

Hybrid Coronary Artery Revascularization for Takayasu Arteritis with Major Visceral Collateral Circulation from the Left Internal Thoracic Artery

Hyung Tae Sim, M.D.¹, Jeong-Won Kim, M.D.²,
Jae Suk Yoo, M.D.¹, Kwang Ree Cho, M.D., Ph.D.¹

¹Department of Thoracic and Cardiovascular Surgery, Sejong General Hospital,

²Department of Thoracic and Cardiovascular Surgery, Kyungpook National University Hospital

Coronary arterial involvement in Takayasu arteritis (TA) is not uncommon. Herein, we describe a case of TA with celiac trunk and superior mesenteric artery occlusion combined with coronary artery disease. Bilateral huge internal thoracic arteries (ITAs) and the inferior mesenteric artery provided the major visceral collateral circulation. After percutaneous intervention to the right coronary artery, off-pump coronary artery bypass grafting for the left coronary territory was done using a right ITA graft and its large side branch because of its relatively minor contribution to the visceral collateral circulation.

Key words: 1. Takayasu arteritis
2. Coronary artery disease
3. Coronary artery bypass
4. Internal thoracic artery
5. Collateral circulation

Case report

A 49-year-old man presented with exertional chest pain. He had hypertension that was well controlled with medication. He did not show any constitutional symptoms such as fever, malaise, or fatigue. Inflammatory markers were suggestive of mild disease; the erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were 13 mm/hr (normal range, 0 to 10 mm/hr) and 1.1 mg/L (normal range, 0 to 5 mg/L), respectively. Coronary angiography (CAG) showed 80% concentric stenosis at the left main coronary artery, chronic total occlusion of the left anterior descending (LAD) artery, and 95% stenosis of the prox-

imal right coronary artery (Fig. 1A, B). Transthoracic echocardiography showed normal left ventricular systolic function with severe hypokinesia at the mid-inferior and inferolateral wall. Flow acceleration at the abdominal aorta was also suspected. Computed tomography (CT) of the aorta revealed a diffuse severe tapered narrowing of the descending thoracic artery through the abdominal aorta with the narrowest dimension of 6 mm at the level of the renal arteries. The arch vessels were intact with mild stenosis at the left common carotid artery. Total occlusion of the celiac trunk and the superior mesenteric artery (SMA) was identified with major visceral collateral circulation from both the inferior mesenteric artery

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Corresponding author: Kwang Ree Cho, Department of Thoracic and Cardiovascular Surgery, Sejong Heart Institute, Sejong General Hospital, 28 Hohyeon-ro 489beon-gil, Sosa-gu, Bucheon 14754, Korea
(Tel) 82-32-340-1440 (Fax) 82-32-340-1237 (E-mail) ckrym@hanmail.net

