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Invited Commentary

It's Not the Pump, It's How You Use the Pump!

The authors used a clever and inexpensive method to confirm the conclusions previously described by Wake Forest University investigators, who used vastly more expensive techniques in animals and human models: namely, the source of lipid microemboli during cardiac surgery are largely derived from the return of cardiotomy suction blood and, to a lesser extent, cell saver treated blood (1,2).

The authors' recommendation to limit lipid microembolization is to avoid cardiopulmonary bypass and to use off-pump surgical techniques, at least for routine CABG. The CardioNeuroProtection research team at Wake Forest came to a somewhat different conclusion (3,4). We demonstrated that we could avoid lipid embolization by minimizing bleeding and thereby the need to return any blood products regardless of whether the pump was used or not.

Our current research demonstrates that it is not necessary for a lipid or gaseous embolus to occlude a vessel to cause damage (5). The mere passage, or rather extrusion, of a deformable embolus through a vessel can cause a disruption of endothelial function, which in the case of the brain, results in a breakdown of the Blood Brain Barrier with subsequent vasogenic and cytotoxic edema, the release of cytokines, neutrophil adhesions, and the transmigration of leukocytes in to the brain substance (6). Avoiding the return of shed blood in its many forms potentially contributes to a reduction in the systemic inflammatory response. Our recent paper (7) demonstrates equivalent neurologic outcomes between patient groups undergoing CABG with and without the pump by avoiding the use of partial occlusion clamps and minimizing the return of suctioned blood. Further analysis has demonstrated fewer persistent neurologic deficits in the on-pump group than those undergoing off-pump surgery. We speculated that the neuroprotective effect of hypothermia contributed to the improved outcomes in the CPB patients.

However, we caution that not all pumps, filters, and cell savers are equally effective at handling gaseous and or lipid microemboli (2,8). The contribution of emboli from the surgical field is a confounding factor when attempting to ascribe "blame" for negative outcomes. The pump is an easy target despite the fact that gaseous and lipid microemboli from the surgical field can pass completely through both the patient and circuit. Emboli are not absent during off-pump surgery and they are delivered to a warm brain. It is critical to avoid introducing embolic material and not rely on a filtration system to rectify a preventable problem (9).

The clever experimental design used by these investigators will contribute to an accelerated resolution as to how best to avoid lipid microembolization and improve outcomes, with or without the pump.

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