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EDITORIAL COMMENT

Continuous Direct Left Atrial Pressure During MitraClip Therapy

One Key to Clinical Success?*

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Mitral regurgitation (MR) is frequent, being the second most common form of valvular heart disease. It is classified as either primary (degenerative) or secondary (functional). Although surgery (surgical repair or replacement) is indicated for severe primary MR, about 50% of patients are considered too high risk to be suitable for surgery because of their age and/or comorbidities (1,2). This has paved the way for the development of catheter-based interventions to correct MR percutaneously. The MitraClip system (Abbott Vascular, Menlo Park, California) is the only technique that has been evaluated for transcatheter organic MR repair so far, providing a therapeutic alternative to open heart surgery. Although less effective in reducing the degree of MR, the MitraClip was proved to be safer than surgery in EVEREST II (Endovascular Valve Edge-to-Edge Repair Study) (3,4).

Because residual MR after MitraClip placement is associated with suboptimal outcomes and increases mortality, the goal of the procedure is to reduce MR as much as possible, so that implantation of multiple clips is often needed (3). Nevertheless, multiple clip implantation is associated with a reduction of the mitral valve opening area and an increase in the transmitral pressure gradient. Hence, the goal is to define an acceptable compromise between residual MR and transmitral gradient. Indeed, it has been demonstrated that both mitral stenosis and MR after MitraClip therapy have a negative impact on the long-term clinical outcomes of treated patients (5,6). Transesophageal echocardiography and color Doppler are the only tools to assess both residual MR and transmitral gradient, but accurate echocardiographic evaluations are limited by operator dependence and the fact that the analysis of a double-orifice valve is challenging (7,8). Indeed, the native mitral orifice is reduced and divided into 2 or more separate orifices with often eccentric residual jets (9–11). Hemodynamic parameters could be helpful to guide MC therapy. Intraprocedural assessment of left atrial pressure (LAP) has been described as a helpful tool during MitraClip implantation (12,13). Eleid et al. (12) described a simplified technique to assess continuous and real-time LAP during MitraClip therapy. Horstkotte et al. (13) showed that multimodality assessment of intraprocedural MR (including transesophageal echocardiographic evaluation and LAP monitoring) was associated with superior intraprocedural results leading to improved MR reduction.

In this issue of *JACC: Cardiovascular Interventions*, Kuwata et al. (14) report their prospective use of continuous real-time direct measurements of LAP and left ventricular pressure during MitraClip therapy. They assessed the additional benefit of measuring left-sided heart pressures as a complement to echocardiographic assessment during MitraClip therapy and assessed the prognostic impact of left atrial hemodynamic status on clinical outcomes at short-term follow-up. A minority (30%) of included patients had secondary MR. The most important study finding was the existence of a relation between indexed mean LAP (LAP adjusted to left ventricular pressure) and clinical outcomes: post-implantation increase of indexed mean LAP was significantly associated with heart failure and rehospitalization at follow-up, independently of echocardiographic findings ($p = 0.044$). This study is the first to provide

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evidence for an adjunctive value of real-time monitoring of left heart hemodynamic status during MitraClip therapy in predicting clinical outcomes. This result is a key point for interventionists during MitraClip therapy. Indeed, in case of residual MR after implantation of a clip, operators must decide between clip repositioning or implantation of an additional clip, depending on transvalvular gradient, that is to say between residual MR and mitral valve gradient and area. The question is, What is the best and what is the worst between residual MR and residual mitral stenosis in terms of clinical outcomes for a given patient? On the basis of Kuwata et al.'s (14) study, hemodynamic data can now be added to the decision-making process: if indexed mean LAP increases during an additional clip implantation, it may be necessary to remove it and probably to respect the residual MR. If not, an additional clip could be implanted to limit the degree of residual MR.

The second most important point is the interest of continuous monitoring of the v-wave behavior during clipping. When successful, grasping in the area of the regurgitant jet is associated with reduction of the v-wave amplitude. This observation could be very helpful during MitraClip therapy, especially in case of residual MR at transesophageal echocardiographic evaluation.

The investigators should be commended for this very interesting paper, which raises 3 issues from a routine practice point of view.

First, it would be very interesting to evaluate continuous pressure and cardiac output during MitraClip therapy. It has been shown that the reduction in regurgitant volume results in acute augmentations in forward cardiac output and forward stroke volume (15).

Second, specific studies on primary versus secondary MR are needed, because population and diseases are not the same. In the recently published MitraFr study, there was no evident benefit of MitraClip therapy in case of functional MR with a left ventricular ejection fraction lower than 40% (16). It is questionable whether this study could have given different results with per procedure LAP monitoring.

Third, because it has been proved that left atrial v-wave pressure measurement through a dedicated catheter during MitraClip therapy has superior accuracy compared with the manufacturer-provided steerable guiding catheter, and because parallel puncture of the femoral vein could be responsible for hemorrhagic complication, we await a dedicated steerable guiding catheter allowing direct and continuous LAP and cardiac output monitoring (17).

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