Arterial Switch Operation With and Without Coronary Relocation for Intramural Coronary Arteries

Hiroshi Koshiyama, MD, Mitsugi Nagashima, MD, Goki Matsumura, MD, Takeshi Hiramatsu, MD, Toshio Nakanishi, MD, and Kenji Yamazaki, MD

Department of Cardiovascular Surgery, Tokyo Women's Medical University, Tokyo, Japan

Background. **The arterial switch operation (ASO) for the transposition of the great arteries (TGA) with intramural coronary arteries has been performed using several techniques to avoid coronary events. We mainly performed ASO without coronary relocation by creating an aortopulmonary fenestration (Imai technique). Coronary circulation was rerouted by covering the aortopulmonary window and coronary orifices with a nonfacing sinus flap. Long-term results have not been reported. We describe our early and late results.**

Methods. **Among 551 patients who underwent an ASO between 1985 and 2014, intramural coronary arteries were detected in 15 of them. Coronary arteries were managed using 2 techniques: the double-button method in 5 patients (with unroofing and trapdoor incision in 1 patient) and the Imai technique in 10 patients.**

Results. **There were 3 hospital deaths and 3 deaths after discharge, 5 of which showed coronary complications. Actual survival and freedom from coronary complications at 15 years were 70% and 67%, respectively, with the Imai technique and 40% and 20%, respectively, with the double-button method. Late coronary intervention was performed for a long intramural coronary artery stenosis in 1 patient who underwent the Imai technique. In the others, late aortography showed good patency of the aortopulmonary window and growth of the coronary pouch after the Imai technique.**

Conclusions. **The Imai technique can be an option for coronary management in the presence of high-risk coronary anatomy, particularly distal intramural coronary artery stenosis and inseparable coronary arteries with an almost single orifice. Adequate neopulmonary artery augmentation must be performed to prevent right ventricular outflow stenosis.**

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The arterial switch operation (ASO) is the standard technique for the transposition of the great arteries (TGA). The overall mortality rate after operation has been reported to be between 1.1% and 6.0%. However, the presence of an intramural coronary artery (IMCA) was considered to increase mortality and coronary events [1].

Several techniques have been used for avoiding coronary complications when performing ASO for TGA with an IMCA [2]. In 1978, Aubert and colleagues [3] reported ASO without coronary relocation. In this procedure, coronary arteries were left in situ and covered with bovine pericardium; perfusion was created using an aortopulmonary window. Various modifications have been described [4–7]; however, late results have not been reported.

At our institution, we mainly performed the modified Aubert procedure (Imai technique) [2, 6, 7] using a nonfacing sinus flap for covering the aortopulmonary window and coronary orifices to prevent late tunnel obstruction and thrombus. We evaluated our early and late results.

Patients and Methods

The Tokyo Women's Medical University Institutional Review Board approved this retrospective study; the need for informed consent was waived. We retrospectively reviewed the medical records, operative notes, echocardiographic findings, cardiac catheterization reports, and multislice computed tomographic angiography findings of 551 patients who underwent ASO for TGA or double-outlet right ventricle at our institution between November 1985 and December 2014.

Fifteen patients (2.8%) with an IMCA were identified. There were 12 boys and 3 girls, including 7 neonates. At the time of operation, their median age was 81 days (11–804 days) and their weight was 3.8 kg (2.5–10.5 kg). Ten patients had TGA with an intact ventricular septum, 3 patients had TGA with a ventricular septal defect (VSD), and 2 patients had a Taussig-Bing anomaly. Associated anomalies included aortic coarctation in 2 patients, muscular VSD in 1 patient, straddling mitral valve in 1 patient, bicuspid pulmonary valve in 1 patient, and

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Address correspondence to Dr Koshiyama, Department of Cardiovascular Surgery, Tokyo Women's Medical University, 8-1 Kawada-cho, Shinjuku-ku, Tokyo 162-8666; email: hkoshi.md@gmail.com.

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Abbreviations and Acronyms

ASO = arterial switch operation
CABG = coronary artery bypass grafting
IMCA = intramural coronary artery
LAD = left anterior descending
LCA = left coronary artery
RCA = right coronary artery
TGA = transposition of the great arteries
VSD = ventricular septal defect

bicuspid aortic valve in 1 patient. Five patients had undergone previous palliative procedures, 4 patients had undergone pulmonary artery banding with a Blalock-Taussig shunt for left ventricle training before ASO, 1 patient had received a subclavian flap using pulmonary artery banding for coarctation repair, and no patients received antiplatelet treatment after operative treatment.

