

## LETTERS TO THE EDITOR

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### Follow-up studies after the arterial switch operation

#### *To the Editor:*

In the December 1997 issue of the Journal, Williams and colleagues<sup>1</sup> reported a comprehensive, detailed, and thoughtful analysis of the incidence of and risk factors for developing supravulvar obstruction after the arterial switch operation. This adds to a growing series of publications<sup>2-4</sup> from the Congenital Heart Surgeons Society (CHSS) on this cohort of patients, who have been enrolled since shortly after birth and have had meticulous attention recorded on preoperative anatomy and operative technique.

Although some types of multiinstitutional studies may suffer from difficulties in study design, protocol adherence, and the like, the authors appropriately and succinctly address the limitations of their findings with this type of study design. Importantly, this type of observational longitudinal study actually benefits from what the authors term “fortuitous heterogeneity,” as institutional dogma and practice patterns, limited numbers of patients at a given institution, and infrequently occurring outcome variables (e.g., death, supravulvar pulmonary stenosis) rarely allow this detailed analysis of risk factors for adverse outcomes to be obtained at a single institution. The follow-up available on this group of patients is quite impressive, and this type of on-going study will continue to provide prospective data for years to come.

With any surgical procedure for congenital heart disease, the constant and critical analysis of late surgical outcomes is crucial to improve the current approach to a disease. For example, as late sequelae of various modifications of the Fontan operation become appreciated (e.g., sinus node dysfunction and atrial tachyarrhythmias), the operation has been modified to, ideally, decrease the incidence of these late problems. In this report, Williams and associates have identified a number of risk factors for the development of supravulvar pulmonary stenosis—some of which are amenable to improvement (method of coronary transfer and sinus reconstruction) and some of which are beyond the control of the surgeon (coexisting anatomic features such as neopulmonary annular hypoplasia, as may be seen with coarctation, certain coronary anatomy, and low birth weight).

The authors have shown that surgical technique plays a significant role in both early and late obstruction. This is evidenced by certain procedure-related variables, as well as by the fact that both earlier date of operation and certain “institutions” carry higher risk. Surgeons must therefore learn from both personal experience and the group data as a whole and modify technique when indicated.

An additional important feature of this report is the observation that supravulvar obstruction may occur proximally, distally, or in combination. The authors appropriately conduct an analysis of each type of obstruction

separately. Proximal obstruction appears to occur early after surgery, and although it may be principally related to a congenitally hypoplastic native aortic anulus, the risk may be minimized by meticulous attention to detail of sinus reconstruction, especially by avoiding prosthetic material to fill in the coronary donor sites.

Distal obstruction may occur both early and late after surgery, and the incidence of this late complication may be most amenable to modifications in surgical technique. This report confirms the findings of another series that reported certain unusual coronary artery patterns to be related to the development of late supravulvar obstruction. This suggests that the method of coronary transfer and/or reconstruction of the posterior facing sinus (sinus 2) in these subgroups (intramural left coronary artery, retropulmonary left coronary artery) should be modified if possible to allow better growth of this area.

This report also demonstrates that continued prospective follow-up of the distal supravulvar reconstruction is important, inasmuch as there appears to be a constant hazard that continues for the duration of follow-up, confirming findings in other series.<sup>5</sup> In particular, as the authors clearly indicate, the mean (7.6 years) and maximum age at follow-up (no patient older than 11 years) does not yet encompass the period of rapid somatic growth that will occur in adolescence. Because there is a peak incidence of reintervention in the first year of life, commensurate with a doubling or tripling of body size, it is reasonable to assume that there will be an increased incidence of reintervention in this cohort during the next 5 to 10 years of follow-up.

Once supravulvar obstruction has been detected, reintervention may be performed either percutaneously or surgically. The authors conclude that surgical intervention was, “in general, the more effective procedure.” However, this conclusion may have been biased by percutaneous procedures that were attempted—perhaps with little likelihood of success—in patients during a catheterization performed before a likely surgical intervention. Balloon procedures are not likely to be effective if (1) there is hypoplasia of the neopulmonary anulus or (2) there is obstruction at the anastomosis. Successful dilation of anastomotic obstruction would require a balloon that is two to three times the size of the narrowest diameter of the obstruction, and balloon size may therefore be limited in these patients by the size of the right ventricular outflow tract. The precise details of the type of obstructions attempted to be relieved percutaneously are not available in this report. This may explain why “the chances of requiring another reintervention were higher if it had been a percutaneous procedure.”

The authors also report that the chance of a second reintervention was higher if the pressure gradient was higher after the first intervention and also that preprocedure gradients were higher in the surgical group. Although percutaneous techniques are not likely to be

successful at the anastomosis, balloon angioplasty is likely to be successful in areas of discrete stenosis at the branches of the pulmonary arteries.<sup>6</sup> Isolated (especially unilateral) branch pulmonary artery stenosis is usually not associated with a large gradient but, rather, with asymmetry of pulmonary blood flow. This suggests that unsuccessful percutaneous techniques were most likely performed in patients with more severe proximal or anastomotic obstructions. In their study design and analysis, “distal” obstruction refers to both anastomotic and branch stenoses, so that analysis for the success of percutaneous procedures is limited. Thus, when indicated, the type of reintervention should be chosen on the basis of the anatomic type of obstruction. Branch stenoses should be initially managed by percutaneous techniques, whereas diffuse hypoplasia of proximal structures and/or isolated anastomotic narrowing should be managed surgically. Contrary to what one might have expected, it is somewhat concerning that only 82% of children in whom a surgical procedure was used were free of another reintervention 5 years later.

Finally, this report emphasizes that the arterial switch operation—although widely applied and currently considered the procedure of choice for transposition of the great arteries—is not a “cure.” The truly “long-term” results of this approach are unknown. As evidenced in this and other reports,<sup>5, 7, 8</sup> the long-term fate of the right ventricular outflow tract, neopulmonary valve, and pulmonary artery reconstruction requires constant reevaluation. In particular, what will be the fate of the anatomic pulmonary valve and reconstructed neo-aortic root after decades of high pressure in the systemic circulation?<sup>9, 10</sup> What will be the fate of the coronary arteries, transferred in the neonatal period, when coronary artery disease becomes significant in the latter half of life?<sup>11</sup> How will these factors affect the incidence of late, premature death after the arterial switch?<sup>5, 8, 12</sup>

There is no doubt that current surgical management of complex congenital heart disease in general, and transposition of the great arteries in particular, results in an excellent quality of life in the overwhelming majority of children. However, we must keep in mind that even the most successful “repairs” are really “palliative” operations, and efforts must continue to decrease the long-term morbidity in our patients. Studies such as the current report from Williams and the CHSS support this view and, importantly, provide critical data to improve our approach to managing complex heart disease in children.

*Gil Wernovsky, MD*  
*Director, Cardiac Intensive Care Unit*  
*Associate Physician in Cardiology*  
*Children's Hospital of Philadelphia*  
*Associate Professor of Pediatrics*  
*University of Pennsylvania School of Medicine*  
*Philadelphia, PA 19104*

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12/1/87357

### **Temperature during cardiopulmonary bypass for coronary artery operations does not influence postoperative cognitive function: A prospective, randomized trial**

*To the Editor:*

We read with great interest the article by Plourde and associates.<sup>1</sup> They have compared the effects of normothermic ( $n = 30$ ) versus hypothermic ( $n = 24$ ) cardiopulmonary bypass (CPB) for cognitive outcomes of patients undergoing