OUTCOMES for children with complex congenital heart disease have improved, but the combination of developmental and circulatory vulnerability in the face of major surgery and anesthesia continues to result in significant morbidity and mortality. Crowley et al. now suggest that prolonged (more than 18 min) profound venous oxygen desaturation (ScvO₂ less than 40%) measured with an oximetric catheter in the superior vena cava (SVC) is highly predictive of major adverse events (MAEs) after complex congenital heart surgery and advocate its use to improve outcomes. Few adequately powered prospective randomized clinical trials pertaining to the perioperative management of complex congenital heart surgery have been published. Such lack of high-quality data is largely due to the great variety of congenital lesions and surgical interventions, many of which occur relatively infrequently and each of which requires different, highly tailored diagnostic and therapeutic interventions to address lesion- and patient-specific pathophysiological limitations. Individual programs have developed center-specific diagnostic and therapeutic approaches that have been refined continuously over many years of prospective observational data collection, albeit often applying retrospective data analysis (e.g., in our institution universal use of regional oximetry and intensive after-load reduction for single ventricle palliation evolved as an institutional standard in this fashion); consequently, many clinicians are reluctant to randomize their patients to alternative approaches that they deem inferior to their experience. If clinicians do not consider equipoise to be present for two competing perioperative strategies, it seems unethical to ask parents to have their children enrolled in a randomized controlled trial.

Such considerations probably played a role in the current study of continuous venous oximetry after pediatric cardiac surgery by Crowley et al. They and others have evaluated the technology in patients and animal models previously, albeit with somewhat variable results concerning accuracy and validity, especially at extremes of physiology where the technology may not be as reliable. Their current observational study used commercially available, percutaneously placed pediatric oximetric venous catheters positioned in the SVC to measure ScvO₂ continuously during and after major heart surgery in children without any residual postrepair shunt lesions. The authors then assessed whether duration and intensity of ScvO₂ desaturation episodes after repair correlated with MAEs, such as need for extracorporeal support, refractory cardiogenic shock, multiorgan dysfunction, and reoperation during the first 24 h after surgery. Perhaps not surprisingly, prolonged ScvO₂ less than 40% was significantly associated with MAEs, as was also observed after the first stage of single ventricle palliation with a similar approach; however, as little as 18 min of ScvO₂ less than 40% was highly sensitive and specific for MAEs. Based on their observations, Crowley et al. conclude that continuous SVC oximetry is better than either intermittent...
venous oxygen saturation or lactate measurements in predicting poor perioperative outcome, and they suggest that avoiding prolonged major SVC desaturation episodes should be considered a target in high-risk pediatric cardiac surgery patients to minimize the risk of MAEs. Although the observed 18 min of SCVO₂ less than 40% probably are a marker for recurrent, unobserved deficits in systemic oxygen delivery beyond the 24-h period of data collection, the occurrence of severe or prolonged venous desaturation could identify a subgroup of patients who would benefit from more intensive or different treatment strategies.

The current study suffers from some limitations of similar small single-center studies in this field. Only 54 patients were recruited, and 50 were available for evaluation. The types of lesions and resulting surgeries were highly heterogeneous (see table 1 and appendix 1). Similarly, the nine patients with MAEs (see table 3) were highly heterogeneous with regard to prerepair cardiovascular anatomy and the resulting postoperative pathophysiology, and the proportion of neonates and infants was higher in the subgroup that experienced MAEs than in the subgroup that did not. Thus, even if we accept the premise that prolonged major SVC desaturation is indicative of inadequate systemic oxygen delivery (low cardiac output) and that avoiding such occurrences will improve clinical outcomes, it is readily apparent to specialists in the field that perioperative treatment strategies to accomplish such a goal will be highly lesion- and pathophysiology-specific and therefore widely divergent for these highly heterogeneous patients, probably making it impossible to design a clear and uniform goal-directed treatment strategy for such a diverse population.

