Too much of a good thing? Reducing cannula size and flow rates during extracorporeal life support

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Extracorporeal life support (ECLS) has been increasingly utilized for the management of refractory cardiogenic shock because of ease of implementation and the provision of complete circulatory and pulmonary support. Initiation of ECLS requires access to peripheral vessels when deployed outside operating room settings and frequently employs percutaneously placed venous and arterial cannulas of sizes that permit an optimal flow rate typically above 2.0 to 2.3 L/min/m².¹ The use of larger arterial cannula sizes to achieve these desired flows and to reduce blood trauma have a greater potential to lead to arterial injury, limb ischemia, bleeding, thromboembolism, and other vascular complications. High flows during ECLS can also lead to increasing arterial afterload resulting in left ventricular distension and pulmonary hypertension with subsequent pulmonary hemorrhage.

Takayama and colleagues² report on a strategy of ECLS cannulation utilizing a small arterial cannula size (15F) compared with a strategy employing larger arterial cannula sizes (eg, 17F-24F). The authors hypothesized that a smaller cannula would provide adequate ECLS flow and hemodynamic support while reducing complications associated with larger arterial cannula sizes (eg, vascular complications) and higher ECLS flows (eg, higher arterial afterload). Importantly, the authors demonstrated equivalent hemodynamic support and survival between the 2 different strategies despite significantly lower ECLS flows in the small arterial cannula cohort. The authors also observed a significantly lower rate of bleeding complications at the cannulation site in the small arterial size cohort, and importantly, the use of smaller arterial cannula size was associated with a greater ability to utilize percutaneous techniques for placement of the arterial cannula and a greater probability of deploying ECLS at the bedside.

There are a number of important considerations with the study by Takayama and colleagues.² First, this is a single-center retrospective observational study reporting on a relatively small cohort of approximately 100 patients. Lack of randomization may have introduced bias in patient selection in each arm that might have included important factors such as degree of residual cardiac function.

The authors conclude from the study data that a strategy employing a small arterial cannula size provides equivalent hemodynamic support. However, this conclusion should be taken in the context of the characteristics of the study population. The range of body surface area (BSA) sizes in the 2 study cohorts was similar but the number of very large BSA sizes, and their outcomes, in each group was not available. The authors attempt to address this issue by dividing the small cannula cohort into small and large BSA groups and the authors demonstrated similar outcomes between the 2 subgroups. However, cohort sizes in the subgroup analysis were too small to draw important conclusions. The authors also did not compare outcomes of the larger BSA sizes between small and large arterial cannula size cohorts. Thus, caution must be used in determining whether small arterial cannula sizes with limited ECLS flow are effective for patients with a very large BSA.

Another important consideration in interpretation of the study results was the use of ancillary circulatory support with an intraaortic balloon pump or Impella left ventricular assist device (Abiomed, Danvers, Mass). The authors hypothesized that lower ECLS flows with a small arterial cannula may reduce the risk of high afterload and risk of left ventricular distension. However, the use of ancillary support was greater in the cohort utilizing the small arterial cannula size, suggesting a greater need for left ventricular decompression. One could argue that the cumulative morbidity from other needed ancillary circulatory support should be considered in the overall strategy of small versus larger arterial cannula sizes. More importantly, the higher frequency of use of ancillary circulatory support in the small arterial cannula size cohort may have compensated for the lower ECLS flows by increasing native cardiac output. Total cardiac output between the 2 strategies was not available and could have been similar despite significant differences in ECLS flows. Given the small sample cohort size, a higher use of ancillary circulatory support in the small arterial

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cannula size cohort could have accounted for similar outcomes between the 2 cohorts. The authors attempted to address this issue by performing a subgroup analysis comparing patients in the small arterial cannula cohort with and without ancillary circulatory support and demonstrated similar outcomes. However, the sizes of the subgroups were again too small to draw any important conclusions.

Despite the above considerations, the observation by Takayama and colleagues² that a smaller arterial cannula size can provide adequate ECLS with similar outcomes compared with larger arterial cannula sizes is unique and important to the field. The authors have provided

data to validate a technical approach to ECLS that provides a similar degree of support and survival, and does so with fewer bleeding complications and greater ability to deploy ECLS using percutaneous techniques at the bedside.

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