Theatre Ventilation

Clare Langley

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Aims

• Reduce air borne bacterial content
• PP to reduce influx of contaminated air
• Displace contaminated air from operation site
• Maintain acceptable environment for staff and patient
Sources of contamination

- Direct from surgical team
- Instruments
- Airborne - 95%
- Patient
Clean Air

• Defined by “air cleanliness”
• Bacteria carrying particles per cubic metre (BCP/m^3)
• Colony forming units per cubic metre (CFU/m^3)
Clean air

- Measured with a microbiological volumetric slit sampler or settle plates
- Draw in volume of air/minute (30-70L/min), incubated 48hrs at 37°C
- Colonies are counted
- In ultra clean theatres recommended every 3 months inside and outside enclosed area.
Clean air

• Standard theatre: <35 CFU of bacteria/m$^3$ of air and <1 CFU/m$^3$ of C. perfringens and S. aureus.

• Ultra clean theatres: <20 CFU/m$^3$ at the periphery and <10 CFU/m$^3$ at the centre
Source of Ventilation

• Intake of air at roof level
• Drawn by fans through filters to remove bacteria
• High-efficiency particulate air filters (HEPA) are used
• Can filter particles of 0.5 microns at 99.97% efficiency
• Humidified +/- warmed/cooled
Plenum

- $P_{\text{inside}} > P_{\text{outside}}$
- Clean air enters via ceiling diffuser and let out via vents placed at floor level.
- Opening doors and movement of personnel make system less efficient
- 15-25 changes of air /hr
Laminar flow

- “entire body of air within a designated space moving with uniform velocity in a single direction along parallel flow lines”
- Horizontal
- Vertical – most common design
- Exponential (Howorth enclosures)
- “room-in-a-room” principle
- Flow rate 0.3 m/s
Literature

• Charnley (1972)
  – Vertical laminar flow
  – 1960-1970, 5800 THR
  – Reduction in deep infection from 7% to 0.5%
  – Multiple reasons: improved wound closure, improved gowns and cleaner air.
Literature

• Lidwell (1982)
  – MRC prospective RT
  – THR and TKR, 8000 operations
  – Sig ↓ in wound contamination and deep joint sepsis in ultra clean theatres
  – Infection rate: control 1.5%, trial 0.6%
Literature

• Lidwell (1982)
  – Vertical better than horizontal laminar flow
  – Antibiotic cement and systemic antibiotic effective in decreasing deep joint sepsis
Literature

- Stacy and Humphreys (2002)
  - Hospital Infection Society Working Party on Infection Control and Operating Theatres.
  - Guidelines for environmental monitoring.