Masters of Cardiothoracic Surgery

Single incision right transaxillary robotic valve and coronary artery bypass grafting: a future therapy

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Introduction

Minimally invasive and robotic-assisted cardiac surgery has evolved significantly, offering reproducible alternatives to conventional median sternotomy (1). Robotic approaches to mitral and aortic valve surgery via a right transaxillary approach, as well as totally endoscopic coronary artery bypass (TECAB) via the left chest, have been established. Patients requiring traditional concomitant coronary artery bypass grafting (CABG) and valve surgery present a unique challenge, particularly in frail individuals with multiple comorbidities. Recently, the technique for concomitant valve and CABG performed via a single-incision right transaxillary robotic approach has been established (2). This approach may provide a minimally invasive option that facilitates exposure of both the valve and coronary targets while minimizing surgical trauma.

We present two cases where a single-incision right transaxillary robotic approach was used to perform combined valve replacement and CABG.

Clinical vignette

Case 1: robotic aortic valve replacement (AVR) with CABG

A 73-year-old frail woman presented with heart failure symptoms despite guideline-directed medical therapy. Medical history included chronic obstructive pulmonary disease (COPD), low body mass index (BMI) of 17 kg/m^2, prior stroke, and mechanical fall resulting in a subdural hematoma that required craniotomy. She also had cardiomyopathy with significant proximal stenosis of the left anterior descending artery (LAD) and severe aortic insufficiency. Given her high-risk profile [Society of Thoracic Surgeons (STS)-predicted mortality of 10%], robotic right transaxillary approach was planned for combined AVR and CABG. The heart team determined that a transcatheter approach was unsafe based on a review of imaging and the patient's risk profile.

Case 2: robotic mitral valve replacement (MVR) with CABG

A 70-year-old frail woman with severe rheumatic mitral stenosis, moderate mitral regurgitation and single vessel coronary artery disease involving the LAD. Her history included severe COPD, prior left-sided empyema, and a BMI of 21 kg/m^2. Her STS-predicted mortality risk was 8.6%. The case was reviewed by the heart team and was deemed unsuitable for balloon valvuloplasty because of concurrent moderate mitral regurgitation. A robotic right transaxillary approach was selected for concomitant MVR and CABG.

Surgical technique

Preparation

Both patients were positioned supine with the right

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hemithorax elevated to facilitate left-sided exposure. The ipsilateral arm was suspended to optimize access. Standard anesthesia induction was performed, and a double-lumen endotracheal tube was placed for selective lung ventilation. Femoral arterial and venous cannulation were performed under transesophageal echocardiography (TEE) guidance for cardiopulmonary bypass (CPB).

Exposition

A right lateral mini-thoracotomy was performed in the fourth intercostal space, lateral to the anterior axillary line. A soft wound protector was used to maintain exposure. Three additional robotic ports were inserted and triangulated around the access port. The left internal thoracic artery (LITA) was harvested in a skeletonized fashion using robotic instruments.

Operation

Case 1: robotic AVR with CABG

Due to severe aortic insufficiency, the AVR was prioritized. An aortotomy was created, and ostial antegrade cardioplegia was administered. After valvectomy and sizing, a bioprosthetic valve was implanted using circumferential horizontal mattress sutures secured with suture fasteners. The aortotomy was then closed with a 4-0 polypropylene running suture.

Following valve replacement, attention was directed to the LAD. The left pericardium was marsupialized, tacking it to the chest wall to rotate the heart and optimize exposure. Counter-retraction sutures further improved visualization. A sharp arteriotomy was created using a No. 11 blade and extended with robotic Potts scissors. A side-to-side anastomosis was chosen to facilitate exposure. A standard running 7-0 polypropylene suture was used to complete the anastomosis. The cross-clamp was removed, and the patient was weaned from CPB with good hemodynamic function.

Case 2: robotic MVR with CABG

Following LITA harvest, the LAD was exposed using a Tentacles device inserted through the right lateral port. These suction devices were placed lateral to the LAD and pulled upward with pericardial marsupialization sutures through the left chest wall, axially rotating the heart to facilitate exposure. The aorta was then cross-clamped, and cardioplegia was administered. The LAD arteriotomy was created, and an intracoronary shunt was placed. A running 7-0 polypropylene suture was used for an end-to-side anastomosis. Following coronary revascularization, the mitral valve was robotically accessed and the heavily calcified anterior leaflet was excised. A 29-mm bioprosthetic valve was secured using interrupted horizontal mattress sutures and the left atriotomy closed. The patient was weaned from CPB with stable hemodynamics and no paravalvular leakage.

Completion

For both cases, after deairing the heart, CPB was discontinued, and protamine was administered. Temporary epicardial pacing wires were placed. Hemostasis was confirmed, and all ports and incisions were closed in layers. The patients were transferred to the intensive care unit for monitoring.

Comments

Clinical results

Both patients had uneventful recoveries. Postoperative echocardiography confirmed excellent prosthetic valve function with no paravalvular leaks. Case 1 was discharged home postoperative day (POD) 6, and Case 2 on POD 5, both in stable condition.

Advantages

This series highlights the feasibility of performing robotic concomitant valve and CABG through a right lateral transaxillary approach. This technique may provide several advantages:

- ❖ Minimally invasive: avoiding a median sternotomy reduces pain, infection risk, and recovery time;
- ❖ Enhanced exposure: marsupialization of the left pericardium and robotic assistance optimize visualization of the LAD;
- ❖ Improved precision: robotic instruments allow for meticulous dissection and anastomosis, even in high-risk patients;
- ❖ Single incision access: the right lateral approach enables simultaneous valve and coronary procedures through one incision.

Caveats

- ❖ Learning curve: robotic concomitant valve-CABG

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requires expertise in both robotic CABG and valve surgery.

- ❖ Patient selection: patients with prior right thoracotomy or severe pleural adhesions may not be suitable candidates.
- ❖ Operative time: the combined approach may initially prolong operative duration compared to isolated robotic CABG or valve surgery.

Conclusions

Robotic right lateral access may offer a viable alternative to conventional median sternotomy for patients requiring combined CABG and valve surgery. This approach facilitates LAD exposure through axial cardiac rotation, enhancing the feasibility of fully robotic concomitant coronary revascularization and valve replacement. Further multicenter experience is needed to confirm outcomes and reproducibility.

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Footnote

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Ethical Statement: The West Virginia University Institutional Review Board approved this study with waiver of consent (Protocol #2210660362).

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