Improved Efficiency in the EP Lab with *syngo* DynaCT Cardiac

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At the University Hospital Gasthuisberg in Leuven, Belgium *syngo* DynaCT Cardiac has become a useful application during ablation therapy. The team in the cardiology department describes their experiences with the system and how it contributes to an efficient workflow and excellent results.

Image integration for ablation of atrial fibrillation

Pre-procedural imaging and three-dimensional (3D) reconstruction of the left atrium and pulmonary veins is performed in the majority of centers before atrial fibrillation (AF) ablation procedures.[1] Detailed anatomical information can help achieve a more effective and successful ablation and may prevent procedure-related complications. Patient-specific 3D models can be integrated with 3D mapping systems. The University Hospital Gasthuisberg pioneered integration of 3D models with real-time biplane fluoroscopic imaging to guide catheter navigation and ablation.[2] Image integration is usually based on cardiac CT or MRI images that are acquired prior to the procedure, and reconstructed into a 3D model for treatment planning. One drawback of this approach is the possibility of changes in the left atrial geometry between imaging and the ablation procedure due to differences in cardiac loading conditions, resulting in inaccurate image integration during the procedure. Moreover, an additional ambulatory hospital visit or earlier hospitalization is often required for the patient to acquire the images necessary for 3D reconstruction. This leads to extra logistical overhead.

syngo DynaCT Cardiac now offers the possibility of CT-like imaging of the left atrium and pulmonary veins during the ablation procedure. At the beginning of 2008, we evaluated a new workflow in which *syngo* DynaCT Cardiac images were acquired during AF ablation procedures and reconstructed into a 3D model for integration with biplane fluoroscopic imaging. Catheter navigation and ablation were guided solely by *syngo* DynaCT Cardiac-based 3D-fluoroscopy integration, without the use of a 3D mapping system. Our goal was to develop a workflow resulting in high quality 3D reconstructions of the left atrial anatomy with the lowest possible patient radiation exposure, eliminating the need for additional pre-procedural imaging and improving image integration accuracy.

Imaging the left atrium with a single C-arm rotation

syngo DynaCT Cardiac offers the possibility for both ungated image acquisition with a single 5-second C-arm rotation over 200°, and an ECG-gated image acquisition using 4 sequential 5-second rotations with retrospective ECG gating. To reduce patient radiation dose, we opted for the ungated acquisition protocol. Images are acquired at 60 frames per second during a single 5-second rotation and were automatically transferred to the Siemens Workplace for 3D reconstruction to axial images and further 3D processing (Fig. 1 A-C). Whereas contrast administration for left atrial *syngo* DynaCT Cardiac examinations is conventionally performed in the pulmonary artery, we developed a new approach in which diluted contrast agent is directly injected into the left atrium. To obtain optimal contrast filling and to reduce cardiac motion artifacts, contrast injection and *syngo* DynaCT Cardiac acquisition were performed after administration of adenosine-triphosphate (ATP) to induce transient ventricular asystole (Fig. 2 A) or during rapid right ventricular pacing to reduce cardiac output and cardiac motion (Fig. 3 A-B). This approach resulted in high quality 3D reconstructions of the left atrium and pulmonary veins, using only a limited dose of ionizing radiation and contrast agent. Given the excellent quality of *syngo* DynaCT Cardiac, pre-procedural imaging with Cardiac CT or MRI is no longer considered necessary for clinical use in our center.

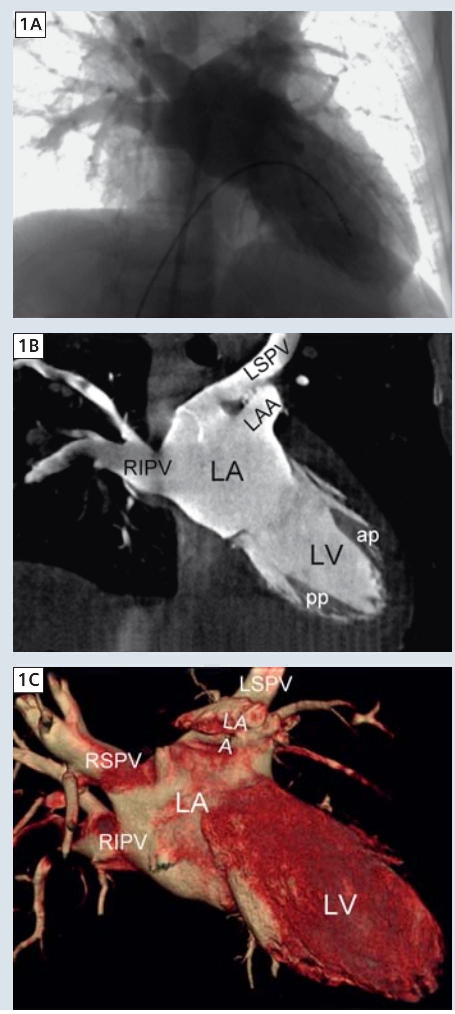
syngo DynaCT Cardiac for 3D image integration

