Work in progress report - Valves

Preliminary experience with the no prolapse system. A new device for ensuring the proper length of artificial chordae in mitral valve repair

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Abstract

Mitral valve repair is the procedure of choice to treat mitral valve regurgitation. However, the feasibility and durability of repair are influenced strongly by the valve pathology. The classic features of degenerative mitral valve disease include leaflet prolapse and annular dilatation. Risk of repair failure is increased by isolated anterior leaflet prolapse or bileaflet prolapse. A variety of techniques have been used to treat this pathology. The most popular include partial leaflet resection, chordal shortening, chordal transfer and chordal replacement. Use of artificial chordae with expanded polytetrafluoroethylene (e-PTFE) sutures is a well-known technique for mitral valve repair and long-term data validate this approach. The primary challenges with this technique are judging the proper length of the neo-chordae and tying the PTFE. Several different techniques have been proposed to solve these items but none of the established are very satisfactory. I describe a preliminary experience with a new device to determine the correct length of the neo-chordae and tying the knots without sliding in ten patients with severe mitral insufficiency referred for mitral valve repair.

Keywords: Mitral valve; Mitral valve repair; Sutures

1. Introduction

Today mitral valve repair is considered the procedure of choice to treat mitral valve insufficiency. However, pathology varies considerably and influences the complexity of repair. The repair of the posterior leaflet is routinely performed in many centers with good results but anterior leaflet (AL) prolapse is less common and is more surgical demanding. The most popular techniques to treat AL prolapse are the partial leaflet resection, the chordal transfer, the chordal shortening and the chordal replacement. Chordal replacement with expanded polytetrafluoroethylene (e-PTFE) has gained increasing popularity because of its availability and long-term durability [1–3]. The main challenges with chordal replacement are the determination of its appropriate length as well as tying without knot slipping. In this preliminary study, I describe a new surgical device that ensures the correct length of new mitral chords and helps the surgeon to repair AL prolapse.

2. Methods

2.1. The no-prolapse system

The no-prolapse system (Labcor Laboratorios, Belo Horizonte, Brazil), is a simple device with two separated pieces; the T-shape component and the Arch component. Both are made entirely of polycarbonate. The Arch component presents a major hole in its middle portion that permits it to be mobile along the long arm of the T-shape component. Both components have multiple holes along their structure (Fig. 1) to facilitate the fixation with sutures.

The Goretx chords are placed in situ as usual technique; first anchoring the neo-chordae in the head of papillary muscle and then passed through the free edge of the prolapsing scallops of the AL. Both arms of the suture are left untied. Remodeling annuloplasty is performed. The no-prolapse device is placed on the top of the prosthetic ring and fixed with three temporary sutures (5-0 polypropylene) at both the commissural level and central point of posterior annulus. The AL is then fixed with two or more temporary sutures (5-0 polypropylene) to the Arch component of the device (Fig. 2). Now, the no-prolapse device holds the mitral leaflet in the proper plane of coaptation and the new artificial chordae exactly matches the normal chordae in length. Then, we knot the neo-chordae carefully (Video 1).

The use of the no-prolapse device permits the surgeon to avoid both the overtightening and the undertightening of the artificial chords because the device itself is a mechanical barrier and stops the finger of the surgeon when he/she ties every knot without tension or traction on the papillary muscles and the AL.
Fig. 1. The no-prolapse device (Labcor Laboratorios, Belo Horizonte, Brazil), is made of two separated components; the T-shape and the Arch. Both pieces are made entirely of polycarbonate. The Arch component presents a major hole in its middle portion that permits it to be mobile along the long arm of the T-shape component. Both components present multiple holes along their structure.

Fig. 2. The no-prolapse device is located and fixed on the top of the prosthetic ring with three temporary sutures (5-0 polypropylene) at both commissural level and central point of posterior annulus. The anterior leaflet is then fixed with two or more temporary sutures (5-0 polypropylene) to the Arch component of the device. Then, we knot the neo-chordae carefully.

3. Results

Operations were performed by a single surgeon. For isolated AL prolapse involving A2, two artificial chordae were used. For extensive prolapse (A1, A2 and A3) a range of 4–6 chordae were necessary. In addition, when posterior leaflet prolapse was involved, triangular resection of P2 was used. Mitral annuloplasty with prosthetic ring was performed in all cases.

Tricuspid annuloplasty was added in nine patients. Cross-clamp times ranged from 73 to 94 min.

Trivial MR or less was demonstrated during intraoperative transesophageal echocardiography (TEE) after separation of cardiopulmonary bypass. There were no operative deaths and all patients were discharged on postoperative day 8. There have been no recurrences of MR during early follow-up. After 6 months postoperative echocardiography (ECHO) showed no significant regurgitation and all patients were in New York Heart Association (NYHA) functional class I–II.

4. Discussion

The depth and the length of the contact surface of the mitral leaflets during systole are critical to functional competence of mitral valve. Primary chordae ensure that the contact surfaces of the leaflets coapt without leaflet prolapse or flail. Under normal conditions, the coaptation point of the mitral valve leaflets in systole practically reaches the level of the mitral annulus.

Since the introduction of artificial e-PTFE sutures as a chordal substitute, repair of AL has become an established technique with good long-term results [4]. Nevertheless, the main challenge with chordal replacement is the determination of its appropriate length.

A neo-chordae that is too short result in a restricted leaflet motion and a neo-chordae that is too long will be ineffective in controlling leaflet prolapse. Several methods to ensure the optimal length of the artificial chord have been reported. Use a normal non-prolapsing segment of posterior leaflet as a reference point, repair of AL has become an established technique with good long-term results [4]. Nevertheless, the main challenge with chordal replacement is the determination of its appropriate length.

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I propose a simple device (no prolapse-system) that fixes the prolapsed AL of the mitral valve to the mitral annulus. At this level the length of the artificial chordae matches perfectly the papillary-annulus distance.

The device also prevents overtightening of the chordae because the Arch component prevents the pulling of the papillary muscle up to the valve when you have tied every knot.

This device is best applied in patients who require bi-leaflet repair including those with extensive AL prolapse. This technique is simple and reproducible and is adaptable to any type of the commercially available annuloplasty rings.

We believe that our technique has a much higher reproducibility compared with other techniques and provides a simple tool to repair complex cases with very good results.

References


