a lower incidence of recurrent MR at 1 year with leaflet coaptation lengths of ≥8 mm among patients undergoing posterior leaflet repairs. Consequently, should a second crossclamp and re-repair be entertained in cases when the width of leaflet coaptation is significantly less than 1 cm, mild residual prolapse, or chordal systolic anterior motion is noted, even if only trace to no residual MR is noted on TEE? One could argue that re-repair in such instances may be warranted, invoking the optimization of mid- to long-term outcomes as justification.

In conclusion, striving for and accepting nothing less than perfect structural results for surgical mitral repair should no longer be perceived as risky, braggadocious, or even as not-so-subtle justification for directing referrals to a select few centers. It not only serves the interest of achieving the best clinical outcomes but serves as a staunch reality check and gold standard against which current and nascent catheter-based mitral repair devices should rightfully be evaluated. Compared with its aortic valvular counterpart, the complex structural and dynamic complexities of the mitral valve apparatus would seem to require much greater degrees of technologic sophistication for nonsurgical approaches to achieve this standard.

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Commentary: Residual mitral regurgitation: The fork in the road

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CENTRAL MESSAGE

Data-driven strategies for residual intraoperative mitral regurgitation are essential to determine when to employ a second crossclamp and can result in excellent and durable repair results.

After repair of degenerative mitral regurgitation (DMR), it is not uncommon to reach a fork in the road. You've done a beautiful repair, confirmed it by testing the valve, but after weaning from cardiopulmonary bypass, there is residual

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mitral regurgitation (MR). Now what? Is it tolerable, or do you need to re-crossclamp and re-repair the valve, or even replace it? Fortunately, this issue of the *Journal* has papers from Mount Sinai and Northwestern to provide answers to that question.[1,2] Each describe the thought process underpinning the decision, and the outcomes for each choice.

El-Eshmawi and colleagues,[1] from Mount Sinai, provide an excellent work with commendable outcomes from a referent surgeon and a referent center. A second crossclamp was needed in 2% of DMR repairs, successful repair was eventually possible in 100%, and there was good midterm durability. All MR that was more than mild was treated with a second crossclamp if: (1) systolic anterior motion (SAM) did not resolve after the usual practice of volume loading, beta blocker, and stopping inotropes or (2) no reduction of MR after a low dose of inotropes was used to increase the force of coaptation for some patients with a jet along the coaptation zone. These 2 scenarios address physiologic problems after repair. Even with mild or less MR but with: (3) the jet originated through the leaflet, along the annulus, or due to residual correctable leaflet height (anatomic problems), a second crossclamp was applied. This is a simple and practical algorithm to guide surgical decision-making about when to re-crossclamp. At Northwestern, inotropes were not employed to help resolve MR, but it is logical and corresponds to a finding in the Northwestern paper. The Mount Sinai paper does acknowledge sometimes the surgeon chose to proceed down the other fork in the road, tolerating mild residual MR along the coaptation line, but the paper does not include how often they made that choice, or outcomes for that group.

The other path is described by Imielski and colleagues[2] from the Northwestern group. They also reported more than mild residual MR needed a second crossclamp in 2% of DMR repairs, identical to the Mount Sinai experience. Northwestern did not report on the outcomes for patients who went down that path. The lack of SAM in their series could be related to the technique of repair: measured resections and partially folding the posterior leaflet, and the use of larger annuloplasty rings if the coaptation point to septal distance was 25 mm or less.[3,4] Mild MR was present in 6%, and of these 60% had reduced to no or trivial MR by hospital discharge. In retrospective review of the echocardiograms discussed in the paper, it was noted that MR resolved in the group who recovered LV function. This group may have resolved in the operating room with the Mount Sinai approach using inotropes. There was no impact on late survival or need for late reoperations for patients with residual mild MR, with only 2 early reoperations (overall 99.5% free from reoperations at 10 years). There was a difference in late recurrent MR for referent versus nonreferent surgeon. The 10-year results for the referent surgeon in patients with mild residual MR (3% moderate to severe, zero severe) compare favorably to the late results reported by David and colleagues.[5]

There are important practical and complimentary lessons from both papers. The algorithm (1, 2, 3 define previously) from Mount Sinai provides good advice regarding when a second crossclamp should be applied. Attempts at re-repair are warranted and successful in these situations, and midterm results can be excellent. The surgeons need a strong partnership with an experienced echocardiographer. Determining not just how much MR, but the mechanism and exact location, is crucial information to make the correct decision about which path to take. For example, mild MR through the suture line in the midbody of the valve leaflet needs a second crossclamp. In contrast, mild-to-moderate MR from SAM in the setting of hypovolemia likely does not and can be improved with better medical management. A referent surgeon, with the aid of the echocardiographer, may have more experience assessing a mild jet localized along the coaptation line when the anterior leaflet is contacting a small irregularity along the reconstructed posterior leaflet. These jets seem to be benign at 10 years' follow-up.

In the Northwestern experience, 8% of patients either needed a second crossclamp or had residual mild MR, so what to do about residual MR is not an uncommon decision. Between these 2 papers, surgeons now have a better idea of the best path for these patients.

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