Abstract

Project Bubble Watch - Gaseous microemboli removal efficacy comparing oxygenators with and without arterial filter during cardiopulmonary bypass: a pilot study

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Background
Gaseous microemboli (GME) are frequently detected during cardiopulmonary bypass (CPB) and have been associated with postoperative neurological injury and inflammatory activation. The European guidelines state that an arterial line filter should be considered to remove GME, but the benefit remains debated.

Aim
To compare the efficacy of GME removal between two oxygenators, one incorporating an integrated arterial filter and one without an arterial filter.

Methods
This pilot study included 20 adult patients undergoing elective cardiac surgery with CPB. The control group (n=10) was perfused without arterial filter (Inspire 8), while the intervention group (n=10) with arterial filter (Inspire 8F). GME were quantified using an ultrasonic bubble counter with probes positioned pre- and post-oxygenator. Primary outcome was total post-oxygenator GME volume. Secondary outcomes included proportion of GME removal, GME count by size category, and maximum bubble size. Data are medians and 25-75 percentiles. Statistical comparisons were performed using Mann-Whitney U and Wilcoxon signed-rank tests.

Results
Total post-oxygenator GME volume was higher in the no-filter group (0.0185 µl [0.0078-0.0620]) compared with the filter group (0.0017 µl [0.0006-0.0119], p=0.0115), however, the no-filter group was exposed to a higher, but not statistically significant, pre-oxygenator GME volume (2.311 µl [0.2008-41.20] and (1.001 µl [0.6218-1.745], respectively, p=0.6305). Proportion of GME volume removal (no-filter: 97.5% [89.0-100] and filter: 99.9% [99.2-100], p=0.2475) and proportion of bubble count removal (no-filter: 99.0% [96.6-99.8] and filter: 99.6% [99.5-99.9], p=0.1051) were similar in both groups. The majority (96%) of detected bubbles in both groups measured 20-100 µm. Bubbles larger than 200 µm were rare, and no oversized emboli (>2000 µm) were observed.

Conclusion
The total post-oxygenator GME volume and count were lower using the arterial filter oxygenator than when using the no-filter oxygenator, but the no-filter oxygenator had similar GME removal efficacy. Given the low absolute GME volumes and counts, which probably have low clinical impact, in both groups, a no-filter oxygenator (Inspire 8) can be considered to have acceptable GME removal performance within the limitations of this study.