

|||||  
**Case Report**  
|||||

## Aortic Valve Replacement in Anomalous Aortic Origin of Right Coronary Artery

Toshiyuki Kuwata, Hirotsugu Fukuda, Yasuyuki Yamada, Ikuko Shibasaki,  
Takayuki Hori, Go Tsuchiya, Hironaga Ogawa, Yusuke Takei, Takashi Kato

*Department of Cardiac and Vascular Surgery, Dokkyo Medical University, Tochigi, Japan*

### SUMMARY

A 75-year-old man with severe aortic regurgitation was referred to our department for surgery. Coronary angiography revealed 75% stenosis at left coronary artery (LAD) and a normally positioned left coronary artery. However, the location of the right coronary artery was anomalous. The right coronary artery ostium originated from the ascending aorta above the left coronary cusp. Emergency surgery proceeded to address severe dyspnea due to congestive heart failure. The higher portion of the right coronary artery was incised in sigmoid fashion, the aortic valve was replaced with a 23-mm stented bioprosthesis and coronary bypass grafting proceeded. The postoperative course was uneventful.

**Key Words** : aortic regurgitation, aortic valve replacement, anomalous right coronary artery

### INTRODUCTION

Although the incidence of coronary artery anomalies is thought to be about 1%, a recent prospective angiographic study of 1,950 consecutive patients found an incidence of 5.6%<sup>1)</sup>. Among these patients undergoing coronary angiography (CAG), the right coronary artery (RCA) originated from the left coronary sinus in about 0.03-0.9%<sup>2)</sup>. The RCA very rarely originates from the ascending aorta above the left coronary cusp.

We describe a patient with severe aortic regurgitation whose RCA originated from the ascending aorta above the left coronary cusp. The aortic valve was replaced with a stented bioprosthesis without complications related to the coronary artery.

### CASE REPORT

A 75-year-old man with severe aortic regurgitation was referred to our department with exertional dyspnea (New York Heart Association functional class III). A physical examination revealed a grade IV/VI Levine diastolic murmur at the 4<sup>th</sup> intercostal space of the left sternal border. Electrocardiography showed atrial fibrillation at 98 beats/min. A chest X-ray showed a 68% cardiothoracic ratio with pulmonary congestion and bilateral pleural effusion. Blood data revealed a white blood cell count of  $16.0 \times 10^3/\mu\text{L}$ , hemoglobin (Hb) 11.9 mg/dL, creatine 2.97 mg/dL and brain natriuretic peptide (BNP) 5184.9 pg/mL.

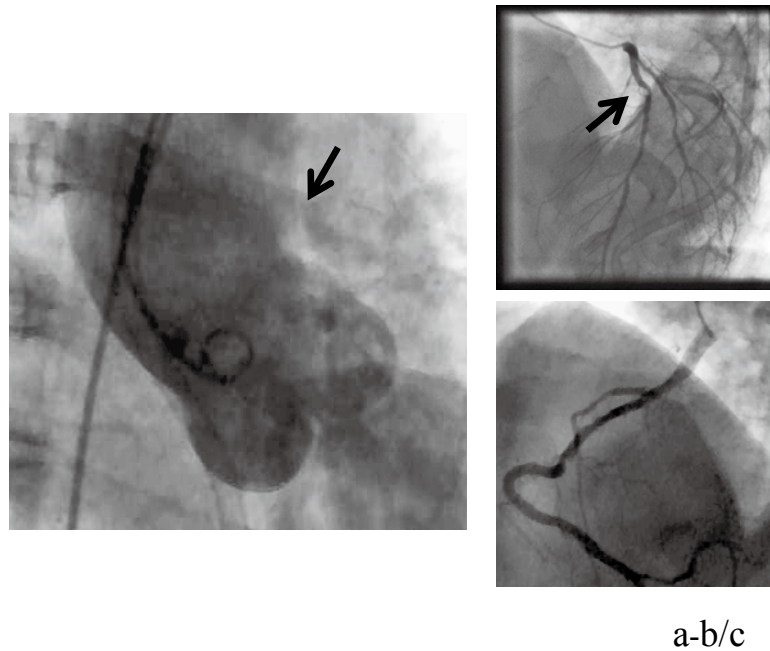
Transthoracic echocardiography showed severe aortic regurgitation with mild left ventricular systolic dysfunction (ejection fraction, 40%). The systolic and diastolic dimensions of the left ventricle were 42 and 53 mm, respectively. The anomalous position of the RCA was visualized by aortography (Fig. 1a). Coronary angiography revealed 75% stenosis at LAD (Fig. 1b), a normally positioned left coronary artery and an abnor-

