

A simple and cost-effective strategy to prevent HPE in cardiopulmonary bypass circuits

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Background

High-pressure events (HPE) in cardiopulmonary bypass (CPB) oxygenators became a significant clinical concern in our cardiac surgery program during 2023. HPE was characterized by a sudden rise in trans-oxygenator pressure, accompanied by reduced blood flow and impaired gas exchange during CPB. These events disrupted surgical workflow, increased the risk of inadequate perfusion, and occasionally required emergency oxygenator replacement. Initial management followed Hjarle's protocol using epoprostenol to reduce oxygenator resistance. Although effective, epoprostenol raised concerns regarding platelet dysfunction and increased postoperative bleeding, creating the need for a safer preventive strategy.

Methods

We modified our CPB priming protocol by adding albumin to a 1400 ml Ringer-acetate priming solution. Albumin was initially added at 100 ml, and then gradually reduced to 50 ml and 20 ml while maintaining the same priming volume. Clinical outcomes were evaluated through routine monitoring of trans-oxygenator pressures, CPB performance, and blood gas analysis during consecutive cardiac surgery procedures.

Results

Following implementation of albumin priming, no HPE occurred with either the 100 ml or 50 ml protocols across approximately 300-500 CPB cases. After reducing the dose to 20 ml, no HPE was observed in an additional 500 consecutive procedures. In contrast, 4-5 cases, in which albumin was inadvertently omitted from the priming solution, developed high oxygenator pressures, strongly supporting the protective effect of albumin. Similar findings using the same protocol were independently confirmed at other cardiac surgery centers in Norway.

Conclusion

The addition of albumin to the CPB priming solution appears to effectively prevent HPE in oxygenators during cardiac surgery. Our experience suggests that as little as 20 ml albumin in a 1400 ml Ringer-acetate prime is sufficient to eliminate HPE while avoiding the potential bleeding risks associated with epoprostenol. This simple, practical, and cost-effective strategy warrants further prospective evaluation, including assessment of whether even lower albumin doses can provide the same protective effect.