Coronary Anatomy

The coronary anatomy was determined based on the description in the operative records. IMCA stenosis was found in 5 patients. The following 3 anatomic types were identified (Fig 1):

1. Type A (n = 6): In 4 patients, the left anterior descending (LAD) artery arose from the right-facing sinus and passed intramurally behind the facing commissure. In the other 2 patients, the LAD artery originated above the facing commissure. The right coronary artery (RCA) and the left circumflex artery originated centrally in the right-facing sinus. One patient had a single orifice (type A1) and another patient had 3 orifices (type A3). The other 4 patients had 2 orifices (type A2).
2. Type B (n = 8): The left coronary artery (LCA) originated from the right-facing sinus and coursed intramurally behind the facing commissure. The RCA originated centrally from the right-facing sinus. Six patients had 2 orifices (type B2). The other 2 patients had a single orifice (type B1).
3. Type C (n = 1): The right major ventricular branch was intramural and coursed anteriorly between the aorta and the pulmonary artery. The right major ventricular artery, RCA, and LCA originated separately from the right-facing sinus.

Surgical Technique

Through a median sternotomy, cardiopulmonary bypass was established by aortic and bicaval cannulation. Cardioplegia was induced. The ascending aorta was divided above the sinotubular junction. The coronary arteries were carefully inspected before deciding on coronary management. The pulmonary artery was divided just before the bifurcation. Coronary arteries were managed using 2 techniques (Table 1).

1. Double-button method: The facing commissure of the aorta was detached. All coronary orifices were excised

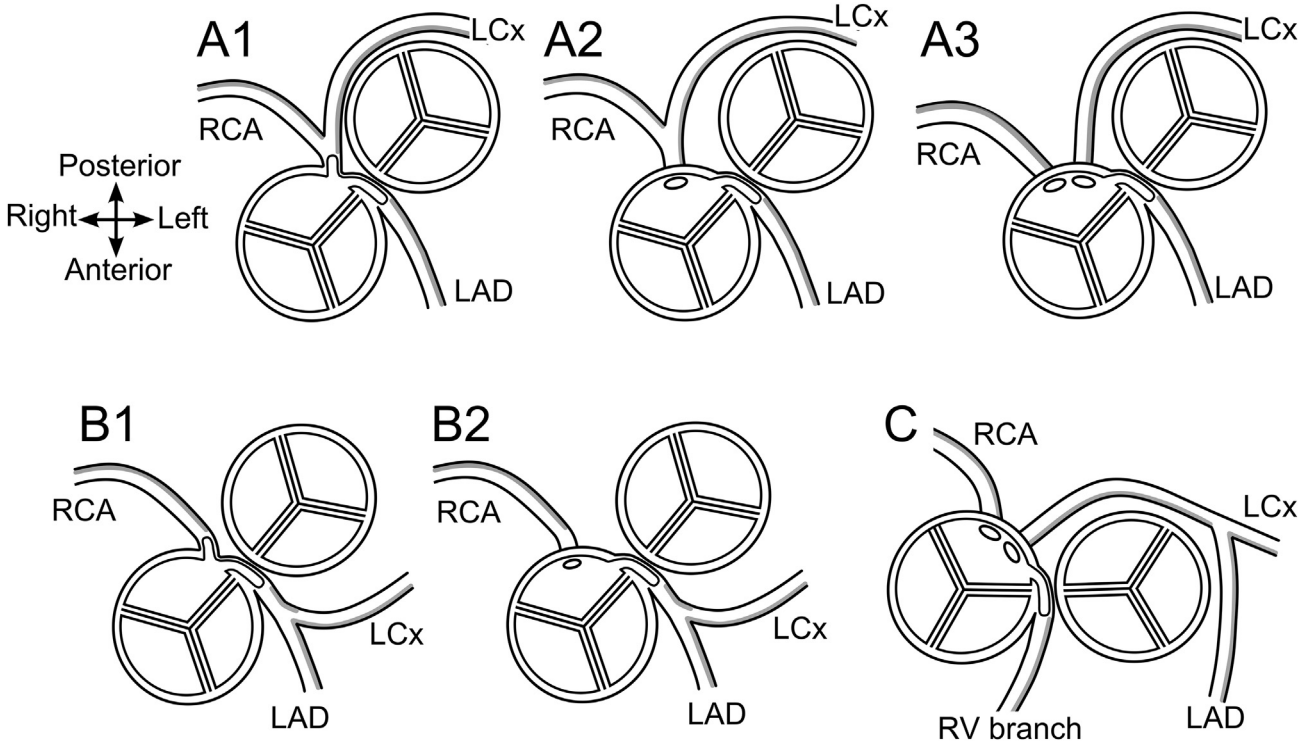

Fig 1. Coronary artery anatomy types. (LAD = left anterior descending; LCA = left coronary artery; LCx = left circumflex; RCA = right coronary artery.)