Highlights of Research in Congenital Cardiac Anesthesia: Summary of Selected Abstracts From the 2020 Congenital Cardiac Anesthesia Society Annual Meeting

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Days before COVID-19 changed the fabric of society in North America, the 2020 Annual Meeting of the Congenital Cardiac Anesthesia Society (CCAS) was held on February 27 in Nassau, Bahamas. A total of 83 abstracts were submitted for the conference that marked the 15th anniversary of the society. Among this group, several case reports and 16 original research abstracts were accepted for presentation. The top 5 scored original research abstracts were granted a brief podium presentation in the general assembly hall, and all were presented during professor poster rounds. Once again, *Seminars in Cardiothoracic and Vascular Anesthesia* has published the original research abstracts of the 2020 CCAS annual meeting in a supplemental volume of the journal. The purpose of this article is to highlight the important and emerging research themes from this year’s abstracts.

Post-bypass coagulopathy and optimal transfusion strategies remain a challenge for pediatric cardiac anesthesiologists. Abstracts concerning bleeding and transfusion once again dominated the research abstracts at the 2020 conference. Oluwamayokun Oshinowo and colleagues from Emory and Children’s Healthcare of Atlanta utilized a novel quantitative test of platelet function with platelet contraction cytometry. Simplistically, clot formation relies on dynamically contracting platelets, fibrin polymers, and entrapped blood cells. These platelet nanomechanics of contraction can be measured by cytometry. The authors demonstrated that cardiopulmonary bypass (CPB) significantly lowers platelet contraction force in neonates, which was then associated with increased transfusion requirements. Transfusion of donor platelets restored the platelet contraction force and may reflect restoration of hemostasis. Perhaps quantification of platelet contraction will become part of our dynamic bleeding tests in the future. Another team from Children’s Healthcare of Atlanta, Fiedorek et al performed a small study comparing the use of the Thromboelastogram Functional Fibrinogen assay (Haemonetics Corporation, Braintree, MA) versus the traditional laboratory-derived Clauss method to guide post-CPB hypofibrinogenemia treatment with either cryoprecipitate or fibrinogen concentrate to a target level of 300 mg/dL. While other studies have demonstrated that the functional fibrinogen assay typically overestimates fibrinogen levels, data from Fiedorek showed sufficient correlation. However, the strongest correlation was post-CPB, which perhaps includes contribution from donor adult fibrinogen posttransfusion. There was no difference in correlation between the cryoprecipitate or fibrinogen concentrate groups.

Optimal perioperative transfusion strategies are poorly understood in the pediatric congenital heart disease population. Robert Chu and colleagues from Johns Hopkins studied the presence and impact of preoperative anemia at their program during a 3-year period. As has been demonstrated in the pediatric noncardiac surgical population, the authors’ data demonstrated an association between preoperative anemia and postoperative complications and length of stay. The question of how to manage those with preoperative anemia remains. Current guidelines from the Network for the Advancement of Patient Blood Management, Haemostasis and Thrombosis recommend iron supplementation when iron deficient and erythropoietin only in special circumstances (eg, Jehovah’s Witness), but preoperative transfusion thresholds are not discussed. It is intuitive that young children with anemia presenting to cardiac surgery will have an increased transfusion requirement, and transfusions are associated morbidity. Justin Long and colleagues (Children’s Healthcare of Atlanta) conversely investigated the association between hematocrit on intensive care unit admission with mortality and major complications in pediatric cardiac surgical patients. Analysis of

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more than 27,000 pediatric cases in the Society of Thoracic Surgeons database demonstrated that a high postoperative hematocrit was associated with increased risk of mortality and composite outcomes. As can be seen in the graphs of the published case reports, incremental increases in hematocrit above 38 in acyanotic children and 42 in cyanotic children were associated with increased risk. Jack Crawford and colleagues from the University of Alabama at Birmingham compared outcomes in pediatric cardiac surgical patients treated with either solvent-/detergent-treated plasma (SDP) or fresh frozen plasma. A study of more than 400 children in intensive care suggested that use of SDP may be associated with improved survival compared with use of fresh frozen plasma, but this question has not been studied in randomized controlled fashion nor in the pediatric cardiac population. Crawford reported that SDP was associated with lower intra- and post-CPB fibrinogen levels and longer prothrombin time. The last abstract in the bleeding and transfusion section was a survey of current anesthesia practices during neonatal CPB surgeries, which was performed by the CCAS’s Hemostasis Interest Group and led by Kelly Machovec at Duke. In short, considerable variability was found in 44 of the 46 variables among the 17 institutions responding to the survey, as well as among individual providers within the same institution. The variability is simply due to the lack of definitive data guiding so many of the practices surrounding anticoagulation, fibrinolysis, blood product management, CPB management, neuromonitoring, and so on, in this patient population. These findings can be used to identify pressing gaps in our knowledge and guide future research priorities.

