Concomitant Robotic Mitral and Tricuspid Valve Repair: Technique and Early Experience

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Background. **Robotic mitral valve repair has been successfully performed since the late 1990s, but concomitant robotic tricuspid repair has not yet been widely adopted. We report our first 5 years' experience with concomitant robotic mitral-tricuspid valve repair.**

Methods. **Records were reviewed for all patients who underwent concomitant robotic mitral-tricuspid valve repair in a single practice. Cardiopulmonary bypass was performed with femoral cannulation, antegrade and retrograde cardioplegia, and aortic cross-clamping by balloon occlusion. Access was through 5 ports. Tricuspid repair techniques included De Vega, modified De Vega with annuloplasty band, and annuloplasty band with interrupted suture repair.**

Results. **From August 2006 to December 2011, 50 patients underwent concomitant robotic mitral-tricuspid valve repair. The mean age was 73.4±9.3 years, and all patients had mitral or tricuspid regurgitation grades of 2+ or greater preoperatively. Cross-clamp and cardiopulmonary bypass times decreased significantly with surgeon experience. There were no conversions to sternotomy and one conversion to mitral valve replacement. Six patients required reexploration for bleeding or hemothorax, most of them early in the series. There were no infections, no intraoperative strokes, and no new-onset acute renal failure requiring dialysis. Two postoperative strokes resolved completely. Two patients experienced nitinol clip fracture and mitral ring dehiscence requiring reoperation. There were 2 early deaths. All patients had regurgitation grades of less than 2 at follow-up ($p < 0.001$).**

Conclusions. **Combined robotic mitral-tricuspid valve repair can be performed safely and reproducibly, with acceptable early results. Long-term follow-up will be needed to establish this as an alternative to traditional sternotomy approaches.**

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Tricuspid valve regurgitation (TR) often occurs secondary to mitral insufficiency. It has been clearly established that tricuspid valve repair (TVP) should accompany mitral valve repair (MVP) when moderate TR of 2+ or greater is present [1]. It has been further proposed that tricuspid annular dilatation greater than 70 mm, even without significant TR, may be a reasonable indication for concomitant TVP [1, 2].

Since the introduction of robotic techniques for MVP (rMVP) in the late 1990s by Mohr, Chitwood, and Murphy, many surgeons have viewed the need for concomitant TVP as a contraindication for a robotic approach, primarily because of concerns related to cannulation, isolation of the right atrium, and the potential for prolonged cross-clamp and cardiopulmonary bypass (CPB) times. To our knowledge, there has been one report of concomitant rMVP and rTVP, by Jones and colleagues [3], but a combined robotic approach to treatment of mitral regurgitation (MR)-TR is not otherwise common.

Early in our experience with rMVP, we embarked on routine application of robotic techniques to treat combined MR-TR. We have used a retrospective review to evaluate our experience with the first 50 patients treated with concomitant rMVP and rTVP, including early clinical results and the evolution of our surgical techniques, with the goal of defining best practices for this novel procedure.

Patients and Methods

Expedited review and approval of this study was obtained from the Investigational Review Board at Sarasota Memorial Health Care System, and individual patient consent was waived.

Study Population

We reviewed hospital and office records and The Society of Thoracic Surgeons (STS) database to identify all

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Abbreviations and Acronyms

CPB	=	cardiopulmonary bypass
ICS	=	intercostal space
MCL	=	midclavicular line
MR	=	mitral valve regurgitation
MVP/rMVP	=	mitral valve repair/robotic mitral valve repair
PTFE	=	polytetrafluoroethylene
SD	=	standard deviation
STS	=	Society of Thoracic Surgeons
TEE	=	transesophageal echocardiography
TR	=	tricuspid valve regurgitation
TVP/rTVP	=	tricuspid valve repair/robotic tricuspid valve repair

patients on whom we had performed rMVP from the inception of our robotics program at one hospital through our current experience at a second hospital.

Preoperative Workup, Planning, Robotic System Setup, and Patient Preparation

All patients with isolated mitral/tricuspid insufficiency were considered candidates for the port-access, robotic, combined rMVP-rTVP. Patients were not excluded for prior open heart operations (other than those listed below), the need for Cox-Maze ablation, or need for atrial septal defect repair. Patients were excluded for one or more of the following reasons: mitral stenosis, prior MVP or replacements, prior TV operation, significant coronary artery disease requiring concomitant revascularization, a history of prior right chest operations, or a history of aortic dissection.

