Airborne bacteria in hospital operating theatres during surgery

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Introduction

Post-operative infections obtained from open-wound surgeries constitute an unnecessary load on both healthcare and affected patients. The annual cost for post-operative infections in Sweden is estimated to 4 billion SEK.

It is well established that increased air cleanliness reduces the number of post-operative infections. Therefore, the ventilation system is important in order to reduce the number of infectious particles in the air during surgery. Ventilation with high airflow, as in operating theatres, consumes a high amount of energy and it is thus desirable to find energy efficient solutions.

The purpose of this work is to evaluate air quality, energy efficiency and working comfort for different ventilation techniques in operating theatres.

Methods

Three different ventilation systems were evaluated: turbulent mixed airflow (TMA), laminar airflow (LAF) and the newly developed technique temperature controlled airflow (TAF).

TAF is based on HEPA-filtered under-tempered air falling from air-showers arranged in a circle above the operating table, see Figure 1. This technique leads to the usage of lower airflow volumes and less fan power. Additional air-showers are located in the peripheral parts of the room, controlling the overall cleanliness of the air in the operating room.

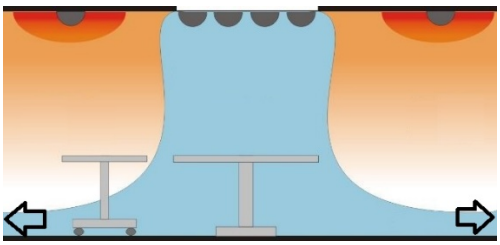

Figure 1: Schematic picture of the TAF ventilation system.

In total, measurements were performed during 45 elective operations: 15 for each type of ventilation system. The concentration of colony forming units (CFU)/m^3 was measured at three locations in the rooms: close (<0.5 m) to the wound, behind the operating staff and in the peripheral part of the room. Additional measurements were carried out, where the number of CFU/m^3 was compared to the number of viable particles detected by a high airflow fluorescence spectrometer (BioTrak 9510-BD, TSI).

Results

In this study we show that LAF and TAF, but not TMA, have less than 10 colony forming units (CFU)/m^3 at all locations in the operating room, which is in line with the recommendations in most countries (Figure 2). TAF has up to 30% lower energy consumption than LAF, which is related to the almost double airflow volume in LAF.

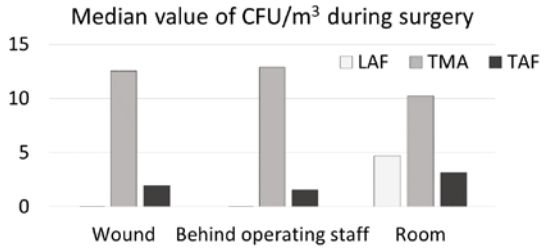

Figure 2: The diagram shows the different concentrations of CFU/m^3 in the three ventilation systems.

The high airflow fluorescence spectrometer showed that there are more viable particles in the air than reproductive bacteria (CFU).

A questionnaire was given to the operating staff, and their answers showed that they experienced less disturbance from noise and draught in TMA and TAF than in LAF. The experienced working environment is of high importance since it is unwanted to expose the operator to additional stress.

Conclusions

Reducing the CFU concentration in operating theatres is difficult, since most particles are emitted by the staff. Nevertheless, both the LAF and TAF ventilation keep high air cleanliness with low CFU concentrations throughout the operation. The comparison of the conventional CFU measurements and the fluorescence measurements will deepen our understanding of airborne bacterial viability.

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