Three-Dimensional Reconstruction of the Coronary Sinus With Rotational Angiography

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Background High-speed rotational coronary venous (CV) angiography (RCVA) permits dynamic, multi-angle visualization of the CV anatomy.

Methods and Results RCVA uses a rapid isocentric rotation over a 108° arc, right anterior oblique (RAO) 54° to left anterior oblique (LAO) 54°, in 4 s. Three-dimensional models of the venous tree were reconstructed, and the rotational images were analyzed using a full range of gantry angles, providing the operator with considerably more information about the CV anatomy than standard coronary sinus angiography images (SCVA).

Conclusions The SCVA view, which optimally displayed the appropriate coronary sinus branch for left ventricular lead implantation, was often different from the conventional RAO and LAO views. (Circ J 2008; 72: 1020–1021)

Key Words: Cardiac resynchronization therapy; Coronary sinus; Rotational angiogram

Implantation of the left ventricular lead for biventricular resynchronization devices can be challenging because of the anatomic variations in the branching pattern of the coronary sinus (CS). Standard angiography provides only a static fixed-pattern view of the coronary venous tree. Typically, multipurpose contrast injections are obtained to gain a better understanding of vessel overlap and foreshortening. But even within this information, the site of side branch takeoff, its angulation, and course cannot be reliably predicted in the presence of complex branching patterns. High-speed rotational coronary venous angiography (RCVA) is a newly developed angiographic modality that offers dynamic multi-angle visualization of the coronary venous tree.

In this study, we describe our initial experience with RCVA and evaluate the performance of 3-dimensional (3-D) reconstruction software to reproduce the anatomy of the CS and its branches.

Six patients who underwent radiofrequency ablation for supraventricular tachycardia (n=5) or pacemaker implantation for complete atrioventricular block (n=1) were enrolled into the present study. The CS angiograms were obtained utilizing a 4-s isocentric rotation of the imaging camera (INFX, Toshiba Corp, Tokyo, Japan), acquiring 121 frames over a 108° arc (54° right anterior oblique (RAO) to 54° left anterior oblique (LAO)). After cannulation of the CS with a 6F end-hole balloon catheter, RCVA was performed without contrast dye injection and then during a single bolus injection of 20 ml of contrast after occluding the CS with the balloon. A 3-D model of the coronary venous tree was then reconstructed. Two-D digital subtraction CS angiography taken from RCVA is shown in Fig 1, and 3-D reconstruction of the RCVA is shown in Fig 2. As can be seen in Fig 2, RCVA provides more information about the branching pattern and angulation of the posterolateral coronary venous tree than CS angiography does.

We could obtain good 3-D reconstruction images in 4 of 6 patients. In the other 2 patients, good 3-D reconstruction images could not be obtained because these 2 patients could not hold respiration during the procedure. This is the first report to evaluate coronary venous anatomy with rotational venography and 3-D reconstruction. Previous studies have shown the usefulness of the RCVA and also depicted 3-D reconstruction of CS and a coronary venous tree. However, the 3-D images in those studies were reconstructed from 2 static images of the RCVA (The CardiOp-B System, Paieon, Halifa, Israel). We reconstructed 3-D images of the CS and coronary venous tree with a full-range RCVA. The optimal angle had to be changed significantly to visualize each of the 3 critical stages for left ventricular lead advancement, namely engagement of the CS, the turn from the CS into a first-order tributary, and maneuvering the lead into its final position. Blendea et al reported that the optimal angle for viewing different segments of the coronary venous tree varied between patients and spanned the full range of the 110° arc. They also showed that for a lead implant in the posterior vein (PV) territory, these angles were significantly different for each of the 3 stages: LAO 45±9° (CS), LAO 11±25° (CS-PV junction), and LAO 5±27° (PV branch). Similarly, for an implant in the lateral vein (LV) territory, the angles for each stage were quite different: LAO 45±9° (CS), LAO 1±20° (CS-LV junction), and RAO 14±22° (LV branches).

RCVA shows that the optimal view for left ventricular lead placement is specific to the patient and the underlying coronary venous anatomy and might change depending on the part of the coronary venous tree being evaluated. Fur-
Moreover, 3-D reconstruction of the RCVA can show the CS and coronary venous tree images from a cranial or caudal view, thus providing the operator with considerably more information about the coronary venous tree than standard angiographic images do.

References


