

## **Porcelain aorta: a new indication for on-pump beating heart mitral valve replacement**

*Kardiyopulmoner baypas altında atan kalpte mitral kapak replasmanı için yeni bir endikasyon: Porselen aort*

**Kerem Yay, Muhammet Onur Hanedan, Veysel Başar, Ufuk Tütün, Garip Altıntaş,  
Ferit Çiçekçiöğlü, Salih Fehmi Katırcıoğlu**

Department of Cardiovascular Surgery, Türkiye Yüksek İhtisas Training and Research Hospital, Ankara

Conventionally, mitral valve replacement (MVR) is performed under cardioplegic arrest. A 69-years-old male patient was admitted to our clinic with severe dyspnea, orthopnea and palpitation. Transthoracic echocardiography revealed fibro-calcified mitral valve stenosis. Without cross-clamping the aorta, beating heart MVR under cardiopulmonary bypass (CPB) was performed. Since no dissection of the ascending aorta is performed, the risks of injury and embolic complications are minimized. Porcelain aorta with the mitral valve disease is a new indication for beating heart MVR under CPB.

**Key words:** Beating heart; mitral valve replacement; porcelain aorta.

Conventionally, mitral valve replacement (MVR) is performed under mild hypothermic cardiopulmonary bypass (CPB) with cardioplegic arrest and cross-clamping of the aorta.<sup>[1]</sup> However, with some unique conditions like porcelain aorta, the conventional technique cannot be performed, and an alternative approach is needed. In our case reported here, MVR was carried out with an on-pump normothermic CPB that was accessed through the femoral artery via the beating heart technique without cross-clamping the aorta because of the porcelain aorta of the patient. Consequently, the heart was perfused antegradely through the native anatomical route. A similar technique was described in the literature for cases of redo valve surgery, especially with the open coronary grafts or poor ventricles associated with valvular diseases.<sup>[2-7]</sup> On-pump beating heart mitral valve replacement without cross-clamping along with cannulating the aorta offers a safe approach for the untouched porcelain aorta.

Geleneksel olarak mitral kapak replasmanı (MKR) kardioplejik arest altında yapılmaktadır. Altmış dokuz yaşında erkek hasta şiddetli dispne, ortopne ve çarpıntı yakınmaları ile kliniğimize başvurdu. Transtorasik eko-kardiyografide fibrokalsifik mitral kapak stenozu tespit edildi. Aorta kross-klemp konmadan kardiyopulmoner baypas (CPB) altında atan kalpte MKR uygulandı. Çıkan aort diseke edilmediği için yaralanma ve embolik komplikasyon riski minimize olur. Mitral kapak hastalığı ile birlikte porselen aort; CPB altında atan kalpte MKR'nin yeni bir endikasyonudur.

**Anahtar sözcükler:** Atan kalp; mitral kapak replasmanı; porselen aort.

### **CASE REPORT**

A 69-year-old hypertensive male was admitted to the hospital with severe dyspnea, orthopnea, and palpitation. Transthoracic echocardiography (TTE) showed fibro-calcified mitral valve stenosis. The valve area was 0.8 cm<sup>2</sup>, and the mitral valve gradient was 14/9 mmHg with 52 mmHg systolic pulmonary artery pressure (SPAP). Other than minimal aortic insufficiency, no pathological findings were reported at TTE. The cardiac rhythm was atrial fibrillation as seen on an electrocardiogram. Coronary angiography was performed and showed only minimal coronary arterial disease. The patient was prepared for mitral valve replacement.

### **Surgical technique**

Under general anesthesia, a median sternotomy and pericardiectomy were performed. During evaluation of the aorta for arterial cannulation, we noticed that