---

Received September 3, 2014 ; accepted October 27, 2014

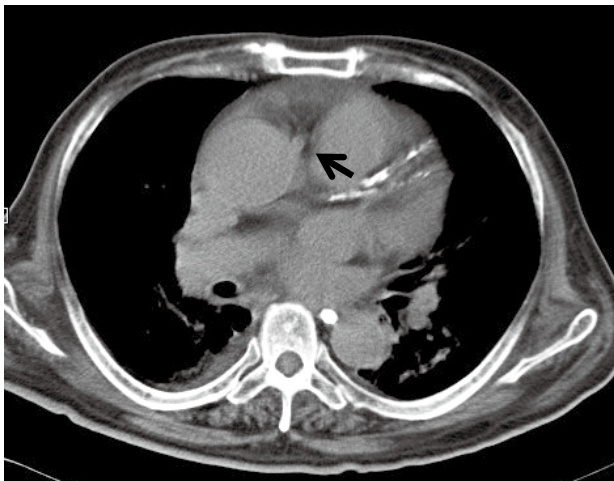
Reprint requests to : Toshiyuki Kuwata, M.D.

Cardiac and Vascular Surgery, Dokkyo Medical  
University 880 Kitakobayashi, Mibu, Tochigi  
321-0293, Japan



**Fig. 1** Aortography and coronary angiography findings.

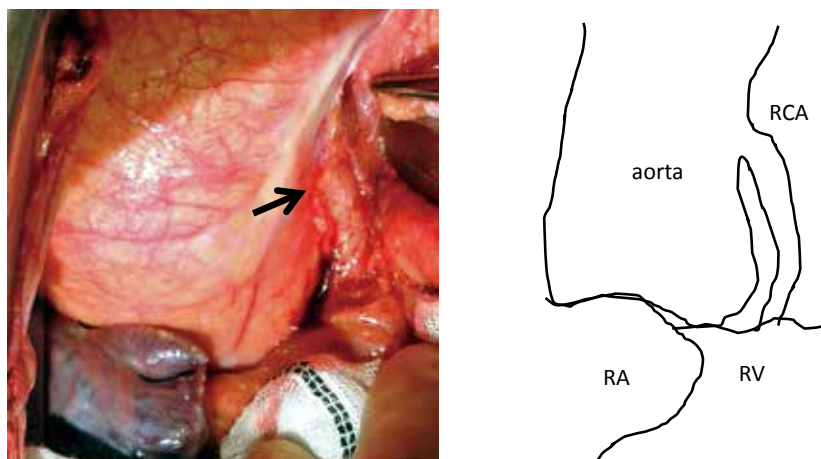
- a** : Aortography [Right Anterior Oblique (RAO)] shows anomalous position of right coronary artery (RCA) (arrow).  
**b** : Coronary angiography [left Anterior Oblique-Cranial (LAO-CR)] shows LCA and 75% stenosis at LAD (arrow).  
**c** : Coronary angiography [LAO-CR] shows RCA.



