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## Prosthesis selection for repair of degenerative mitral valve disease



Mitral valve repair has become the first-line treatment for degenerative mitral valve disease due to low surgical mortality, low incidence of late adverse events, and no need for anticoagulation. Excellent long-term durability has resulted in surgeons favoring repair over replacement of the mitral valve. According to the Japanese Association for Thoracic Surgery annual reports, the number of mitral valve procedures has increased 1.6 times in a decade, and repair rates increased from 43% to 60% [1]. Guidelines for performing mitral valve surgery have been expanded to include patients without symptoms [2].

Recently, the quality of valve repair has been under focus, especially in relation to prolapsed leaflets, and repair techniques are changing [3–7]. For example, the size of cut has been modified for resection and suture, moving from quadrangular resection to triangular resection. The sliding leaflet technique and its modifications have been used to prevent systolic anterior motion by decreasing the height of posterior leaflets in combination with a larger annuloplasty ring. The concept of “respect rather than resect” using the loop technique has been widely proposed, even for posterior leaflets, and has been supported by excellent results. The goal of all these modifications has been to decrease residual mitral regurgitation, increase mitral orifice area, and improve long-term durability. However, prosthesis selection or prosthesis size selection have been less frequently discussed. Prosthesis-patient mismatch (PPM) has been more widely explored in patients undergoing aortic valve replacement than in patients undergoing mitral valve surgery.

Our report presented in the *Journal of Cardiology* showed that the standard resection and suture technique for posterior prolapse, and chordal replacement for anterior prolapse with ring annuloplasty achieved excellent durability with a 10-year reoperation rate of 3%. However, it should be noted that a small ring may cause functional mitral stenosis regardless of the repair technique selected [8]. Functional mitral stenosis, equivalent to PPM, was defined as more than 5 mmHg of mean transmitral pressure gradient and developed in approximately 15% of patients. Although prosthesis size was selected based on the length between trigons or anterior leaflet size in our cohort, smaller size prostheses seemed to be selected, perhaps (psychologically) in order to gain enough coaptation depth. Their opinion that the purpose of ring annuloplasty is to restore the annulus but reduce the annular length is correct. As a result, we found small prosthesis selection was an independent risk factor for PPM. Recently, we reported additional data in which mitral PPM induced higher tricuspid regurgitant pressure gradient and increased left atrial diameters, implying pulmonary hypertension and remodeling of left atrium [9,10]. These factors were linked to late onset of atrial fibrillation and freedom from reoperation. Thus, when repairing mitral valves with additional degenerative changes, more attention should be paid to the selection of the correct size of prosthesis to avoid PPM. Since this discovery, our practice has changed to select larger

prostheses. While agreeing with our opinion, Lee et al. described that 8 mm of the coaptation length for middle part of mitral valve leaflet, and 4 or 5 mm length for lateral and medial parts was sufficient for good coaptation and that overreduction of the mitral annulus can be harmful in mitral valve repair for degenerative mitral valve disease.

However, the concept that fixed coaptation length may avoid recurrence of mitral regurgitation suggests full ring prosthesis should be selected, especially for patients with anterior lesions. Long-term durability of anterior lesion repair was reportedly inferior to that of posterior lesion repair. Our recent data showed that there was no difference in long-term durability between full ring and partial band repair in patients with posterior lesions [11], however, a difference was observed in patients with anterior lesions. Increased recurrence was observed in the medial side in patients with partial band repair of anterior lesions. It is not clear what the reason for this difference is, but it could be due to tethering or annular dilatation. As a result, full ring annuloplasty is recommended for repairing anterior lesions. It should also be noted that the mitral annulus moves from a flat to a saddle shape during the cardiac cycle. Avoiding fixation of the anterior annulus, allowing the aortic curtain to move during the cardiac cycle, may result in a wider diastolic mitral orifice, which could help prevent functional mitral stenosis.

In conclusion, prosthesis selection is important for repairing the mitral valve in patients with degenerative mitral valve disease. Larger prostheses are recommended as long as enough coaptation depth can be gained. Partial band may be beneficial to avoid PPM, but this choice should be made carefully in patients with anterior lesions.

## Conflict of interest

The authors declare that there is no conflict of interest.

