analyses of stroke risk reduction in nonvalvular atrial fibrillation (NVAF) used lifetime analyses ranging from 20 to 30 years. Similarly, we reported lifetime results and demonstrated LAAC was the most cost-effective therapy relative to warfarin and NOACs. We questioned the relevance of these lifetime results for some decision makers, given the reduced life expectancy of many Medicare patients with NVAF. In an effort to be as informative as possible, and in accordance with good research practices published by the International Society for Pharmacoeconomics and Outcomes Research (3), we reported cost-effectiveness ratios at various time horizons. Nonetheless, we strongly support the caution provided by Drs. Singh and Wijeysundera and acknowledge that results may be misinterpreted if an inappropriately short time horizon is used, especially when a device-based procedure is compared to chronic pharmacologic therapy. However, we observed that once cost effectiveness was achieved, it was maintained over the lifetime horizon. This bolsters confidence in the results and appropriateness of reporting time to cost effectiveness.

*Vivek Y. Reddy, MD
Ronald L. Akehurst, DSc
Stacey L. Amorosi, MA

*Helmsley Trust Electrophysiology Center
Icahn School of Medicine at Mount Sinai
One Gustave L. Levy Place, Box 1030
New York, New York 10029
E-mail: Vivek.Reddy@mountsinai.org

http://dx.doi.org/10.1016/j.jacc.2016.01.078

Please note: Drs. Reddy and Akehurst are paid consultants for Boston Scientific. Ms. Amorosi is an employee of Boston Scientific. Bruce D. Lindsay, MD, served as Guest Editor for this paper.

REFERENCES

1. Reddy VY, Akehurst RL, Armstrong SO, et al. Time to cost-effectiveness following stroke reduction strategies in AF: warfarin versus NOACs versus LAA closure. J Am Coll Cardiol 2015;66:2728–39.

2. Ruff CT, Giugliano RP, Braunwald E, et al. Comparison of the efficacy and safety of new oral anticoagulants with warfarin in patients with atrial fibrillation: a meta-analysis of randomized trials. Lancet 2014;383:955–62.

3. Ramsey S, Willke R, Briggs A, et al. Good research practices for cost-effectiveness analysis alongside clinical trials. Value Health 2005;8:521–33.

Our Perspective on Ventricular Arrhythmias Originating From Pulmonary Sinus Cusp

We read with great interest the paper by Liao et al. (1), wherein they proposed the novel concept of ventricular arrhythmias originating from pulmonary sinus cusp and used reversed U curve catheter method for successful ablation. It is a new method for treating complicated and hard-to-ablate ventricular arrhythmias in the clinic. However, we have some reservations about this paper.

First, this study (1) showed that the site of pulmonary left sinus was the lowest, but the electrocardiographic characteristics (Table 2) illustrated that R wave amplitude in the leads II, III, and aVF of patients with ventricular arrhythmias originating from left pulmonary sinus were higher than those originating from right and front sinuses. Theoretically, the lower the originating site, the lower would be the R wave amplitude of the inferior lead, which was opposite in this paper.

Second, in previous reports, pulmonary artery-derived ventricular arrhythmias were believed to originate mostly from pulmonary sinus cusp. In 17% of the patients with ventricular arrhythmias, mean ventricular myocardial extensions (VME) 3.25 ± 1.3 mm long and 0.83 ± 0.71 mm thick could be observed. This was pathological anatomy basis for pulmonary artery-derived ventricular arrhythmias (2) and could also explain that most such arrhythmias originated from the pulmonary root, that is, the pulmonary sinus cusp. The study by Liao et al. (1) also demonstrated that 24 cases of pulmonary artery-derived ventricular arrhythmias originated from pulmonary sinus cusp.

Third, we believe that not all ventricular arrhythmias originating from pulmonary sinus cusp need reversed U curve catheter method for ablation. Pulmonary valve is composed of left, right, and front cusp. The right and front sinuses attach to the free lateral wall of pulmonary conus in the right ventricle, and the left one attaches to the interventricular septum (3,4). The activity of right ventricle and pulmonary free lateral wall is higher than that of interventricular septum, and the reversed U curve catheter method for ablation can increase the stability and attachment degree of ablation catheter. Therefore, for patients with ventricular arrhythmias originating from right and front pulmonary sinuses, using reversed U curve catheter method can increase the efficiency and success rate of ablation. The left pulmonary sinus attached to interventricular septum has lower activity and is easy to attach with good stability. Currently, at our institute, conventional method (nonreversed U curve catheter method) is used to successfully ablate ventricular arrhythmias originating from left pulmonary sinus cusp. Sekiguchi et al. (5) also used nonreversed U curve catheter method to ablate such arrhythmias. Left sinus is

closer to coronary artery than right and front sinuses. The ablation by reversed U curve catheter method will make the tip of the catheter closely attach to the arterial wall. It makes ablation energy passing through the arterial wall stronger, which increases the risk of coronary artery damage. Therefore, how to use or whether to choose reversed U curve catheter method to perform ablation for ventricular arrhythmias originating from pulmonary sinus cusp and avoid the occurrence of complications is an important issue that needs further study.

