Pulmonary function and shunt size after single ventricle palliation—Classic cardiopulmonary interactions*

A clear understanding of cardiopulmonary interactions is vitally important to the management of infants and children with inherited and acquired heart disease. The effect of lung function and mechanical ventilation on compromised cardiac function has been an important topic and has even been the focus of entire chapters in authoritative textbooks of pediatric critical care (1). However, the focus on cardiopulmonary interactions has often leaned toward what effects pulmonary function have on cardiac function and not as much on what effects cardiac function have on the pulmonary system. With respect to the surgical and perioperative management of infants with single ventricle physiology, much attention is appropriately paid to the size of the systemic to pulmonary shunt and its effects on cardiac output and systemic blood flow. Less attention has been paid to the effects of the size of the pulmonary to systemic ratio on lung function and specifically to lung compliance, resistance, and gas exchange.

*See also p. 60.

Key Words: shunt; congenital heart disease; compliance; resistance

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In this issue of *Pediatric Critical Care Medicine*, Matthews et al (2) have attempted to address some of these pulmonary issues in children undergoing repair of single ventricle congenital heart defects. In this study, the authors measured lung compliance, resistance, and carbon dioxide exchange in 15 infants with single ventricle cardiac anatomy who had all previously undergone surgery for placement of systemic to pulmonary shunts in infancy. Measurements were made at the time of cardiac catheterization in preparation for a surgical bidirectional cavopulmonary connection. The authors noted that respiratory compliance was significantly compromised in infants with large systemic to pulmonary arterial shunts and that compliance was inversely correlated with shunt size. The also found that the size of the heart had dramatic effects on respiratory resistance with significantly increased resistance in infants with larger hearts on chest radiograph. The also noted that end-tidal CO_2 did not correlate well with arterial CO_2, and that the correlation was particularly poor in infants with smaller shunts.

So what is the take home message of this interesting study for physicians who care for infants with single ventricle physiology? Congenital cardiac surgeons already realize the importance of trying to place the correct size and length of systemic to pulmonary arterial shunt in these complicated infants. Even the optimal type of shunt is being actively researched in an National Institutes of Health sponsored randomized clinical trial in infants with hypoplastic left heart syndrome (3). Where this study may play a key role is in potentially identifying infants at risk for interstage death between the systemic to pulmonary arterial shunt and their bidirectional cavopulmonary connection. With the significant reduction in surgical mortality after a stage I Norwood procedure, interstage death now accounts for most of the mortality in these complex infants. Decreased pulmonary compliance and increased pulmonary resistance are potential risk factors that deserve study in a larger multicenter approach.

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