

Sub-valvular repair of ischemic mitral regurgitation in a patient with severe tethering of mitral leaflets

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Clinical vignette

A 61-year-old male presented with a six-month history of dyspnea [New York Heart Association (NYHA) Class III-IV]. He had a myocardial infarction three years previously. His comorbidities included claudication due to a right iliac artery stenosis.

His transthoracic (TTE) and transesophageal (TOE) echocardiograms diagnosed ischemic mitral regurgitation (MR): the left ventricular (LV) end-diastolic diameter was 7.1 cm and the ejection fraction (EF) was 30%. The apex was dyskinetic while the anterior and inferior mid-segments were hypokinetic. A severe central jet of MR due to tethering of both leaflets (tenting height 16 mm) was identified. The 'seagull sign' due to anterior leaflet restriction by secondary chordae from the posterior papillary muscle (PPM) was noted. Coronary angiography showed occluded left anterior descending (LAD) and right coronary arteries. Cardiac magnetic resonance (CMR) confirmed the TOE findings and showed evidence of a transmural scar on the inferior wall.

Patient selection

This patient was referred for coronary artery bypass graft (CABG) and mitral valve surgery on prognostic and symptomatic grounds. He was unsuitable for undersized annuloplasty repair due to the extent of leaflet tethering and the high risk of early recurrent MR (1-3). Given the poor LV and integrity of the mitral leaflets, mitral replacement

was discarded and a sub-valvular apparatus repair was undertaken.

Surgical technique

Preparation

To perform a tailored repair of the sub-valvular apparatus, it is critical to evaluate the displacement of the PPM in three dimensions (inferior, posterior and lateral) and the consequent effect on each mitral leaflet. If the MR jet is eccentric, the PPM displacement affects the posterior leaflet more than the anterior. In this case, PPM repositioning could be sufficient to correct the MR. If the MR jet is central, intervention on the anterior leaflet as well achieves better results. This involves transposition of the secondary chordae responsible for the 'seagull sign' to the primary position with a 'cut and transfer technique'.

If a scar is identified on the inferior or lateral walls on CMR, a longitudinal plication reduces the LV diameter and distance between the PPM and mitral annulus, further relieving leaflet tethering. A non-undersized, complete, semi-rigid annuloplasty ring is implanted to stabilize the repair and prevent further dilatation.

Exposure

After mid-sternotomy, the left internal mammary artery (LIMA) was harvested and cardiopulmonary bypass instituted at 32 °C by cannulation of the ascending aorta

and both venae cavae with angled cannulae. Carbon dioxide was insufflated into the pericardium at 3 L/min. Two tapes were passed through the oblique and transverse sinuses to displace the heart.

Once the aorta was cross-clamped and antegrade cold blood cardioplegia was given, the LIMA was anastomosed to the mid portion of the LAD. Subsequently, the inferior wall of the heart was exposed and the transmural scar was identified and plicated longitudinally using 2-0 polypropylene reinforced with three pieces of Teflon felt.

Both venae cavae were then snared and a Guiraudon approach to the mitral valve was performed. The right atrium was incised parallel to the atrio-ventricular groove and the inter-atrial septum was incised vertically at the fossa ovalis. Both the septal and right atrial incisions were extended to meet at the left atrial roof between the superior vena cava and aorta.

Operation

The mitral valve was exposed by suspending the upper edge of the left atrial incision with pledgeted 4-0 Ethibond stitches and passing all the 2-0 Ethibond stitches for the annuloplasty. Mitral scallops were assessed to exclude any hidden defect.

The lengths of the chordae of the PPM inserting into the anterior and the posterior leaflets were evaluated. Secondary chordae restricting the movements of the anterior leaflet were severed at their insertion on A2 and reimplanted on the free edge of A2 using 5-0 polypropylene ('cut and transfer' procedure).

PPM relocation was performed: 4-0 Gore-Tex reinforced with two pericardial pledgets was stitched through the base of the PPM and tied, with both strings passed through the mitral annulus at the anterior commissure. A Sorin Memo 3D (Sorin, Saluggia, Italy) size 30 annuloplasty ring was then implanted with an inter-trigonal distance of 30 mm.

The Gore-Tex stitch was also passed through the annuloplasty ring. With the ring tied down, the repair was tested with different lengths of the Gore-Tex stitch. This was eventually tied once the correct length, which resulted in no residual MR, was identified.

The left and right atrial incisions were closed using 3-0 Prolene, the heart was de-aired and the cross-clamp removed.

Conclusions

Once cardiopulmonary bypass was discontinued, the

mitral repair was evaluated by TOE while maintaining a mean blood pressure ≥ 90 mmHg and a pulmonary wedge pressure ≥ 15 mmHg, aiming to achieve less than mild residual MR and a tenting height < 8 mm. In this case, the residual MR was trivial and the tenting height reached 6.7 mm. Mitral leaflets regained their natural convexity and the 'seagull sign' on the anterior leaflet disappeared. This achieved a more physiological shape than the typical 'mono-leaflet' valve obtained with an undersized annuloplasty (4).

Comments

Clinical results

The postoperative course was uncomplicated: the patient was extubated on postoperative day 1 and discharged on day 7. Six weeks later, the NYHA Class was II and a repeated CMR and TTE showed trivial MR and an improved EF (35%). Six-month and one-year NYHA Class were stable, as were the TTE findings.

Advantages

This technique allows mitral replacement to be avoided in patients with ischemic MR and severe leaflet tethering, a cohort otherwise deemed unsuitable for undersized annuloplasty given the high risk of repair failure (1-3). Two-year results on 49 patients who underwent mitral repair with our technique have been recently published (5).

Caveats

The main concerns with this technique include the following:

- (I) There is a lack of long-term results from a large cohort, especially regarding survival, repair durability and LV function remodeling, to enable a meaningful comparison with undersized annuloplasty or mitral replacement;
- (II) The method for combining these three sub-valvular techniques is based on preoperative imaging and intraoperative findings, but there is no objective measure to guide this visually-based decision, except for the direction of the MR jet. This also applies to the length of the Gore-Tex stitch;
- (III) Depending on the size of the mitral annulus and the LV, the subvalvular apparatus is not always easily accessible, requiring more expertise and

cross-clamp time compared to performing an undersized annuloplasty.

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References

1. McGee EC, Gillinov AM, Blackstone EH, et al. Recurrent mitral regurgitation after annuloplasty for functional ischemic mitral regurgitation. *J Thorac Cardiovasc Surg* 2004;128:916-24.
2. Krishnaswamy A, Marc Gillinov A, Griffin BP. Ischemic mitral regurgitation: pathophysiology, diagnosis, and treatment. *Coron Artery Dis* 2011;22:359-70.
3. Calafiore AM, Di Mauro M, Gallina S, et al. Mitral valve surgery for chronic ischemic mitral regurgitation. *Ann Thorac Surg* 2004;77:1989-97.
4. Green GR, Dagum P, Glasson JR, et al. Restricted posterior leaflet motion after mitral ring annuloplasty. *Ann Thorac Surg* 1999;68:2100-6.
5. Cappabianca G, Bichi S, Patrini D, et al. Cut-and-transfer technique for ischemic mitral regurgitation and severe tethering of mitral leaflets. *Ann Thorac Surg* 2013;96:1607-13; discussion 1613.

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