

Pulmonary Vein Electrical Isolation for the Cure of Paroxysmal Atrial Fibrillation Guided by a Novel Geometry Mapping System

CAIYI LU, SHIWEN WANG, XINPING DU, YINGLONG HOU, QIAO XUE, XINLI WU, RUI CHEN, PENG LIU

From The Institute of Geriatric Cardiology, 301 Hospital, Beijing, China

LU ET AL.: Pulmonary Vein Electrical Isolation for the Cure of Paroxysmal Atrial Fibrillation Guided by a Novel Geometry Mapping System. Objectives: The purpose of the study is to evaluate the feasibility and effect of left wall (LA) ablation guided by a novel geometry mapping system in the treatment of older patients with paroxysmal atrial fibrillation (PAF). **Methods:** Regular electrophysiological study was conducted to exclude atrioventricular reentrant tachycardia (AVRT) with accessory pathways, atrioventricular nodal reentrant tachycardia (AVNRT) and other inducible tachyarrhythmias. Twice transseptal puncture was achieved with L1 and R1 Swartz sheaths. Pulmonary vein (PV) angiographies were conducted to evaluate their orifices and branches. LA geometry was constructed under either sinus rhythm or PAF using Ensight3000 Navx system. Two lesion loops and three lines (see details in the text) for electrical isolation were outlined and created by radiofrequency catheter ablation on the three-dimension geometry of LA. Each lesion point was ablated in 30 seconds with preset temperature 50°C and energy 30W. The disappearance or 80% decrease of the amplitude of LA target potential and 10 to 20 Ω decrease of ablation impedance were used as effective index. **Results:** Three patients included two males and one female of age 67.3 ± 3.6 . PAF history was 7.4 ± 5.1 years. Mean 3.5 ± 1.2 antiarrhythmic agents were used in 5.7 ± 2.3 years without PAF effectively prevention. No organic heart diseases and stroke complications were founded. Left atrium was 38.7 ± 3.2 mm and LVEF was 58.6 ± 4.3 on echocardiography. Altogether 59-126 (63.7 ± 11.2) lesion points were created to complete two loops and three lines. Rapid burst pacing up to 600 beats per minute was delivered from the distal coronary sinus electrode pair without PAF provoked. The procedure time was 2.8 ± 0.7 hours and fluoroscopy time was 19.6 ± 8.3 minutes. Patients were discharged with long-term oral warfarin and without any antiarrhythmic agent. During the follow up of 5.6 ± 2.3 months, one patient was free of symptom and PAF attacks were decreased more than 80% in the other two patients by evaluation of Holter monitoring. **Conclusions:** Ensight3000 Navx guided LA wall ablation near PV orifice to cure PAF in the elderly is safe and feasible and has the advantages of clear procedure endpoint, shorter X-ray exposure, less complication and satisfied long-term effect. Large number of cases and long-term follow up data are needed to validate these primary results. (J HK Coll Cardiol 2004;12: 58-63)

Electrophysiology, paroxysmal atrial fibrillation, radiofrequency ablation

摘要

目的：評價新型電解剖標測設備指導的左心房壁消融肺靜脈隔離術治療老年人陣發性房顫(PAF)的可行性和效果。

方法：常規電生理檢查除外房室折返性心動過速(AVRT)、房室結折返性心動過速(AVNRT)和其他可誘發性快速心律失常。兩次房間隔穿刺分別送入Swartz L1和R1長鞘，肺靜脈造影評價其開口及其分支。在竇律或房顫下對左房採用Ensight3000 Navx作電解剖構形，以導管射頻消融法在左右心房製作兩個消融環和三條消融線。每個消融點放電

Address for reprints: Dr. Caiyu Lu

The Institute of Geriatric Cardiology, 301 Hospital, 28 Fuxing Road, Beijing 100835, China

