See Article page e343.

Commentary: Spooky action at a distance—an example of ventricular entanglement

Leora B. Balsam, MD,^a and Eugene A. Grossi, MD^{b,c}

The concept of left ventricular reshaping with a transventricular stent is resurrected in Onohara and colleagues' new study in the *Journal*.¹ Because wall stress is lower in an elliptical, rather than spherical, left ventricle (LV), reshaping solutions ranging from surgical ventricular restoration to passive restraint devices have been proposed. In the hands of experts, reshaping of the post-infarcted heart with surgical ventricular restoration has yielded positive results, yet when applied more broadly, results have been less consistent. Reshaping with a transventricular stent is another strategy that was explored nearly 20 years ago with the Myosplint device.²⁻⁴ This device consisted of 2 epicardial pads connected by an adjustable transventricular chord; in the clinical feasibility studies in humans, 3 devices were placed along the long axis of the LV to draw together the opposing anterior and posterior walls.⁵ The device's design was further adapted for off-pump treatment of functional mitral regurgitation, resulting in the Coapsys device, which again consisted of posterior and anterior epicardial pads connected by an adjustable transventricular subvalvular chord. In the pivotal trial RESTOR-MV (Randomized Evaluation of a Surgical Treatment for Off-Pump Repair of the Mitral Valve), the Coapsys device reduced mitral regurgitation grade in patients with ischemic mitral regurgitation, although less effectively than surgical mitral valve repair.⁶ What was particularly intriguing, however, was the improved late survival in patients in the Coapsys group compared with the control group. One hypothesis was that

Leora B. Balsam, MD, and Eugene A. Grossi, MD

CENTRAL MESSAGE

Ghosts of the past are revisited in a new experimental study that explores the functional and structural effects of left ventricular reshaping after myocardial infarction.

the device has salutary effects on the remote myocardium. The trial was terminated prematurely due to loss of funding, and the parent company, Myocor (Minneapolis, Minn), was dissolved.

Onohara and colleagues¹ revisit ghosts of the past, Myosplint and Coapsys, in their small animal study of ventricular reshaping after transmural anterior myocardial infarction. They use a scaled-down but similar transventricular reshaping device consisting of 2 epicardial pads and an adjustable transventricular suture and evaluate its impact on left ventricular function and mechanics over time. In addition, in this experimental study, they revisit the effect of transventricular reshaping on the post-infarct remote ventricle. They find that by decoupling the remote LV with a transventricular stent, deleterious changes in the remote non-infarct LV are ameliorated.

But the remote effect may not be so spooky. Previous finite element modeling and analysis of a human subject treated with the Coapsys device demonstrated a reduction in both diastolic and systolic ventricular fiber stress.⁷ With a "splinted" inferior wall infarct, the uninvolved septal and lateral walls showed a nearly 30% reduction in systolic stress and almost 50% reduction in diastolic stress in the mid- and endocardial layers. These calculated diastolic reductions in remote myocardial stress are in the known range of the force-response curves of the giant sarcomeric protein, titin. Titin is a key determinant of myocardial passive stiffness and stress sensitive signaling. Along with

From the ^aDivision of Cardiac Surgery, UMass Memorial Medical Center, Worcester, Mass; and ^bDepartment of Cardiothoracic Surgery, NYU Langone Medical Center and ^cNew York Harbor Veterans Affairs Medical Center, New York, NY.

Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Aug 30, 2020; revisions received Aug 30, 2020; accepted for publication Aug 31, 2020; available ahead of print Sept 3, 2020.

Address for reprints: Leora B. Balsam, MD, Division of Cardiac Surgery, UMass Memorial Medical Center, University Campus, 55 Lake Ave North, Worcester, MA 01655 (E-mail: leora.balsam@umassmemorial.org).

J Thorac Cardiovasc Surg 2022;163:e357-8

0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2020.08.101>

colleagues, one of these authors (E.A.G.) generated the hypothesis that reductions in diastolic stresses were altering signaling from titin and other mechano-transducers, decreasing the triggers for remote myocyte apoptosis and negative remodeling.

