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LETTER TO THE EDITOR

Cardiac Magnetic Resonance Myocardial Perfusion After Arterial Switch for Transposition of Great Arteries

Coronary artery (CA) obstruction is the most worrying post-operative complication after the arterial switch operation (ASO) for transposition of the great arteries. Although extremely rare, late mortality is predominantly a result of sudden death and myocardial infarction (1–3).

We retrospectively reviewed cardiac magnetic resonance (CMR) of 132 consecutive and asymptomatic patients after ASO, who had no coronary artery stenosis at first systematic screening (Table 1). Seventy-nine had a coronary angiogram, 33 a computed tomography scan, and 20 had both with a mean delay between CMR and screening of 9 ± 5 years. CMR was performed using a 1.5-T scanner (HdxT or MR450 GE Medical Systems, Milwaukee, Wisconsin).

The complete imaging protocol included 3-dimensional respiratory-navigated balanced steady-state free precession sequence, first-pass perfusion before and after dipyridamole injection, unenhanced cine steady-state free precession sequences before and after dipyridamole injection, and late gadolinium enhancement studies. Segmental myocardial first-pass perfusion after dipyridamole stress and at rest were evaluated qualitatively and assessed as normal or as revealing a perfusion abnormality. The semi-quantitative evaluation of myocardial perfusion was performed by the analysis of myocardial perfusion first-pass perfusion images as previously described (4). A perfusion reserve index (PRI) was calculated as the ratio of dipyridamole to rest maximal signal intensity-slope. A PRI value <1.5 in 2 contiguous myocardial segments was the perfusion positivity criterion.

Position of coronary arteries was evaluated as previously described (5). Only 1 new lesion could be identified (right coronary ostium stenosis). All 132 patients had qualitative analysis of myocardial perfusion at CMR. No qualitative defect was found.

Fifty-seven patients had a semiquantitative analysis of myocardial perfusion. Of them, 7 patients (12%) had a PRI <1.5 in at least 2 contiguous myocardial segments. In 12 patients, the left CA was reimplanted in clock position between 12 and 1 o'clock. These patients with left CA in clock position 12 to 1 o'clock had more frequent perfusion abnormality than did patients with other sites of reimplantation (7 of 12 vs. 0 of 45; p = 0.0001) and significantly lower PRI in myocardial segments irrigated by left CA myocardial than did patients with other sites of reimplantation (2.0 ± 1.0 vs. 2.7 ± 1.0; p < 0.05). No late gadolinium enhancement was found. No ischemic event was noted during annual follow-up at our institution (mean 3.0 ± 1.7 years).

Long-term outcomes in adults after ASO and risk of CA disease remain to be defined. Late mortality is predominantly a result of sudden death and myocardial infarction, but the limited number of late ischemic events after the ASO raises the question of the necessity to screen patients for CA stenosis after the ASO. First, we confirmed that myocardial perfusion is normal in a majority of patients after ASO. Consequently, sequential follow-up of myocardial perfusion is probably not mandatory once imaging of coronary anatomy shows no stenosis. Hitherto, however, we identified a subgroup of patients with anteriorly reimplanted left CA with a higher probability of perfusion abnormality. This finding is consistent with our previous report on the risk factors for early stenosis of the left coronary artery (5). This anterior position between the 2 great vessels is possibly due to the evolution of the rearrangement of the CA and the great vessels during growth. Indeed, the geometric relationships late after ASO may not be

TABLE 1 Patient Characteristics

	Normal Coronary Arteries at Screening (N = 132)
Age, yrs	17.0 ± 6.0
Age at initial screening, yrs	5.0 ± 3.3
Coronary artery anatomy	
A	87 (66)
B	11 (8.3)
C	3 (2.2)
C intramural (LCA)	3 (2.2)
C intramural (RCA)	1 (0.8)
D	19 (14.4)
D intramural	0 (0.0)
E	8 (6.0)
Age at CMR, yrs	15.0 ± 5.7
Qualitative analysis	132 (100.0)
Qualitative defects	0
Semiquantitative analysis	57 (43.0)
Semiquantitative defects	7 (12.0)

Values are or mean ± SD, n (%), or n. A, B, C, D, and E are Yacoub classifications (6).
LCA = left coronary artery; RCA = right coronary artery.

truly reflective of the geometric relationships that surgeons are confronted with in the operating room. Patients with anterior position of the left ostium represent a limited proportion of ASO patients, and this may explain the low prevalence of quantitative perfusion defects in previous series. It remains hypothetical that this subgroup of ASO patients is at higher risk of late cardiovascular events.

Our data confirm that sequential follow-up of coronary perfusion is not necessary in all patients after ASO when no coronary stenosis is found. We suggest that this follow-up has to be done in patients with anteriorly reimplanted left coronary artery. Long-term follow-up of this subgroup of patients is needed to relate this particular post-operative anatomy with potential cardiovascular events.

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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. Lalezari S, Bruggemans EF, Blom NA, Hazekamp MG. Thirty-year experience with the arterial switch operation. Ann Thorac Surg 2011;92:973–9.

3. Angeli E, Raisky O, Bonnet D, Sidi D, Vouhé PR. Late reoperations after neonatal arterial switch operation for transposition of the great arteries. Eur J Cardiothorac Surg 2008;34:32–6.

4. Pingitore A, Lombardi M, Scattini B, et al. Head to head comparison between perfusion and function during accelerated high-dose dipyridamole magnetic resonance stress for the detection of coronary artery disease. Am J Cardiol 2008;101:8–14.

5. Ou P, Khraiche D, Celermajer DS, et al. Mechanisms of coronary complications after the arterial switch for transposition of the great arteries. J Thorac Cardiovasc Surg 2013;145:1263–9.

6. Yacoub MH, Radley-Smith R. Anatomy of the coronary arteries in transposition of the great arteries and methods for their transfer in anatomical correction. Thorax 1978;33:418–24.