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Correspondence: Muhammet Onur Hanedan, M.D. Türkiye Yüksek İhtisas Eğitim ve Araştırma Hastanesi, Kalp ve Damar Cerrahisi Kliniği, 06100 Sıhhiye, Ankara, Turkey. Tel: +90 312 - 306 12 34 e-mail: ohanedan@hotmail.com

the ascending and arcus aorta were fully calcified, which is known as porcelain aorta. Thus, we changed the operational strategy and decided to perform mitral valve replacement with the normothermic on-pump beating heart without cross-clamping the aorta. Right femoral artery cannulation was performed for arterial inflow after systemic heparinization. Bicaval venous cannulation was accomplished. Right upper pulmonary vein vent cannulation was carried out for blood suction from the left heart. Without cross-clamping the aorta, normothermic CPB (rectal temperature between 35 °C to 37 °C, flow rate about 2.5 L/min/m<sup>2</sup>, and mean systemic pressure between 60 to 90 mmHg) was initiated. The left atrium dissection was transacted through Sondergaard's groove to expose the native stenotic mitral valve, which was excessively calcified; therefore, it was dissected and replaced with a 29 mm mitral St. Jude bileaflet mechanical prosthetic valve (St. Jude Medical, Inc, St. Paul, MN, USA). During the procedure, antegrade normothermic blood perfusion to the myocardium was delivered via the native coronary arteries with the help of normothermic CPB throughout the femoral arterial cannulation access, and the heart continued to beat throughout the procedure. To prevent air embolism, the patient was positioned in a head-down tilt (Trendelenburg) position until de-airing of the left heart was achieved. For de-airing the left heart, we utilized the Trendelenburg position, allowing the left heart to fill with blood just before closure of the left atrium and apex with a de-airing needle. The left atrium was sutured, and cardiopulmonary perfusion was terminated without any complications. Transesophageal echocardiography (TEE) was used to determine air bubbles while weaning from CPB (CPB time: 62 minutes). After decannulation and closure of the sternum, the patient was discharged to the intensive care unit (ICU).

### Postoperative period

The patient started to awaken postoperatively at the third hour and was extubated at the ninth hour. He was discharged to the recovery ward on the first day and from the hospital on the fifth day with no complications.

### DISCUSSION

Conventionally, MVR is performed under hypothermic CPB with cardioplegic arrest and cross-clamping of the aorta.<sup>[1]</sup> As an alternative procedure to conventional mitral valve surgery, beating heart mitral valve surgery without cross-clamping the aorta has been used for valvular operations and reoperations with acceptable clinical results.<sup>[2-7]</sup>

Sometimes heavy calcification or severe adhesions around the ascending aorta may not allow us to cross-clamp the aorta safely.<sup>[4]</sup> In this situation, hypothermic fibrillatory arrest or deep hypothermia/total circulatory arrest techniques are mostly performed for mitral valve surgery.<sup>[8]</sup>

In this case, because of the porcelain aorta of the patient, beating heart MVR under normothermic CPB via femoral access without cross-clamping the aorta was the other choice for protecting the aorta. Cannulation and cross-clamping the calcified aorta contains a risk of stroke in the central nervous system (CNS) because of the emboli of calcified debris from the aorta. Other techniques like hypothermic fibrillatory arrest or deep hypothermia/total circulatory arrest can also cause CNS complications, especially cerebral edema. Besides CNS complications, hypothermia and fibrillation can result in myocardial ischemia and myocardial edema. Our beating heart MVR technique eliminates these problems; therefore, it offers optimal myocardial protection, particularly for patients with impaired left ventricular functions.<sup>[5]</sup> Complications due to CNS are also very low with this procedure, especially concerning air embolism.<sup>[9-10]</sup> A competent aortic valve that acts like a cross-clamp and the Trendelenburg position prevent air embolism during the surgical procedure. Filling the left heart totally with blood just before left atrium closure and de-airing from the apex seem adequate for de-airing. This can also be controlled by TEE, as is done at our facility. Continuous aortic suction is also helpful for de-airing, but it was not suitable for our case.

The beating heart MVR technique also shortens the CPB time by having no cooling and rewarming periods, which also reduces the risk of adverse effects of CPB.

Similar to what Toyama et al.<sup>[11]</sup> who performed CPB arterial cannulation through the ascending aorta, we performed a successful MVR with the beating heart technique without cross-clamping aorta in this porcelain aorta case via femoral arterial access without touching the porcelain aorta. No cerebrovascular event was observed, and the patient was discharged from the hospital in healthy condition.

In conclusion, the beating heart under normothermic CPB by femoral access without aortic cross-clamping technique offers a simple, effective, and safe alternative to conventional or hypothermic techniques. From a surgical viewpoint, not dissecting the ascending aorta minimizes the risk of injury and embolic complications. As a result, we believe that porcelain aorta is a new indication for the beating MVR without cross-clamping aorta technique.

**Declaration of conflicting interests**

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