How-to-do-it
Homemade expanded-polytetrafluoroethylene flexible mitral annuloplasty ring

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Abstract
A homemade mitral annular prosthesis has been developed using expanded-polytetrafluoroethylene material. It is safe in that it avoids the risk of prosthesis wrinkle when stitches are tied. Simultaneously, it is strong enough to prevent future stretching and rupture. This device has been implanted in 60 patients with good and stable results at 42 months of follow-up. Our flexible mitral annular prosthesis is cost-effective and easily available in developing countries.

Keywords: Mitral valve repair; Mitral annular prosthesis

1. Introduction
As the cost of the health care in developing countries increases, a cost-effective strategy may become more demanding. In this way, the purpose of this study is to describe a surgical technique for fashioning a homemade flexible mitral annular prosthesis using a polytetrafluoroethylene (PTFE) vascular graft and to evaluate its intermediate results.

2. Technique
Our flexible mitral annular prosthesis is fabricated in two steps intra-operatively. First step, before the aortic clamping, a PTFE vascular graft of length 10 cm and diameter 5 mm is folded along its long axis and held in that position by clips (Fig. 1). In this way, a flat strip of breadth 4 mm is formed of four layers of PTFE. Second step, after the aortic clamping and the repair of the mitral valve leaflet are achieved, our flexible mitral annular prosthesis is tailored to the length of the curvature of a well-fitted Carpentier Edwards1 sizer where excess length is cut out. Our flexible mitral annular prosthesis is fixed to the posterior native mitral annulus from one trigone to the other using U-stitch interrupted sutures after removing the clips (Fig. 2). We recommend to use 4-0 braided polyester suture and to perform seven knots for each U-stitch in order to avoid suture unknotting. All the patients were anticoagulated for two months post-operatively (I.N.R. = 2).

3. Patients and results
Our flexible mitral annular prosthesis has been systematically used in our institution from 1999 till now. The first 60 consecutive patients (1999—2001) operated for severe mitral regurgitation (MR) were prospectively assessed. We performed 50 quadrangular resections of the posterior leaflet, 14 artificial chordae implantations, 4 chordae transpositions, 3 posterior annular decalcifications and 2 Alfieri repairs. The hospital mortality was 3.2% (one adult respiratory distress syndrome and one stroke). One patient (1.6%) required immediate mitral valve replacement for systolic anterior motion.

Clinical and echocardiographic follow-up ranged from 24 to 50 months (mean = 42 ± 11 months). There were two late deaths (3.4%). Forty-eight patients (83%) were asymptomatic (NYHA class I); 7 (12%) were in NYHA class II and 1 (1.7%) was in NYHA class III (ischemic cardiomyopathy). There was no re-operation in the follow-up. Transthoracic echocardiographic findings were as follows: no MR in 20 patients (36%), trace MR (<+1) in 24 patients (43%), +1 MR in 10 patients (17%) and +2 MR in 2 patients (3%). Mean transmitral pressure gradient was 3.6 ± 0.7 mmHg.

4. Comment
Various PTFE mitral annular prostheses have been described [1–3]. PTFE is a highly flexible material that conforms to the native annulus and is strong enough to prevent future annular dilatation. Chang et al. [1] used PTFE
vascular prosthesis of diameter 3 mm. In this approach, the prosthesis has only two layers of PTFE. Good long-term results in this study prove that PTFE used is strong enough to resist longitudinal traction. Unfortunately, two layers of PTFE are not tough enough to avoid the wrinkle of the prosthetic ring when knots are tied. So there is a risk that the implanted prosthetic ring becomes shorter than the suitable size when knots are tied. This technique does not result in a measured plication of the posterior annulus. Furthermore, the plication of the posterior annulus varies depending on the tension that the surgeon places on individual sutures. If excessive tension is placed on the sutures, the posterior annulus can be overreduced [2]. Roux et al. [3] reported a very low-cost PTFE annular prosthesis in which the PTFE vascular graft used is strengthened with stainless steel wire. In this approach the prosthesis does not wrinkle when tying the U-stitch sutures, but it is a rigid prosthesis and all the reported advantages of annular flexibility [4] are lost. Our flexible mitral ring, being formed out of four layers of PTFE, is relatively stiff to avoid horizontal wrinkling and shrinkage when knotting the U-stitch sutures (Fig. 1). This phenomenon has been noticed in all cases as an intra-operative finding. Our flexible mitral annular prosthesis is resistant to longitudinal traction in that it does not stretch out and thus provides annular stability and contributes to better prevention of future annular dilatation. We have not reported any rupture of our flexible mitral annular prosthesis in the follow-up. Simultaneously, our flexible mitral annular prosthesis is flexible enough in the plan of the mitral annulus (Fig. 2), thus retaining all the reported advantages of mitral annulus prosthesis flexibility.

Furthermore, in France, the PTFE vascular graft used in our series costs 200 USD. In contrast, a commercially available mitral ring costs in average 1000 USD.

It has been reported [5,6] that the stability of mitral valve repair with annular ring prosthesis is significantly better than that of mitral valve repair with a simple suture line for reduction of the posterior annulus without prosthetic ring. Our results are similar, in terms of residual MR, transmitral gradient and re-operation, to those of the series reported using commercialised annular ring prosthesis [7,8].

Our homemade mitral annular prosthesis is cost-effective, flexible and without the risk of wrinkle in the suture line. It is a safe alternative to other commercial rings, in particular in developing countries.

References