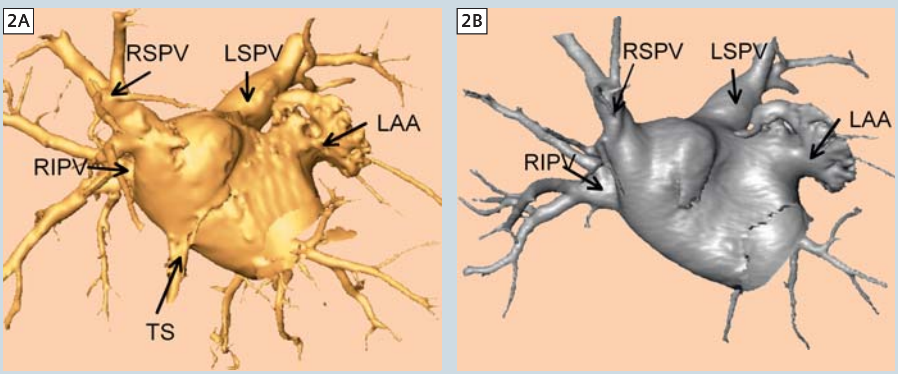
In our opinion, one of the most important advantages of *syngo* DynaCT Cardiac lies in the new possibilities for 3D image integration. AF ablation procedures are performed in our center under general anesthesia. As a result, no patient movements occur and patient position is identical during *syngo* DynaCT Cardiac acquisition and fluoroscopic im-

1A Ungated *syngo* DynaCT Cardiac acquisition (after ATP)

1B 2D Slice Reconstruction

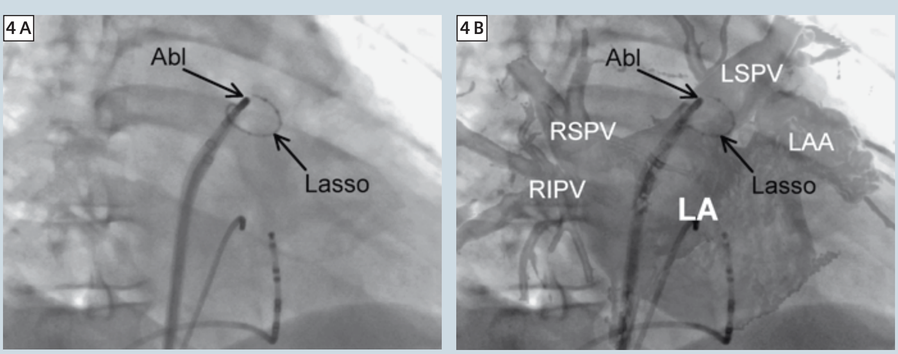
1C 3D Volume Rendering
syngo DynaCT Cardiac: (LA: left atrium, LV: left ventricle, RIPV: right inferior pulmonary vein, LSPV: left superior pulmonary vein, RSPV: right superior pulmonary vein, ap: anterior papillary muscle, pp: posterior papillary muscle, LAA: left atrial appendage)



