

Contaminated air conditioners as potential source for contaminating operation theatre environment

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doi: 10.3396/ijic.v8i1.009.12

Abstract

Five patients developed endophthalmitis after cataract surgery. On evaluation of operation-theatre complex, fungal spores were demonstrable from environment and surfaces. Air conditioner's filters were grossly contaminated. *Aspergillus* and *Mucor* spp. were isolated. Phenotypically similar fungi were isolated from three of the patients (*Aspergillus* spp. from two and *Mucor* spp. from one). As a follow up study, filters of the air conditioning devices in twenty five operating rooms of hospitals nearby were evaluated periodically. The results of this surveillance study were used to educate the hospitals about need for routine cleaning and disinfection of gadgets, like air conditioners, for minimizing the chances of proliferation and dispersal of potentially pathogenic fungi.

Key words

AIR CONDITIONING; AIR POLLUTION, INDOOR; OPERATING ROOMS- *microbiology*; FUNGI; PRODUCT SURVEILLANCE, POSTMARKETING

Maintenance of strict asepsis is essential to minimize the chances of post-operative infections and their consequences. Infective agent could be transmitted due to inadequately sterilized equipment, presence of shedders of pathogenic microorganisms amongst the

hospital personnel, contaminated environment and contaminated surfaces.¹

The eye is an inimitable and cherished organ of the human body. Operation Theater (OT) is regarded as

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a highly specialized unit by ophthalmologists where strict asepsis is scrupulously and stringently adhered to. Postoperative infections including endophthalmitis continue to be one of the most disastrous complications of eye surgery. Sporadically, mini-outbreaks get reported. Prevention of such infective complications is achievable albeit not easy. Microbiological guidelines for prevention of exogenous source infections, though proposed, are not binding on hospitals.²

Fungi that can cause health care associated infections include *Aspergillus* spp., members of the order Mucorales and moniliaceous moulds. Many of these fungi proliferate in the air filtration devices and air conditioning (AC) units.³ Fungi belonging to the genus *Aspergillus* are ubiquitous; having a spore diameter of 2-3.5 µm. The spores have buoyancy and can remain air borne indefinitely in air currents. Other opportunistic fungi are also known to cause nosocomial infections. In a study of endophthalmitis subsequent to cataract surgery carried out in northern India, predominance of fungi as etiological agents has been documented.⁴ Spores of *Aspergillus* and other pathogenic fungi can inoculate the operative site and initiate infection. The number of spores that could potentially lead to infection continues to be a subject of research.⁵

Five cases of post cataract endophthalmitis were reported from an ophthalmic hospital situated near Pune, a large town in the western part of India. The hospital is an ophthalmic day care centre where the ophthalmologist operated twelve patients for cataract in the same operating theatre over a span of a week in June 2008. Three patients were operated on Monday, three on Tuesday, two on Wednesday and four on Friday. Five of these patients (two from Monday, one from Tuesday and two from Friday) reported with complaints suggestive of infective pathology after about a week of operation. The clinical picture was suggestive of infective etiology probably fungal endophthalmitis. Anterior chamber fluid aspiration was conducted under strict aseptic conditions. The anterior chamber fluid aspirated was evaluated by gram staining and wet mount microscopy for presence of bacterial or fungal pathology. The remaining fluid was then utilized for bacterial and fungal cultures. Fungal culture was done using Sabouraud's Dextrose Agar (SDA) slants. The slants of SDA were evaluated on

weekly basis for four weeks for presence of any fungal growth; standard mycological methods were used to identify the fungus.⁶ Fungal growth was evident in three patients. The fungi were evaluated and identified as *Aspergillus* spp. in two cases and *Mucor* Spp. in one sample. The other two samples did not yield any fungal growth. None of the samples evaluated showed bacterial growth. The patients were treated for fungal endophthalmitis using intravitreal, topical and oral antifungal agents. Two of the three patients improved significantly with these interventions. One patient had to undergo vitrectomy procedure due to non-responding infection.