Yufan Yang, MD
***Qiming Liu, MD, PhD**
Shenghua Zhou, MD, PhD
Yichao Xiao, MD

*Second Xiangya Hospital attached to Central South University
Cardiac Catheterization Lab and
Department of Cardiology
Second Xiangya Hospital attached to Central South University
139 Middle Renmin Road
Changsha, Hunan, 410011
P.R. China
E-mail: lqiming0731@126.com

http://dx.doi.org/10.1016/j.jacc.2016.01.080

Please note: The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

REFERENCES

1. Liao Z, Zhan X, Wu S, et al. Idiopathic ventricular arrhythmias originating from the pulmonary sinus cusp. J Am Coll Cardiol 2015;66:2633–44.

2. Hasdemir C, Aktas S, Govsa F, et al. Demonstration of ventricular myocardial extensions into the pulmonary artery and aorta beyond the ventriculoarterial junction. Pacing Clin Electrophysiol 2007;30:534–9.

3. Gross L, Kugel MA. Topographic anatomy and histology of the valves in the human heart. Am J Pathol 1931;7:445–73.

4. Azadani AN, Chitsaz S, Matthews PB, et al. Regional mechanical properties of human pulmonary root used for the Ross operation. J Heart Valve Dis 2012;21:527–34.

5. Sekiguchi Y, Aonuma K, Takahashi A, et al. Electrocardiographic and electrophysiologic characteristics of ventricular tachycardia originating within the pulmonary artery. J Am Coll Cardiol 2005;45:887–95.

REPLY: Our Perspective on Ventricular Arrhythmias Originating From Pulmonary Sinus Cusp

We thank Dr. Yang and colleagues for their interest in our paper (1). First, we agree with their comment that the R wave amplitude of the inferior leads in ventricular arrhythmias (VAs) from the right pulmonary sinus cusp (PSC) is significantly lower than that of VAs from the anterior and left cusp, although the right cusp (RC) is anatomically higher than the anterior and left cusp. This phenomenon can be explained by the anatomical features that the right and anterior PSCs attach to the free wall of pulmonary conus in the right ventricle, and the left one attaches to the interventricular septum. Second, in RC VAs, the phased excitation from the right ventricular free wall to the left ventricle leads to a decreased absolute R wave magnitude and a prolonged total QRS duration in the inferior leads, whereas in the left cusp (LC) VAs, the 2 ventricles are excited almost simultaneously, resulting in a higher absolute R wave magnitude in the inferior leads and a shorter QRS duration. The finding was similar to that of VAs from right ventricular outflow tract free wall and septum (2).

Furthermore, we concur with the authors that the anatomical location of arrhythmogenic foci in our study is within or near the PSC, which was confirmed by activation and pace mapping and successful ablation within the PSC. Also, pathology studies supported the finding that the right ventricular myocardium extended at the base of all 3 PSCs, and fibrosis and fatty tissue among these muscular sleeves can lead to arrhythmogenesis due to abnormal automaticity and conduction (3).

Third and finally, the PSC anatomically straddles the right ventricular outflow tract with short distance between the right ventricular outflow tract septum and LC as shown in our 3-dimensional map in Figures 2 to 4 (1). Theoretically, the LC VAs can be successfully ablated with the conventional method and high energy when the known anatomical distance is very close. However, in our study, previously failed ablation was observed in 7 patients who underwent conventional ablation method. During the study, radiofrequency energy delivery just below the PSC in the initial 7 patients resulted in transient disappearance of VAs in 4 and slight changes of QRS morphology in the other 3 patients, in whom VA originated from the LC in 1 patient (Figure 6 [1]). Definitely, we do not know whether VAs from LC could be abolished with conventional ablation method in all 8 patients because RF was delivered with conventional ablation method in only 2 patients. By using the reversed U curve catheter method, we were able to map the PSC, and better contact with effective energy delivery within the PSC could be achieved. Additionally, no complications of pulmonary artery stenosis or damage to the coronary artery occurred in our patients, although the LC is very close to left coronary artery. It can be explained that high flow in the PSC and coronary artery in our young patients can prevent this potential injury. Therefore, we recommended that careful attention be paid to power and impedance