Transapical Beating Heart Mitral Valve Repair

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Repair of mitral valve (MV) leaflet prolapse using chordal replacement is an established procedure in open heart surgery for the treatment of mitral regurgitation (MR). The technique has proven high reproducibility and excellent long-term outcomes for posterior leaflet prolapse, with freedom from valve-related reoperation of >95%. Striving toward a less-invasive treatment for structural heart disease, the concept of transapical beating heart chordae replacement for MV repair using the NeoChord DS1000 device (NeoChord Inc; Minnetonka, Minn) has been introduced and proven in acute and chronic animal studies. The rationale of this approach is to imitate native valve anatomy by replacing ruptured or elongated chordae tendineae of the MV that cause prolapse of the MV leaflet with subsequent MR. The aim of this report is to elucidate this new therapy while presenting our initial experience with this procedure in humans.

New Therapy

Patient Screening
The primary selection criteria, including morphological characteristics of patients, are (1) severe MR, (2) presence of symptoms, (3) isolated prolapse of the posterior leaflet in the P2 segment (Carpentier classification type II), (4) no or only mild annular dilatation, and (5) no additional cardiac pathology with an indication for concomitant procedures.

Patient
The patient was a 62-year-old woman with posterior leaflet prolapse due to degenerative MV disease causing severe MR (grade 3+). Clinical examination was normal, and medical history was empty. The patient was in New York Heart Association functional class II to III heart failure. Intraoperative transesophageal echocardiography (TEE) verified the isolated prolapse of the posterior mitral leaflet in the P2 segment due to chordae rupture (supplemental Video 1). The mitral annulus was normal (39 mm).

NeoChord Device
The NeoChord DS1000 device has 3 important features: (1) a grasping mechanism to catch the respective prolapsing leaflet segment; (2) a device monitor based on fiber-optic technology that allows for confirmation of successful grasping; and (3) a semidull needle to puncture the leaflet, to anchor the neochord to the leaflet, and to retract the neochord extracardially (Figure). A standard polytetrafluoroethylene (Gore-Tex; WL Gore & Associates Inc, Flagstaff, Ariz) is used.

Operative Approach
With the patient under general anesthesia, a transapical access to the MV was established using a left-lateral minithoracotomy in the sixth intercostal space through a small incision (5 cm). Two purse-string sutures were placed on the apex in standard fashion. TEE was used intraoperatively to guide the procedure. The device was introduced into the beating heart and advanced through the MV into the left atrium (supplemental Video 2). After opening of the 2 jaws on the very tip of the device, the posterior leaflet was grasped on the beating heart while gently lifting the posterior mitral leaflet on the proximal jaw and pushing toward the posterior annulus. The jaws then were closed, and adequate tissue grasping was confirmed with the device monitor. The needle was advanced through the leaflet and retracted after “hooking up” the 4-0 Gore-Tex suture. After retracting the device, a girth hitch knot was tied and fixed to the prolapsing segment. The implantation procedure was repeated 3 times, with distribution of 3 neochordae to the prolapsing P2 segment (supplemental Video 3). The proper neochord length was then determined with TEE guidance during normal physiological stress (ie, beating heart). After evaluation of the final repair result, the neochordae were subsequently secured to the left ventricular apex over an additional felt pledget using a French eye needle. Final evaluation with TEE showed no evidence of prolapse and MR (supplemental Video 4). The patient was extubated 1 hour after the procedure and had an overall uneventful postoperative course.

Conclusions
We present our initial clinical experience with the new therapeutic concept of transapical beating heart MV repair with implantation of neochordae. This successful case shows that the concept and approach are feasible and safe for isolated P2
prolapse. However, special consideration needs to be given to the number and length of neochordae to correct the prolapse. To our understanding, the application of this novel technique is another step toward full percutaneous MV repair.

Disclosures
None.

References

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