Standard preoperative evaluation included left and right heart catheterization along with surface and transesophageal echocardiography (TEE) to accurately identify all relevant cardiac pathologies and to select patients for a nonsternotomy approach. A preoperative computed tomography angiogram and digital reconstruction were used to help plan the minimally invasive operation.

Significant aortoiliac or iliofemoral peripheral vascular disease is a contraindication for peripheral cannulation and is a contraindication to a robotic approach in some centers. In such cases, our preference was to use alternate cannulation strategies, most often direct cannulation of the distal ascending aorta and standard aortic cross-clamping with femoral venous cannulation.

Operative Technique

All operations were performed using the da Vinci S Surgical System (Intuitive Surgical Inc, Sunnyvale, CA), by the same console surgeon (C.L.) and table side surgeon (R.S.). Double-lumen endotracheal tubes were placed for single-lung ventilation. Bilateral brachial arterial catheters for occlusion balloon positioning and a TEE probe for placement of all catheters were routinely used. Neck catheters included two introducers: the first for a retrograde cardioplegia catheter, and the second for a pulmonary artery vent. A 14-gauge Angiocath angiocatheter (BD Medical Franklin Lakes, NJ) was placed into the right internal jugular vein low in the neck and prepared into the operative field to provide access to the superior vena cava during later cannulation.

Five ports were created in the right chest wall (Fig 1). Three 8-mm ports in the second, sixth, and fifth intercostal spaces (ICSs) were created for the robot's left, right, and third (retractor) arms. A 12-mm camera port was placed in the fourth ICS just lateral to the midclavicular line (MCL), and a 2-cm working port 2 cm lateral to the camera port in the same fourth ICS allowed for a totally endoscopic "CO_2 tight" approach. Three long, 14F angiocatheters were placed for retraction of the pericardium; one each in the second and sixth ICS along the anterior axillary line and the third in the sixth ICS at the MCL for retraction of the right diaphragmatic central tendon, when necessary.

A 4-cm oblique incision was made in the right groin to allow access to the femoral artery and vein. All cannulas were placed in the groin using a Seldinger technique under TEE guidance, through Prolene purse strings (Ethicon, Somerville, NJ). A 25F femoral venous catheter was placed in the right femoral vein and advanced into the superior vena cava under TEE guidance. A 23F arterial cannula with a side arm for the aortic occlusion balloon was placed into the right femoral artery and the occlusion balloon advanced into the ascending aorta under TEE guidance. A 15F femoral arterial cannula (Medtronic Inc, Minneapolis, MN) was placed over a guidewire into the superior vena cava through the right internal jugular vein angiocatheter and extended into the venous circuit using a Y connector. We did not perform special monitoring for leg ischemia. When the right femoral artery was too small to accommodate a 23F catheter, a bilateral approach was used with a 19F balloon introducer placed in the right femoral artery and

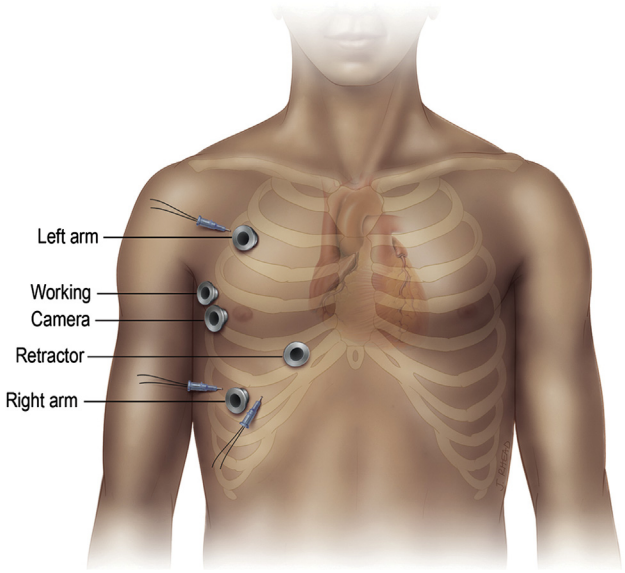

Fig 1. Schematic illustration shows placement and functional use of ports in concomitant robotic tricuspid valve and mitral valve repair.