vular tensor apparatus was managed at operation. Left ventricular function is unquestionably related to this. At least in the context of randomized controlled trials, complete preservation of the apparatus results in better left ventricular performance,⁴ which also means a lower chance of thrombus and later embolism development.⁵ This generates another confounding factor when interpreting the data. Third, the underlying strategy for anticoagulation control should be addressed and controlled for in the inclusion criteria. Finally, the presence or absence of perioperative atrial fibrillation is acknowledged as important by both operating surgeons/manufacturers.

It is possible that these factors were considered; however, for the sake of the reader, it is necessary to include them in the discussion. Such consideration will reduce chance-related outcome and broaden the horizon of the reader when transferring a statistical critique to clinical reality.

Jeffrey H. Shuhaiber, MD

Malek Massad, MD

Alexander Geha, MD

Department of Surgery

University of Illinois at Chicago

840 Southwood St (CSB suite 518-E)

Chicago, IL 60612

References

1. Grunkemeier GL, Wu Y. "Our complication rates are lower than theirs:" statistical critique of heart valve comparisons. *J Thorac Cardiovasc Surg.* 2003;125:290-300.
2. Lim KH, Caputo M, Ascione R, Wild J, West R, Angelini GD, et al. Prospective randomized comparison of CarboMedics and St Jude Medical bileaflet mechanical heart valve prostheses: an interim report. *J Thorac Cardiovasc Surg.* 2002;123:21-32.
3. Wehinger C, Stollberger C, Langer T, Schneider B, Finsterer J. Evaluation of risk factors for stroke/embolism and of complications due to anticoagulant therapy in atrial fibrillation. *Stroke.* 2001;32:2246-52.
4. Yu KL, Sintek CF, Miller DC, Pfeffer TA, Kochamba GS, Khonsari S, et al. Randomized trial comparing partial versus complete chordal-sparing mitral valve replacement: effects on left ventricular volume and function. *J Thorac Cardiovasc Surg.* 2002;123:707-14.
5. Sharma ND, McCullough PA, Philbin EF, Weaver WD. Left ventricular thrombus and subsequent thromboembolism in patients with severe systolic dysfunction. *Chest.* 2000;117:314-20.

doi:10.1016/S0022-5223(03)00729-3

Reply to the Editor:

We thank Dr Shuhaiber and colleagues for their comments on our study comparing two heart valve models on the basis of reports from the literature. In describing the limitations of such comparisons, they give us another opportunity to stress the main purpose of our report, which was to point out precisely these limitations.

The ideal way to compare valve performance across multiple studies is to use risk-adjustment techniques with individual, patient-level data. But only summary, study-level information is available from published reports. We emphasized also that the simple, weighted-average pooling of results within valve types is not appropriate if these results are statistically heterogeneous.

A regression approach that does allow for heterogeneity was used to adjust for some series-level risk factors: the mean, maximum, and completeness of follow-up; bleeding rate, as a surrogate for anticoagulation intensity; mean age; percentage of male patients; year of publication; number of valves; and journal impact factor. Three of the risk factors that Dr Shuhaiber mentions, etiology, surgical technique and atrial fibrillation, were generally not available in these reports.

It can be seen from the plots of linearized rates that by arbitrarily selecting groups of studies, the superiority of either valve in either position for any of the three outcomes studied can be supported. Because there is a tendency to perform these literature comparisons despite the described limitations, we used statistical techniques that can account for some of these limitations. We also stressed the "cautious interpretation" of even the most carefully done comparisons.

Gary L. Grunkemeier, PhD

YingXing Wu, MD

Providence Health System

9155 SW Barnes, Suite 33

Portland, OR 97225

doi:10.1016/S0022-5223(03)00730-X

Esophageal perforation during left atrial radiofrequency ablation: Is the risk too high?

To the Editor:

The recent article by Doll and colleagues documents a 1% incidence of esophageal

perforation with intraoperative radiofrequency ablation of atrial fibrillation (AF).¹ This observation serves as an important word of caution as we increase the application of surgical ablation and design minimally invasive procedures to treat AF. In our exploration of new approaches to cure AF, we must first follow the edict "do no harm." Although AF is an undesirable and dangerous heart rhythm, we cannot justify major complications in its treatment.

The esophageal injuries described by Doll and colleagues resulted from the application of a heat-based energy source to the left atrial endocardium. In each case, the esophagus, which courses posterior to the left atrium, suffered a burn with resulting esophageal perforation. They note that this complication has occurred with unipolar radiofrequency and microwave energies.^{1,2} It is likely that collateral damage in general and esophageal injury in particular will occur occasionally with any heat-based, endocardial approach to AF ablation that lacks precise control of lesion depth and direction.

Safety in AF ablation requires that the depth of tissue injury be controlled during ablation; delivery of energy must be focused and directed to avoid collateral damage. In addition, however, it is generally accepted that efficacy requires transmural atrial lesions. There are several promising modalities that satisfy both of these criteria. Safety may be reliably achieved with bipolar or epicardial energy delivery. Bipolar radiofrequency devices ablate only the tissue between the jaws of the clamp, eliminating the risk of esophageal injury.³ Epicardial delivery of energy with a shielded, directional catheter is also an attractive option. Epicardial ablation using ultrasound energy may have particular advantages, as this energy source allows reliable creation of a lesion that is 10 mm in depth and design of the ultrasound catheter ensures directional delivery of energy from the epicardium to the endocardium.

