Left ventricular remodeling in chronic mitral regurgitation

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Remodeling of the left ventricle (LV) occurs due to conditions like ischemic heart disease (IHD) or dilated cardiomyopathy (DCM). These changes disrupt the normal geometric relationships between the LV and the mitral valve. Secondary mitral regurgitation (MR) arises not from inherent issues with the mitral valve itself but from the altered geometry of the LV. This results in a change in how the valve apparatus functions. The remodeling leads to a mismatch between the forces that close the valve and those that tether it to the LV walls. This imbalance can result in regurgitation, where blood flows backward into the LV during contraction[1]. Understanding these mechanisms is crucial for managing patients with heart failure and can influence treatment decisions, including surgical interventions or the use of device therapies.

Echocardiography is vital for diagnosing the cause and severity of MR, as well as for characterizing LV remodeling. This information is crucial for selecting the right therapeutic approach. It's important for echocardiographic studies to differentiate between functional MR due to global ventricular dilation and MR caused by localized abnormalities. Understanding how altered LV geometry affects MR is key to effective management. In cases of IHD, an inferolateral myocardial scar leads to localized remodeling, which distorts the LV's normal geometry. This distortion displaces the posteromedial papillary muscle, causing an imbalance between the forces that close the mitral valve and those that tether the valve leaflets[2]. The asymmetrical displacement of the papillary muscles results in improper alignment of the mitral valve leaflets. This misalignment leads to an eccentric and posteriorly directed jet of MR, which can significantly impact patient outcomes. In DCM, both papillary muscles are symmetrically displaced posteriorly and apically. This symmetrical movement results in an apical displacement of the coaptation line of the mitral valve leaflets, leading to a central regurgitant jet. Reverse remodeling refers to the regression of the left ventricle's hypertrophy, size, shape, and function. This process is associated with improved morbidity and mortality in patients[3]. Both types of LV remodeling—those caused by chronic volume overload due to primary valve lesions and the initial remodeling leading to secondary MR—can be reversed following various therapeutic interventions. This highlights the potential for recovery and improvement in cardiac function. Echocardiography remains the preferred imaging modality for monitoring patients with MR post-intervention. It is crucial for evaluating the success of treatments and assessing their effects on the LV's geometry and function.

Optimal medical treatment is considered the first line for managing MR, by the European Society of Cardiology (ESC) guidelines[4]. This approach is particularly important in secondary MR cases. For patients with secondary MR, the initial treatment often focuses on addressing the underlying cardiomyopathy, whether it's DCM or IHD. The current ESC guidelines for the management of valvular heart disease recommend a surgical strategy for symptomatic patients and asymptomatic patients presenting with chronic primary MR and LVESD ≥45 mm, placing emphasis on the worse postoperative outcome of patients with LVESD of 40-44 mm compared to those with LVESD less than 40 mm[4]. After surgical intervention (both mitral valve repair and valve replacement), symptom and cardiac function improvement occur rapidly. Echocardiography is the most important imaging tool for assessing LV reverse remodeling by documenting the decrease in LV volumes that usually occurs between four and six months after the surgery. After a successful percutaneous edge-to-edge mitral valve repair, MR severity and loading conditions decrease. The LV unload can explain the rapid decrease in LVEDV already seen 24 hours after the intervention[5]. After 12 months, further favorable changes are seen in the echocardiography follow-up consistent with a greater reduction in LVEDV and decreases in LVESV and LV mass[6]. Left ventricular remodeling may be the consequence of chronic volume overload in the case of primary MR or the cause of valvular insufficiency in the case of an LV with a distorted geometry resulting from IHD or DCM. Echocardiography is an invaluable tool able to differentiate between both etiologies of MR (primary or secondary) and characterize the remodeling of the LV as well as reverse remodeling secondary to therapeutic interventions.

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