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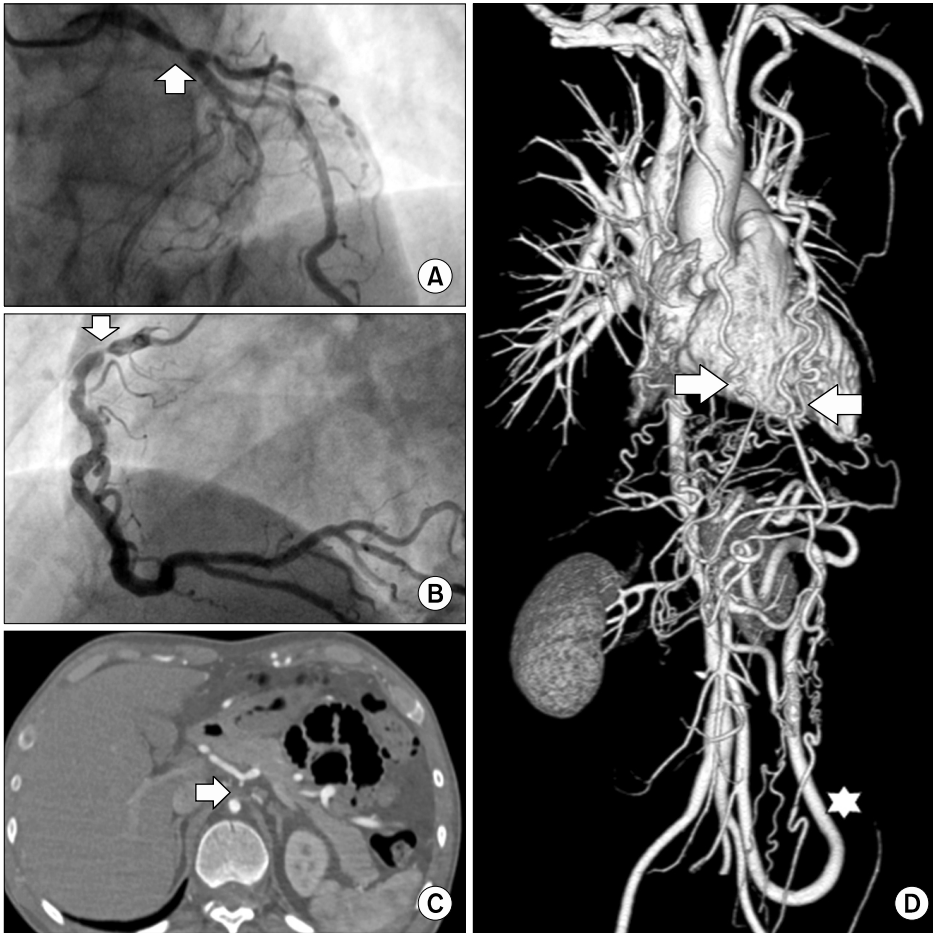


Fig. 1. (A) Preoperative coronary angiography showed 80% concentric stenosis at the left main coronary artery (arrow) and chronic total occlusion of the left anterior descending artery. (B) Right coronary angiography showed 95% stenosis of the proximal right coronary artery (arrow). (C) Computed tomographic angiography showed total occlusion of the celiac trunk and the superior mesenteric artery (arrow). (D) The inferior mesenteric artery (asterisk) and bilateral internal thoracic arteries (arrow) provided the main visceral collateral circulation.

(IMA) and the bilateral internal thoracic arteries (ITAs) (Fig. 1C, D). The ankle-brachial index had decreased to 0.7 on both sides. In order to enlarge the narrowing aortic lumen and to increase the forward flow to the IMA and the lower extremities, a vascular stent for the abdominal aorta (12 mm×100 mm, Hercules Vascular; S&G Biotech Inc., Seongnam, Korea) was first deployed. After this procedure, the patient received steroid therapy under the impression of Takayasu arteritis (TA). During a 5-month follow-up period, the angina class deteriorated from Canadian Cardiovascular Society II to III. Follow-up CT angiography showed slightly improved abdominal aortic dimensions (Fig. 2B). The ankle-brachial index also recovered to the normal range, and inflammatory markers such as ESR and CRP likewise dropped to the normal range. Considering the patient's young age and the absence of possible arterial grafts, we adopted a hybrid approach for complete revasculari-

zation. First, drug-eluting balloon angioplasty (SeQuent Please; B. Braun, Melsungen, Germany) for the proximal right coronary artery (RCA) lesion was done during the follow-up CAG (Fig. 2A). Then, he received dual antiplatelet therapy (aspirin and clopidogrel). Two weeks later, off-pump coronary artery bypass grafting (OPCAB) for the LAD and the large ramus intermedius (RI) was carried out using the right ITA *in situ* and its large side branch. Aspirin was continued on the day of surgery, and clopidogrel was stopped 1 week before surgery. The right ITA was selected because it provided relatively less collateral circulation to the visceral organs than the left ITA. In the operating field (Fig. 2C, D), the right ITA was very large (diameter: 5 mm), and the lumen was high-quality and did not show any calcifications. A large side branch was also identified and used for lengthening the graft by connecting the free side branch to the end of the *in situ* right ITA (I-compo-