Fax: (86) 10-68225548

Received May 21, 2004; revision accepted September 21, 2004

30秒，預設溫度 50°C ，能量30瓦，消融點左房電位消失或振幅降低80%、阻抗下降 $10\sim 20\Omega$ 為放電終點。**結果：**3例病人中男2例，女1例，平均年齡 67.3 ± 3.6 歲，PAF病史 7.4 ± 5.1 歲，服用抗心律失常藥物 3.5 ± 1.2 種效果不佳。無器質性心臟病，左房直徑 $38.7\pm 3.2\text{ mm}$ ，LVEF $58.6\pm 4.3\%$ 。兩個環和三條線共由59-126 (63.7 ± 11.2)個消融點組成，經冠狀竇快速心房刺激不能誘發PAF。手術操作時間 2.8 ± 0.7 小時，透視時間 19.6 ± 8.3 分鐘。隨訪 5.6 ± 2.3 月，1例病人無PAF發作，2例病人Holter檢查。**結論：**Ensite3000 Navx 指導的肺靜脈口左房壁消融法治療老年人PAF安全有效，具有操作終點明確、透視時間短、併發症少和遠期效果好的優點。這一初步結論需積累更多病例和隨訪結果加以驗證。

關鍵詞：電生理 陣發性房顫 射頻消融

Paroxysmal atrial fibrillation (PAF) in elderly is usually triggered or driven by electrical foci originated from atrial muscle sleeves (AMS) mostly from pulmonary veins.¹ PAF could be cured either by ablating AMS focus or isolating target AMS electrically.^{2,3} Due to the high recurrence rate of the former technique, later therapies are more frequently used in clinical interventional electrophysiology.⁴ Radiofrequency (RF) catheter ablation at the orifice of target pulmonary vein (TPV) was used at first in the cure of PAF, but early and long-term stenosis of TPV limited the usage of the method.³⁻⁵ Therefore, novel non-contact geometry mapping systems are used to guide the isolation of AMS in the left atrial wall just near their orifice.⁶ Ensite3000 Navx is one of these new systems. The main difference between Ensite3000 Navx and Carto quick map is the former adapts a regular RF large tip catheter to construct left atrial and AMS geometry and creates the RF lesion circles or lines at either sinus rhythm or PAF rhythm. Three older PAF patients were treated with Ensite3000 Navx and clinical effect and experience were reported.

Clinical Data

Three patients included two males and one female of age 67.3 ± 3.6 . PAF history was 7.4 ± 5.1 years. Mean 3.5 ± 1.2 antiarrhythmic agents (including amiodarone, propafenone, propranolol, sotalol, quinidine, etc.) were used in 5.7 ± 2.3 years without PAF effectively prevention. One male

case had controlled hypertension. No other organic heart diseases and stroke complications were founded in all patients. Left atrium was $38.7\pm 3.2\text{ mm}$ and LVEF was 58.6 ± 4.3 on echocardiography. Repetitive P' on T atrial prematures and PAFs were confirmed by regular ECG (Figure 1) and Holter monitoring.

Electrophysiological Study

After written informed consents were obtained, regular electrophysiological studies were conducted to exclude atrioventricular reentrant tachycardia (AVRT) with accessory pathways (AVAP), atrioventricular nodal reentrant tachycardia (AVNRT) and other inducible tachyarrhythmias. The methodology of standard electrophysiological study was reported elsewhere and briefly described as follows. A decapolar electrode catheter was placed in the distal coronary sinus via left subclavicle vein. A tetrapolar electrode catheter (Josephson curve) was put at His bundle branch and another catheter (Cournad curve) was settled at the high right atrium at first and then right ventricular apex. Both programmable and non-programmable electrical stimulations were conducted via high right atrium and right ventricular apex electrode pairs with two times of diagnostic threshold value and 0.5 ms pulse width. AVRT and AVNRT were not found according to their electrophysiological criteria. PAF could be induced with high rate burst pacing at distal coronary sinus in two patients.

