

Environmental *Aspergillus spp.* contamination during the move of an onco-hematological pediatric unit in a temporary ward: efficacy of protective measures

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Introduction:

Fungal infections have increased in recent years and represent a major concern for hospitals, especially in wards receiving immunocompromised patients. Due to the delay to move in a new ward, the onco-hematological pediatric (OHPU) unit was relocated in a ward of 12 beds with an anteroom and a ventilation system including high-efficiency particulate air (HEPA) filters but without positive pressure to maintain the air pressure at a higher level than the surroundings and with a very low air changes rate (2 per hour). The objective of the study was to evaluate the impact of mobile air decontamination systems to prevent environmental contamination in an oncohematology unit.

Methods:

to evaluate the performances of the air handling system and therefore the feasibility of the moving of the OHPU in the temporary ward, particulate air counts and microbiological (bacterium, yeasts, moulds) air and surfaces samplings (Samplair, AES, Biomérieux, France using trypticase soy and chloramphenicol sabouraud agar Petri dishes; 25 cm² trypticase soy agar Petri dishes for bacteriological samples and 10 cm² surface swabbed areas cultured on Sabouraud dextrose agar containing chloramphenicol for moulds samples respectively) were performed in the ward at baseline without care activity (period 1 in 2011), after installation of mobile air decontamination systems Plasmair and Immunair (AirInSpace, Elancourt, France) in the rooms and the corridors of the ward without care activity (period 2 in 2012) and after the moving of the OHPU with use of the mobile air decontamination systems (period 3 from 2012 to 2015). The comparison of the environmental contamination according to these 3 periods was performed using SPSS 20.0 (Chicago, IL, USA).



Fungal contamination of the surfaces in the onco-hematology unit during the study period 3: the more purple areas correspond to the most contaminated places



Fungal contamination of the air in the onco-hematology unit during the study period 3: the more purple areas correspond to the most contaminated places

Results: The fungal air and surfaces contamination of the rooms and the corridors of the ward was significantly lower in period 2 compared to period 1 (P<0.05 for the number of positive samples, P<0.0001 for the fungal load respectively) allowing the moving of the OHPU. In period 3, the rate of the environmental contamination remained stable (Table). No invasive aspergillosis was documented during the follow-up.

Variable	Period 1				Period 2				Period 3			
	Rooms		Corridors		Rooms		Corridors		Rooms		Corridors	
	N= 111 Air (CFU/m ³)	N= 695 Surface (CFU/10m ²)	N= 23 Air (CFU/m ³)	N= 84 Surface (CFU/10m ²)	N= 66 Air (CFU/m ³)	N= 377 Surface (CFU/10m ²)	N= 27 Air (CFU/m ³)	N= 59 Surface (CFU/10m ²)	N= 386 Air (CFU/m ³)	N= 1860 Surface (CFU/10m ²)	N= 182 Air (CFU/m ³)	N= 548 Surface (CFU/10m ²)
Fungal contamination (CFU/m ³)												
Proportion of positive samples (%)	60%	54%	100%	60%	6%	8%	52%	8.5%	26%	10%	38%	13%
Mean (min-max)	168.9 (0-916)	862.2 (2-9102)	26.1 (0-148)	28.2 (0-223)	1.67 (0-10)	9.9 (0-24)	0.89 (0-4)	1.00 (0-3)	26.9 (0-4)	32.1 (0-304)	3.92 (0-24)	5.35 (0-300)
Fungal contamination with <i>A. fumigatus</i>												
Proportion of positive samples (%)	9%	2.5%	9%	7%	0%	1%	0%	2%	1%	0.1%	2%	0%
Mean (min-max)	2.8 (0-12)	2.71 (0-13)	0.54 (0-4)	1.1 (0-9)	0 (0-0)	1.66 (0-11)	0 (0-0)	0.25 (0-2)	0.13 (0-4)	0.1 (0-6)	0.18 (0-8)	0 (0-0)
Fungal contamination with <i>Aspergillus spp.</i>												
Proportion of positive samples (%)	1%	0.7%	0%	0%	0%	0.3%	0%	0%	0.5%	0.1%	1%	0.2%
Mean (min-max)	0.2 (0-2)	0.5 (0-3)	0 (0-0)	0 (0-0)	0 (0-0)	0.11 (0-1)	0 (0-0)	0 (0-0)	0 (0-4)	0.06 (0-3)	0.2 (0-2)	0.01 (0-1)
		<i>A. niger</i> (1)				<i>A. niger</i> (1)			<i>A. flavus</i> (1)	<i>A. glaucus</i> (2)	<i>A. flavus</i> (1)	<i>fusarium sp.</i> (1)
		<i>A. flavus</i> (1)							<i>A. glaucus</i> (1)	<i>A. oryzae</i> (1)	<i>Rhizopus sp.</i> (1)	
											<i>A. niger</i> (1)	

Discussion:

This study highlights the added value of mobile air decontamination systems to improve the air handling system of a unit, without and with care activities. The devices used are mobile air decontamination systems using a technology, combining the action of electrostatic fields and non-thermal plasma, which destroys airborne microorganisms¹. For patients at lower risk of fungal infection, in addition to mobile air decontamination systems in the anteroom and the corridors (Plasmair™), a mobile air treatment system (Plasmair™) was installed in each patient's room. For patients at high risk of fungal infection, protective plenums with ISO 5 performance under unidirectional flow (Immunair™) were placed in each patient's room. As illustrated in our study and as stipulated recently in guidelines of the French Society for Hospital Hygiene², in the absence of laminar air flow facilities, it is possible to use a mobile system for treating air to reduce the fungal environmental contamination. The limit of these systems is linked to the absence of positive air pressure. Further studies need to be realized to evaluate the effect of these systems on the risk of fungal infections according to the level of immunosuppression.

Conclusion: The existing air handling system in the temporary ward did not allow the moving of the OHPU because of the high rate of environmental fungal contamination. The use of mobile air decontamination system significantly reduced this environmental contamination and the performances were maintained during care activity. Such systems may represent an efficient help in units receiving immunocompromised patients to improve the performances of the air handling system if not adequate.

References:

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