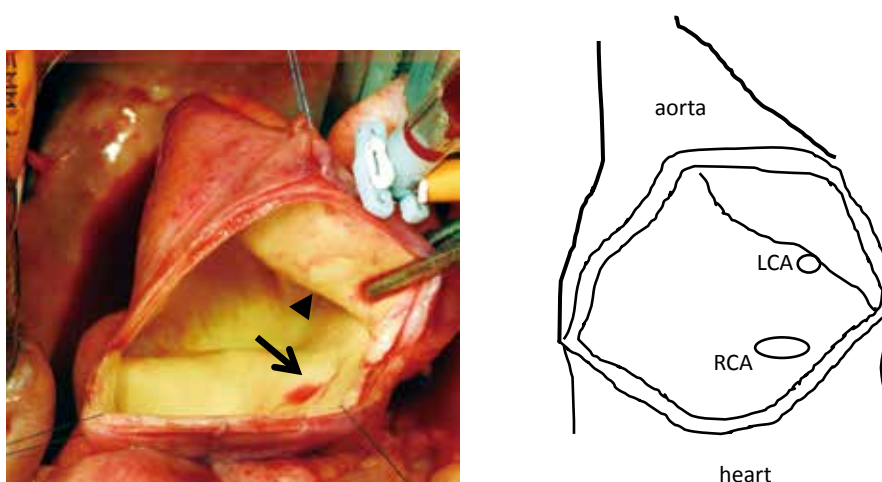
**Fig. 2** Plain computed tomography findings.  
 RCA ostium originates from ascending aorta (arrow).

mally located RCA. The RCA ostium originated from the ascending aorta at the coronary cusp (Fig. 1c). Computed tomography (CT) showed that the anomalous RCA originated from the ascending aorta above the left coronary cusp (Fig. 2). We proceeded with emergency aortic valve replacement and revasculariza-

tion for LAD due to severe aortic regurgitation and coronary artery disease. After a median sternotomy, the left intrathoracic artery was harvested using a full skeletonized technique. After the pericardium was opened in the midline, we found the RCA at the ascending aorta (Fig. 3, 4). A cardiopulmonary bypass (CPB) was established by cannulating the aortic arch and right atrium. An aortotomy was prepared from 1 cm above the RCA to the non-coronary sinus of Valsalva in sigmoid fashion. The aortic valve had tricuspid leaflets that appeared normal, but the commissures between the right and left coronary cusp and the left and non-coronary cusp were destroyed. The ostium of the RCA was located at the ascending aorta above the left coronary cusp. The aortic valve was replaced with a 23-mm stented bioprosthesis (Carpentier-Edwards Perimount valve, Carpentier-Edwards Lifesciences, Irvine, CA, USA) implanted in an intra-annular fashion. Finally, the left intrathoracic artery was anastomosed in situ to the left anterior descending artery. The aorta was declamped and an intra aortic balloon pump was inserted due to difficulty weaning the patient from



**Fig. 3** Intraoperative findings.  
Anomalous right coronary artery arising from ascending aorta (arrow).



**Fig. 4** Intraoperative findings.  
Anomalous right coronary artery arising from ascending aorta (arrow) and left coronary artery (arrow head).

CPB. Thereafter, the patient was easily weaned from CPB. The durations of aortic cross-clamping, CPB and surgery were 120, 199 and 423 min, respectively. The postoperative course was uneventful.

## DISCUSSION

Coronary artery anomalies are very rare. The reported overall incidence of coronary artery anomalies is 5.64%, but that of an anomalous aortic origin of the coronary artery from the opposite sinus (AAOCA) is only 1.07%. The incidences of a left main coronary artery arising from the right coronary sinus (ALCA) and of the right coronary artery arising from the left coronary sinus (ARCA) are 0.15% and 0.92%, respec-

tively<sup>2)</sup>. Anomalous origin of coronary artery can be classified as an absent left main trunk, anomalous location of the coronary ostium with an aortic root or a near-proper aortic sinus of Valsalva (for each artery), anomalous location of the coronary ostium outside normal "coronary" aortic sinuses, anomalous origin of the coronary ostium from opposite side facing the "coronary" sinus and a single coronary artery<sup>3)</sup>. Our patient had anomalous location of the coronary ostium outside the normal "coronary" aortic sinuses (that is, the ascending aorta above the left coronary sinus). Although rare, AAOCA has been associated with sudden death<sup>4,5)</sup>. Theories regarding the pathophysiology associated with such sudden death include an inter-mural

