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ORIGINAL ARTICLE/ARTICLE ORIGINAL

Evaluating of fungal contamination in hospital wet cooling systems in Markazi province, Central Iran

M. Mosayebi [a], Z. Eslamirad [a], R. Hajihossein [a], B. Ghorbanzadeh [b], M. Shahverdi [c], M. Didehdar [a,d,*]

[a] Department of medical parasitology and mycology, Arak university of medical sciences, Arak, Iran
[b] Department of medical parasitology, Tarbiat Modares university, Tehran, Iran
[c] Department of biotechnology, Arak university of medical sciences, Arak, Iran
[d] Molecular and medicine research center, Arak university of medical sciences, Arak, Iran

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Summary
Objective. — Fungal infections are common complication among hospitalized patients especially between who is immunocompromised. Wet cooling systems in the hospital environment play a critical role as a source of these infections. The aim of this study was survey of wet cooling system of hospitals for fungal contamination in Arak city.
Materials and methods. — This study was conducted during May to September of 2016. Sampling was done as random. Samples were obtained from water and straw of 84 wet cooling systems of four hospitals in Arak city. Samples were cultured in Sabouraud dextrose agar medium contain of chloramphenicol. Identification of fungi was performed by Slide culture method.
Results. — From 84 wet cooling systems, 32 (38.1%) were contaminated with fungi. The highest fungal contamination was found in wards of oncology and CCU. The most prevalent of fungi isolated in this study were *Aspergillus* spp. and *Candida* spp., respectively.
Conclusion. — The findings of this descriptive cross-sectional study clearly indicate, in wards of the hospital that used wet cooling systems, there was considerable fungal contamination, particularly *Aspergillus* contamination. These results highlight a clear need for greater attention to the use of non-aqueous or closed circulation cooling systems, especially where susceptible patients receive medical care.

* Corresponding author at: Department of medical parasitology and mycology, Arak university of medical sciences, Arak, Iran.
E-mail addresses: didehdar_m@Arakmu.ac.ir, didehdar_m@yahoo.com (M. Didehdar).

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Introduction

Saprophytic fungi are important agents causing the nosocomial infections in a tertiary care hospital [1]. Due to effective immune defense mechanisms, such as the T-dependent response, these fungi rarely cause symptoms in healthy individuals. Reducing of immunity for any reason, including cancer, AIDS or organ transplant and also the long-term use of immunosuppressive drugs may lead to uncontrolled fungal proliferation and infections [1,2]. In the recent years, saprophytic fungal infections are increasing, because risk factors for these infections are increasing in frequency [3]. Nosocomial fungal infections are common complication among hospitalized patients and the environmental conditions of hospital play critical roles as source of these infections [4–6]. Airborne transmission of Aspergillus to hospitalized patients has been reported previously. The most common cause of pulmonary infection in immunosuppressed patients is inhalation of Aspergillus spores [7]. One of the possible sources of nosocomial infections is air-conditioning systems in hospitals. In order to minimize the concentration of fungal spores in hospitals, high-efficiency air-conditioning system is required [8]. So far, there was no study to evaluate the existance and type of fungal species isolated from air-conditioning systems in Arak hospitals. Therefore, the purpose of this study is to determine the presence of fungal species in air-cooling systems of different hospital wards.

Materials and methods

This descriptive cross-sectional study was performed on air-cooling system of four hospitals in Arak city between May and September in 2016 (Table 1).

Hospital sampled

Arak University of Medical Sciences comprises four hospitals (A, B, C and D) with wet air conditioning (Table 1). Due to the main hospital wards have independent wet air-conditioning systems, the sampling were done from air cooling systems in different wards of hospitals including surgery (A, B, and D), Burn (B), Neurology (A and B), ENT (Ear, Nose and Throat) (D), CCU (Coronary Care Unit) (A, B, and D), ICU (Intensive Care Unit) (A, B, C, and D), NICU (Neonatal Intensive Care Unit) (D), Emergency (A, B, C, and D), Laboratory (A, B, and C), Gynecology (A and B), Hematology (C and D), Ophthalmology (D), Infectious disease (A, B, and D), Internal (A and B), Reception (A, B, C, and D), Hallway (A, B, C, and D). From each wet cooling system, 100 ml water and some straw from different parts were collected. The water sample was transferred to steril falcon tube and straw sample was placed into steril zip lock nylon. The samples were coded and transferred to the mycology laboratory of Arak University of Medical Sciences for examination.

Table 1 Rate of fungal contamination in wet cooling systems of four hospitals in the study.

Hospital	No. of coolers	No. of contaminated coolers	% of contamination
A	16	5	31.2
B	33	15	45.4
C	5	2	40
D	30	10	33.3
Total	84	32	38.1

Isolation of fungi from water samples

Fifty milliliters of each water samples were filtered by nitrocellulose membranes (pore-size, 0.45 μm) (Merck, Germany). The filters were placed on Sabouraud chloramphenicol dextrose medium (Merck, Germany) and Mycosel agar (BD Diagnostics, NJ, USA) under sterile conditions and incubated at 28–30 °C. After one to three weeks, filamentous fungal isolates were identified on the basis of their macroscopic and microscopic morphological characteristics and yeast species were identified by physiological and biochemical tests.

Isolation of fungi from straw samples

Straw samples of each cooling system were placed into sterile tubes containing 50 ml of distilled water and were mixed for 15 min. The solution was centrifuged in 2500 rpm for 5 min and the supernatant was filtered by nitrocellulose membranes (pore-size, 0.45 μm) and these membranes were placed on Sabouraud chloramphenicol dextrose agar medium (Merck, Germany) and Mycosel agar (BD Diagnostics, NJ, USA), under sterile conditions and incubated at 28–30 °C for 1–2 weeks. Filamentous fungi were identified on the basis of their macroscopic and microscopic features and yeast species were identified by physiological and biochemical tests.

Results

Among the 84 wet cooling system were investigated in the 4 hospitals, 32 (38.1%) were positive for fungi contamination (Table 1). The most frequently isolated species were

Table 2 Frequency of fungal species isolated from wet cooling systems in this study.

Fungal species	No.	%
Aspergillus fumigatus	6	16.2
Aspergillus flavus	6	16.2
Candida albicans	6	16.2
Mucor spp.	3	8.1
Penicillium spp.	3	8.1
Alternaria spp.	3	8.1
Aspergillus niger	2	5.4
Rhizopus spp.	2	5.4
Cladosporium spp.	2	5.4
Fusarium spp.	1	2.7
Candida parapsilosis	1	2.7
Rhodotorula spp.	1	2.7
Paecilomyces spp.	1	2.7
Total	37	100