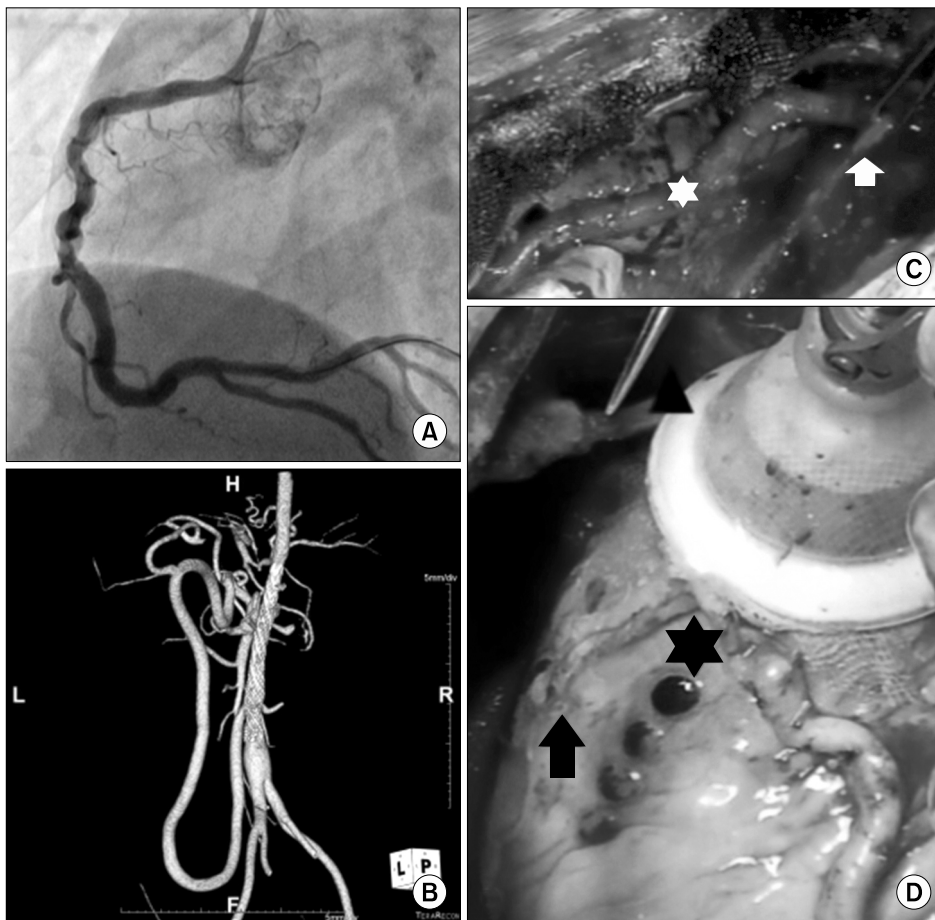


Fig. 2. (A) Follow-up coronary angiogram of the right coronary artery after drug-eluting balloon angioplasty. (B) Follow-up computed tomography scan after vascular stent insertion in the abdominal aorta. (C) Operative findings: a huge dilated right ITA (asterisk) and its large proximal branch (arrow). (D) The right ITA was anastomosed *in situ* to the left anterior descending artery (asterisk), and an I-composite graft (free side branch) was anastomosed to the ramus intermedius branch (arrow). The large left ITA (arrow head) providing visceral collateral circulation was preserved. ITA, internal thoracic artery.

site graft). The right ITA was anastomosed *in situ* to the LAD, and the I-composite graft (side branch) was anastomosed to the RI branch. The intraoperative graft patency was excellent on the transit time flow measurement pattern measurement. The peak postoperative creatine kinase-myocardial band troponin-T levels were 4.8 ng/mL and 0.15 ng/mL, respectively. The postoperative course was uneventful, and the patient was discharged from the hospital on postoperative day 6 without any complications. The postoperative CRP level was 6.4 mg/L before discharge. At the most recent follow-up at the outpatient clinic, he was in excellent clinical condition with oral steroid maintenance therapy.