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## Role of liver stiffness in prediction of adverse outcomes in heart failure



Heart failure (HF) is a complex clinical scenario presenting with a constellation of manifestations such as dyspnea, fatigue, exercise intolerance, cough, and fluid retention. HF results in structural and functional dysfunction leading to impaired filling and ejection of heart chambers. Furthermore, heart failure can be divided into preserved ejection fraction (HFpEF) and reduced EF HF (HFrEF) considering the value of EF [1]. EF is a vital prognostic marker—numerous clinical decisions are related to left ventricular EF (LVEF) such as drugs for HF, primary prevention implantable cardiac defibrillator, left ventricular assist devices, the timing of interventions for valve repair or replacement, cardiac transplant, and others. Central venous pressure (CVP) changes in relation to the functional status of the heart and a change in CVP or systemic volume status is directly associated with a change in liver stiffness due to venous congestion, reduced perfusion of liver tissue, etc. Few studies in the literature reported the association between HF and liver stiffness with its usefulness for the predictive role in clinical outcomes.

HF has been classified into three subtypes on the basis of LVEF: HFrEF (<40%), HF with mid-range EF (40–49%) and HFpEF (>50%). HFpEF could be misleading since the process is silent. HFpEF at many occasions associated with underlying right-sided HF. We want to applaud Kitaoka and colleagues for putting light on the prognostic value of serum tenascin-C (TN-C) in HF patients with hypertrophic cardiomyopathy (HCM). TN-C is an extracellular matrix glycoprotein expressed during embryogenesis, but it might reappear during pathological circumstances such as myocardial infarction and dilated cardiomyopathy. Kitaoka et al. conducted a retrospective study involving 36 participants with especially HCM, and it illustrated that prevalence of HF was more often in the patients with high serum TN-C level than in those with low TN-C level. Therefore, in a HF patient with HCM, serum TN-C might be another important prognostic marker [2].

Liver stiffness (LS) measured by non-invasive ultrasound-based transient elastography using fibroScan® [Echosens™; Paris, France] has reformed the recognition of liver pathologies to be

specific liver fibrosis or cirrhosis. LS is a useful surrogate marker for advanced liver fibrosis (F3) and cirrhosis (F4) surpassing the past non-invasive approach to detect hepatic abnormalities. LS value below six kPa has been considered to be normal and excludes ongoing liver disease. LS of 8 and 12.5 kPa corresponds to cut-off values for F3 and F4 fibrosis respectively. More than 20 kPa LS strongly correlates to elevated portal pressure, and presence of esophageal varices. LS is reversibly associated with CVP with the direct strong relationship—increases exponentially with cardiac functional deterioration and improves dramatically after diuretic therapy (decongestion). So, LS could be used as a guiding tool for the optimal therapy during acute decompensated HF. Further, measuring LS may be helpful in identifying patients at risk of developing cardiac cirrhosis due to heart failure, as higher systemic venous pressure is well-recognized as a major risk factor of cardiac cirrhosis [3].

A recent study published in JACC by Taniguchi et al. illustrated that LS is a rewarding index for assessing the severity of HF and volume status. The study involved 171 participants diagnosed with HF with no signs of liver disease and disclosed a captivating fact—highest tertile LS (>6.9 kPa, corresponding to an estimated right filling pressure of >7.1 mmHg) had advanced New York Heart Association functional class, high prevalence of jugular venous distention, moderate/severe tricuspid regurgitation, and large inferior vena cava diameter. LS has remarkable predictive abilities for hospitalization, morbidity, and mortality as well [4].

Taniguchi and colleagues performed a study that included 31 participants in the test group and a validation group of 49 additional patients. They calculated LS using transient elastography in 31 patients without structural liver disease undergoing right-sided catheterization. They sought the relationship between LS and right atrial pressure (RAP), which proved to be correlated in the test group ( $r=0.95$ ,  $p<0.0001$ ). When the equation derived from test participants applied in the validation group, anticipated RAP was related with actual RAP ( $r=0.90$ ,  $p<0.0001$ ). As a matter of fact, measurement of LS for RAP assessment remains a reliable method even in the presence of severe tricuspid regurgitation or mechanical ventilation. It has been associated with greater accuracy compared to conventional echocardiography [5].

Some circumstances such as hepatitis, mechanical cholestasis, amyloid deposition, and cellular infiltration in the liver can affect the LS values. So, the usefulness of LS measurement in HF patients remains limited in patients with chronic liver diseases but the easier learning curve, reproducibility, rapidness, and non-invasiveness are favorable aspects for practical use of LS for selected HF populations. In the future, we need a larger dedicated study to establish other remarkable uses of LS in current medicine apart from HF, liver fibrosis, and cirrhosis subjects. And we look forward to using LS in our day-to-day medicine as an important prognostic marker and for making clinical decisions in various scenarios.

## Conflict of interest

There is no conflict of interest.

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