SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The objective of this research was to study the performance of vertical and horizontal LAF (unidirectional) in the reduction of BCPs in the surgical area.

DESIGN IMPLICATIONS

The authors indicate from this study that choosing between the two laminar airflow systems depended on operational practice and ventilation flow rate. They, however, recommend that sources of bacteria should be placed downstream from the surgical site and instruments, and that no activities should take place in the space between the operating area and the airflow.

A numerical investigation of vertical and horizontal laminar airflow ventilation in an operating room

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Key Concepts/Context

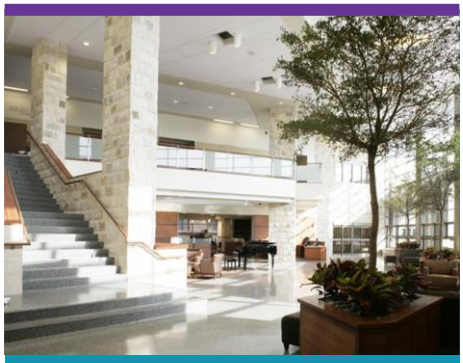
Laminar airflow (LAF) ventilation or parallel distribution system is the most commonly-used ventilation system in operating rooms (ORs). There is, however, much uncertainty about better efficacy of vertical or down flow LAF and horizontal or lateral flow LAF in controlling infections in ORs. The authors indicate that operating room staff members can also be a source of contamination. This study examined the two types of LAF and their impact on reducing the concentration of bacteria-carrying particles (BCPs) in ORs. The study found that preferring one ventilation system over another depends on the airflow rate and the positions of fixtures, equipment, and personnel in the surgical area.

Methods

For this research, computational fluid dynamics was used to make a numerical comparison in a simulated OR with vertical and horizontal LAF conditions. For an equitable comparison of the two strategies, size, turbulence intensity, air temperature, etc. of the ventilation systems were at identical settings. Three scenarios were simulated – staff, instrument tables, equipment, and medical lamps were placed in the same position for the vertical airflow (vertical case 1) and the horizontal airflow (horizontal case 1); for the third scenario, one staff member was positioned between the laminar flow diffuser and the operating table, in the case of the horizontal airflow (horizontal case 2). The study also simulated passive and active air sampling methods to explore deposition and distribution of BCPs in the OR.

Findings

On comparing the three scenarios of airflow, it was found:



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- If fixtures, equipment, and personnel are positioned improperly, it can disturb the lateral unidirectional pattern of airflow.
- When a staff member is positioned between the laminar flow diffuser and the operating table, there is potential for BCPs to be diffused towards the operating wound and surgical instruments.
- In all three scenarios, it was seen that increasing the airflow rate decreased the concentration of
- BCPs in the operating area.
- In horizontal case 1, when the airflow rate was increased to 50 air changes per hour (ACH), the amounts of BCPs settling on the operating table were reduced.
- In horizontal case 2, even though the airflow was disrupted and BCP deposits in the operating table area were higher, BCP concentration was the same as in horizontal case 1.
- In the vertical case, increase in the airflow rate to 40 ACH lessened the BCP count in the operating area.
- Increasing the ventilation flow rate beyond 40 ACH is likely to increase turbulence; the dispersion BCPs in the OR would be beyond control.
- When the OR is supplied with a vertical flow of air, the area below the medical lamps positioned over the operating table becomes stagnant, creating a potential for concentration of bacteria.
- To maintain a low concentration of bacteria deposits around the patient, sources of the bacteria should be positioned downstream from the surgical site and instruments, and the space between the airflow diffusers and the operating area should be kept clear of all activities.

Limitations

The authors do not identify any limitations for their study. One limitation of the research is that it is a simulated study; a study conducted under real life scenarios would yield more generalizable and robust findings.

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