Novel Post-Processing Image for the Visualization of the Coronary Sinus by Multidetector-Row Computed Tomography Before Cardiac Resynchronization Therapy

—— Edge-Enhanced Image ——

Minoru Yamada, MS; Masahiro Jinzaki, MD*; Sachio Kuribayashi, MD*; Kozo Sato, MD*; Yutaka Tanami, MD*; Kotaro Fukumoto, MD**; Kojiro Tanimoto, MD**; Toshiaki Sato, MD**; Kyoko Soejima, MD**; Satoshi Ogawa, MD**

Background  Before performing cardiac resynchronization therapy (CRT), it is useful to visualize the position of the coronary sinus (CS) orifice where the CS lead is inserted.

Methods and Results  A raysum image was created in which the outermost 1-voxel layer of the right atrium (RA) and CS was extracted. This image enabled visualization of the positional relationship between the RA and CS ostium using the same geometry as retrograde CS venography.

Conclusion  New post-processing imaging of the CS orifice will make the procedure of CRT safer.

Key Words:  Cardiac resynchronization therapy; Coronary vein; Multidetector-row computed tomography

In recent years, multidetector-row computed tomography (MDCT) has been used for imaging the heart and its application has been extended to evaluation of the coronary vein before cardiac resynchronization therapy (CRT). When performing CRT, it is important to examine the anatomy of the patient’s coronary vein beforehand in order to plan the placement of the left ventricular lead on which coronary vein is inserted, because the patients who need the CRT have an enlarged right atrium (RA) from heart failure and thus the actual position of the CS ostium may differ from its normal position. CS injury is a complication of CRT. Post-processing techniques following MDCT data acquisition enable enhanced visualization of the anatomical structure. We propose a novel post-processing image that can guide the insertion of the CS lead into the CS ostium, and present its advantages.

The newly proposed post-processing image can be created in 3 steps after obtaining static axial source images of the whole heart. First, the RA and CS are segmented. Second, only 1 voxel from the outermost zone of the segmented data is extracted. Third, the sum of the voxel values is projected with a hypothetical visualization ray (raysum algorithm). An edge-enhanced image of the RA and CS is produced with parallel projection (Fig 1).

In 16 patients scheduled for CRT, ECG-gated contrast-enhanced computed tomography (CT) scan (LightSpeed VCT, GE Healthcare, Milwaukee, WI, USA) was carried out during a single breath-hold. The main scanning parameters were as follows: 64×0.625 mm collimation, 120 kV, 400–500 mA, rotation time of 0.35 s, pitch of 0.20–0.24:1, and

Fig 1.  Edge-enhanced imaging of the right atrium and coronary sinus.
enables the positional relationship between RA and CS vein before performing CRT and the post-processing image cannot be used clinically because the patients who need the addition, it would seem that sufficient contrast medium flows into the coronary vein through the coronary artery. In obtaining a high CT attenuation because the contrast medium threshold of CT attenuation. It is occasionally difficult to contrast medium, whereas the endoscopic view requires a post-processing image can be created regardless of the density of electrophysiology cardiologists. Second, the post-processing image was created as outlined earlier. The RA and CS in all patients could be displayed.

The endoscopic view, one of the post-processing images, is generally used for visualizing of the inner structure of the heart. However, our newly proposed post-processing image has 2 advantages over endoscopy. First, the image has the same geometry as retrograde CS venography (Fig 2), and thus facilitates insertion of the CS lead into the CS ostium. The endoscopic view is quite different from the images obtained by retrograde CS Venography and thus is unfamiliar to electrophysiology cardiologists. Second, the post-processing image can be created regardless of the density of contrast medium, whereas the endoscopic view requires a threshold of CT attenuation. It is occasionally difficult to obtain a high CT attenuation because the contrast medium flows into the coronary vein through the coronary artery. In addition, it would seem that sufficient contrast medium cannot be used clinically because the patients who need the CRT may have lower cardiac function and renal dysfunction.

MDCT has been recently used to evaluate the coronary vein before performing CRT and the post-processing image enables the positional relationship between RA and CS ostium to be assessed in 1 image, as well as demonstrating the CS orifice at the same angle as for retrograde CS venography. We believe our post-processing image will make insertion of the CS lead safer.

Acknowledgments
The authors would like to thank Koichi Sugisawa, RT, Kiyotaka Nakajima, RT, and Yoshitaka Okano, RT, from Keio university hospital, for MDCT data acquisition, and Kotsuko Sasaki, MS, Chisa Hamaguchi, RT, and Koji Segawa, RT, from GE Healthcare, for their technical support.

References