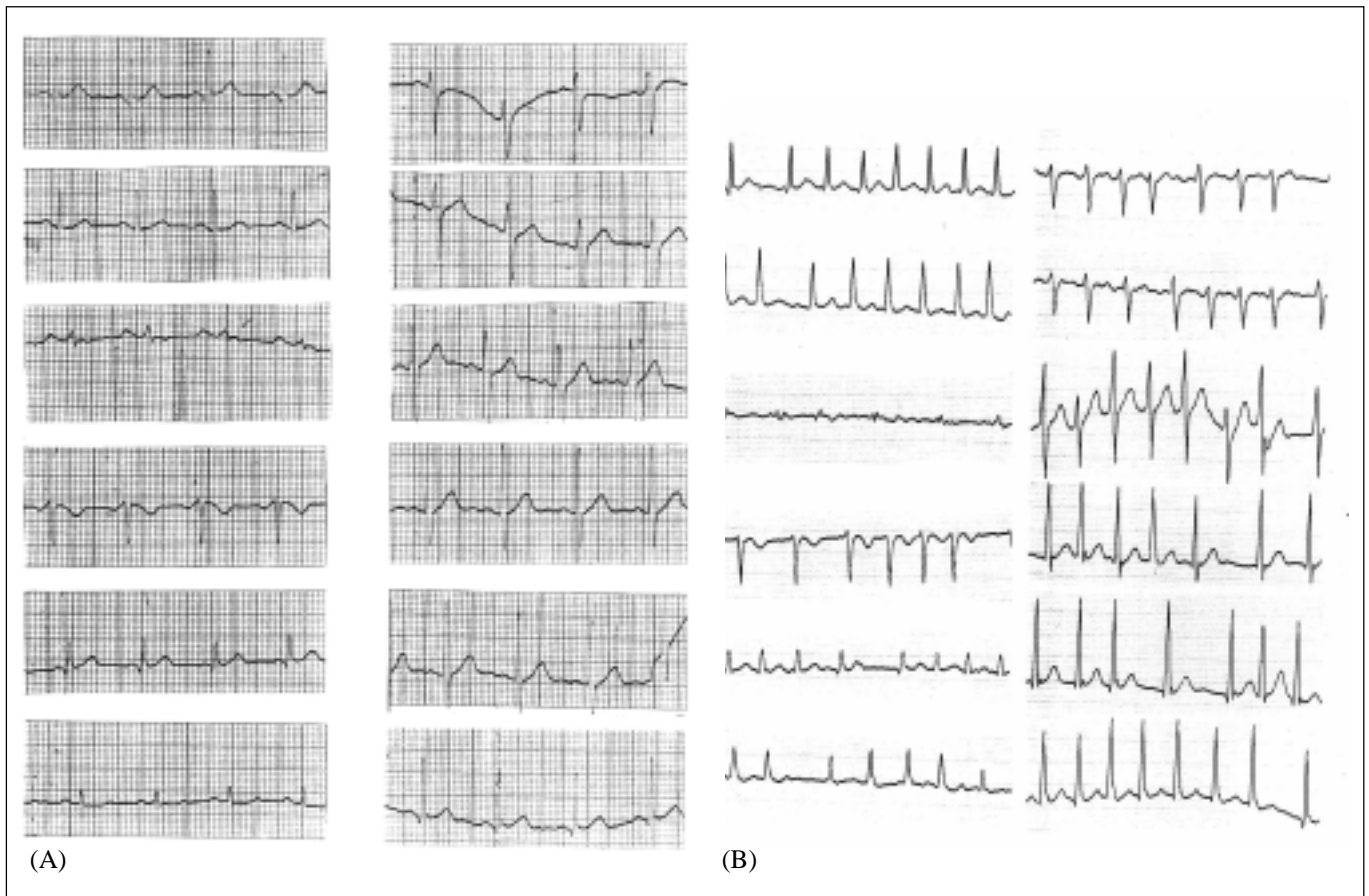


Figure 1. Twelve lead ECG during sinus rate (A) and paroxysmal atrial fibrillation (B).

Pulmonary Vein Identification and Geometry Creation

Twice transseptal puncture was achieved with L1 and R1 Swartz sheaths. A large-tip ablation catheter (Bard Co., 7F) and a non-contact balloon mapping catheter were introduced into left atrium (LA). The tip of the balloon mapping catheter was mounted at the left superior pulmonary vein with a 0.035 inch wire. Pulmonary vein angiographies were conducted to evaluate their orifices and branches (Figure 2A). LA geometry was constructed under either sinus rhythm or PAF using Ensight3000 Navx system (Figure 2B) and the large-tip ablation catheter as land mark in LA chamber. On the three-dimension

geometry of LA, two ablation loops and two ablation lines for electrical isolation were outlined. The two loops encircled left and right sided pulmonary vein orifices respectively. The top line connected two loops on the roof of LA and the bottom line linked between the lower part of the left loop and the lateral part of mitral valvular ring.

