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Commentary: The (un)usual suspects

Jonathan M. Chen, MD

Arguably the most critical step of an arterial switch operation (ASO) is the transfer and reimplantation of the coronary arteries. Many of the early technical challenges in this regard have largely been surpassed over decades of experience, allowing for the “democratization” of the procedure, such that it is performed with low mortality worldwide. Indeed, the literature is rife with ingenious solutions by master surgeons to even the most complex coronary conundrums, with large case series refuting the previous dogma that described a several-fold increase in mortality related to atypical coronary anatomy alone.¹ In this issue of the *Journal*, Frick and colleagues² contribute further evidence from 1033 cases that suggest we may be incrementally closer to eliminating the additional risk attributable to anomalous coronary anatomy in the ASO.

The question remains, however, what in aggregate we can glean from yet another large series? Each center has its methodology—Yacoub/Leiden, open/closed, trap door/bay window—that works best for them. One of the most notable characteristics of the study of Frick and colleagues is that the results were durable across 30 years, several surgeons, and 2 hospital sites. They also demonstrate that for the 6 patients who later developed coronary complications worthy of reoperation, all but one did quite well, implying that once discovered, many postoperative coronary distortions can be ameliorated, a corollary of sorts to recent data encouraging intraoperative revision in the face of clinical or echocardiographic imperfection.³

I still vividly recall Jan Quaegebeur insisting emphatically that “those coronaries are not normal! They are usual!” (J.M. Quaegebeur, personal correspondence,

CENTRAL MESSAGE

Embracing the concept that all coronary arteries in transposition—usual or unusual—are themselves not “normal” may help to reframe our future focus on potentially important long-term coronary risk.

1998). While at the time he was surely referring to branching pattern vocabulary, perhaps this statement was prescient: maybe no coronary in transposition—pre- or post-transfer—is truly “normal.” Ostial fibrosis, intimal thickening, geometrical distortion, and extrinsic compression all undoubtedly occur silently in some patients.^{4,5} Indeed, our obligation in addition to stamping out early morbidity from the transfer of aberrant coronaries may also be to remember that the (un)natural history of coronary development post-ASO is largely unknown. Several groups have described a somewhat-intuitive correlation between anomalous coronary branching at the time of ASO and the later development of coronary occlusion by advanced imaging.⁶ One responsibility, then, of centers with such large series is to help develop recommendations and triggers for late coronary interrogation (and possibly delineate when to intervene potentially even for the asymptomatic ASO survivor with late coronary stenosis or occlusion).

Finally, coronary anatomy and its relationship to postoperative mortality is naturally but one piece of the puzzle. Attributing all-cause mortality purely to successful coronary transfer fails to acknowledge so many of the other factors that influence the likelihood of survival, not the least of which is the abnormal fetal environment that may determine all the cards before they are dealt.⁷ The authors are to be commended on a remarkable series; the work now (having chased down the common culprits) is to identify the other villains and bring them, also, to justice.

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References

1. Pasquali SK, Hasselblad V, Li JS, Kong DF, Sanders SP. Coronary artery pattern and outcome of arterial switch operation for transposition of the great arteries: a meta-analysis. *Circulation*. 2002;106:2575-80.
2. Fricke TY, Bell D, Daley M, d'Udekem Y, Brizard CP, Alphonso N, et al. The influence of coronary artery anatomy on mortality after the arterial switch operation. *J Thorac Cardiovasc Surg*. 2020;160:191-9.e1.
3. Nield LE, Dragulescu A, MacColl C, Manlhiot C, Brun H, McCrindle BW, et al. Coronary artery Doppler patterns are associated with clinical outcomes post-arterial switch operation for transposition of the great arteries. *Eur Heart J Cardiovasc Imaging*. 2018;19:461-8.
4. Ou P, Khraiche D, Celermajer DS, Agnoletti G, Sang KLQ, Thalabard JC, et al. Mechanisms of coronary complications after the arterial switch for transposition of the great arteries. *J Thorac Cardiovasc Surg*. 2013;145:1263-9.
5. Szymczyk K, Moll M, Sobczak-Budlewska K, Moll JA, Stefanczyk L, Gzelak P, et al. Usefulness of routine coronary CT angiography in patients with transposition of the great arteries after an arterial switch operation. *Pediatr Cardiol*. 2018;39:335-46.
6. Angeli E, Formigari R, Napoleone CP, Oppido G, Ragni L, Picchio FM, et al. Long-term coronary artery outcome after arterial switch operation for transposition of the great arteries. *Eur J Cardiothorac Surg*. 2010;38:714-20.
7. Gaynor JW, Parry S, Moldenhauer JS, Simmons RA, Rychik J, Ittenbach RF, et al. The impact of the maternal-foetal environment on outcomes of surgery for congenital heart disease in neonates. *Eur J Cardiothorac Surg*. 2018;54:348-53.

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Commentary: The arterial switch operation: Is it still all about the coronaries?

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Ever since the first successful arterial switch operation (ASO) by Jatene in 1975,¹ it has been recognized that coronary artery transfer is the most critical step of this procedure.² Advances in surgical techniques, such as the use of generous trapdoor incisions to minimize axial rotation of the coronary buttons during translocation (Figure 1), have improved surgical results and allowed the successful transfer of all coronary patterns.³ However, despite the recognition that all patterns are “switchable,” there are unquestionably some that are technically more challenging to translocate than others. Do these technical challenges translate into differences in outcomes?

Large studies from the 1980s and 1990s described a greater mortality for patients with single and intramural coronaries.^{4,5} Despite some recent studies still showing a greater mortality in patients with a single coronary,⁶ others

Trapdoor incision technique for coronary artery translocation.

CENTRAL MESSAGE

Despite improvements in outcomes with the arterial switch operation, patients with coronary abnormalities continue to be a challenge. The long-term effects of coronary translocation are still unclear.

have concluded that coronary abnormalities are no longer a risk factor for mortality,⁷ presumably due to increased surgical experience.

In this issue of the *Journal*, Fricke and colleagues⁸ report an impressive series of 1033 patients who underwent ASO between 1983 and 2013 in 2 centers in Australia with a median follow-up of 14 years. The authors should be commended for their effort. In the study, the trapdoor technique was used for all patients. Early mortality was 3% for patients with usual coronary arrangement and 3.9% for those with any abnormal coronary anatomy. Despite this relatively similar mortality rate, the subset of patients that had all coronaries arising from the same sinus had an early mortality of

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