Mitral Valve Surgery for Congestive Heart Failure

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KEYWORDS

• Mitral valve disease • Mitral valve repair • Congestive heart failure • Mitral regurgitation
• Transcatheter device

KEY POINTS

- Mitral valve disease is a common cause of congestive heart failure. It can be categorized from the functional standpoint in mitral regurgitation, mitral stenosis, or mixed lesions.
- Every year approximately 22,500 patients undergo surgery for mitral valve disease. More than 95% of the mitral repairs and 75% of the replacements are performed to correct mitral regurgitation.
- An increased number of patients with mitral regurgitation who are considered either inoperable or at high risk for surgery are treated with transcatheter devices. More than 5000 patients received a transcatheter mitral procedure in 2016.
- Transcatheter mitral valve procedures is an evolving treatment modality that will likely expand the number of mitral valve procedures performed.
- Mitral valve disease can be categorized from the functional standpoint in regurgitant lesions, stenosis, or both.

INTRODUCTION

Mitral valve disease is a common cause of congestive heart failure.[1,2] It can be categorized from the functional standpoint in mitral regurgitation, mitral stenosis, or mixed lesions.

Every year approximately 22,500 patients undergo surgery for mitral valve disease.[3] More than 95% of the mitral repairs and 75% of the replacements are performed to correct mitral regurgitation. In addition, an increased number of patients with mitral regurgitation who are considered either inoperable or at high risk for surgery are treated with transcatheter devices.[3] More than 5000 patients received a transcatheter mitral procedure in 2016 (Society of Thoracic Surgery [STS]/American College of Cardiology [ACC] Transcatheter Valve Therapy Registry, personal communication, 2017). This is an evolving treatment modality that will likely expand the number of mitral valve procedures performed.

MITRAL REGURGITATION

Mitral valve regurgitation can be categorized based on its etiology as either primary (organic) or secondary (functional). This discussion is limited to chronic mitral regurgitation.

PRIMARY OR ORGANIC MITRAL VALVE REGURGITATION

In primary mitral valve disease, the regurgitation occurs as a consequence of a structural defect on the valvular apparatus (leaflets, chordae, or papillary muscles).[2] The most common etiology for primary mitral regurgitation is mitral valve prolapse secondary to either myxomatous degeneration or fibro-elastic deficiency[4] (**Fig. 1**). Other less common etiologies include rheumatic heart disease, infective endocarditis, connective tissue disorders, radiation, and congenital heart disease.

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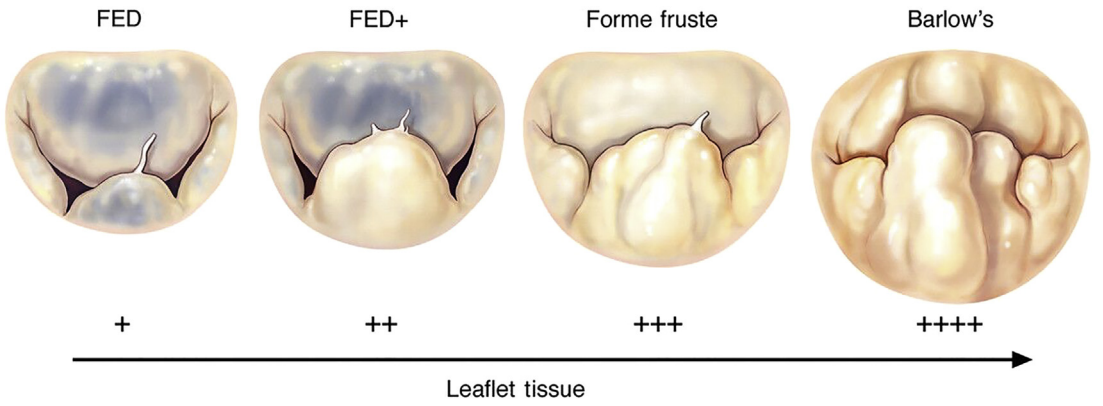

Fig. 1. Degenerative mitral valve disease ranges from fibroelastic deficiency (FED) to full myxomatous valve disease (Barlow disease). In FED, there is a deficiency of collagen with thin and almost transparent leaflets and 1 or more ruptured chordae. In myxomatous valve disease, the leaflets are diffusely thickened, redundant, with excess tissue with elongation or rupture of 1 or several chordae tendinea leading to leaflet prolapse or flail. +, increased amount of leaflet tissue. (*From* Adams DH, Rosenhek R, Falk V. Degenerative mitral valve regurgitation: best practice revolution. Eur Heart J 2010;31(16):1959; with permission.)

SECONDARY OR FUNCTIONAL MITRAL VALVE REGURGITATION

Secondary or functional mitral regurgitation is a ventricular disease in which there are no abnormalities of the mitral valve leaflet or subvalvular apparatus. The mitral regurgitation is secondary to remodeling and global or regional dysfunction of the left ventricle. Remodeling of the left ventricle leads to apical and lateral papillary muscle displacement with leaflet tethering that prevents coaptation and leads to mitral regurgitation (**Fig. 2**).[5–7] Annular dilatation plays a small role as a mechanism for the mitral regurgitation. Ischemic and nonischemic cardiomyopathy are the most common causes of functional mitral regurgitation.[8]

The presence of functional mitral regurgitation after a myocardial infarction and in patients with heart failure is a marker of poor prognosis.[9–12] It is associated with increased mortality, increased severity of heart failure symptoms, and increased rate of readmissions to the hospital. The severity of the regurgitation also affects the prognosis. Patients with mild to moderate functional (effective regurgitant orifice [ERO] 1–19 mm^2) had a 5-year survival of 49%, whereas patients with severe functional mitral regurgitation (ERO $\geq$20 mm^2) had a 5-year survival of 29%.[9–11] In functional mitral regurgitation, lesser regurgitant volumes have significantly more impact in prognosis than in patients with primary mitral regurgitation.

The pattern of annular dilation, leaflet tethering, and the direction of the mitral regurgitant jet differ with the etiology and severity of functional mitral regurgitation[13–16] (see **Fig. 2**). In ischemic cardiomyopathy, the initial ventricular remodeling occurs in the posterior-medial papillary muscle. Thus, the posterior-medial portion of the posterior leaflet (P3) is tethered and lower than the anterior, leading to a posteriorly directed mitral regurgitation jet (see **Fig. 2**, parts 1 and 2). This pattern is called "asymmetric tethering." Ischemia of the anterior wall of the left ventricle leads to functional mitral regurgitation in more advanced stages of ventricular remodeling than in patients with inferior infarction (more spherical ventricles with more tenting and lower left ventricular ejection fraction [LVEF]). Both papillary muscles are displaced laterally and apically, and therefore, both leaflets are tethered. The regurgitant jet is central. This pattern is called "symmetric tethering" (see **Fig. 2**, parts 3 and 4). Ventricular remodeling in nonischemic cardiomyopathy is also "symmetric," involving both papillary muscles and leading to a central regurgitation jet[13–16] (see **Fig. 2**, parts 3 and 4).

Because functional mitral regurgitation is a ventricular problem, reestablishing the competency of the mitral valve is not curative. In addition, there is no conclusive evidence that correcting functional mitral regurgitation improves survival.[17,18]

TREATMENT OF PRIMARY OR ORGANIC MITRAL VALVE REGURGITATION

The surgical treatment of organic mitral regurgitation is well established. Mitral valve repair is the preferred treatment for patients with mitral valve