Radiofrequency Catheter Ablation

Along with the loops and lines, radiofrequency ablation was delivered to form continuous lesion by the direction of Ensight3000 Navx system. Each lesion point was ablated in 30 seconds with preset

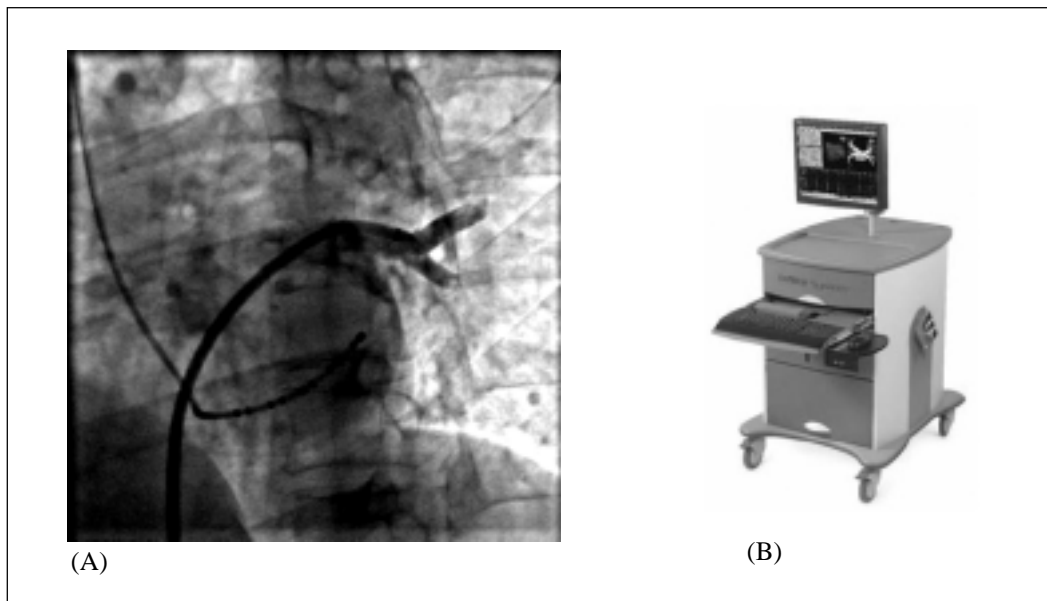


Figure 2. (A) Left superior pulmonary vein angiography through a trans atrial septal sheath positioned at the pulmonary vein ostium. (B) Configuration of a novel three-dimensional electro-anatomical mapping system Ensite3000 Navx.

temperature 50°C and energy 30W. The disappearance or 80% decrease of the amplitude of target potential and 10 to 20 Ω decrease of ablation impedance were used as effective index. Altogether 59-126 (63.7 ± 11.2) lesion points were needed to complete the two loops and two lines (Figure 3). Then activation mapping in sinus rhythm on three-dimensional geometry was repeated to confirm the electrical disconnection between PVs and LA. Rapid burst pacing up to 600 beats per minute was delivered from the distal coronary sinus electrode pair to provoke PAF. After that, the geometry of right atrium was constructed by withdrawing the balloon and ablation catheter. Radiofrequency lesion line between tricuspid ring and inferior vena cava was achieved with another 6 lesion points (Figure 4). The procedure time was 2.8 ± 0.7 hours and fluoroscopy time was 19.6 ± 8.3 minutes. Total 10 mg morphine was injected intravenously during the period of energy delivery.

