Mitral Valve Repair in Non-ischaemic Dilated Cardiomyopathy

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Abstract

The role of mitral valve repair for dilated cardiomyopathy is less well established. Observational studies are promising and suggest that it may be beneficial but patient selection needs to be better defined. Longer follow-up is also needed and randomised studies are needed. Important surgical principles must be followed when performing this surgery to ensure long term durability of the valve repair.

Keywords

Dilated cardiomyopathy • Mitral valve repair • Mitral valve annuloplasty • Left ventricular function

Mitral valve repair has been used in patients with dilated cardiomyopathy who have at least moderate mitral regurgitation. Initial observational studies have shown that mitral valve repair in these patients may improve cardiac function and functional status. Survival also appeared to be better compared to historical groups of patients treated by medication alone [1]. These results, however, need to be confirmed in randomised controlled trials. The indications for mitral valve repair in these patients also need to be better defined and predictors of success of surgery need to be better identified. At present, there is no consensus on mitral valve surgery for the treatment of dilated cardiomyopathy.

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Principles of Treatment

It is now recognised that the mitral valve is an integral part of the structure of the left ventricle (LV). The mitral valve annulus and papillary muscles contribute significantly to LV function. The reverse is also true and significant impairment of LV function in patients with advanced dilated LV failure can significantly impair mitral valve function such that mitral regurgitation occurs. Dilatation of the LV not only results in dilatation of the mitral annulus but also tethering of the papillary muscles as the ventricular wall

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dilates. Both of these lesions result in impaired coaptation of the mitral leaflets with resulting central mitral regurgitation. The anatomy of the mitral valve apparatus with overlap of a large portion of the leaflet surface area in a normal patient means that the left ventricle is often very significantly dilated before functional mitral regurgitation occurs.

The physiological basis for mitral valve annuloplasty in patients with significant mitral regurgitation due to advanced left ventricular failure is to stop the vicious cycle whereby mitral regurgitation begets more mitral regurgitation through volume overload and geometric distortion. Restoring the competency of the mitral valve restores forward flow of blood through the left ventricle and hence increases cardiac output. Both preload and afterload are also reduced as a result. There is also emerging evidence that restoring the size and shape of the mitral annulus in these patients also restores the volume and geometry of the dilated left ventricle. This concept was first proposed by Bolling who suggested that reducing the size of the mitral annulus not only reduces the volume of the dilated left ventricle, but also draws the base of the left ventricle inwards, resulting in the long axis of the left ventricle becoming more ellipsoid from base to apex [2]. This restores the spherical dilated ventricle to a more normal elliptical shape [1, 2]. A reduction in left ventricular volume would reduce left ventricular wall stress and hence improve subendocardial perfusion and oxygenation. Restoring the left ventricle to a more ellipsoid shape would restore the orientation of myofibrils to a more oblique direction optimising its efficiency during ventricular systole.

The technique of mitral annuloplasty has been described in a separate chapter. The mitral annulus is sized and an annuloplasty ring that is at least one size smaller than that measured is implanted. Undersizing is done to achieve leaflet coaptation and to restore the elliptical shape of the left ventricle. An important principle in this type of surgery is to use a rigid complete ring and not a flexible band. This is because the mitral annulus has been shown to dilate in both the anterior and posterior annulus. A smaller ring also achieves better long term results. However, care must be taken to place sufficient number of sutures and of sufficient depth as the sutures and annuloplasty ring are at increased tension due to the undersizing.

Results of Treatment

In Bolling's series of patients with both dilated and ischaemic cardiomyopathy, undersized mitral annuloplasty alone resulted in a reduction in LV end diastolic volume from 281 to 206 mls. This was associated with a marked reduction in the sphericity of the left ventricle. Ejection fraction also improved from 17 to 26 % and cardiac output from 3.3 l/min to 5.2 l/min at 22 months. In-hospital mortality was 2 % and two-year survival was 70 %. NYHA functional class improved from 3.9 to 1.8 and peak oxygen consumption improved from 14.5 to 18.6 ml/kg/min [1]. Bolling's series included patients with both ischaemic and idiopathic dilated cardiomyopathy. All his patients with ischaemic cardiomyopathy had undergone previous coronary artery bypass grafting. None of these patients, however, had regions of hibernating myocardium as determined by a negative dobutamine stress echo test or positron emission tomography. However, in a propensity matched study from the same centre comparing mitral annuloplasty versus medical treatment, Wu, et al., found no differences in survival between the two treatment groups. 30-day mortality was 4.8 % [3].

The results of mitral valve surgery in dilated cardiomyopathy have been reported by several others. Cope, et al., reported an operative mortality of only 3.4 % following undersized mitral annuloplasty in patients with both ischaemic and idiopathic dilated cardiomyopathy [4]. The preoperative ejection fraction was 22.9 %. Although no follow-up data on cardiac function was reported in this study, the mean survival of patients undergoing undersized mitral annuloplasty was 66 months, which is similar to that of patients undergoing heart transplantation (70 months). Bishay, et al., has also recently reported an operative mortality of only 2.3 %

following mitral valve repair in dilated cardiomyopathy with an improvement in NYHA class from 3.8 to 1.2, and ejection fraction from 28 to 36 %. Two and 5 year survival was 86 % and 67 % respectively [5]. Gummert, et al., reported an operative mortality of 6.1 %; 1 and 5 years actuarial survival was 86 % and 66 % respectively [6]. De Bonis, et al., reported an in-hospital mortality of 5.6 % and improvements in LV geometry, ejection fraction and NYHA functional class. Actuarial survival at 6.5 years was 69 % and freedom from recurrence of significant mitral regurgitation was 90 %. Successful atrial fibrillation ablation appeared to improve survival and LV reverse remodelling [7].