The model created by Onohara and colleagues will help us tease out these pathways, understand the ideal patients for reshaping therapy, and perhaps identify other therapies to block these remote effects. Effects are only spooky when you don't understand them.

References

1. Onohara D, Corporan DM, Kono T, Kumar S, Guyton RA, Madala M. Ventricular reshaping with a beating heart implant improves pump function in experimental heart failure. *J Thorac Cardiovasc Surg*. 2022;163:e343-55.
2. Mueller XM, Tevacearai, Boone Y, Augstburger M, von Segesser LK. An alternative to left ventricular volume reduction. *J Heart Lung Transplant*. 2002;21:791-6.
3. McCarthy PM, Takagaki M, Ochiai Y, Young JB, Tabata T, Shiota T, et al. Device-based change in left ventricular shape: a new concept for the treatment of dilated cardiomyopathy. *J Thorac Cardiovasc Surg*. 2001;122:482-90.
4. Guccione JM, Salahieh A, Moonly SM, Kortsmit J, Wallace AW, Ratcliffe MB. Myosplint decreases wall stress without depressing function in the failing heart: a finite element model study. *Ann Thorac Surg*. 2003;76:1171-80.
5. Fukamachi K, McCarthy PM. Initial safety and feasibility clinical trial of the Myosplint device. *J Card Surg*. 2005;20:S43-7.
6. Grossi EA, Patel N, Woo YJ, Goldberg JD, Schwartz CF, Subramanian V, et al. Outcomes of the RESTOR-MV Trial (Randomized evaluation of a surgical treatment for off-pump repair of the mitral valve). *J Am Coll Cardiol*. 2010;56:1984-93.
7. Carrick R, Ge L, Lee LC, Zhang Z, Mishra R, Axel L, et al. Patient-specific finite element-based analysis of ventricular myofiber stress after Coapsys: importance of residual stress. *Ann Thorac Surg*. 2012;93:1964-71.

See Article page e343.

Commentary: Reshaping ventricular geometry of mice and men: How long is the string?

Edward Buratto, MBBS, PhD,^{a,b,c} and
Igor E. Konstantinov, MD, PhD, FRACS^{a,b,c,d}

Adverse left ventricular (LV) remodeling in ischemic cardiomyopathy is an appealing target for surgical therapy. First described by Cooley in 1958, surgical ventricular reconstruction promised improvements in LV volumes, ejection fraction, functional class, and even survival.^{1,2} Since then, a variety of techniques, with and without cardiopulmonary bypass, have been described.²⁻⁴ Onohara and colleagues⁵ report the results

Drs Edward Buratto and Igor E. Konstantinov

CENTRAL MESSAGE

Left ventricular reshaping can be achieved with an intracardiac string; this has potential clinical application.

From the ^aDepartment of Cardiac Surgery, Royal Children's Hospital, Melbourne, Victoria, Australia; ^bDepartment of Paediatrics, University of Melbourne, Melbourne, Victoria, Australia; ^cHeart Research Group, Murdoch Children's Research Institute, Melbourne, Victoria, Australia; and ^dMelbourne Centre for Cardiovascular Genomics and Regenerative Medicine, Melbourne, Victoria, Australia.

Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Aug 31, 2020; revisions received Aug 31, 2020; accepted for publication Sept 1, 2020; available ahead of print Sept 4, 2020.

Address for reprints: Igor E. Konstantinov, MD, PhD, FRACS, Department of Cardiac Surgery, Royal Children's Hospital, Flemington Rd, Parkville, VIC 3029, Australia (E-mail: igor.konstantinov@rch.org.au).

J Thorac Cardiovasc Surg 2022;163:e358-9

0022-5223/\$36.00

Crown Copyright © 2020 Published by Elsevier Inc. on behalf of The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2020.09.002>

of an experimental trial of an LV shaping device used in a rat model of ischemic cardiomyopathy. In their model, ischemic cardiomyopathy was induced via ligation of the coronary artery. Three weeks later the investigational group underwent an LV reshaping procedure by intraventricular string connected to silicone pads placed on the beating heart to reduce the short access diameter and restore elliptical LV shape (Figure 1, A and B). At 12 weeks, rats with the reshaping device had improved LV volumes, decreased wall stress, increased LV wall