Several abstracts discussed novel techniques that could improve our management of children with heart disease. Kaplan et al from Duke shared a novel method for generating 3-dimensional patient-specific fluid dynamic simulations of the Norwood shunt type. The models assist understanding of how the Blalock-Taussig or Sano shunt for a child’s upcoming Norwood might affect coronary perfusion and pulmonary artery shear stress and thus reduce mortality and morbidity from the Norwood procedure. Please see the published abstracts in the supplemental issue for representative images of the work. Goverdahn Puri and colleagues from Chandigarh, India, prospectively evaluated the tricuspid annular plane systolic excursion by tranesophageal echocardiography (TEE) and its interchangeability with transthoracic echocardiography (TTE), which has been reported in adults but not children. Their study reports the feasibility, bias, and limits of agreement between TEE and TTE when using either M-mode or anatomic M-mode in 4 TEE views. Last, Mikel Gobia and the group at Children’s Medical Center in Dallas described their early anesthetic experience with the new transcatheter patent ductus arteriosus occlusion device in premature infants <1500 g. Low birth weight infants with cardiopulmonary compromise present a considerable anesthetic challenge as regards temperature regulation, appropriate ventilation, fluid management, and pulmonary to systemic flow ratios. Their preliminary report of the first 10 patients provides encouraging data regarding the overall perioperative safety of the transcatheter approach.

Three abstracts sought answers to decrease the risk of end-organ compromise during pediatric cardiac surgery. Several studies have found a correlation between time spent with low renal regional tissue oxygenation (rSO2)—as measured near infrared spectroscopy—and development of severe acute kidney injury (AKI) in children undergoing cardiac surgery. Lee Ferguson and colleagues at Boston Children’s studied this relationship in children undergoing the Fontan operation and confirmed the presence an association between low renal rSO2 and severe AKI. Future research will need to address 2 questions: what are the thresholds of renal rSO2 and other markers of renal injury that signal the development of severe AKI; and can interventions to improve renal rSO2 desaturations during surgery decrease the incidence of AKI? Eric Vu and coauthors from Texas Children’s Hospital, Children’s Colorado, and Lurie Children’s Hospital reported important ongoing work generating cerebral autoregulation curves for children undergoing cardiac surgery. Over a nearly 5-year period at Texas Children’s Hospital, autoregulation curves were generated by using cerebral rSO2, cerebral hemoglobin volume index, and invasive arterial blood pressure in 169 neonates. Wide interpatient variation of the lower limits of autoregulation (LLA) was found, suggesting the need to individualize hemodynamic goals. In addition, neonates in the cohort spent 17% of time under the LLA. Of note, this abstract won the Society of Pediatric Anesthesia Young Investigator Award. The high incidence of neurologic injury after pediatric cardiac surgery is well recognized. While the etiology is likely multifactorial and thus challenging to fully elucidate, discovering a medication that is directly neuroprotective is enticing. Kenza Ibrir and colleagues from Université de Montréal studied the impact of dexmedetomidine and ketamine on postoperative electroencephalograms in neonates undergoing cardiac surgery. In this small cohort, administration of either ketamine or dexmedetomidine resulted in improved brain recover at 15 to 18 hours compared with controls. Interestingly, the benefit of early electroencephalograms recovery was not seen in those administered both ketamine and dexmedetomidine. I personally look forward to additional data in larger cohorts, such as upcoming data from the Pediatric Heart Network Investigators.
The last 2 abstracts concerned regional anesthesia and simulation. Chinedu Otu and coauthors from Boston Children’s Hospital studied analgesic outcomes of children undergoing coarctation of the aorta repair via thoracotomy. A group receiving regional anesthesia (thoracic epidural catheters, paravertebral catheters, erector spinae plane catheters, extrapleural catheters) were compared with those who did not. While length of stay and pain scores at 24 and 48 hours were relatively unchanged, morphine consumption in the first 24 hours was significantly reduced in the regional group, suggesting improved analgesic efficacy within the first 24 hours. Casey Chai and the group at Johns Hopkins Children’s Center investigated the use of a cognitive aid to improve advanced cardiac life support team performance during anesthesia resident simulations. Use of the cognitive aid by the cardiac arrest “code” recorder to prompt the code leader of time-based interventions improved team performance and allowed the code leader to focus on differential diagnosis and treatment.

Overall, the 16 abstracts chosen for publication in the special supplement of Seminars in Cardiothoracic and Vascular Anesthesia represent cutting-edge research, novel techniques, important updates, and pragmatic approaches to common problems within pediatric cardiac anesthesiology. The reader is invited to read through the abstracts.

References