It is understandable that the authors recoiled from undertaking such a Sisyphusian task. Presumably because of ethical concerns and patient recruitment considerations, the authors also decided not to shield themselves from the logistically more manageable task of avoiding bias in the evaluation of this technology to predict poor outcomes, either by concealing the venous oximetry data for all patients from the clinicians or, alternatively, by randomizing patients into two subgroups (with data from one subgroup concealed from the clinicians) until all relevant clinical outcome data had been collected. Such a study design could have significantly strengthened the validity of their data, because one cannot rule out that real-time knowledge of venous oximetry data (both of adequate and low saturations) influenced the authors’ therapeutic decision-making, such as escalation or reduction of inotropic medications and ventilatory support. For example, it is possible that some MAEs were avoided by early intervention in response to venous desaturation; however, because of the lack of concealment within a randomized experimental design, it is impossible to know. Alternatively, interventions based on low SCVO₂ might have been harmful, contributing to worsened outcome in some patients, an interpretation also consistent with the data. Thus, generalization of the findings could actually increase MAEs.

Undoubtedly, the weight of evidence favors the authors’ conclusion that low SCVO₂ is a marker for systemic oxygen debt that is pathophysiologically linked with morbidity and poor outcome, probably mediated by hypoxic cellular dysfunction. Indeed, meta-analyses of goal-directed interventions in high-risk perioperative adult patients strongly suggest a beneficial effect of preemptive management to avoid dyoxia detected by SCVO₂ monitoring, and it may be a standard care to endeavor complex high-risk procedures without adequate goal-directed tools. In view of this, the authors are to be commended for collecting and analyzing data in a systematic fashion while trying not to deprive their patients of a monitoring tool likely to have a favorable impact on outcome in high-risk patients.

Because the authors’ working hypothesis is reasonable, we hope that the current data will give rise to a multicenter study to further evaluate the clinical value of this technology (and/or related technologies, such as two-site regional oximetry) in identification of shock states in the pediatric cardiac surgical population. The anatomical, physiologic, and surgical complexity in patients with congenital heart disease predisposes these patients to injury from circulatory shock, which is inadequately identified by arterial oxygen saturation or systemic blood pressure alone but more reliably tracked by continuous SVC oximetry. A multicenter study of these technologies in conjunction with clearly defined, goal-directed interventions and measurements of clinically important outcomes in a much larger, more homogeneous group of pediatric patients undergoing complex cardiac surgery would be challenging but welcome.

Eckehard A. E. Stuth, M.D., George M. Hoffman, M.D., Department of Anesthesiology, Medical College of Wisconsin, Milwaukee, Wisconsin. estuth@mcw.edu

References

ANESTHESIOLOGY REFLECTIONS

McCarty’s “Dental Anaesthetic”

Known later as Lice-bane after Hippocrates introduced it as a pediculicide, Delphinium staphysagria (Greek for “dolphin bunch-of-wild-grapes”) is a blue flowering plant, the buds of which resemble a dolphin’s snout or a lark’s heel (hence its other name, Larkspur). The foul smell and burning taste of staphysagria’s seeds did not discourage ancient Greeks from chewing them to relieve toothache. To avoid cocaine’s toxicity, an Iowan named Alfred L. McCarty was granted U.S. Patent No. 402,263 (center) on April 30, 1889, for the “Dental Anaesthetic” that he compounded from cocaine, chloroform, cloves, and staphysagria (clockwise from bottom left). Blissfully unaware of staphysagria’s medicinally useful polyoxygenated norditerpenoids, McCarty was likely cognizant of the herb’s use both by the ancients and by his contemporaries, many of whom used it in homeopathic doses for toothache. (Copyright © the American Society of Anesthesiologists, Inc. This image also appears in the Anesthesiology Reflections online collection available at www.anesthesiology.org.)

George S. Bause, M.D., M.P.H., Honorary Curator, ASA’s Wood Library-Museum of Anesthesiology, Park Ridge, Illinois, and Clinical Associate Professor, Case Western Reserve University, Cleveland, Ohio. UJYC@aol.com.

Anesthesiology 2011; 115:926–8