Echocardiographic Findings Before and After ‘Edge to edge’ Mitral Valve Repair for Myxomatous Prolapse and Severe Mitral Regurgitation

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Abstract — Mitral valve prolapse due to myxomatous degeneration is the most common etiology of mitral regurgitation in developed countries. In recent years, mitral valve repair has been shown to be preferable to mitral valve replacement for the majority of patients undergoing surgery for severe symptomatic mitral regurgitation. Surgeons have recently evaluated experimental techniques to further improve mitral valve repair and, together with cardiologists, nourish strong interest in the potential of the percutaneous approaches. The edge-to-edge technique has been advocated for the complex repair of myxomatous mitral valves. We report here a complication of moderate functional mitral stenosis after “edge to edge” mitral valve repair that can happen in case of not concomitant annuloplasty and of reduced mitral annulus size. Therefore, correctly size concomitant annuloplasty is required to improve the long-term results of the “edge to edge” repair both in terms of efficacy and durability.

Keywords — Myxomatous mitral valve disease; mitral regurgitation; Percutaneous treatment; edge to edge technique; functional mitral stenosis

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I. INTRODUCTION

Although the synthesis of vitamin D3 occurs naturally in the
The mitral valve prolapse (MVP) is characterized by the
displacement of one or more portions (scallops) of the
anterior or posterior, or both, leaflets of the mitral valve into the
left atrium during systole. In developed countries, the mitral
valve prolapse is the most common cause of chronic mitral
regurgitation1. More than 150 million people around the world
can be affected2. The natural history of prolapse of the mitral
valve is heterogeneous and is largely determined by the severity
of mitral regurgitation. In the more common, classic form, there
are thickened and redundant myxomatous mitral leaflets
resulting from abnormal connective tissue3. Through the
two-dimensional transthoracic echocardiography (2D TTE)
MVP is defined as systolic atrial displacement of one or both
leaflets >2mm in the parasternal long axis view. Although the
majority of patients remain asymptomatic and can have a nearly
normal life expectancy, approximately from 5% to 10% of
these patients have a progression to a severe regurgitation4,5
that requires a timely cardiac surgery. During the past years,
growing evidence demonstrates that the repair of the mitral
valve is technically preferable to mitral valve replacement for
the majority of patients undergoing surgery for mitral
regurgitation (MR) for various reasons6. Why is Mitral valve
repair the preferred surgical approach for treatment of severe
mitral regurgitation? The advantages of the mitral valve repair
are essentially represented by a low incidence of
thromboembolic phenomena, a greater resistance to bacterial
endocarditis, and, in particular, by an excellent resistance over
time in the absence of anticoagulant therapy6. Surgeons have
recently evaluated experimental techniques to further improve
mitral valve repair and together with cardiologists nourish
strong interest in the potential of the percutaneous approaches7.
Though complex leaflet repair is currently beyond the reach of
a percutaneous approach, in selected patients, effective
"double-orifice" surgical repair proposed by Maisano and
coworkers8 can be reproduced. The edge to edge approximation
(Alfieri repair) consists of suturing the two leaflets of mitral
valve together to create a "double orifice"9-18.

II. REPORT

A 61-years-old female came to our office asking for a clinical
evaluation as time before, she had suffered from a heart
murmur and recently accused annoying palpitations with
shortness of breath, especially during physical exertion, such as
climbing stairs or walking fast. Physical examination noted a
fast heart rate with a holosystolic murmur of mitral
regurgitation with mid-systole click typical of mitral valve
prolapse with relative mitral regurgitation. The resting
electrocardiogram showed sinus rhythm, normal AV
conduction and signs of left atrial enlargement (Figure 1).
Figure 1: The resting electrocardiogram shows sinus rhythm, normal AV conduction and signs of left atrial enlargement.

