How-to-do-it

Early experience with robotic aortic valve replacement

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Abstract

We report our initial experience with aortic valve replacement using robotic assistance. All procedures were performed with peripheral cardiopulmonary bypass, transthoracic aortic cross-clamp, and antegrade cold crystalloid cardioplegia. One or two ports and a 5-cm intercostal incision in the right chest were used for access. All patients had aortic valve replacement performed robotically. Between February and September 2004, five patients underwent robotic aortic valve replacement. The mean age was 59 years (range 35–82 years). There were no incisional conversions, death, stokes, or reoperations for bleeding. Overall mean study times were as follows: procedure, 231.2 min (range 180–315 min); cardiopulmonary bypass, 121.5 min (range 83–173 min), and cross-clamp, 98.2 min (range 67–140 min). One patient developed postoperative pneumonia. Aortic valve replacement can be successfully performed with the da Vinci robotic system.

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1. Introduction

Minimally invasive endoscopic operative techniques are used widely in a variety of surgical disciplines, and are slowly being applied in cardiac surgery. Recently, a new generation of surgical telemanipulation systems has allowed surgeons to perform robotically assisted, coronary artery bypass grafts [1], patent ductus arteriosus closure [2], atrial septal defect closure [3], mitral valve repair and epicardial ablations for treatment of atrial fibrillation [4]. If this procedure has become routine in mitral valve repair no cases of aortic valve replacement has been yet reported. The purpose of this study was to demonstrate the feasibility of performing aortic valve replacement (AVR) in adults using a robotically assisted surgical system.

2. Material and methods

2.1. Patients

Between February 2004 and September 2004, five adults underwent robotically assisted aortic valve replacement. These patients were operated after institutional review board approval and informed consent. The patients comprised three men and two women, with a mean age of 59±20 years (range 35–81). Four patients had calcified aortic stenosis and one older patient had aortic insufficiency.

2.2. Surgical technique

After systemic heparinization the right femoral vessels were cannulated with a 21 F cannula in the vein, and a 17 F cannula in the artery. Additionally, a 17F wire-bound cannula was inserted in the right internal jugular vein for optimal drainage as with one venous cannula the total calculated flow could not be reached. Cardiopulmonary bypass was instituted and cooling to 28°C rectal temperature was obtained. A 4.5-cm anterior incision was made in the right third or fourth intercostal space, the exact location was determined according to a preoperative gated CT scan (Fig. 1). A 30° angled camera was placed through the anterior aspect of the incision. Two ports were placed, one in the second intercostal space mid axillary and one in the fifth or fourth intercostal. The heart was arrested with cold crystalloid cardioplegia in the aortic root, and a cold saline irrigation was maintained in the pericardium. A left ventricular vent was positioned through the right upper pulmonary vein. The ascending aorta was cross-clamped with a transthoracic aortic cross-clamp and the aorta was retracted with sutures. The annulus was exposed by placing three sutures at each commissure. The da Vinci™ Surgical system (Intuitive Surgical, Inc., Sunnyvale, CA, USA) was used to excise the valve and to place 12 stitches of 2/0 Ethibond pledgets sutures (Ethicon, Somerville, NJ, USA) on the annulus, and to close the aortotomy. Calcified debris was removed with irrigation placed through the aortotomy. All the sutures were placed on the annular prosthesis before it
was lowered in place, and all knots were secured with a knot pusher. De-airing was done through the ascending aorta.

3. Results

There was no mortality and no procedure-related morbidity. The mean cardiopulmonary bypass time was $121.5 \pm 37.5$ min and the cross-clamp time of $98.2 \pm 30.4$ min. The mean length of stay in the intensive care unit was $1.8 \pm 2$ days, and the mean length of stay was $8.6 \pm 3$ days. Pain was controlled with a morphine drip used for the first 48 h which was then relayed by per os medication.

4. Discussion

Our technique reported here shows a simple approach to AVR with robotic assistance which is similar to conventional surgery.

A number of incisions have been described to approach the aortic valve, J or L with partial sternal splitting or a mini thoracotomy in the right second intercostal space [5-8]. Comparing with other type of mini incision we have noticed in our limited experience that patients experienced incisional pain only in the first day’s postoperative (Fig. 2). The patients described in this series seemed to regain upper extremity mobility quicker with reduced pain, and there was no discomfort due to sternal splitting as can be felt in the costal cartilages or in the scapulas. The cosmetic approach is different between male and female. In the male we perform the skin incision over the site of thoracotomy whereas in the female the incision is made under the breast. We also did not experience any problems due to femoral cannulation as we used a seldinger technique without vessels clamping, and we therefore maintained flow to the leg during all the procedure. ICU and in-hospital stay are rather long, as this is our early experience we preferred to keep patients in the hospital until they were adequately anticoagulated.

This early experience of combining robotic assistance and a mini thoracotomy is a first step toward total endoscopic aortic valve replacement.

References