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Case Report

Mitral Valve Re-repair After Late Rupture of Expanded Polytetrafluoroethylene Neochords

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Mitral valve chordae replacement using expanded polytetrafluoroethylene (ePTFE) GORE-TEX sutures (W.L. Gore & Associates Inc, Newark, DE) has enabled durable repair strategies that "respect rather than resect" the native leaflet tissue.[1,2] This nonabsorbable monofilament suture material is flexible, pliable, and resistant to degeneration.[1] As such, there are few isolated cases of ruptured ePTFE neochords. We describe a case of late rupture of CV-5 ePTFE neochords with successful re-repair.

Novel Teaching Points

- Neochord rupture may be attributed to previous chest trauma and degenerative factors.
- Tensile strength consideration should be a factor for determining suture calibre for neochord insertion during mitral valve repair to reduce risk of rupture.
- Most reports of ruptured neochords involve subsequent mitral valve replacement, but re-repair strategies should be given a greater focus.

Case

A 60-year-old man was admitted to our hospital with heart failure following 2-weeks of progressive dyspnea. Eight years ago, he had undergone mitral valve repair for prolapsed P2 segment using CV-5 ePTFE GORE-TEX neochords and a 30-mm Physio II (Edwards Lifesciences, Irvine, CA) annuloplasty ring and since had been clinically well. Eight months before admission, a routine follow-up transthoracic echocardiogram showed normal biventricular function with moderate mitral regurgitation (MR). On admission, echocardiography showed normal biventricular function with severe anteriorly directed MR caused by recurrent prolapse of the posterior leaflet (Fig. 1A). Given his acute change in symptoms and imaging findings, he was consented for a redo mitral valve operation.

With a redo median sternotomy approach, the heart was arrested, and the mitral valve was exposed through a left atrial incision. Valve analysis found the previously implanted annuloplasty ring to be completely endothelialized. The 4 GORE-TEX neochords that had been inserted on to the free margin of the lateral, and medial aspect of P2 had ruptured midway between the leaflet and papillary muscles (Fig. 2). Neochord insertions at the leaflet and the papillary muscles were intact and removed before re-repair. The previous annuloplasty ring was left in situ and working through the ring, the valve was re-repaired using 6 CV-4 ePTFE neochords, sutured from the free edge of P2 to the medial and lateral papillary muscle heads. Residual clefts between P1 and P2, and P2 and P3 were sutured closed. Post-cardiopulmonary bypass transesophageal echocardiography revealed trivial-to-mild residual MR (Fig. 1B). The patient's postoperative course was uncomplicated. With atrial fibrillation delaying his discharge, the patient went home from hospital on postoperative day 8. Follow-up echocardiography 1.5 years after reoperation showed normal biventricular function with trivial MR.

Discussion

Chordal replacement with ePTFE sutures was first reported by David et al. and has since garnered reproducible results.[1] Rupture of ePTFE neochords is a rare event, with reports suggesting it can occur from 2 months to 14 years, postoperatively.[2-4] Most previously reported cases have required subsequent valve replacement. In cases of early rupture, within months of the operation, the neochords appeared structurally normal. Neochord failure has been attributed to excessive intracardiac forces on the sutures or excessive friction following a loop-in-loop technique.[2] Late rupture is believed to be associated with suture calcification, causing weakness and loss of integrity.[3,4]

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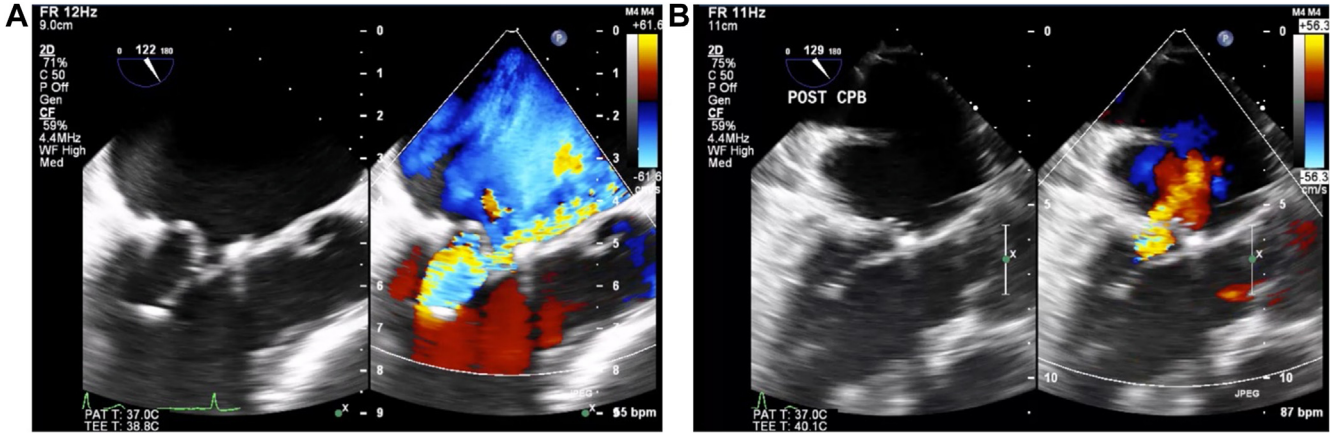

Figure 1. (**A**) Pre-CPB transesophageal echocardiography demonstrating prolapsing posterior leaflet and severe MR. (**B**) Post-CPB transesophageal echocardiography demonstrating repaired mitral valve with mild MR. CPB, cardiopulmonary bypass; MR, mitral regurgitation

We report a similar case of late ePTFE neochord rupture suspected to be caused by suture calcification and weakening, based on gross inspection of the explanted neochords. Histopathology was not obtained; however, previous reports that included histopathologic analyses showed that late ruptured ePTFE sutures had focal dystrophic calcification of the fibrous tissue covering the sutures with markers of inflammation.[4] Other reports mention near complete replacement of the synthetic material with calcium deposits.[3] Overall, these changes are suspected to cause significant weakening of the suture, leading to rupture.

