If You Cannot Trust a Bulboventricular Foramen, Whom Can You Trust?

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Central Message

Systemic to pulmonary artery shunting can be combined with pulmonary artery banding in children with univentricular hearts and unreliable integrate pulmonary blood flow.

For neonates born with single ventricle physiology, the source and magnitude of pulmonary blood flow ranges from entirely ductal-dependent to completely unrestricted. Somewhere in the middle of this continuum lies a group of patients with some degree of obstruction to pulmonary blood flow, most commonly caused by either a restrictive bulboventricular foramen or valvar pulmonary stenosis (possibly with a subvalvar dynamic component). The present report is a single-center, retrospective analysis of 60 such patients in whom the degree of antegrade pulmonary blood flow was judged to be "unreliable" (unlikely to suffice until superior cavopulmonary anastomosis could be safely performed) and who were managed with placement of a systemic to pulmonary shunt (SPS) with concomitant pulmonary artery banding (PAB).[1]

The philosophy behind this "belt and suspenders" strategy is to create a reliable source of pulmonary blood flow with the SPS, while simultaneously allowing a small amount of antegrade pulmonary blood, in recognition of the potential "unreliability" of the SPS itself. Beyond the obvious "safety net" in the event of shunt thrombosis or stenosis, persistence of some degree of antegrade blood flow up to the second stage operation and beyond has theoretical advantages of improving hemodynamics for the Fontan, maximizing pulmonary arterial growth, and minimizing formation of pulmonary arteriovenous malformations.[2] Importantly, prior work from the authors has demonstrated that the presence of antegrade flow does not increase the likelihood of SPS occlusion,[3] and should therefore at least not be harmful. At the other end of the spectrum, some authors have advocated ligating and dividing the main pulmonary artery and placing an SPS, thus relying on a single and fixed source of pulmonary blood flow.[4]

The strengths of the present work include a very large cohort of 60 consecutive patients over 11 years, including 62% with a potentially restrictive bulboventricular foramen, 33% with heterotaxy and pulmonary stenosis, and an additional 5% with less common arrangements. Another important attribute of the study was a consistent surgical approach during the study during which 73% of patients were able to undergo initial palliation without cardiopulmonary bypass. Operative mortality for the initial palliation was 12% (7 patients), and an additional 5 patients died during the interstage period. The diagnosis of heterotaxy was a powerful predictor of mortality overall (odds ratio of 10) and was also associated with a substantially higher likelihood of failure to achieve Fontan circulation during the study period (odds ratio of 3.2). Interestingly, of the 45 patients who have undergone a superior cavopulmonary anastomosis, 12 also underwent division of the main pulmonary artery and pulmonary valvectomy, losing the potential benefits of persistent antegrade pulmonary blood flow prior to Fontan. No patients died between the second stage and Fontan procedures.

The authors describe the primary aim of their work as "to report the feasibility of the combined SPS and PAB as a viable option in this patient population," and they have certainly accomplished this. However, absent a contemporaneous or historical control group from their own institution, the authors cannot make assertions beyond feasibility. Certainly, an overall survival rate of 80% for a cohort of shunted single ventricle patients, a third of whom had heterotaxy syndrome, compares well with most published series describing similar patients, and centers may be moved to consider (or continue) this approach depending on local preferences. A question not contemplated in the present work is the role of ductal stenting as opposed to SPS. Two recent publications have strongly suggested the superiority of the former approach,[5,6] which could be combined with PA banding in a hybrid strategy to achieve

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DOI of original article: http://dx.doi.org/10.1053/j.semtcvs.2018.09.019.

https://doi.org/10.1053/j.semtcvs.2018.10.012

the physiologic goals outlined by the authors in this work. To understand the proper role of this approach of SPS with PAB, successful as it has been in Los Angeles, future studies must involve direct comparison of patients undergoing SPS (or ductal stenting) and PAB to matched patients who managed with other palliative procedures. Such an undertaking would almost certainly require involvement of multiple centers, but the present work certainly supports the prerequisite of equipoise when evaluating alternative approaches to the double-barreled strategy the authors have reported.

REFERENCES

1. Wiggins LM, Wells WJ, Starnes VA, et al: Simultaneous systemic to pulmonary shunt and pulmonary artery banding is a viable option for neonatal palliation of single ventricle physiology. Semin Thorac Cardiovasc Surg 31:234–241, 2019
2. Henaine R, Vergnat M, Mercier O, et al: Hemodynamics and arteriovenous malformations in cavopulmonary anastomosis: The case for residual antegrade pulsatile flow. J Thorac Cardiovasc Surg 146:1359–1365, 2013
3. Wells WJ, Yu RJ, Batra AS, et al: Obstruction in modified Blalock shunts: A quantitative analysis with clinical correlation. Ann Thorac Surg 79:2072–2076, 2005
4. Bradley SM, Simsic JM, Atz AM, et al: The infant with single ventricle and excessive pulmonary blood flow: Results of a strategy of pulmonary artery division and shunt. Ann Thorac Surg 74:805–810, 2002. discussion 810
5. Glatz AC, Petit CJ, Goldstein BH, et al: Comparison between patent ductus arteriosus stent and modified blalock-taussig shunt as palliation for infants with ductal-dependent pulmonary blood flow: Insights from the congenital catheterization research collaborative. Circulation 137:589–601, 2018
6. Bentham JR, Zava NK, Harrison WJ, et al: Duct stenting versus modified blalock-taussig shunt in neonates with duct-dependent pulmonary blood flow: Associations with clinical outcomes in a multicenter national study. Circulation 137:581–588, 2018