course, the presence of slit-like ostia, marked artery angulation from the pulmonary artery, arterial spasm, and arrhythmia secondary to minor ischemia insults<sup>6)</sup>. Taylor and colleagues<sup>4)</sup> and Basso and colleagues<sup>5)</sup> showed that sudden death was more commonly associated with ALCA than ARCA, but each anomaly was indeed associated with sudden death. Our patient was asymptomatic at the time of diagnosis.

The precise course of an anomalous vessel may be difficult to fluoroscopically delineate during CAG due to the two-dimensional visualization of complex three-dimensional geometry. However, multidetector computed tomography (MDCT) was a useful, accurate and convenient complementary tool compared with CAG because it precisely showed the anomalous origin and relationships between the ventricle and the coronary and great vessels<sup>7)</sup>. We could not assess our patient by MDCT because he had kidney dysfunction and required emergency surgery. Therefore, the precise course of the anomalous vessel, its origin and relationships between the ventricle and the coronary and great vessels were difficult to visualize.

Surgical concerns during aortic valve replacement about an anomalous RCA arising from the ascending aorta comprise injury as a consequence of dissection or suturing, compression by the prosthetic valve, cardioplegia infusion and concomitant revascularization<sup>8)</sup>. We applied a sigmoid aortotomy from 1 cm above the RCA to the non-coronary sinus of Valsalva of this patient and selected a smaller prosthetic valve with an everted mattress suture for intra-annular implantation. Cardioplegia infusion was straightforward because the ostium was not narrow, slit-like or steeply angled. We performed coronary revascularization at the left anterior descending artery without the RCA because CAG showed 75% stenosis at LAD.

Concomitant coronary artery bypass graft and rare aortic valve replacement in an anomalous aortic origin of the RCA with left coronary disease proceeded safely. However, we recommend that such patients should be assessed using MDCT before undergoing surgery so that the surgeon can precisely understand the course

of anomalous vessels, anomalous origins and relationships between the ventricle and the coronary and great vessels.

#### Disclosure Statement

The authors no conflicts of interest or relationships with industry.

#### REFERENCES

- 1) Angelini P : Coronary artery anomalies-current clinical issues : definition, classification, incidence, clinical relevance, and treatment guidelines. *Tex Heart Inst J* **29** : 271-278, 2002.
- 2) Angelini P : Coronary anomalies : An Entity in Search of an Identity. *Circulation* **115** : 1296-1305, 2007.
- 3) Angelini P, Velasco JA, Flamm S : Coronary anomalies : incidence, pathophysiology, and clinical relevance. *Circulation* **105** : 2449-2454, 2002.
- 4) Taylor AJ, Rogan KM, Virmani R : Sudden cardiac death associated with isolation congenital coronary artery anomalies. *J Am Coll Cardiol* **20** : 640-647, 1992.
- 5) Basso C, Maron BJ, Corrado D, et al : Clinical profile of congenital coronary artery anomalies with origin from the wrong aortic sinus leading to sudden death in young competitive athletes. *J Am Coll Cardiol* **35** : 1493-1501, 2000.
- 6) Davies JE, Burkhart HM, Dearani JA, et al : Surgical management of anomalous aortic origin of coronary artery. *Ann Thorac Surg* **88** : 844-848, 2009.
- 7) Lee J-J, Kim D-H, Byun S-S, et al : A case of acute myocardial infarction with the anomalous origin of the right coronary artery from the ascending aorta above the left sinus of Valsalva and left coronary artery from the sinus of Valsalva. *Yonsei Med J* **50** : 164-168, 2009.
- 8) Hamamoto M, Futagami D : Aortic valve replacement for a patient with anomalous left coronary artery from the right sinus of Valsalva. *Gen Thorac Cardiovasc Surg* **61** : 46-50, 2013.