Editorial

The battleground of the stenotic branch pulmonary arteries: the surgical approach of "less is more"

Damien P. Kenny[1], Jonathan McGuinness[1], Ziyad M. Hijazi[2]

[1]Department of Cardiology and Cardiac Surgery, Our Lady's Children's Hospital, Dublin, Ireland; [2]Weill Cornell Medicine, Sidra Medical and Research Center, Doha, Qatar

Correspondence to: Damien P. Kenny, MD. Department of Cardiology and Cardiac Surgery, Our Lady's Children's Hospital, Crumlin, Dublin 12, Ireland. Email: damien.kenny@olchc.ie.

Submitted May 06, 2016. Accepted for publication May 16, 2016.
doi: 10.21037/tp.2016.05.03
View this article at: http://dx.doi.org/10.21037/tp.2016.05.03

The achievements of congenital cardiac surgery over the past two decades are remarkable. However success comes at a price and occasionally the "sacrificial lamb" in this discipline are the branch pulmonary arteries. This is not to suggest intentional "sacrifice" however the necessity to provide pulmonary blood flow particularly in single ventricle palliation requires manipulation and potential distortion of the branch pulmonary arteries (BPA's). In a large randomized trial assessing initial surgical palliation for hypoplastic left heart syndrome, although antegrade pulmonary blood flow through a Sano shunt provided an early survival benefit over a systemic arterial-pulmonary shunt, re-intervention rates on the BPA's were significantly higher in the Sano cohort (1). The impact of pulmonary artery distortion on long-term survival in single-ventricle patients dependent on passive pulmonary blood flow is unclear, however, unlikely to be negligible. The optimal approach to relieve pulmonary artery narrowing is yet to be determined. No randomized trials comparing surgical versus transcatheter options have been published although non-randomized studies suggest that patients undergoing surgical branch pulmonary arterioplasty are more likely to require re-intervention compared to those undergoing stent placement (2). Equally it is difficult to argue that stents in their current format are the ideal long-term solution. Surgical techniques and patch material may vary and hence influence outcomes, with disappointing recent results seen with the use of a porcine extracellular matrix patch when used to patch the pulmonary arteries (3). The ideal material for surgical patching, which should be pliable and easy to handle, resistant to tearing, calcification or shrinkage, with the potential for growth and restoration of vascular function without the induction of scar tissue may be some way off yet. In the meantime approaches to circumvent some of the consequences of suture induced scaring are required.

In this issue of Translational Pediatrics, we review a recently published novel approach to surgical reconstruction of the BPA's in patients with congenital heart disease (4). Kim *et al.* described their use of "sutureless" patch angioplasty for postoperative pulmonary artery narrowing in 28 patients with a median weight of 7.3 kg, two-thirds of whom had previous palliation for hypoplastic left heart syndrome and 85% of whom had a concomitant superior cavopulmonary anastomosis. The procedure involves longitudinal opening of the stenosed BPA and enucleation of the pre-existing patch material from the surrounding fibrotic tissue. Multiple intimal incisions were made and followed by stretching the vessel manually with a dilator. In some cases the entire stenotic area was excised leaving just the perivascular fibrotic tissue intact. The patch (bovine pericardium) was then sutured to the perivascular fibrotic tissue and to the aortic wall to avoid suture mediated scaring of the intima of the pulmonary artery. Technical and operative outcomes were excellent. The procedure avoids extensive dissection of the pulmonary arteries which has previously proved challenging with retro-aortic stenosis and may also risk damage to surrounding structures. Re-intervention was required in only one patient over the medium-term, with follow-up imaging [computed tomography (CT) or angiography] demonstrating some increase in pulmonary artery dimensions at the area of sutureless patching.

The benefit of "sutureless" techniques have evolved from pulmonary venous reconstruction surgery where exposure of the vein to suture based trauma may lead to excessive scar formation and restenosis (5). It is unclear if this approach will provide similar benefits for mitigating against branch pulmonary artery distortion in the longer-term. Some concerns have yet to be addressed. It is unclear if the absence of intimal tissue will promote true growth of the BPA's, with only patch and scar tissue remaining. The impact of suturing to surrounding vessels, particularly the aorta may distort the vasculature with growth or increase risk of vascular compromise if further transcatheter intervention were to be required. The cause of the sudden massive hemoptysis in one patient on follow-up raises some questions about the potential for fistula formation with less integrity to the neo-pulmonary wall. It is also unclear if loss of vascular function with near complete excision of the vessel, in the setting of a circulation dependent of passive pulmonary blood flow, may have longer-term implications. No mention is made of the impact of the patch on follow-up surgeries, particularly completion of the total cavopulmonary anastomosis where distinguishing the true plane of the pulmonary artery wall with dissection may be challenging. All things considered however, this approach is certainly a welcome addition to the challenge of treating complex BPA narrowing, particularly in the context of irregular long segment stenoses where moulding a patch to the native vessel wall, often variable in diameter, is technically very difficult. It is also likely to help with accessing a retro-aortic stenosis without extensive dissection. In the end, the victor in the race to provide the optimal solution to BPA narrowing is the one most likely to provide the best long-term impact on normal vessel growth, and although this technique may provide a preferable approach in certain anatomical substrates, much work remains to be done.

Acknowledgements

None.

Cite this article as: Kenny DP, McGuinness J, Hijazi ZM. The battleground of the stenotic branch pulmonary arteries: the surgical approach of "less is more". Transl Pediatr 2016;5(3):112-113. doi: 10.21037/tp.2016.05.03

Footnote

Provenance: This is a Guest Editorial commissioned by the Section Editor Xicheng Deng (Department of Cardiothoracic Surgery, Hunan Children's Hospital, Changsha, China).
Conflicts of Interest: The authors have no conflicts of interest to declare.

Comment on: Kim H, Chan Sung S, Choi KH, *et al*. Sutureless Patch Angioplasty for Postoperative Pulmonary Artery Stenosis in Congenital Cardiac Surgeries. Ann Thorac Surg 2016;101:1031-6.

References

1. Ohye RG, Sleeper LA, Mahony L, et al. Comparison of shunt types in the Norwood procedure for single-ventricle lesions. N Engl J Med 2010;362:1980-92.
2. Patel ND, Kenny D, Gonzalez I, et al. Single-center outcome analysis comparing reintervention rates of surgical arterioplasty with stenting for branch pulmonary artery stenosis in a pediatric population. Pediatr Cardiol 2014;35:419-22.
3. Padalino MA, Quarti A, Angeli E, et al. Early and mid-term clinical experience with extracellular matrix scaffold for congenital cardiac and vascular reconstructive surgery: a multicentric Italian study. Interact Cardiovasc Thorac Surg 2015;21:40-9.
4. Kim H, Chan Sung S, Choi KH, et al. Sutureless Patch Angioplasty for Postoperative Pulmonary Artery Stenosis in Congenital Cardiac Surgeries. Ann Thorac Surg 2016;101:1031-6.
5. Yun TJ, Coles JG, Konstantinov IE, et al. Conventional and sutureless techniques for management of the pulmonary veins: Evolution of indications from postrepair pulmonary vein stenosis to primary pulmonary vein anomalies. J Thorac Cardiovasc Surg 2005;129:167-74.

