

SHORT REPORT

Surgical face masks in modern operating rooms—a costly and unnecessary ritual?

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Summary: Following the commissioning of a new suite of operating rooms air movement studies showed a flow of air away from the operating table towards the periphery of the room. Oral microbial flora dispersed by unmasked male and female volunteers standing one metre from the table failed to contaminate exposed settle plates placed on the table. The wearing of face masks by non-scrubbed staff working in an operating room with forced ventilation seems to be unnecessary.

Keywords: Face masks; operating theatre; bacterial dispersal.

Introduction

Surgical face masks have for many decades been worn by operating room staff in the belief that exposed surgical wounds are protected from potential infection by nose and mouth bacteria. Following the commissioning of a newly built operating theatre suite with forced ventilation, in a new hospital, it seemed opportune to review air flows and their effects on airborne microorganisms, and the indications for wearing surgical face masks.

Materials and methods

Air flow studies

Titanium tetrahydrochloride-impregnated swab sticks, which in contact with air yield a dense white smoke of titanium oxide, were used to monitor air movement in an operating room ventilated through six air ducts placed in the ceiling above the operating area with HEPA filtered air under positive pressure at $2.34 \text{ m}^3 \text{ s}^{-1}$ with 20 changes per hour, both before and during a simulated surgical procedure.

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Nose and mouth bacteria dispersal

Male and female volunteers breathed through the nose for 5 min over exposed nutrient agar plates placed 15 cm from the nostrils. Further, volunteers were asked firstly to whisper and secondly to recite out loud with their mouths placed 15 cm from exposed culture plates for 5 min.

Dispersal of mouth bacteria in the operating room

A male volunteer dressed in cotton operating room clothes and disposable head covering recited out loud for 5 min, firstly with and then without a deflector filter type face mask while standing beside an operating table on which were placed three exposed blood agar plates. A further series of observations were made with a male volunteer, followed by a group of two male and two female volunteers speaking out loud in unison, with and without masks, standing at a distance of one metre from the table.

All culture plates were incubated aerobically at 37°C for 18 hours and then left at room temperature for a further 24 hours before inspection for colony forming units (cfus).

Results

Titanium oxide smoke trails in a ventilated operating room, empty apart from the observer, drifted upwards and laterally away from the operating table. During a simulated surgical procedure there was considerable air turbulence in the vicinity of the operation site created by arm movements by the scrubbed staff. Activity by non-scrubbed staff one metre from the table caused no discernible disturbance of air movement over the operation site; the smoke trails drifted towards the periphery of the room.

Airborne microbial dispersal from the nose was negligible during quiet breathing. Contamination from the mouth while talking out loud was substantially reduced when the volunteers whispered. These results are shown in Table I. A small number of cfus were found on settle plates situated on the operating table and the instrument tray when a volunteer recited out loud without a mask. There was no contamination when up to four volunteers recited together standing one metre from the table (Table II).

Discussion

Filter deflector type face masks have been shown to be effective both in preventing microbial contamination from the mouth¹ and in deflecting forcibly exhaled smoke particles, provided they are correctly fitted,² although tracer particles of albumen microspheres were found in operation wounds when tracer impregnated masks were worn³ and it was suggested that expired air passed round the edges of the mask, an effect which could be eliminated by covering the mask edges with a 'bonnet' design of headwear.

Table I. Total numbers of colony forming units after breathing through the nose, whispering and talking over exposed settle plates

| | Total cfus/settle plate | | |
|-----------|-------------------------|------------|---------|
| | Breathing through nose | Whispering | Talking |
| Subject 1 | 0 | 3 | 34 |
| Subject 2 | 0 | 3 | 8 |
| Subject 3 | 0 | 11 | 23 |
| Subject 4 | 0 | 1 | 16 |
| Subject 5 | 0 | 9 | 61 |

Table II. Total numbers of colony forming units after talking with and without masks over exposed settle plates in a fully ventilated operating room

| | Total cfus on 3 settle plates | |
|---|-------------------------------|--------------|
| | With mask | Without mask |
| <i>Beside operating table</i> | | |
| Subject 1 | 0 | 29 |
| Subject 2 | 0 | 12 |
| <i>One metre from operating table</i> | | |
| Subject 1 | 0 | 0 |
| Subject 2 | 0 | 0 |
| Subject 3 | 0 | 0 |
| Subject 4 | 0 | 0 |
| <i>Four subjects one metre from operating table</i> | | |
| Expt 1 | 0 | 0 |
| Expt 2 | 0 | 0 |

The numbers of airborne bacteria expelled from the nose and mouth are insignificant compared with the substantial numbers shed from the skin.⁴ Our studies confirm earlier work^{5,6} that during quiet breathing few, if any, nasal bacteria are expelled into the air, despite heavy colonization of the nose. Quiet talking reduces 2-7-fold oral bacterial contamination compared with ordinary talking. When the talking experiments were repeated in a fully ventilated operating room, expelled oral bacteria from a distance of one metre failed to contaminate settle plates on the operating table or the instrument tray adjacent to the table. Opposing air flows carried airborne contamination away from the centre towards the periphery of the room. These observations suggest that oral bacteria normally conveyed in droplets into the air during ordinary talking by non-scrubbed staff, who are not within the immediate vicinity of the operation site, do not pose an infection hazard and the wearing of masks is unnecessary. The small number of mouth bacteria expelled by the surgeon and the scrubbed members of the surgical team during ordinary talking may contaminate the operation

wound. Although contamination is not the same as infection it would be imprudent for a surgeon and the scrubbed assistants to dispense with masks when performing high risk surgery, e.g. prosthetic implants; in low risk general surgery contamination by oral bacteria seems to be a negligible hazard. In one study there was no increase in wound infection when no masks were worn in an operating theatre for 6 months.⁷ There have been similar reports in other situations. There was no significant difference in infection rates when wounds were sutured in an emergency department, whether or not mask and cap were worn.⁸ There were no cases of infection following cardiac catheterization procedures when cap and mask were not worn.⁹

There is little evidence that mouth flora expelled by talking scrubbed staff causes significant infection and, with the exception of high risk surgery, the wearing of masks by the surgeon and scrubbed assistants is of unproven value. Oral microbial dispersal by talking non-scrubbed staff poses no risk to the patient on the operating table. The routine wearing of masks by all staff working in a modern operating room with forced ventilation is a costly and unnecessary ritual.

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