"Cinching" the mitral valve

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This method may well prove to have a place in the surgical correction of mitral insufficiency.

—John Borrie, 1951¹

Mitral regurgitation may be caused either by structural defects of the valve apparatus or by discrepancy between the size of the orifice and the leaflet surface available to seal it during ventricular systole. Although the dividing line between these groups is distinct, treating modalities do overlap; surgical narrowing of the orifice may correct not only annular dilatation but in some cases faulty valve function as well.

Methods intended to restrict the mitral orifice with the heart open and the valve exposed are used routinely in contemporary cardiac surgery. The proposed procedure of Kollar,² however, accomplishes annular narrowing externally, without exposing the mitral orifice and without the need for cardiopulmonary bypass.

Restricting the size of the mitral orifice by external "cinching" is nothing new. As a matter of fact, surgery for mitral regurgitation began this way. Interestingly enough, these initial experiments were designed not to correct mitral incompetence but to create mitral stenosis to provide animal models as "proving grounds" for methods to treat mitral stenosis. This was already the aim of Bertrand Bernheim, a distinguished surgeon of the very early 20th century who was also the first to treat successfully a popliteal aneurysm with resection and replacement with a 15-cm segment of the saphenous vein³—an accomplishment described by Matas as a "splendid contribution to vascular surgery."⁴ Bernheim, in 1909, was also the first who placed a circumferential suture parallel to the circumflex coronary artery with the intention to create mitral stenosis in the canine model. Of 30 animals, he had 10 survivors. No long-time results were provided.⁵

In 1924 Elliott Cutler's group,⁶ pioneers of closed mitral commissurotomy, attempted to narrow the mitral orifice to create stenosis in dogs and cats by either "puckering the auricular-ventricular ring with a suture placed beneath the coronary vessels" or by "removing a wedge-shaped portion of the myocardium with the gap reapproximated." Neither of the 2 methods proved successful.

Creation of mitral stenosis was also the goal of the experiments of Robert Ellison and colleagues,⁷ who in 1952 passed a heavy silk suture beneath the epicardium just above the coronary vessels. Fourteen to 21 days later, they pulled the ends of the suture through a cannula anchored in the subcutis and created a "smooth stenosis with no interference with closure of the mitral valve cusps." The operative mortality was minimal and the suture was accurately placed in 95% of the cases. Although the group's aim was also to create stenosis, the method was potentially suitable to correct regurgitation.⁸

This method was later modified by Katz and Siegel,⁹ who, to avoid injury to the coronary artery, placed 2 sutures, one to the anterior and the other to the posterior wall. The ligatures were kept in place "by threading them through a series of loops fastened to the auricular walls." The purpose of his procedure was only to study hemodynamic changes as they may occur in mitral stenosis.

In 1954, John Borrie¹ operated on a patient with known mitral regurgitation with the hope of finding some stenosis as well that he might improve with "closed" commissurotomy. He found no stenosis, only a "strong current of regurgitant blood," what he attributed to "dilatation of the atrioventricular fibrous ring." He

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speculated that “passing a circular suture around the mitral orifice, normal function may be re-established.” The idea was tested in sheep, applying circumferential sutures passed either below the other or above the circumflex coronary artery. Multiple anchoring stitches were also placed into the interventricular septum. These experiments were notable that they were the first, intended not to create mitral stenosis but to investigate the potential of cinching to correct regurgitation.

In 1955, at the suggestion of Robert Gross, Hurwitz and Ferrecia¹⁰ narrowed the mitral annulus by excising a wedge-shaped portion of the myocardium just beneath the atrioventricular groove under the protection of 2 heavy stay-sutures. This technique differed from Cutler’s group⁶ in that it penetrated only about two thirds of the thickness of the ventricular wall. By tying the stay-sutures together, the circumference of the annulus was reduced by the width of the excised wedge. Hurwitz and Ferrecia’s experiments were important because they were carried out on dogs with previously induced mitral regurgitation. The effectiveness of the correction was proven by hemodynamic studies performed months after the intervention.

In 1955, Davila and Glover¹¹⁻¹³ presented a wealth of anatomical observations from animal experiments and clinical studies, and in the course of which they not only provided an anatomical and physiological basis of the possibility of correction of mitral insufficiency by restricting the size of the dilated annulus but they also presented clinical data of 27 patients in advanced stage of heart failure on whom they performed the external “mitral purse-string operation,” with marked decrease in their left atrial pressures. Eleven patients survived the operation. The autopsy performed on those lost perioperatively showed no stenosis, and observations in the pulse duplicator revealed an average of 80% improvement in the degree of regurgitation. The 11 patients who survived surgery were closely followed up, 5 of them as long as 6 to 18 months, and were described by Davila as “living a relatively normal life and carrying out a full schedule of household activity. Their murmur of regurgitation either decreased significantly or became completely abolished and the size of their heart decreased significantly.”¹³ I could not find any data in the literature that the “Davila operation” was attempted by other authors. However, there are anecdotal references that Charles Bailey¹⁴ of Philadelphia and Andrew Morrow (personal communication) of Bethesda experimented clinically with the procedure with very limited success. I also attempted the procedure twice. Although the patients survived surgery, the improvement in mitral regurgitation, if any, was minimal.

In 1988, a description of “clinical” application of mitral cinching came from the realm of veterinary medicine. Kerstetter and colleagues¹⁵ of the School of Veterinary Medicine of Pennsylvania attempted “purse-string” mitral sur-

gery, using a Teflon-coated thread passed through a silastic tube, to correct heart failure in 15 dogs with regurgitation. There were only 3 chronic survivors with some signs of moderate improvement.

In the age of invasive cardiology, one should not be surprised of the ongoing study related to mitral cinching (ie, percutaneous narrowing of the mitral orifice) using percutaneous noninvasive technique. The method takes advantage of the proximity of the coronary sinus to the mitral annulus and applies a self-constricting device inserted into the coronary sinus along the posterior aspect of the annulus. Preliminary studies have shown the procedure to reduce the degree of artificially induced mitral incompetence in the canine model.¹⁶

Now, with Kollar’s article,² it looks like the cat of mitral cinching is out of the sack again. Will his experiments encourage him or other surgeons to resuscitate this method that yielded only very modest results in the past? The odds are that if they do, they will probably fail. On the other hand, it does occasionally happen that ideas that did not succeed initially or had forbidding mortality, due to progress in general surgical techniques, anesthesia, and perioperative care, succeed later on. Time will tell.

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