Robotic septal myectomy for hypertrophy cardiomyopathy

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Clinical vignette

A 65-year-old man presented with symptomatic hypertrophic cardiomyopathy (HCM). The resting pressure gradient over the left ventricular outflow tract was 68 mmHg. There was preserved left ventricular function with an ejection fraction of 68%, with thickened septal muscle and severe mitral regurgitation due to systolic anterior motion (SAM). He underwent alcohol injection into the septal branch of the left anterior descending artery twice with an unsatisfactory result, as the septal branch artery was small. A high pressure gradient over the left ventricular outflow tract and severe mitral regurgitation remained. The patient was scheduled for a robotic myectomy and mitral repair. After surgery, the gradient decreased to 6 mmHg and there was no mitral regurgitation. He was discharged 7 days post-surgery.

Surgical technique

Preparation

After anesthesia with a single lumen endotracheal tube, the patient was placed in supine position with the right chest elevated. Peripheral cardiopulmonary bypass was established under echocardiography guidance. The 3-cm working port was placed in the 4th intercostal space around the right anterior axillary line. The right arm was inserted into the 6th intercostal space and the left arm into the 3rd intercostal space (1). The atrial retractor was inserted into the 4th intercostal space. A cardioplegic needle and aortic cross-clamp were inserted through the working port, and antegrade cardioplegic solution was delivered. Standard left atrial approach was adopted, with an incision through Sondergaard's plane (2).

Operation

After exposing the mitral valve by lifting the left atrium with a dynamic atrial retractor, the valve was inspected, and the anterior leaflet size measured. Next, the anterior leaflet was taken out from commissure to commissure to expose the septum behind the mitral valve. The aortic valve was inspected to avoid injury to it and the conduction system. The hypertrophied muscle was recognized via the jet lesions on the myocardial surface. A stay suture was used to assist in the extraction of the hypertrophied septum, and then the hypertrophied muscle was removed using robotic scissors. The depth of incision was estimated using the length of the robotic scissors. The hypertrophied muscle can be taken out from the septum behind the mitral valve to the apical portion if necessary. After complete removal of the hypertrophied muscle, the anterior leaflet was reattached to the annulus and extended with a bovine pericardium patch. Finally, the left atrial incision was closed, and the patient was weaned from cardiopulmonary bypass. The post-operative transesophageal echocardiography showed that the left ventricular outflow tract was opened with a maximum pressure gradient less than 10 mmHg and without mitral regurgitation.

Comments

Clinical results

From 2012 to 2019, a total of 18 adult HCM patients with concomitant severe mitral regurgitation and SAM of the mitral valve underwent robotic surgical treatment at the National Taiwan University Hospital. Hypertrophied muscle included the diffuse type in 5 patients and mid-ventricular type in 8 patients, all of whom had more than grade III mitral regurgitation and with a mean pre-operative intraventricular pressure gradient of 69±14.2 mmHg. There was no surgical mortality or surgical conversion. The mean operation time was 237.5±22.4 minutes. After surgery, all patients had mitral regurgitation of less than grade II, and the mean pressure gradient was reduced to 1.5± 2.6 mmHg (3). Reasons for the success of the procedure in eliminating both the pressure gradient over the left ventricular outflow tract and mitral regurgitation include, firstly, the extended myectomy. The hypertrophied muscle and jet lesions can be clearly identified. A wider myectomy can be performed through the submitral area, which gives the surgeon a better view towards the whole septum and apex. Secondly, anterior leaflet patch augmentation not only augments the anterior leaflet, but also increases the aorto-mitral angle. Furthermore, during the systolic phase, the patch distends towards the left atrium, which further widens the outflow tract. Using this patch, the mitral coaptation area increases in size and eliminates mitral regurgitation.

Advantages

While the strategy of using a small incision that does not interfere with thoracic cage integrity provides potential benefits such as reduced surgical trauma and blood loss, decreased intensive care and overall length of stay (3,4), a totally endoscopic approach with robotic assistance offers the surgeon greater flexibility in complex surgical procedures. Using robotic trans-mitral myectomy, the surgeons can clearly see the whole septum after taking down the anterior leaflet. This approach can also be used in patients with an abnormal sub-mitral apparatus that obstructs the outflow tract, as in the instance of abnormal papillary muscle and chordae insertions.

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Caveats

Understanding the minutia of the robotic approach is of utmost importance, with the most important element of all being safety. Surgeons should be familiar with the differences between small incision surgery and conventional surgeries before adopting the robotic approach.

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Footnote

Conflicts of Interest: Both authors have no conflicts of interest to declare.

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