As surgeons explore these technologies and devise new procedures to cure AF, we must follow the lead of the group from Leipzig and share our experiences, whether they be favorable or unfavorable. This strategy will facilitate development of effective and safe procedures to ablate AF. And this, in turn, will offer the possibility

of AF ablation to large numbers of patients, including those with isolated or lone AF.

A. Marc Gillinov, MD
Patrick M. McCarthy, MD
Gosta Pettersson, MD
Bruce W. Lytle, MD
Thomas W. Rice, MD
The Center for Atrial Fibrillation
The Cleveland Clinic Foundation
Cleveland, Ohio

References

1. Doll N, Borger MA, Fabricius A, et al. Esophageal perforation during left atrial radiofrequency ablation: is the risk too high? *J Thorac Cardiovasc Surg.* 2003;125:836-42.
2. Gillinov AM, Pettersson G, Rice TW. Esophageal injury during radiofrequency ablation of atrial fibrillation. *J Thorac Cardiovasc Surg.* 2001;122:1239-40.
3. Gillinov AM, McCarthy PM. Atricle bipolar radiofrequency clamp for intraoperative ablation of atrial fibrillation. *Ann Thorac Surg.* 2002;74:2165-8.
doi:10.1016/S0022-5223(03)00947-4

Reply to the Editor:

Gillinov and colleagues have commented on our article describing esophageal perforation following unipolar radiofrequency ablation of the left atrium. These authors from the Cleveland Clinic have a vast experience in atrial fibrillation ablation techniques and have also reported esophageal injury following unipolar radiofrequency ablation. Although esophageal perforation is an uncommon complication of this procedure, it is also a very serious and potentially lethal one.

We agree with the authors that bipolar and epicardial radiofrequency ablation are promising techniques that may eliminate the possibility of esophageal injury. However, these procedures may carry an increased risk of circumflex artery or coronary sinus injury when creating the lesion line down to the mitral annulus. Ultrasound ablation is another promising technique but very little clinical data is available at this time.

Atrial fibrillation ablation surgery is an area of intense research and marketing activity at this time. We completely agree that the honest reporting of favorable and unfavorable results will ultimately deter-

mine which treatment modality is the most safe and effective.

Nicolas Doll, MD^a
Michael A. Borger, MD, PhD^b
Friedrich W. Mohr, MD, PhD^a
Clinic for Heart Surgery^a
Heart Center
University of Leipzig
Leipzig, Germany
Toronto General Hospital^b
University of Toronto
Toronto, Ontario, Canada
doi:10.1016/S0022-5223(03)00948-6

Atrioesophageal fistula: Is it an unavoidable complication of radiofrequency ablation?

To the Editors:

The article by Doll and colleagues¹ was of great interest. We want to share a similar experience where a patient (1 of 42) died of an atrioesophageal fistula.

Clinical Summary

A 58-year-old female patient with rheumatic valve disease, ostial stenosis of the right coronary artery (RCA), chronic atrial fibrillation, and a dilated left atrium (78 mm) was operated through a median ster-

notomy for the replacement of the aortic and mitral valves with mechanical prostheses, De Vega annuloplasty of the tricuspid valve, bypass graft to the RCA, and a left atrial radiofrequency ablation (RFA) using the Cobra RF System (Boston Scientific, Boston, Mass) with the technique of Melo and colleagues.² The patient was discharged on postoperative day 7 with no complication but paroxysmal atrial fibrillation despite amiodarone.

On the postoperative day 22, she was readmitted with fever, shivering, and numbness of the right arm. Echocardiography revealed a left atrial thrombus. The next day the patient suddenly lost consciousness and was immediately operated for thrombectomy from the left atrial cavity. After easy weaning from cardiopulmonary bypass (CPB), we noted a massive hemorrhage through the nasogastric tube. Esophagoscopy showed a 15-mm laceration on the anterior wall, 33 cm from the incisors. We restored CPB. Air bubbles could be noticed within the left atrium. A fistula between the esophagus and the laceration on the atrial wall between the right and left pulmonary vein orifices was detected. The defect was repaired with pericardial-pledgeted sutures. At the end of the operation the patient was transferred to the

Figure 1. A, The connecting points of 2 overlapping circles (arrows) around right and left pulmonary veins are the stress points receiving twice the dose of RF, thus are the most vulnerable points in the posterior wall of the left atrium neighboring the esophagus. B, Connecting line between 2 circles should be as high as possible to avoid heat injury of the esophagus (the hatched area represents the posterior wall of the left atrium in close neighborhood with the esophagus). RSPV, Right superior pulmonary vein; RIPV, right inferior pulmonary vein; LSPV, left superior pulmonary vein; LIPV, left inferior pulmonary vein.