Cardiopulmonary bypass and the endothelial glycocalyx: Shedding new light

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Cardiopulmonary bypass (CPB) remains a necessary component for the surgical repair of many congenital heart defects. As such, there is an ever-present risk of known complications associated with CPB, including a systemic inflammatory response, capillary leak syndrome, and end-organ dysfunction.¹ The deleterious effects of CPB on the microvasculature have been demonstrated in animal models and implicated in clinical reports linking CPB duration to postoperative outcomes in pediatric patients undergoing cardiac surgical procedures.^{2,3} In this month's issue of the *Journal*, Nussbaum and colleagues⁴ demonstrate for the first time that exposure to CPB in infant patients significantly reduces the endothelial glycocalyx (EG) and microvascular perfusion in infant patients in the early postoperative period.

Nussbaum and colleagues⁴ show that, on average, reductions in the dimension of the EG and circulation through the microvasculature occurred within 1 hour of the patient's return to the intensive care unit before normalizing to baseline levels at postoperative 24 hours. By comparison, there was no such change in the hour after intervention in patients undergoing cardiac catheterization, surgery for cleft palate, or even cardiac surgery without CPB. The inclusion of these other groups was a strength of the study and supports its central message that the use of CPB in infants alters the EG and microcirculation. These findings contribute to our understanding of the pathologic changes induced on the microcirculation by CPB.

What remains unclear, however, is the clinical relevance of the transient changes observed in the EG and microvasculature after CPB. In this study, there was no correlation between any of the measured parameters and clinically significant end points, including need for mechanical ventilation, inotropic use, and capillary leak syndrome. Meanwhile, Nussbaum and colleagues⁴ did find an association between CPB duration and the

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Central Message

This study demonstrates that cardiopulmonary bypass changes the endothelial glycocalyx in patients with congenital heart disease.

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requirement for mechanical ventilation and use of 1 or 2 inotropes, which suggests that CPB is implicated in a more complicated postoperative course but not predominantly as a result of changes in the EG or microcirculation. This raises the question of whether other factors related to CPB, such as levels of circulating inflammatory cytokines or other patient factors, might be more predictive of postoperative events. Alternatively, further study in a high-risk group of patients might find that CPB exacerbates ongoing EG and microvascular injury, which could result in a more pronounced relationship between alterations in the EG and postoperative events.

In summary, Nussbaum and colleagues⁴ present a novel and interesting study demonstrating the effect of CPB on changes in the EG and microvasculature. Because of the EG's known role in maintaining vascular permeability, shedding of the EG associated with CPB likely contributes to postoperative morbidity at some level, although such a contribution was not clearly captured in this study. Additional studies are needed to define better the clinical utility of EG measurement in pediatric patients undergoing cardiac surgery with CPB, but this study offers important preliminary evidence that CPB is associated with alterations in the EG and microcirculation in infants with congenital heart disease.

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