G39: Does the Use of Laminar Airflow Reduce Risk for Surgical Site Infection (SSI)/Periprosthetic Joint Infection (PJI) in Patients Undergoing Major Orthopaedic Procedures?

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Response/Recommendation: There is no evidence to demonstrate that the use of traditional Laminar Airflow Systems is effective in reducing Surgical Site infection or Periprosthetic joint Infection in orthopaedic surgery.

Strength of recommendation: Strong

Delegate Vote:

Rationale:

The effectiveness of Laminar airflow (LAF) systems in reducing surgical site infections (SSI) and periprosthetic joint infections (PJI) during orthopaedic surgeries has been a subject of debate. In their landmark paper, Lidwell et al. (1982)[1] reported reduced infection rates when using LAF in a multicentre randomized controlled trial (0.6% in LAF compared to 1.5% in conventional settings), but they failed to control for confounders, including antibiotic prophylaxis. Furthermore, conventional turbulent ventilation systems have evolved and current designs with high-efficiency particulate air filters cannot be compared to historical systems. The ICM 2018[2] declared that LAF was not necessary in orthopaedic procedures. The World Health Organization recommends against the use of LAF system[3].
Using a review of PubMed and Embase (Ovid) databases we evaluated the current evidence to support the use of LAF in reducing SSI and PJI. Thirty-three studies were included of which 10 were[4-13] in the most recent systematic review and meta-analysis[14], including studies from 2000 to 2022. They concluded that the overall pooled OR against the use of LAF of all included studies was 1.70 (95% CI 1.10–2.64), and the overall pooled RR was 1.27 (95% CI 1.02–1.59) with $p < 0.05$. Other earlier systematic reviews,[15,16] found no significant advantage of LAF in reducing PJIs following total knee arthroplasty (TKA), with some studies even reporting higher infection rates for total hip arthroplasty (THA)[6,9].

Observational studies provide conflicting evidence. Brandt et al[6] reported an increased likelihood of SSIs in LAF-equipped operating rooms for THA, with an odds ratio of 1.63. Conversely, Kakwani et al.[5] found no infections in LAF settings compared to a 4% infection rate in non-LAF rooms for Austin-Moore hemiarthroplasties. A recent study by Wang et al.[12] compared two high volume arthroplasty hospitals with the same surgical staff and protocols that differed only in the ventilation system used. They found LAF was not associated with a reduction of the risk of PJI (adjusted odds ratio, 0.94; 95% CI, 0.40-2.19; $P = 0.89$).

Level 1 evidence provided by two recent randomized clinical trials (RCTs)[17,18] has been limited to assessing air quality by quantifying particulate load and colony forming units but had low

patient numbers and although they both demonstrated better air quality using LAF they were unable to show any improvement in SSI or PJI. LAF, as commonly used, fails to address the environment outside of the immediate laminar flow zone, which is about a $3m^2$ area, leaving implant and instrument trays exposed to any unclean air which may inadvertently blow off the floor or personnel outside the laminar flow zone.

Perhaps the strongest evidence comes from registry-based studies using large databases. Hooper et al.[9], using data from the New Zealand Joint Registry, found higher infection rates in LAF-equipped operating rooms (OR=1.6). Meanwhile, Pinder et al.[11] identified no discernible advantage of using LAF for orthopaedic trauma.

Conclusions:

This review does not support the routine use of LAF in major orthopaedic procedures. Not only is LAF expensive, but it is also resource-intensive and requires significant investment in installation, high energy consumption, and considerable maintenance. Consequently, in settings with limited resources, funds may be better allocated to interventions with demonstrable efficacy, such as preoperative skin preparation and standardized infection prevention protocols. However, maintaining clean air exchange rates and controlling contamination in critical zones should remain a priority, regardless of LAF use.

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