital who provide close monitoring and intensive care for patients with life-threatening conditions¹.

The aetiological profile of fungal infections is changing: fungal species, formerly considered as harmless, increase their virulence, this results from the resistance of fungal strains to numerous antifungals, prolonged antimicrobial treatment, but also from poor general condition of the patients, caused by the underlying disease^{2,3}.

The contamination of the hospital rooms may occur due to the growth of fungi on the organic matter of building materials. The spores emanating from these colonies may invade immunosuppressed patients with inhaled air as well as through the equipment used in diagnostics and care

of the patients, causing local infections, prior to possible dissemination^{4,5}.

Moreover, *Candida albicans* as the most important nosocomial fungal pathogen can survive up to 4 month on surfaces, persistence is shorter for *Candida parapsilosis* (14 days), a low temperature, and high humidity have been described as leading to longer persistence⁶.

Thus, it is clear that monitoring of the hospital environment is an essential element in the control of nosocomial infections.

Materials and methods:

Sampling was made in "Hassani Abdelkader" teaching university hospital of Sidi-Bel-Abbès (Algeria), intensive care unit (ICU) was chosen, the study took place in an adult medical ICU. The ventilation system was running at normal rate during sampling, the ambient temperature was 25°C and the humidity 65%.

To evaluate the presence of fungi on surfaces, 100 samples were collected in the early morning of May 28, 2017.

Sampling procedure

The use of wipe samples for detecting contaminant presence can be applied on different substrates, technique is most effective on smooth surface as glass, metal and painted surfaces, we used sterile swab moistened with sterile isotonic liquid on different surfaces:

-The floors

- Inanimate objects like medical trolley worktop, drip stand, protective gloves-container, respirator monitor, bedside table top Figure 1

-Vertical surface like walls and doors including light switch and door handle

Identification

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Figure 1. A1 and A2: sites of sampling in ICU; B1: *Trichosporon* sp; B2: *Candida parapsilosis*; B3: *Aspergillus niger*

Cultures of surfaces on Sabouraud dextrose agar and Malt extract agar were incubated at 27°C and were examined daily for fungal colonies for three or four weeks.

Fungal isolates were identified by a combination of their macroscopic and microscopic criteria as described in the mycology note books⁷⁻¹², biochemical Auxcolor© tests were used to identify yeasts that failed to produce filaments in plasma or serum.

Results:

Out of 100 samples taken from surfaces a total of 24 positive cultures were isolated from 9 different genera belonging to both moulds (7 genera) representing 75% and yeasts (2 genera) representing 25%. Identification and classification of isolated fungi was made with an accordance of the current procedures, and results are shown in Table 1 .

Results summarized in Table 2 revealed that 6 genera of fungi were isolated from vertical surfaces (walls/doors), 4 genera from the floors and 3 genera from inanimate objects.

Aspergillus genus was the only one to be recognized in all types of surfaces.

Discussion:

The results of the present study showed that out of the total number of the 100 surfaces samples examined, the occurrence of yeasts and moulds in ICU made 24%, other authors found large amounts of moulds and yeast at ICUs^{5,13,14} .

Our study was conducted during spring of 2017, in the study of Segvić Klarić et al. (2006) airborne fungi peaked during spring and summer, high prevalence of *Aspergillus*, *Penicillium*, *Fusarium*, and *Cladosporium* were describe during this period, these fungi are frequent and abundant species¹⁵ , this can explain their presence in our study.

Mould were found in 18 samples (75%), and yeasts were found in 6 samples (25%), airborne mould are the most reported in hospitals^{5,15-17} .

In our study, *Aspergillus* was the most encountered genera in the ICU, this coincides with the results of other studies on fungal diversity in ICUs¹⁶ .

Aspergillus, *Cladosporium*, *Penicillium*, *Fusarium* and several other fungal genera were recorded in the air of different ICU and operating rooms at Assiut university hospitals, Egypt¹⁴ . In Nigeria, fungi recovered from hospital were *Aspergillus*, *Penicillium*, *Fusarium*, *Candida*¹⁷ Most of these fungi isolated from surfaces and collected in this study

Table 1. Distribution of genera and species isolated from ICU

Fungi	Number of isolation	%
<i>Aspergillus niger</i>	6	25,00%
<i>Candida parapsilosis</i>	3	12,50%
<i>Mucor sp</i>	3	12,50%
<i>Cladosporium sp</i>	2	8,33%
<i>Penicillium sp</i>	2	8,33%
<i>Trichosporon sp</i>	2	8,33%
<i>Absidia sp</i>	1	4,17%
<i>Alternaria sp</i>	1	4,17%
<i>Aspergillus candidus</i>	1	4,17%
<i>Aspergillus fumigatus</i>	1	4,17%
<i>Candida rugosa</i>	1	4,17%
<i>Fusarium sp</i>	1	4,17%
Total	24	100,00%