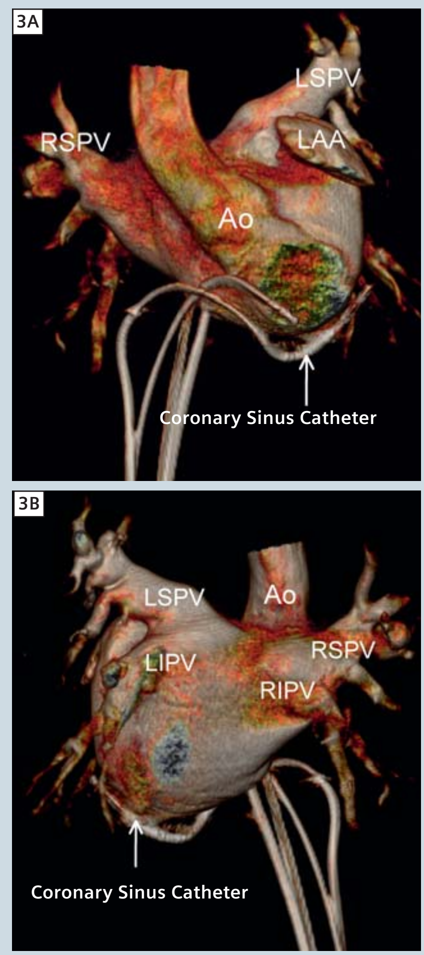


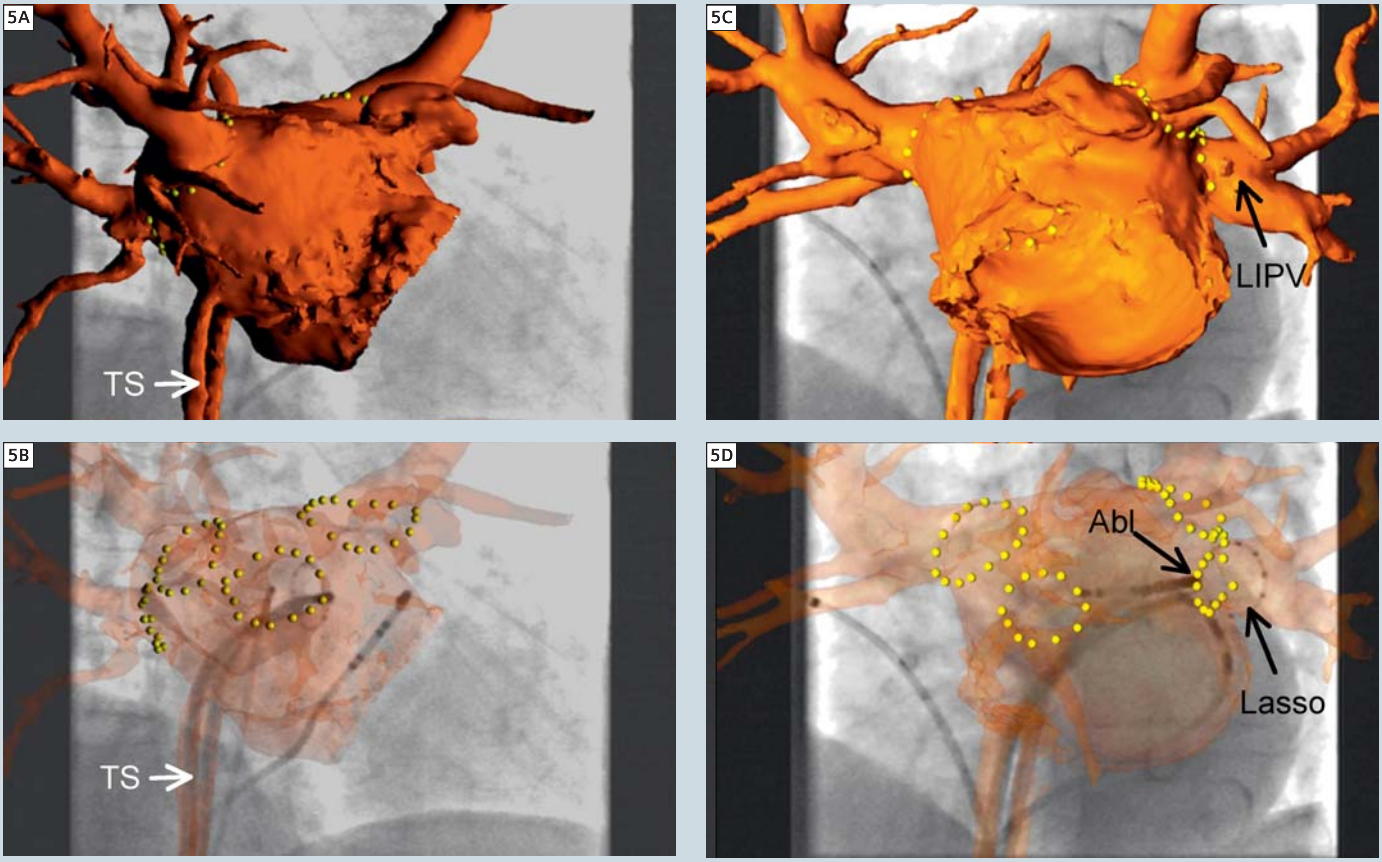
2A *syngo* DynaCT Cardiac, ungated acquisition after ATP

