Operating Room of the Future

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Field measurements of the airflow distribution in close proximity to a patient in an operating room

Summary

In modern hospitals among surgical patients are surgical-site infections (SSIs) the most common hospital-acquired infections. The objective of this study is to characterize the airflow distribution in close proximity to the patient in an operating room with laminar airflow (LAF) system. Field measurements of air velocity were conducted at St. Olavs hospital, Norway. The patient was simulated by a person in supine position, while the indoor environmental conditions were set equal to those of a real surgery. The results show that the airflow above the patient is affected by the supply air from the ceiling being counteracted by the thermal plume of the patient, causing lower velocities above the patient than the surroundings. They also show that the presence of surgical lamps have a major impact.

Challenges connected to ventilation of operating rooms:

- The nature of a surgical procedure is complex and transient
- Large variations depending on the type of procedure
- Possibly varying requirements depending on the patients state of health
- The surgical staff may have different preferences in terms of thermal environment

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Introduction

- Recent studies have found that the correlation between LAF systems and lower rates of SSIs is uncertain.
- Air velocity influences the convective heat loss of a wound, and the temperature of the wound and in the external microenvironment affect the wound healing.
- Positioning and presence of surgical lamps greatly influences the airflow distribution close to the patient.

Objective

The objective of this study was to investigate the air velocity distribution in the external microenvironment of a surgical incision during a mock-up surgery.

Method

Field measurements of airflow distribution above a simulated patient with surgeons were conducted in operating room 8 at the department of orthopaedic with/without surgical lights at St. Olavs hospital.

Figure 1: Scenario 1 in the OR at St. Olavs hospital in Trondheim, Norway

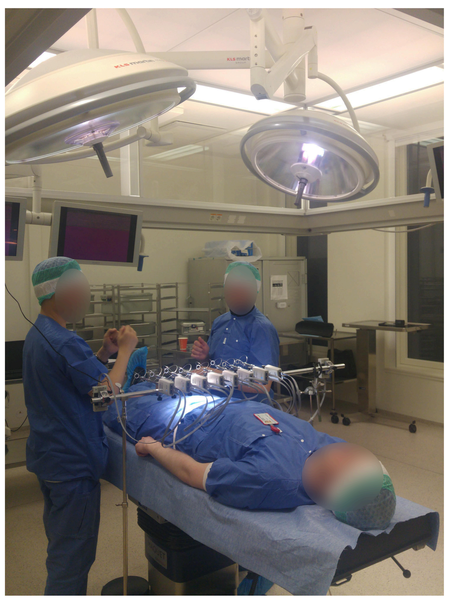

Figure 2: Scenario 2 in the OR at St. Olavs hospital in Trondheim, Norway

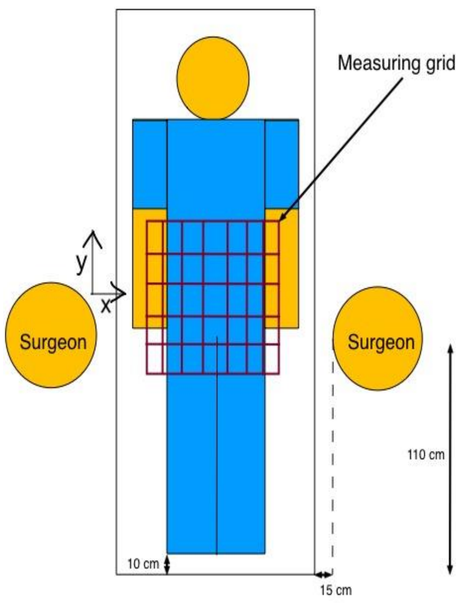

Figure 3: Setup of the velocity distribution measurements

Measurement results

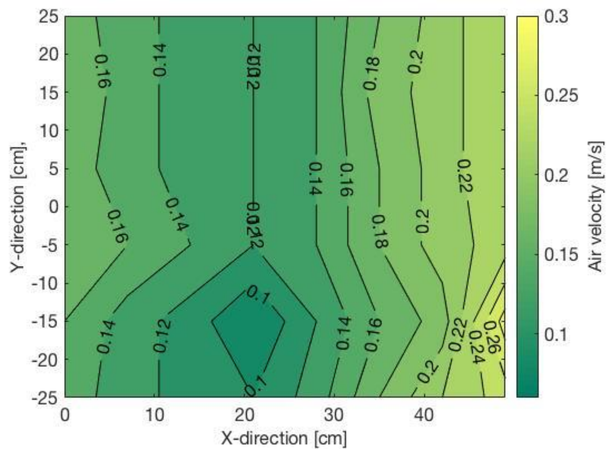

Figure 4: Velocity distribution measurements for scenario 1, 15 cm above the simulated patient in an operating room with laminar airflow.

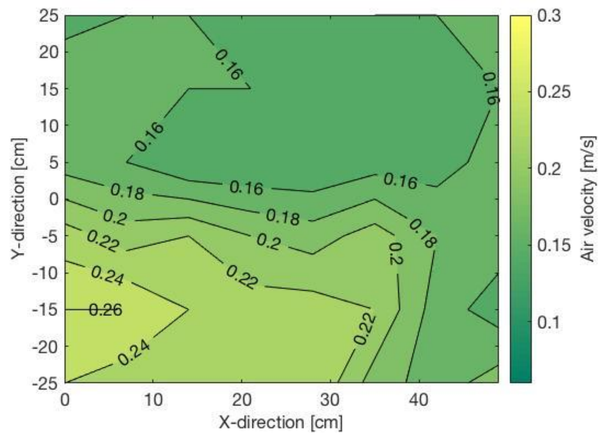

Figure 5: Velocity distribution measurements for scenario 2, 10 cm above the simulated patient in an operating room with laminar airflow.

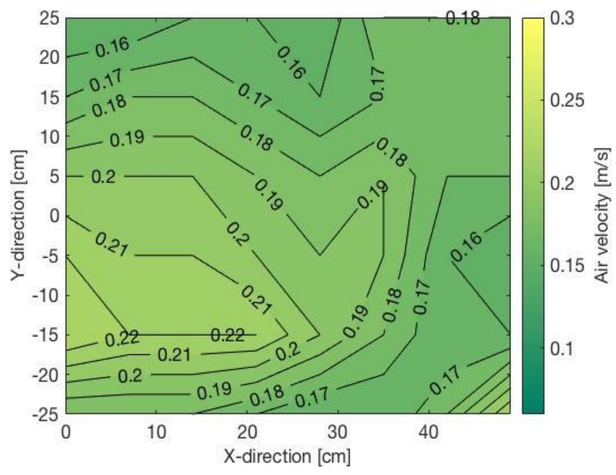

Figure 6: Velocity distribution measurements for scenario 2, 15 cm above the simulated patient in an operating room with laminar airflow.

Conclusions

The laminar airflow appears to be decelerated and disturbed by the thermal plume of the patient. Surgical lamps had a major impact as they interfere with and block the airflow, and possibly by providing additional heat. Hence should the effects of both thermal plumes and obstructions be taken into account when making new guidelines and design specifications.

References

Bischoff, P., Zeynep Kubilay, N., Allegranzi, B., Egger, M., Gastmeier, P. (2017) Effect of laminar ventilation on surgical site infections: a systematic review and meta-analysis. *The Lance Infectious Diseases,* 17(5), pp.553-561.

Hagen, L. (2016) *Postoperative sårinfeksjoner, en observasjonsstudie ved St. Olavs hospital, Røros Sykehus.* Master thesis. Norges teknisk-naturvitenskapelige universitet