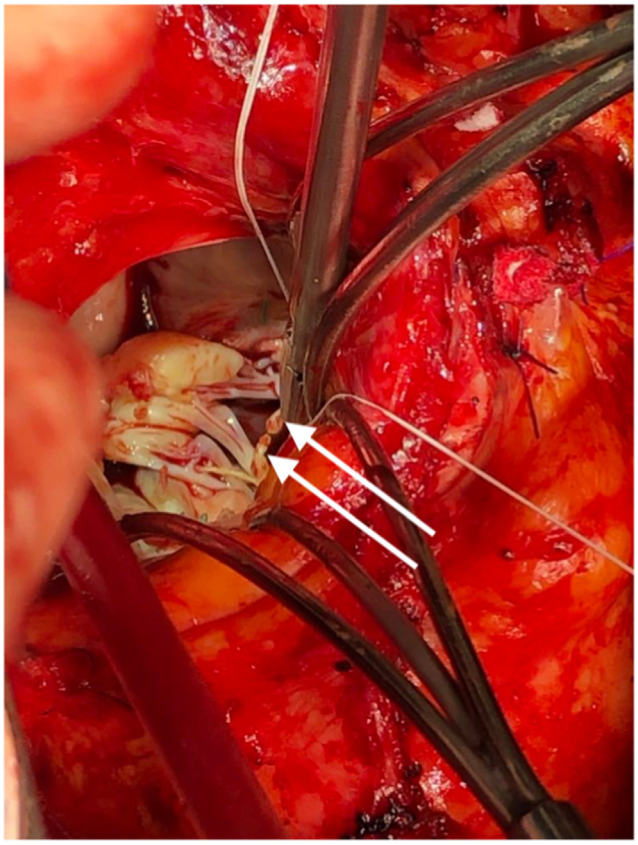

Figure 2. Intraoperative image of the ruptured neochords shown by **arrows**.

Although suture weakening has been reported, ePTFE neochords are, by design, highly resistant to degeneration. It is chemically inert with a net electrostatic negative charge that repels blood elements and bacteria. These factors allow for the material to retain flexibility and strength. However, suture calibre does impart different propensity to rupture. An analysis of the suture rupture forces for ePTFE CV-3 to CV-6 demonstrated less force required for rupture with less suture calibre.[5] The mean rupture force for a single CV-5 ePTFE neochord was 39.9 Newton, or 4.1 kg, in comparison with CV-4 suture with a mean rupture force of 49.0 Newton or 5 kg.[5] Although these forces exceed predicted intracardiac forces, there are clinical data to support that CV-5 suture is significantly weaker than CV-4 suture. A retrospective cohort study of redo mitral valve repair cases found the rupture rate of CV-5 neochords to the posterior leaflet to be 2.3%, compared with the rupture rate of CV-4 neochords at 0%.[6] Therefore, smaller suture calibre, along with structural weakening of the neochords, may have contributed to this case of neochord rupture.

An additional factor that may have contributed to neochord weakening in this case was a previous motor vehicle accident within approximately 1 year of his presentation. Although traumatic valvular injuries are rare following blunt chest trauma, cases of acute mitral valve regurgitation caused by chordal rupture have been reported.[7] The mechanism of injury is suspected to be through an acute rise in intracardiac pressure during isovolumetric contraction. Previous reports have suggested that patients' myxomatous degeneration of the mitral valve may be more predisposed to traumatic chordal rupture.[7] As such, it is plausible that this event may have contributed to further neochord weakening, increasing the risk of rupture in our reported case.

To our knowledge, this is among the first reported cases of successful re-repair following neochord rupture.[6] As the patient's mitral valve apparatus was maintained except for the ruptured chords, reinsertion of neochords was feasible. CV-4 ePTFE GORE-TEX sutures were used for re-repair, as they have greater tensile strength compared with CV-5 ePTFE sutures.[5] In cases of progressed mitral valve sclerosis, stenosis, or other leaflet pathology, re-repair may not be a practical strategy.

Although rare, ePFTE neochord rupture has significant consequences. This case, among others reported, should serve as a reminder that all surgical techniques have intrinsic rates of failure, highlighting the need for continual study and innovation. In addition, this case emphasizes the necessity to continue long-term follow-up with echocardiographic surveillance of postoperative patients to detect possible late complications.

Ethics Statement

This case report has adhered to the relevant ethical guidelines.

Patient Consent

The patient provided informed consent for the preparation of this report.

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Disclosures

The authors have no conflicts of interest to disclose.

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