Off-pump transapical neo-chordae implantation

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Clinical vignette

A 61-year-old female patient presented with isolated posterior mitral leaflet (PML) prolapse due to degenerative mitral valve (MV). Preoperative transthoracic echocardiography confirmed severe mitral regurgitation (MR) and isolated prolapse of the P2 segment. The patient was in New York Heart Association (NYHA) functional class II to III. Her left ventricular function was good with an ejection fraction of 66%, the tricuspid annular plane systolic excursion (TAPSE) of 25 mm, a mitral annulus of 42 mm, anterior mitral leaflet (AML) length of 29 mm, PML length of 22 mm, vena contracta of 0.7 cm, and effective regurgitant orifice area (EROA) of 1.2 cm^2. Medical history included right lung surgery via thoracotomy for lung cancer with chemotherapy in 1982, arterial hypertension and status post hysterectomy in 2002.

Surgical techniques

Selection criteria for patients suitable for off-pump transapical neo-chordae implantation include morphological characteristics such as severe MR, presence of symptoms, isolated prolapse of the posterior leaflet in the P2 segment, minimal or no mitral annulus dilatation and no indication for additional procedures. In brief, the NeoChord DS1000 device (NeoChord, Inc., Minneapolis, Minnesota, USA) enables implantation of neo-chordae using polytetrafluoroethylene sutures (Gore-Tex; WL Gore & Associates Inc, Flagstaff, Arizona, USA) to MV leaflets. It has three essential features: (I) an adjustable-gripper-like tip with two jaws to catch the prolapsing leaflet; (II) a fiberoptic technology with a device monitor allowing confirmation of successful leaflet grasping; (III) a semi-dull needle to puncture the leaflet, to anchor the neo-chordae to the leaflet, and to retract the neo-chordae extracardially (1,2).

For the procedure, a standard anesthetic preparation of the patient is necessary. The NeoChord procedure is performed under 2-dimensional and 3-dimensional transesophageal echocardiographic guidance. First, a so-called safety net is installed by implanting an arterial and venous sheath in the groin, in case of need for cardiopulmonary bypass. Subsequently, a left-lateral minithoracotomy in the 5^{th} or 6^{th} intercostal space with an incision length of about 4 to 5 cm is performed. The left ventricular apex is exposed and temporary pacemaker wire is applied. Two purse-string sutures are placed on the apex in a standard fashion followed by NeoChord DS1000 insertion. The expandable jaws are used to capture and control the prolapsing posterior leaflet. The PML leaflet grasping is performed by directing the jaws towards the flail segment of the leaflet under echocardiographic control. Effective leaflet capture is confirmed by observing the fiberoptic monitor lights changing from red (blood pool) to white (leaflet tissue). Next, the leaflet is penetrated with the semi-dull needle with subsequent retrieval of the polytetrafluoroethylene suture. After retrieving the suture and complete retraction of the device, a girth hitch knot is tied, passively moved towards the leaflet edge and eventually locked to the leaflet. In this case, we placed three sutures to achieve a competent MV. After the implantation the operative result is controlled with transesophageal echocardiography. As the final step of the procedure, the neo-chords are secured under proper tension, to the apex with additional felt pledgets. The final operative result is confirmed with echocardiography. A chest tube is inserted and the pericardium and left lateral mini-thoracotomy are

closed in a standard fashion.

Comments

Recently published data in the Transapical Artificial Chordae Tendinae (TACT) trial included 30 patients who were enrolled in seven different centers. The trial showed in 86.7% of patients, at least one neo-chord implantation with subsequent reduction of severe MR to mild MR. There were two major adverse events—one death and one minor stroke. Overall, four patients needed standard MV repair due to technical or patient specific reasons. Four patients developed recurrent MR and needed open MV repair during their 30-day follow-up (3). Long term follow-up data is yet to be published. However, the very first successful human applications have been followed up and no MR has been found three years after surgery (Leipzig data).

There are six crucial steps to perform a successful neo-chord implantation: (I) grabbing sufficient segments of the prolapsed leaflet; (II) fixation of the neo-chordae to the leaflet edge; (III) sufficient distribution of the neo-chordae along the prolapsed leaflet; (IV) the right length and tension adjustment; (V) result assessment by echocardiography; and (VI) through echocardiographic guidance is necessary throughout the procedure (1,4).

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Conclusions

Off-pump transapical implantation of neo-chordae to correct severe MR is technically safe and feasible, however further clinical experience for efficacy and durability are warranted.

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