See Article page 418.

Commentary: When short-circuiting is a good thing—miniaturized cardiopulmonary bypass decreases morbidity after heart surgery

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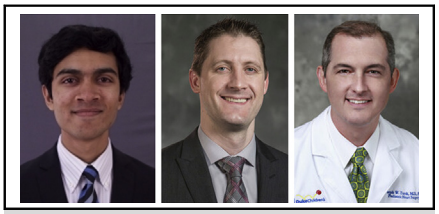

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CENTRAL MESSAGE

Miniaturized extracorporeal circulation may reduce adverse effects associated with traditional bypass. Should adoption of the strategy increase, it may be especially beneficial for pediatric patients.

The advent of cardiopulmonary bypass (CPB) in the 1950s was a landmark advancement in clinical medicine, enabling the development of modern heart surgery.[1] However, CPB is not without its consequences. Adverse systemic effects such as coagulopathy and inflammation precipitated by the contact of blood with air and plastic surfaces have been reported.[2] Minimally invasive, or miniaturized, extracorporeal circulation (MECC) is an alternative strategy designed to reduce adverse effects by using a closed circuit, biologically inert surfaces, reduced priming volumes, and a centrifugal pump.[3] Several randomized controlled trials (RCTs), primarily from Europe, have compared outcomes after traditional CPB and MECC. Although many demonstrate benefit with MECC, the technology is not widely adopted. Furthermore, there is a lack of updated meta-analyses comparing the 2 strategies. That is, until now.

In this issue of the *Journal*, Cheng and colleagues[4] have published a meta-analysis comparing outcomes after conventional CPB (CECC) and MECC in adult cardiac surgery. The authors show that MECC significantly decreased the composite end point of mortality, stroke, myocardial infarction, and renal failure compared with CECC. They also demonstrate reductions in rates of arrhythmia, blood loss, and hospital stay with MECC. The authors are to be commended for publishing this study. This meta-analysis represents the largest of its type, including a total of 42 RCTs spanning the last 2 decades. Their statistical methodology is sound, and the data are well presented. A nice touch is the addition of inflammatory cytokine (interleukin-6, interleukin-8) analyses showing evidence of decreased systemic inflammation after MECC, which has not been reported in meta-analyses to date. However, the study has limitations. For one, there is variability between trials in MECC configurations and definitions of outcome variables. In addition, the conclusion that MECC is clinically superior to CECC in a meta-analysis of small RCTs may not necessarily translate to the "real-world" where expertise, patient care, and funding are more variable.

Proponents of MECC state that the closed-system configuration is more physiologic and results in maintenance of microcirculatory integrity.[5] However, there are also safety concerns, as most iterations do not contain hard-shell venous reservoirs used in the traditional configuration for both bleeding control and rapid manipulation of intravascular volume. Novel MECC systems use a modular configuration whereby a venous reservoir is kept as a standby component, which may mitigate these concerns.

The use of MECC may be especially beneficial in congenital heart surgery. Infants and neonates are more

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susceptible to anasarca, cardiopulmonary dysfunction, and renal injury postoperatively. In theory, having a system like MECC where the bypass circuit could be brought closer to the patient to reduce lengths of tubing and the need for exsanguination priming would be ideal. In fact, there is one study in the literature of 38 infants who received MECC with no conversion to CECC or major adverse cardiac events.[6] However, further study is required in this population.

In summary, Cheng and colleagues[4] have performed an important analysis that demonstrates promising outcomes associated with miniaturized CPB systems. Despite logistical and financial challenges, MECC may eventually represent the path forward to improve the already-good postoperative outcomes in cardiac surgery patients.

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