Follow Up

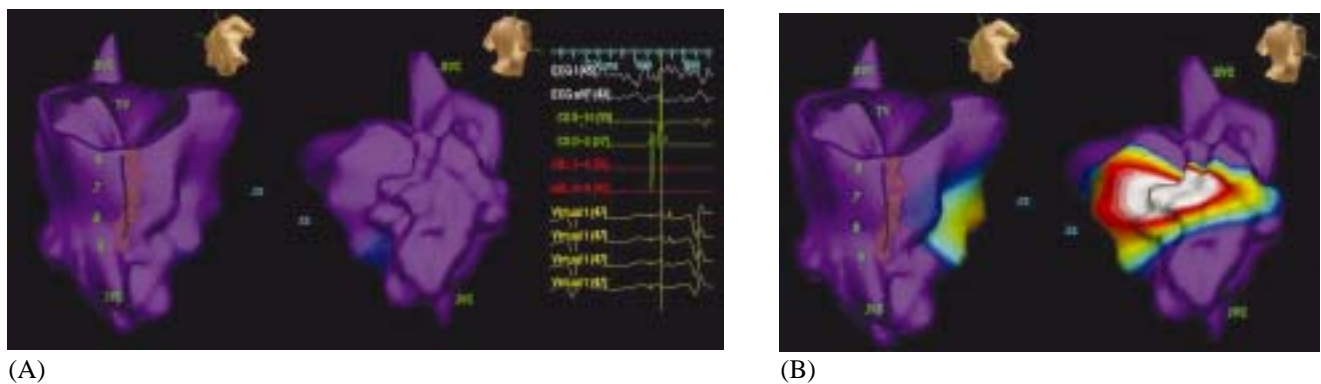
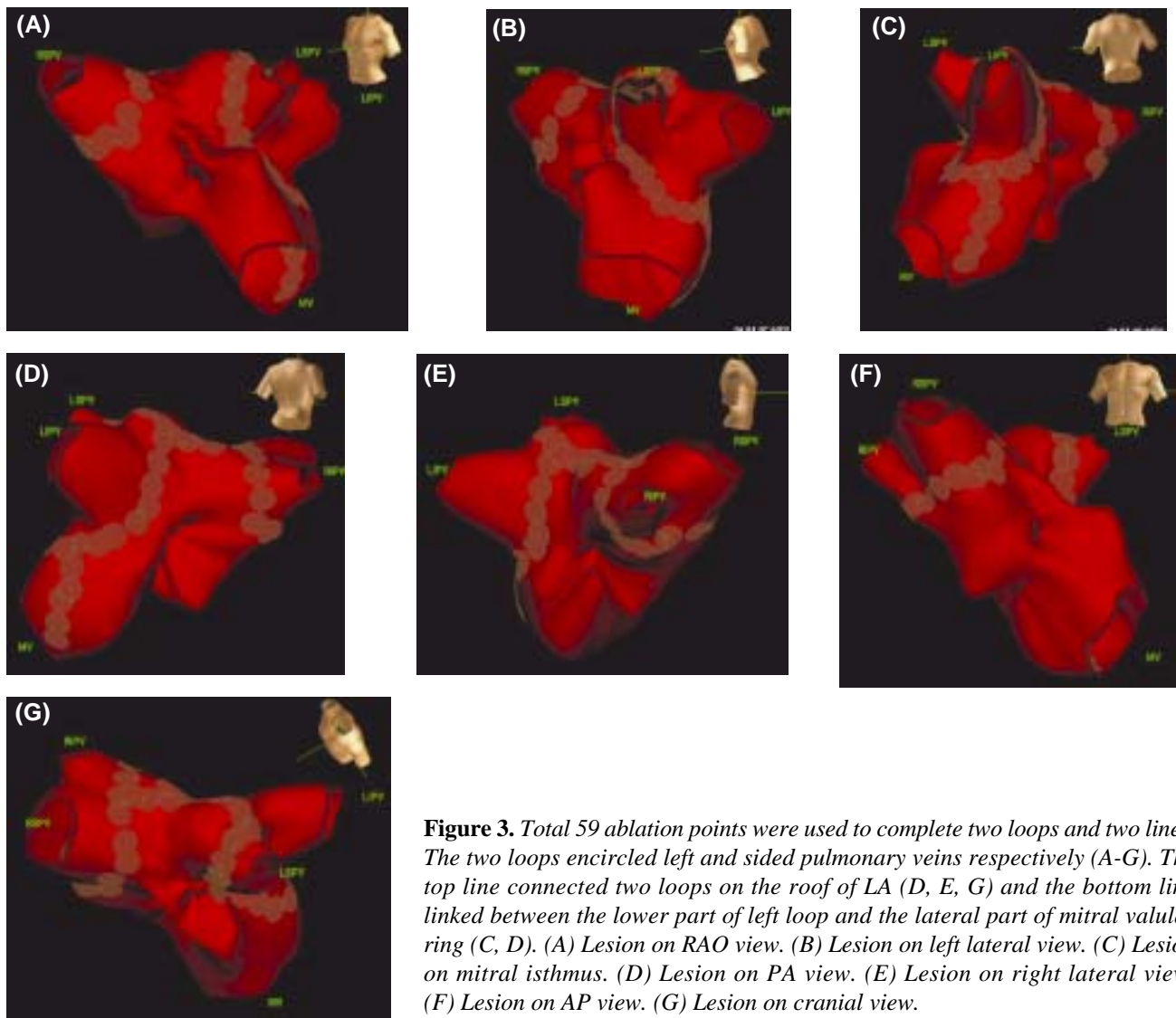
The patients were discharged with long-term oral warfarin and without any antiarrhythmic agent.