Table 2. sampling sites of fungal genera isolates from ICU

Genera	Inanimate objects	walls/doors	Floors
<i>Aspergillus</i>	+	+	+
<i>Penicillium</i>	+	+	-
<i>Fusarium</i>	-	-	+
<i>Alternaria</i>	-	-	+
<i>Cladosporium</i>	-	+	-
<i>Candida</i>	+	-	+
<i>Trichosporon</i>	-	+	-
<i>Absidia</i>	-	+	-
<i>Mucor</i>	-	+	-

may cause different kind of mycosis. Meanwhile, spores can produce mycotoxin-related diseases, they are harmless for healthy people, but they may be dangerous for patients of risk groups, including those who are treated in ICU¹⁴. Other researchers from Europe and America have reported a higher or similar distributions of fungi in ICUs^{5,18}.

Aspergillus niger was the most prevalent fungi in accordance with results of Martínez-Herrera et al.¹⁹, it is not surprising that *Aspergillus* were dominant in the surfaces tested because that fungal genus is ubiquitous. Since conidia and most fragments are smaller than 5 µm, they can penetrate deeply in the respiratory system, mainly *Aspergillus sp*, *Penicillium sp* and *Mucor sp* are responsible of human infections²⁰.

Panagopoulou et al. reported *Aspergillus fumigatus* as the third prevalent *Aspergillus* species after *Aspergillus niger* from the air of the hospitals in Greece²¹, which is in accordance with our results.

In France, a systemic *Aspergillus fumigatus* infection occurred in a patient eleven days after liver transplantation, at the same time lung aspergillosis caused by the same fungal species was detected in two patients at an ICU²². One patient has died due to invasive aspergillosis whose Broncho-Alveolar-lavage specimen and indoor air sample were positive for *Aspergillus fumigatus*²³.

Cladosporium and *Penicillium* were the most recorded fungi in some ICUs^{14,16,24,25}, they should be considered as a possible cause of allergic reactions, asthma exacerbations or fungemia in some patients and allergic reactions, even among health care staff^{14,16,26,27}. Moreover, *Fusarium* was reported as causative agent of superficial and systemic infections¹⁴.

Mucor was recorded in our study and reported at an Egyptian ICU¹⁴. Moreover, a gastrointestinal tract zygomycosis was caused by *Rhizopus*, the infection was transferred through spatulas used by the medical staff of a Spanish ICU⁵.

Since several *Candida* species readily form biofilm, they are frequently isolated from patients, *C. albicans* is the predominant and most virulent species. However, the importance of infections caused by non-*albicans* *Candida* and other unusual yeasts (e.g *Malassezia sp*, *Rhodotorula sp*) has emerged over the last decade²⁸.

Candida genera was the second most recorded fungi in our study after *Aspergillus* genera, even though *C. albicans* is still the most frequent fungal pathogen at intensive care unit, an increase of infections caused by other than *Candida albicans* species is observed^{5,25}.

Candida parapsilosis was the most isolated yeast in our study, this species have been shown to correlate strongly with the presence of an intravascular device and the use of total parenteral nutrition due to the slime-forming ability of this species²⁹.

Particularly dangerous and hard to treat the strains *Candida parapsilosis*, *Candida glabrata*, *Candida tropicalis* are often resistant to azole antifungals⁵.

Trichosporon sp was describe from surfaces at an ICU in Tehran (Iran), which is in accordance with our results¹³, and *Candida rugosa* was isolated from two patients, one patient had acute leukemia and developed invasive disease³⁰.

In our study most of fungi genera were linked to vertical surfaces (walls/doors), this correlate with the results of Gniadek and al. (2007) *Aspergillus*, *Penicillium* and

Cladosporium, as well as yeast fungi *Rhodotorula sp* and *Candida sp* were most frequently isolated from indoor air and walls of ICU⁵.

Conclusion:

Reduction of the numbers of potentially pathogenic fungi in the indoor surfaces should be a standard in the practice of medical staff; it appears that indoor surface monitoring focused on the presence of fungi is an important procedure in wards where risk group patients are treated.

Punctual control is a good and rapid approach in small hospitals, and particularly at intensive care units.

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Conflict of interests None declared

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