Discussion

TA is characterized as pan-arteritis causing ischemic symptoms related to stenotic lesions [1]. TA can be classified according to the involved vessels as fol-

lows: type I (branches of the aortic arch), type IIa (ascending aorta and aortic arch), type IIb (ascending aorta, aortic arch, and descending thoracic aorta), type III (descending thoracic aorta and abdominal aorta), type IV (abdominal aorta and/or renal arteries), and type V (combined features of types IIb and IV) [1]. Our patient showed type V TA. The distribution of the types varies among countries, but a recent study reported that type V (54.5%) and type II (22.3%) were the most common types of TA in Korea [1]. Coronary arterial involvement is not uncommon in TA, and occurs in 10% to 30% of cases. Typical lesions involve stenosis at the coronary ostium or proximal segments of the coronary arteries [2]. This patient had proximal coronary artery involvement without ostial lesions.

This patient was relatively old, considering that TA is typically seen in young patients with an age of onset of less than 40 years [3]. Other possible large vessel vasculitis conditions can occur at this age,

such as infectious aortitis, giant cell arteritis (GCA), or Behcet disease. This patient did not have any sign of infection or history of syphilis. Symptoms of cranial aortitis, which is characteristic of GCA, such as new-onset headache, jaw claudication, or visual problems, were also absent. Aneurysms involving large branches of the pulmonary artery, which are typically seen in Behcet disease, were not present either [3].

As this patient was considered to be in the active stage of TA with elevated inflammatory markers and a thickened aortic wall at the first presentation, he underwent OPCAB after stabilization of the disease activity using oral steroid treatment following aortic stenting. Surgery is strongly recommended during the inactive phase of vasculitis because subsequent steroid treatment can lead to a significant regression of the coronary artery stenosis, resulting in the occlusion of bypass grafts from flow competition [2,4]. We performed total arterial revascularization considering the patient's young age. According to the American College of Cardiology Foundation/American Heart Association guidelines for coronary artery bypass surgery, complete arterial revascularization may be reasonable in patients less than 60 years of age [5]. In this patient, although the IMA provided most of the collateral circulation in the SMA territory, the left ITA provided a significant amount of the collateral circulation in the celiac trunk territory. Thus, we used the right ITA as a blood source for coronary artery bypass grafting. Fortunately, there was a large side branch of the right ITA that was used for lengthening the *in situ* right ITA graft for the sequential anastomosis of the LAD and RI branch. Side branches of the ITA are rarely used for grafts because of their small caliber and histologic differences. However, in the present case, the size and the quality of the side branch were considered excellent for a graft, and a good mid-term patency rate has been reported when the side branch of the ITA was used [6].

We adopted an I-composite graft considering the location of the target coronary artery and the length of the free side branch. This graft made the total graft longer than if a Y-composite graft, which anastomoses the second graft in an end-to-side fashion, were used.

Some controversy exists regarding the *in situ* use of the ITA in TA because of subclavian artery involvement. However, in the present case, both sub-

clavian arteries were normal and the quality of the right ITA was excellent. Long-term patency is considered acceptable in coronary artery bypass grafting using an appropriate-quality ITA even in TA patients [2,4]. As the available arterial grafts were limited in patients with TA, we adopted a hybrid approach (percutaneous intervention for the RCA with a drug-eluting balloon and OPCAB). We first applied the intervention for the RCA lesion before surgery because doing so reduced the risk of perioperative myocardial infarction in the RCA territory. Drug-eluting balloon angioplasty can suppress intimal hyperplasia and has been proven to be safe and effective in terms of mid-term outcomes [7]. Moreover, OPCAB can allow aortic manipulation to be avoided in cases with systemic vasculitis and irregular aortic wall thickening. Although there have been some reports of coronary artery bypass grafting using a dilated ITA in cases with coarctation of the aorta [8], to the best of our knowledge, this is the first report of hybrid OPCAB using a dilated ITA and its branch to treat a patient with TA. Although the quality of the dilated ITA and its branch was good, the long-term clinical outcome and patency need to be confirmed over the course of follow-up.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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