Further insights into the role of mitral valve surgery in heart failure was obtained from a subgroup of 102 patients with dilated cardiomyopathy and significant mitral regurgitation in the Acorn Clinical Trial who received mitral valve surgery alone. All of these patients were in NYHA class III or IV, had an ejection fraction of 35 % or less, a left ventricular end diastolic diameter of 60 mm or more, and a six minutes' walk test of 450 m or less. 84 % of the patients received mitral annuloplasty and 16 % had a mitral valve replacement. The overall operative mortality was 1.6 %. The survival at 12 months was 86.5 % and at 24 months was 85.2 %. LV volumes reduced significantly and consistently from baseline to 24 months and ejection fraction improved. Sphericity index also increased consistent with reverse remodelling of the LV into a more ellipsoidal shape from a spherical shape. Mitral regurgitation severity decreased significantly and the mean mitral regurgitation severity was 0.67 at 2 years. Improvements were also shown in NYHA functional class, six minute walk test, and quality of life questionnaires [8]. It should be noted that in this study, 40 % of the patients studied had moderate or less mitral regurgitation.

Several studies have reported on the risk factors for poor outcome in this group of patients. The severity of leaflet tethering and the size of the left ventricle are important risk factors affecting the durability of mitral annuloplasty and LV reverse remodelling. Calafiore, et al., reported that the durability of mitral annuloplasty in dilated cardiomyopathy is reduced when significant leaflet tethering is present (coaptation distance greater than 10 mm) and recommended mitral valve replacement instead of repair in these patients [9]. De Bonis, et al., recommended addition of the edge-to-edge repair to an annuloplasty when the coaptation depth was greater than 10 mm and identified absence of the edge-to-edge repair as a predictor of repair failure [10]. Horii, et al., reported that LV reverse remodelling and improvement in ejection fraction occurred up to 3 years after mitral valve surgery in this group of patients when the LV end-systolic volume index was less than 150 mL/m^2 but not when it was greater than this. 5-year survival was also better in the smaller LV group [11]. A left ventricular end-diastolic diameter of greater than 65 mm has also been reported to be predictive of reduced LV reverse remodelling and survival [12].

Observational studies therefore suggest that undersized mitral annuloplasty can be performed safely in patients with significant mitral regurgitation secondary to dilated cardiomyopathy. Such surgery appears to improve symptoms, cardiac function, LV reverse remodeling and survival compared with historical controls treated by medication alone. These results, however, need to be confirmed in randomised controlled trials. There is also a need to better identify patients who would benefit most from such surgery.

References

1. Bolling SF, Pagani FD, Deeb GM, Bach DS. Intermediate-term outcome of mitral reconstruction in cardiomyopathy. J Thorac Cardiovasc Surg. 1998; 115:381–6.
2. Bolling SF, Deeb M, Brunsting L, Bach DS. Early outcome of mitral valve reconstruction in patients with end stage cardiomyopathy. J Thorac Cardiovasc Surg. 1995;109:676–83.
3. Wu AH, Aaronson KD, Bolling SF, Pagani FF. Impact of mitral valve annuloplasty on mortality risk in patients with mitral regurgitation and left ventricular systolic dysfunction. J Am Coll Cardiol. 2005;45:381–7.
4. Cope JT, Kaza AK, Reade CC, Shockey KS, Kern JA, Tribble CG, Kron IL. A cost comparison of heart transplantation versus alternative operations for cardiomyopathy. Ann Thorac Surg. 2001;72:1298–305.

5. Bishay ES, McCarthy PM, Cosgrove DM, Hoercher KJ, Smedira NG, Mukherjee D, White J, Blackstone E. Mitral valve surgery in patients with severe left ventricular dysfunction. Eur J Cardiothorac Surg. 2000;17:213–21.
6. Gummert JF, Rahmel A, Bucerius J, Onnasch J, Doll N, Walther T, Falk V, Mohr FW. Mitral valve repair in patients with end stage cardiomyopathy: who benefits? Eur J Cardiothorac Surg. 2003;23:1017–22.
7. De Bonis MD, Taramasso M, Verzini A, Ferrara D, Lapenna E, Calabrese MC, Grimaldi A, Alfieri O. Long-term results of mitral repair for functional mitral regurgitation in idiopathic dilated cardiomyopathy. Eur J Cardiothorac Surg. 2012;42:640–6.
8. Acker MA, Bolling SF, Shemin R, Kirklin J, Oh JK, Mann DL, Jessup M, Sabbah HN, Starling RC, Kubo SH, Investigators ATP. Mitral valve surgery in heart failure: insights from the Acorn Clinical Trial. J Thorac Cardiovasc Surg. 2006;132:568–77.
9. Calafiore AM, Gallina S, Di Mauro M, Gaeta F, Iaco AL, D'Alessandro S, Mazzei V, Giammarco GD. Mitral valve procedure in dilated cardiomyopathy: repair or replacement? Ann Thorac Surg. 2001;71:1146–53.
10. De Bonis MD, Lapenna E, Canna GL, Ficarra E, Pagliaro M, Torracca L, Maisano F, Alfieri O. Mitral valve repair for functional mitral regurgitation in end-stage dilated cardiomyopathy. Circulation. 2005;112:I-402–8.
11. Horii T. Left ventricle volume affects the result of mitral valve surgery for idiopathic dilated cardiomyopathy to treat congestive heart failure. Ann Thorac Surg. 2006;82:1349.
12. Braun J, van de Veire NR, Klautz RJM, Versteegh MIM, Holman ER, Westenberg JM, Boersma E, van der Wall EE, Bax JJ, Dion RAE. Restrictive mitral annuloplasty cures ischemic mitral regurgitation and heart failure. Ann Thorac Surg. 2008;85:430–7.