During the follow up of 5.6 ± 2.3 months, one patient was free of symptom and PAF attacks were decreased more than 80% in the other two patients by evaluation of Holter monitoring.

Discussion

Most focal PAFs could be cured by completely isolating target pulmonary vein electrically.¹⁻⁴ PV isolation could be achieved by spike potential guided catheter ablation at its orifice or by geometry mapping guided circular isolation on the LA wall just near its orifice.^{5,6} Different procedures have the different procedure end point and long-term effect.^{7,8}

Spike potential guided ablation or segmental PV ostial ablation under X-rays suffered with technical challenges associated with identification of PV potential, complete electrical isolation, long distance of PV-LA junction, focus mapping within target PV, irregular PV orifice, long operation and X-ray exposure time, and potential PV stenosis.^{4,6-8} In contrast, left atrial wall ablation near PV orifice guided by non-contact electro-anatomical mapping,⁵ which includes two lesion loops around the left and



right-sided PVs, one lesion line on the roof of LA between two loops, and one lesion line from left loop to the mitral valular ring, can overcome above disadvantages and achieve complete PV isolation. The two lesion lines also have the effect of LA atrial flutter prevention.

From these cases, it is found that Ensite3000 Navx guided LA wall ablation near PV orifice to cure PAF is safe and feasible and has the advantages of clear procedure endpoint, shorter X-ray exposure, less complication and satisfactory long-term effect. Large number case experience and long-term follow up data are needed to validate these primary results.

References

1. Haissaguerre M, Jais P, Shah DC, et al. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. *N Engl J Med* 1998;339:659-66.
2. Haissaguerre M, Shah DC, Jais P, et al. Catheter ablation of atrial fibrillation: targeting the triggers. In: Zipes DP, Haissaguerre. (eds). *Catheter ablation of arrhythmias*. 2nd edition. New York: Futura Publishing Company, Inc, 2002, pp89-105.
3. Chen SA, Hsieh MH, Tai CT, et al. Initiation of atrial fibrillation by ectopic beats originating from the pulmonary veins: electrophysiological characteristics, pharmacological responses, and effects of radiofrequency ablation. *Circulation* 1999;100: 1879-86.
4. Oral H, Knight BP, Ozaydin M, et al. Clinical significance of early recurrences of atrial fibrillation after pulmonary vein isolation. *J Am Coll Cardiol* 2002;40:100-4.
5. Stabile G, Turco P, La Rocca V, et al. Is pulmonary vein isolation necessary for curing atrial fibrillation? *Circulation* 2003;108:657-60.
6. Seidl K, Schwacke H, Zahn R, et al. Catheter ablation of chronic atrial fibrillation with noncontact mapping: are continuous linear lesions associated with ablation success? *Pacing Clin Electrophysiol* 2003;26(2 Pt 1):534-43.
7. Pappone C, Rosanio S, Augello G, et al. Mortality, morbidity, and quality of life after circumferential pulmonary vein ablation for atrial fibrillation: outcomes from a controlled nonrandomized long-term study. *J Am Coll Cardiol* 2003;42:185-97.
8. Ellenbogen KA, Wood MA. Ablation of atrial fibrillation: awaiting the new paradigm. *J Am Coll Cardiol* 2003;42:198-200.