The hospital operation theatre was analysed for contamination of the environment using sedimentation methods. As per this method a blood agar plate of 10 cm diameter was exposed to the environment of the Operation Theatre for a period of 30 minutes. During this period precaution was taken not to generate air currents in the environment being evaluated. The blood agar settle plate was then incubated at 37° C for 24 hours. Bacteria carrying particles (BCP) load in the environment was determined by a formula based on the colony count, area of the plate exposed, and the time of exposure according to the literature.⁷

The window air conditioner was opened for access to the air delivery area where a grossly contaminated filter was noticed (Figure 1). The swabs collected from the filter of the air conditioning unit yielded *Aspergillus* spp. and *Mucor* spp. The growths observed in the SDA slants of the patients and the AC units were phenotypically similar. The walls and areas in the vicinity of the operation theatre also showed growth of fungi. The air conditioning unit was cleaned and thoroughly disinfected but in spite of this the walls continued to harbour the fungi. The operation theatre unit was shut down due to the risk involved and was shifted to a different location.

These findings led us to hypothesize that significant number of air conditioning units in small hospitals may be similarly contaminated. With this background, twenty-five hospitals in the western Indian city of Pune were included in a surveillance study to document the prevalence of fungal colonization of AC unit filters.



Figure 1. Photograph showing grossly contaminated filter of the Window mounted Air Conditioning unit of the operation theatre

Air conditioning units in 25 hospitals where the follow up surveillance was carried out were evaluated over a span of two years. Samples were collected four times a year in the first, fourth, seventh and tenth calendar month. Twenty one AC units were window-mounted and four were split AC units installed on the walls of the operating theatres. Swabs were collected from the filters of the AC units and inoculation done at the site in two SDA slants incorporated with antibiotics. The pair of SDA slants was incubated at 30°C and at 37°C respectively for a period of four weeks and standard mycological methods used to identify any fungal growth.⁶

Fungal isolation rate was higher in window-mounted units (30.3%) than the split air conditioning units (3.1%) (Table I). Split AC unit circulates the air inside the operating room after cooling and filtering the same. Window mounted AC unit on the other hand draws in atmospheric air from an air vent. The chances of filters acquiring higher volume of dust and fungal spores from the atmosphere are therefore higher in the window mounted units. The filters utilised in these units if left unattended can act as suitable *nidus* for growth and proliferation of fungi.

Table I. Isolation of fungi from various types of air conditioners

AC	No of isolations/ No of evaluations (%)
Wall mounted	51/168 (30.3%)
Split	1/32 (3.1%)
Total	52/200 (26%)

At the initial first evaluation, 76% of the air conditioning units yielded fungi. At that point in time, none of the hospitals was following a maintenance program for the AC units. Following the results of first evaluation, hospital personnel were given the basic training in cleaning and disinfecting the filters of air conditioners. The AC units were cleaned and disinfected once every three months wherein the trained staff would clean the AC thoroughly with the help of vacuum suction device followed by wet mopping. During the wet mopping the filters of the AC units would be manually cleaned, washed with mild detergent followed by thorough

Table II. Fungal isolation rates

Months	Number of times fungi isolated (%)	
	First Year (n=25)	Second Year (n=25)
January	First Evaluation 19/25 (76%)	2/25 (8%)
April	3/25 (12%)	3/25 (12%)
July (Rainy Season)	10/25 (40%)	11/25 (44%)
October	2/25 (8%)	2/25 (8%)

washing with water. The filter would then be sun dried before re-installation. The subsequent isolation rate after the processes of cleaning, washing and sun drying were implemented was significantly lower. The fungal isolation rates from the filter beds increased in the month of July and again a year later (Table II). Possible explanation of this apparently seasonal trend could be found in the climatic conditions. The city of Pune is about 70 miles away from the seacoast and monsoon sets in this region of India in the month of May and continues till September. The relative humidity often rises to levels of 80-90% during this period. Moisture gets dehumidified (converted to water) when it comes in an air-conditioned environment. These conditions could create a suitable *nidus* for proliferation of fungi. Based on these findings the trained staff entrusted with cleaning and disinfection of air conditioners was instructed to carry out the procedure once every fortnight instead of three months. Data from the evaluations indicate that simple measures of cleaning and disinfecting at regular intervals based on findings from the surveillance has resulted in reduced risk of fungal contamination of the operating environment in all these hospitals befitting the usefulness of such a surveillance program.

Given the disastrous consequences of fungal infections, in spite of lack of current data to prove or disprove an association between infections and fungal colonization, the operating room AC units should be meticulously maintained and frequently monitored to minimise the chances of growth and proliferation of potentially pathogenic fungi.

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