Novel Beating Heart Repair for Anomalous Origin of Right Coronary Artery
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Anomalous origin of the right coronary artery (ARCA) from the left coronary sinus is a rare anatomic anomaly. It may cause myocardial ischemia and sudden death. Several treatments have been tried, including coronary bypass grafting, unroofing, and reimplantation. These techniques, however, have disadvantages such as postoperative flow competition, aortic insufficiency, or kinks and angulation of the coronary artery, respectively. To overcome these problems, we undertook a novel approach: beating heart repair. It does not require aortic cross-clamping, cardioplegic arrest, aortotomy, or manipulation of the aortic commissure. Beating heart repair is a simple and effective procedure, which adds an ideal treatment option for ARCA.


A nomalous origin of the right coronary artery (ARCA) from the left coronary sinus is a rare anatomic anomaly [1]. The RCA originates from the left coronary sinus and passes between the ascending aorta and the pulmonary trunk. Surgical repair is recommended in symptomatic patients and might be considered in asymptomatic patients because these anatomic variants may be associated with sudden death [1].

Much effort has therefore been made to treat this anomaly, including percutaneous coronary intervention [2], coronary artery bypass grafting [3], reimplantation of the coronary ostia to the correct sinus, and unroofing [4]. The choice of treatment is still open, however. Percutaneous coronary intervention for ARCA does not correct either the aberrant ostium or the interarterial course of ARCA. Its indication is therefore limited, because coronary flow is not impaired at rest in ARCA [2]. For the same reason, coronary artery bypass grafting is associated with a high incidence of graft failure resulting from competitive flow [3]. Unroofing may be the most frequently performed technique, with favorable results [4], although it may cause aortic insufficiency when the valve commissure is involved [5]. Translocation of the coronary orifice using cardioplegic arrest presents problems with anastomosis [6] because evaluation of an adequate design for reimplantation to avoid kinks, stretching, and angulation is often difficult with the patient under cardioplegic arrest.

To eliminate these problems, we undertook a novel approach: beating heart coronary ostial translocation using an anastomosis assist device.

Two patients underwent repair of an ARCA, with a single coronary ostium and no intramural segment. The first patient was a 63-year-old woman, who complained that exercise had induced chest pain for many years. Computed tomography (CT) angiography revealed the ARCA (Fig 1). The second patient was a 61-year-old man, who had complained of frequent and sustained episodes of palpitations and shortness of breath on exertion for years. He was emergently admitted because of heart failure and nonsustained ventricular tachycardia. Coronary angiography revealed the ARCA and 75% stenosis of the left anterior descending coronary artery. He had an episode of ventricular fibrillation.

The operations were performed through a median sternotomy on a beating heart. Standard ascending aortic and right atrial cannulation was performed with normothermic cardiopulmonary bypass. The Valsalva sinus and ARCA were cautiously dissected in a completely skeletonized fashion (Fig 2) using an ultrasonic scalpel (HARMONIC scalpel, Ethicon, Somerville, NJ) to gain sufficient mobility.

Before insertion of the anastomosis assist device, the location of the neo-ostium was determined by transesophageal echocardiography, in which there is no interference with the commissure and cusps.

The proximal anastomosis device (Enclose II, Vitalitec International, Inc, Domalain, France) consists of a dual internal and external assembly called a jaw [7]. The full thickness of the aortic wall was punched out and a neo-ostium was created at the optimal site (Video 1).

The ARCA was divided at its proximal end, and its edge was trimmed for the anastomosis by cutting back and enlarging sufficiently so that there was a cobra-hood–shaped anastomosis (Fig 3). The course of the ARCA was designed to ensure no torsion or stretching. The ARCA was then directly anastomosed in an end-to-side fashion to the right sinus with a 7-0 continuous polypropylene suture (Prolene, Ethicon, Somerville, NJ) in a cobra-hood fashion (Fig 4).

Beating-heart repair could be performed safely in these 2 patients. This technique allowed tension-free anastomosis of the ARCA to the right sinus in a beating heart operation. The Enclose II provided a stable bloodless surgical field without clamping the aorta. The quality of the anastomosis was confirmed immediately after...
anastomosis by direct transit-time flow measurements (Transonic Flow-QC Meter HT313, Transonic Systems Inc, Ithaca, NY), which showed normal coronary flow with good diastolic flow.

Postoperative CT angiography showed a patent RCA originating from the neo-ostium (Fig 5). Cardiac function equal to the preoperative state was preserved, and normal aortic valvular motion was confirmed, together with the absence of aortic regurgitation. The patients had uneventful postoperative courses, with complete relief of their symptoms. They were followed and were free of symptoms for 4 to 15 months.

Comment

Beating heart repair was performed with excellent results. It is a simple and safe procedure, involving minimal surgical steps, ie, dissection of the ARCA and anastomosis to the correct sinus. This technique can eliminate the need to cross-clamp and open the aorta and manipulate the intercoronary commissure with the patient under cardioplegic arrest. It also facilitates optimal anastomosis without kinks, angulation, torsion, or stretching of the translocated coronary artery. The course of the ARCA to the neo-ostium was easy to determine because of the beating heart condition; moreover, the quality of the
anastomosis could be confirmed immediately after anastomosis by transit-time flow measurements.

The Enclose II anastomosis assist device enables ideal anastomosis to an optimal flat round punch hole anywhere in the ascending aorta and aortic root [7]. The ostium can be created at the point at which the ARCA best reaches without tension or angulation. This device is simple and requires only a small area of the normal aorta for deployment. It is therefore particularly advantageous in patients with diseased ascending aortas. Moreover, the Enclose II is designed for conventional suturing techniques, so it should produce patency similar to conventional hand-sewn techniques.

It remains controversial whether the presence of ARCA warrants surgical intervention. Some patients do not complain of symptoms and have normal results on exercise testing; however, a certain number of patients initially experience sudden death [1]. For patients with ARCA with (1) an interarterial course between the aorta and pulmonary trunk, (2) an intramural coronary segment, and (3) an acute-angle takeoff, surgical intervention would be recommended and can completely alleviate the risk of cardiac events [3].

In summary, novel beating heart repair is a simple and effective procedure, which adds an ideal treatment option for ARCA.

References