VIA MEDICA

EDITORIAL

Cardiology Journal
2011, Vol. 18, No. 2, pp. 117–118

ISSN 1897–5593

Computed tomography imaging of the coronary sinus: A valuable preoperative screen for resynchronization therapy?

Mark Preminger, Seth Uretsky, Jonathan S. Steinberg

Al-Sabah Arrhythmia Institute and Division of Cardiology, St. Luke's and Roosevelt Hospitals, Columbia University College of Physicians and Surgeons, New York, NY, USA

Article p. 146

The study by Młynarska et al. [1] expands upon two previous studies [2, 3] evaluating the ability of multi-detector computed tomography (MDCT) imaging to visualize the coronary sinus (CS) and its branches in patients undergoing placement of a cardiac resynchronization therapy (CRT) system.

As previously observed, the main body of the CS could be reasonably well visualized, whereas the lateral coronary veins were less well visualized. In general, successful endovascular implantation of a CRT device can be accomplished in 90–97% of cases [4, 5]. Following implantation, approximately two thirds of patients will improve clinically, with the remaining third being described as 'non-responders'. In order for MDCT image reconstruction to be of value, it must provide information that will lead either to an increase in the success rate for implantation, an improvement in the efficiency of the procedure, or provide information leading to the identification of a means of addressing non-responders. There can be several explanations for a failure to successfully implant a CS lead. These include failure to engage and cannulate the ostium of the CS, failure to advance sheaths into the CS due to proximal tortuosity of the vessel, acute angle takeoffs of the target venous branches, venous stenosis, complete lack of suitable veins, and the relative proximity of the target vessel to the phrenic nerve leading to diaphragmatic pacing.

Imaging techniques would specifically need to identify the location of the CS ostium and visualize the proximal 2 to 3 cm of the CS, rather than the main body of the CS. Beyond this, imaging of the origin and extent of the lateral veins are more important. Improvements in sheath design, lead size, and venoplasty techniques address many of these obstacles. The incremental benefit that would be provided by pre-procedural CT imaging of the CS anatomy is unclear and was not tested in the current study. Indeed, as the authors point out, CT imaging comes at the expense of approximately 120 mL contrast agent and exposure to radiation. Nor does it obviate the need for X-rays and contrast use during the actual procedure.

Current procedure times for resynchronization device implantation range from just over one hour to more than three hours for difficult cases. Road mapping techniques using standard fluoroscopy in orthogonal views provide information. Newer techniques such as high speed rotational angiography [6–8] allow for three-dimensional reconstruction of the CS in real time. In some laboratories, this technique can be combined with the use of remote magnetic navigation to direct a magnetic guidewire to a distal coronary sinus branch through areas of tortuosity [9, 10]. New echocardiographic techniques can identify regions of delayed left ventricular activation. Correlation between lead position and the area of most delayed activation may predict the greatest response to resynchronization therapy [11]. Provided the location, size and extent of the target branches can be identified with MDCT, coupling this with an echocardiogram in order to identify target regions of dyssynchrony could begin to address the third of patients who do not respond to

Address for correspondence: Jonathan S. Steinberg, MD, Division of Cardiology, St. Luke's and Roosevelt Hospitals, 1111 Amsterdam Avenue, New York, NY, USA 10025, tel: (212) 523 4009, fax: (212) 523-3915, e-mail: jss7@columbia.edu

resynchronization therapy and determine implantation tactics, or even whether a patient should undergo CRT. Unfortunately, echocardiographically targeting lead placement sites has yet to be proven of value in large-scale clinical trials.

From a technical point of view, the authors found that none of the vessels had excellent image quality and most of the venous branches had poor or moderate quality. These findings must be seen in the context that the CT scans were carried out to detect coronary artery disease utilizing a protocol to maximize contrast in left-sided structures and minimize contrast in right-sided structures. This protocol results in almost no contrast in the cardiac venous system, and probably contributed to the overall disappointing image quality reported. A protocol timed to maximize contrast in the cardiac venous system would result in higher quality images. Dedicated venous imaging may yield high-quality images that can be used to construct an 'endovascular' view similar to that of the left atrium and pulmonary veins often utilized prior to pulmonary vein ablation procedures. Quality images could yield potentially useful data such as the size of the CS ostium, the angle of CS takeoff, and the distance to venous branches. This should be tested in future studies. Furthermore, as the authors note, their studies were performed in patients with mostly normal systolic function, who will clearly differ from patients with left ventricular dysfunction in whom CRT devices are implanted.

In summary, this study adds to the information available on MDCT. However, its practical value may be swiftly superseded by newer imaging technologies that allow for imaging and 3-D reconstruction to be acquired in real time.

References

1. Młynarska A, Młynarski R, Kargul W, Sosnowski M. Quality of visualization of coronary venous system in 64-slice computed tomography. Cardiol J, 2011; 18: 146–150.
2. Mlynarski R, Sosnowski M, Wlodyka A, Kargul W, Tendera M. A user-friendly method of cardiac venous system visualization in 64-slice computed tomography. Pacing Clin Ectrophysiol, 2009; 32: 323–329.
3. Mlynarski R, Sosnowski M, Wlodyka A, Chromik K, Kargul W, Tendera M. Optimal image reconstruction intervals for noninvasive visualization of the cardiac venous system with a 64-slice computed tomography. Int J Cardiovasc Imag, 2009; 25: 635–641.
4. Burkhardt JD, Wilcoff BL. Interventional electrophysiology and cardiac resynchronization therapy, delivering electrical therapies for heart failure. Circulation, 2007; 115: 2208–2220.
5. Worley S. Left ventricular lead implantation. In: Ellenbogen KA, Kay GN, Lau CP, Wilcoff BL eds. Clinical cardiac pacing, defibrillation and resynchronization therapy. Saunders Elsevier, Philadelphia, PA 2007: 655.
6. Mansour M, Reddy VY, Singh J, Mela T, Rasche V, Ruskin J. Three--dimensional reconstruction of the coronary sinus using rotational angiography. J Cardiovasc Electrophysiol, 2005; 16: 675–676.
7. Blendea D, Shah RV, Aurichio A et al. Variability of coronary venous anatomy in patients undergoing cardiac resychronization therapy: A high-speed rotational venography study. Heart Rhythm, 2007; 4: 1155–1162.
8. Gutleben KJ, Nolker G, Ritscher G et al. Three-dimensional coronary sinus reconstruction-guided left ventricular lead implantation based on intra-procedural rotational angiography: A novel imaging modality in cardiac resynchronization device implantation. Europace, 2011 (in press).
9. Gallagher P, Martin L, Angel L, Tomassoni G. Initial clinical experience with cardiac resynchronization therapy utilizing a magnetic navigation system. J Cardiovasc Electrophysiol, 2007; 18: 174–180.
10. Rivero-Ayerza M, Jessurun E, Ramcharitar S, Van Belle Y, Serruys PW, Jordaens L. Magnetically guided left ventricular lead implantation based on a virtual three-dimensional reconstructed image of the coronary sinus. Europace, 2008; 10: 1042–1047.
11. Ansalone G, Giannantoni P, Ricci R, Trambaiolo P, Fedele F, Santini M. Doppler myocardial imaging to evaluate the effectiveness of pacing sites in patients receiving biventricular pacing. J Am Coll Cardiol, 2002; 39: 489–499.