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A 10-year survey of fungal aerocontamination in hospital corridors: a reliable sentinel to predict fungal exposure risk?

G. Reboux [a,e,*], H. Gbaguidi-Haore [b,e], A.P. Bellanger [a,e], F. Demonmerot [a,c], K. Houdrouge [a], E. Deconinck [d], X. Bertrand [b,e], L. Millon [a,e]

[a] Department of Parasitology-Mycology, University Hospital Jean Minjoz Besançon, France
[b] Department of Hospital Hygiene, University Hospital Jean Minjoz Besançon, France
[c] Department of Innovation and Clinical Research Delegation, University Hospital Jean Minjoz Besançon, France
[d] Department of Haematology, University Hospital Jean Minjoz Besançon, France
[e] UMR/CNRS 6249 University of Franche-Comté, Besançon, France

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SUMMARY

Background: Invasive mould infections represent a threat for high-risk patients hospitalized in haematology units. French guidelines recommend that fungal aerocontamination monitoring should be performed quarterly. Since 2002, Besançon University Hospital has expanded to include several new buildings. Consequently, environmental surveys have been re-inforced and are now performed on a weekly basis.

Aim: To retrospectively assess the contribution of fungal aerocontamination measurement in haematology corridors and main hospital corridors as a sentinel to assess fungal exposure and risk of invasive mould infections.

Methods: Over a 10-year period, 2706 air samples were taken by impaction every week in the same locations in haematology corridors and main hospital corridors. All fungal species were identified. The Haematology and Hospital Hygiene Departments were alerted systematically whenever a peak of opportunistic species was detected and corrective action was planned. Since 2007, each case of invasive aspergillosis has been reported to the French health authorities. Cuzick's test, Mann–Kendall's trend test, autocorrelation and Spearman's correlation rank test were used for statistical analysis.

Findings: Over 10 years of surveillance, 12 peaks of *Aspergillus fumigatus* (>40 colony-forming units/m^3) were observed in the main hospital corridors, and *A. fumigatus* contamination was detected up to six times per year in the haematology corridors. In order to limit fungal exposure, the decision was made to perform additional checks on ventilation systems and heating, increase biocleaning and develop clear instructions.

* Corresponding author. Address: Department of Parasitology-Mycology, University Hospital Jean Minjoz, 2 Bd Fleming, F-25030 Besançon Cedex, France. Tel.: +33 3 81 66 91 65; fax: +33 3 81 66 89 14.
E-mail address: Gabriel.reboux@univ-fcomte.fr (G. Reboux).

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Conclusion: No significant link was observed between *A. fumigatus* detection and invasive aspergillosis. Weekly surveys have helped to improve the vigilance of the medical teams. Nevertheless, 58 cases of invasive aspergillosis have been identified since 2007.

Introduction

Invasive mould infections (IMI) represent a constant threat in hospitals, especially for high-risk patients hospitalized in haematology and bone marrow transplant units. While the contribution of routine air sampling in the prediction of fungal contamination risk has been discussed by some authors,[1–3] French hospital guidelines specify that each hospital is responsible for the air it provides to patients, and that the efficiency of air control must be monitored by specific methodologies. Construction and renovation works increase the risk of fungal exposure;[4] consequently, recommendations have been made to re-inforce air monitoring during these periods.[5]

When performed, fungal aerocontamination surveys generally focus on haematology wards containing patients at risk of invasive aspergillosis (IA); little attention has been paid to the corridors outside the wards.[3] The surveys are performed quarterly in protected areas, as recommended by French guidelines developed at the consensus conference 'Preventing the risk of aspergillus infection in immunocompromised patients' held at the Paris Institut Pasteur in 2000.[6] Extension and renovation works began at Besançon University Hospital (Eastern France) in September 2002 and continued over a period of 10 years. A new protocol of air sampling was initiated from the beginning of this period with increased risk of fungal exposure, including weekly sampling in the corridors of the Haematology Intensive Care Unit (ICU) (HCs) and in the main hospital corridors (MCs). The purpose of these additional measures was to re-inforce the conventional quarterly surveillance in haematology protected areas. This initiative was based on the fact that patients at risk of IA are not constantly hospitalized in a protected environment; they may have to be moved from their protected environment to undergo complementary examinations such as radiological work-up. Moreover, patients sometimes need to attend the outpatient haematology clinic. From a pragmatic point of view, sampling in protected areas may cause discomfort for patients when performed weekly, and is also time consuming.

The aim of this study was to retrospectively assess the contribution of fungal aerocontamination measurement in the HCs and MCs to predict fungal exposure and IMI risk. In addition, this 10-year study was useful to identify indoor and outdoor factors influencing fungal levels in air.

Materials and methods

Haematology ICU

The Haematology ICU at the study hospital has 15 beds and specializes in the treatment of acute lymphoid and myeloid leukaemia. On average, 50 allogeneic transplants are performed in this unit each year (302 from January 2007 to September 2012), and 125 patients/year remain at risk from one to five weeks (275 admissions/year with 85 cases of aplasia treatment or profound neutropenia).

Several preventive measures are applied in the Haematology ICU to protect patients from fungal contamination, including the application of positive pressure (23 Pa) in the rooms and HEPA-filtered air.[7] The air is renewed 40 times/h. Rooms are separated from the corridors by an airlock. Every person entering a protected room wears some type of protection. F7 (EN 779) filters are used in all corridors. The HCs are kept at positive pressure (3 Pa) compared with the MCs. Entrances to the Haematology ICU are separated from the MCs by a double airlock.

Air sampling

Air sampling was performed by impaction with a MAS 100 impactor (Merck, Darmstadt, Germany) for 2.5 min/sample (250 L of air) on 18% dichloran glycerol culture media (DG18; Oxoid, Basingstoke, UK).

Since September 2002, air samplings have been performed weekly, in the same locations, in the MCs on Levels -1, -2 and -3 near the lifts in the centre of the building. These levels were selected because of their proximity to outdoor entrances. Moreover, patients at risk of IA were likely to go to the Radiology Department (Level -2), the Emergency Department (Level -1) or the pharmacy (Level -3) at some point (Figure 1).

Air sampling was also performed weekly, in the same locations, in the HCs on the west side of Level +2: in front of the nurses' station, near the aseptic preparation room and near the storage area, located at the entrance, the middle and the rear of the ward, respectively.

Surface samples were undertaken simultaneously with air sampling (same sampling sites) by swabbing 100 cm^2. Swabbing does contribute to the control of surface biocleaning efficacy, but its contribution is insufficient to detect high variation in *A. fumigatus* contamination. As variations from baseline were generally more difficult to interpret from surface samples compared with air samples, the surface sampling results were not included in the present study.

Identification of fungal species

Impacted DG18 culture media were incubated at 30°C. Cultures were checked after three and seven days of incubation. Fungal species were identified by macroscopic and microscopic examination. Results were expressed as colony-forming units (cfu)/m^3.

Clinical data

Since 2007, the Parasitology-Mycology Department has reported all cases of IMI systematically to the Referent National Centre of Mycosis and Antifungal Therapies, the Regional Health Agency and the National Sanitary Survey Institute. Thus, based on the European Organization for Research and Treatment of Cancer/Invasive Fungal Infections Cooperative Group and the National Institute of Allergy and Infectious Diseases