Figure 2: Panel A and Panel C respectively show a marked mitral valve prolapse with myxomatous posterior leaflet in Parasternal Long Axis View (PLAX) and apical 4 chamber view; Panel B and Panel D respectively show a severe mitral regurgitation in PLAX and apical 4 chamber view.
Subsequently, a 2D trans-thoracic echocardiogram (Figure 2, A-D) showed a pathological thickening of redundant mitral valve leaflets with a marked prolapse of the posterior leaflet behind the plane of the mitral valve annulus (see Figure 2; Panels A-C), and in real time image the distinct abnormal buckling motion of the posterior mitral valve leaflet in systole was clearly evident (see Video 1). The color Doppler flow showed severe valvular regurgitation (see Figure 2; Panels B-D) both in the left parasternal long axis and in 4 chamber apical view (see Video 2), estimated quantitatively by the “proximal isovelocity surface area” method (PISA) the “effective regurgitant orifice area” (EROA) > 0.40 cm² (Figure 3 A-D). Mitral inflow pattern appeared normal in bidimensional mode (see Figure 3; Panel A), while in M mode it showed the systolic displacement of the posterior leaflet (dorsal movement) (see Figure 3; Panel C). Also, the M mode color Doppler in apical view indicated the presence of mitral regurgitation throughout systole (see Figure 3; Panel D). These clinical findings suggested a heart surgery for a possible intervention by percutaneous mitral valve repair. Therefore, the patient underwent mitral valve repair according to Alfieri’s technique. Two months later the patient came to in our office because she complained about palpitations, chest pain, and breathing difficulties when doing squats. The physical examination revealed a mid-diastolic rumbling murmur with pre-systolic accentuation at the apical region and the first heart sound, unusually loud. Consequently, an echocardiogram was performed showing stabilized outcome of edge to edge mitral valve repair and emphasized typical findings of a moderate degree of functional mitral stenosis. Indeed, the ultrasound examination (Figure 4, A-D) showed a relatively restricted motion of both leaflets and also a reduction of the mitral annulus size, an increase blood flow (candle flame) velocity during diastole (see Figure 4; Panel D – Video 3) with pathological elevation of the means of the mitral transvalvular gradients while the functional effective orifice area (EOA) was reduced (see Figure 4; Panel A-B). The typical pattern of functional mitral stenosis was recorded in both mono- (see Figure 4; Panel C) and bi-dimensional echocardiography.

Figure 3: Panel A shows a Pulsed Wave (PW) spectral diastolic transmitral flow pattern; Panel B shows a quantitative measurement of mitral regurgitation with “proximal isovelocity surface area” (PISA) method; Panel C shows the M mode of the mitral valve, with mid-systolic displacement of the posterior leaflet (arrow); Panel D shows the color M-Mode of severe mitral regurgitation in apical 4 chamber view.
III. DISCUSSION

Myxomatous degeneration of the mitral valve is the most common etiology of mitral regurgitation in developed countries. The advantage of repairing regurgitant mitral valve compared with replacement include greater freedom from thromboembolism, endocarditis and complication of anticoagulant therapy. The edge to edge technique has been advocated not only for these reasons but mainly for eliminating residual mitral regurgitation that occasionally occurs after complex repair of myxomatous valve. The risk of functional mitral stenosis is rare and unusual after edge to edge MVR. Moreover, an exercise echocardiographic report has clearly demonstrated that the artificially created double orifice valves follow a physiologic behavior under stress condition, in the absence of significant valvular obstruction in response to the increased cardiac output. Although the mitral valve area is reduced, significant mitral stenosis (MS) does not occur.

However, functional stenosis is fairly common after mitral valve repair and can occur in a substantial proportion of patients who have non residual regurgitation following surgical repair for myxomatous mitral regurgitation. Brinster and colleagues declared in their study that the presence of mitral stenosis was also assessed by TTE postoperatively; mild stenosis developed in 5 patients, moderate mitral stenosis (MS) in 2 patients and 4 patients developed severe MS. Vice versa, all the patients undergoing the "edge to edge" repair for high systolic anterior motion of the mitral valve (SAM) potential had no SAM post-repair and did not develop mitral stenosis. Usually, the "edge to edge" repair is accompanied by integrative and contemporary annuloplasty given that recent studies have shown suboptimal results when performing the edge to edge technique without annular resizing.

Figure 4: Panel A and Panel B respectively show the Continuous Wave (CW) Doppler of the diastolic mitral inflow with the measurement of gradients and EOA (Effective Orifice Area) in 4 chamber and 2 chamber apical view; Panel C shows the M-Mode of the mitral valve in PLAX view; Panel D shows the acceleration of blood flow (Candle Flame) suggestive for mitral stenosis in apical 4 chamber view.
IV. CONCLUSIONS

We illustrated here the possible complication of more severe postoperative functional mitral stenosis than the physiological reduction of the effective orifice area (EOA) and confirmed that such an event is more possible in the case of a concomitant reduction of the mitral annulus size. It follows that this patient requires further evaluation with echo-stress to evaluate exercise gradients. In conclusion, and in agreement with the study of Jimenez and coworkers[16], it is reasonable to assume that the edge to edge repair alone will not eliminate mitral regurgitation, but on the other hand the edge to edge repair with concomitant annuloplasty does not cause significant functional MV stenosis if the annuloplasty reduces the annulus to its normal dimensions.

REFERENCES