2B *Cardiac CT image*
Comparison of 3D surface models of the left atrium in the same patient, based on ungated *syngo* DynaCT Cardiac acquisition after administration of ATP and ECG-gated 64-slice cardiac CT. The quality and accuracy of the ungated *syngo* DynaCT Cardiac-based 3D model is remarkable. (RSPV: right superior pulmonary vein, RIPV: right inferior pulmonary vein, LSPV: left superior pulmonary vein, LAA: left atrial appendage, TS: transseptal sheath)



4 A+B Integration of *syngo* DynaCT Cardiac-based 3D model of the left atrium with fluoroscopy using Siemens *syngo* iPilot. Left: fluoroscopic image in the right anterior oblique view showing the ablation catheter (Abl) and circumferential mapping catheter (Lasso). Right: after *syngo* iPilot image integration of the *syngo* DynaCT Cardiac-based 3D model, the position of the ablation and mapping catheters at the ostium of the left superior pulmonary vein can be accurately determined. (Abl: ablation catheter, Lasso: circumferential mapping catheter, LA: left atrium, RSPV: right superior pulmonary vein, RIPV: right inferior pulmonary vein, LSPV: left superior pulmonary vein, LAA: left atrial appendage)





5 A+B RAO view visualized with LARCA (Leuven Augmented Reality for Catheter Ablation) software

5 C+D LAO view visualized with LARCA software
Biplane integration of a *syngo* DynaCT Cardiac 3D dataset of the left atrium in the right-anterior oblique (RAO) and left-anterior oblique (LAO) imaging planes. A shaded and semi-transparent visualization of the 3D model are shown in the upper and lower panes respectively. Ablation target lines are indicated as yellow dotted circles . The position of the ablation catheter (Abl) and the circumferential mapping catheter (Lasso) can be accurately depicted relative to the ostium of the left inferior pulmonary vein (LIPV), as shown in the semi-transparent LAO view. (TS: transseptal sheaths, Abl: ablation catheter, Lasso: circumferential mapping catheter)

aging. The location of the reconstructed 3D model relative to the fluoroscopic imaging geometry is therefore precise and exact. Using the Siemens *syngo* iPilot function, *syngo* DynaCT Cardiac-based 3D volumes can be accurately projected as a 3D overlay on fluoroscopic images in the primary imaging plane (Fig. 4). Automatic *syngo* DynaCT Cardiac integration in a biplane fluoroscopy environment is already performed in our research setting using in-house developed software (Leuven Augmented Reality for Catheter Ablation, LARCA, Fig.5). It may be available in later versions of systems using *syngo* DynaCT Cardiac, further increasing the value of 3D-fluoroscopy integration. Moreover, 3D overlay provides direct image integration with electro-anatomical mapping systems, obviating the need for registration with 3D geometries acquired with a roving catheter and thereby reducing the duration of the procedure.

References

1. Calkins H, Brugada J, Packer DL et al. HRS/EHRA/ECAS expert Consensus Statement on catheter and surgical ablation of atrial fibrillation: recommendations for personnel, policy, procedures and follow-up. A report of the Heart Rhythm Society (HRS) Task Force on catheter and surgical ablation of atrial fibrillation. Heart Rhythm 2007; 4(6):816-861.

2. Ector J, De Buck S, Huybrechts W et al. Biplane three-dimensional augmented fluoroscopy as single navigation tool for ablation of atrial fibrillation : accuracy and clinical value. Heart Rhythm 2008;In Press.

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University Hospitals Leuven, Campus Gasthuisberg

With 1,894 patient beds and 8,447 employees, the University Hospital Leuven is Belgium's largest medical institution. Recently, the Medical Imaging Center was identified as a new interdisciplinary research center, with a central position in the University Hospital Gasthuisberg. The center is a joint initiative of the University of Leuven (faculties of medicine and engineering) and the University Hospitals Leuven. Over 80 engineers, physicians and physicists from ESAT/PSI, Radiology, Nuclear Medicine, Cardiology and Radiotherapy are working closely together on innovative imaging applications.

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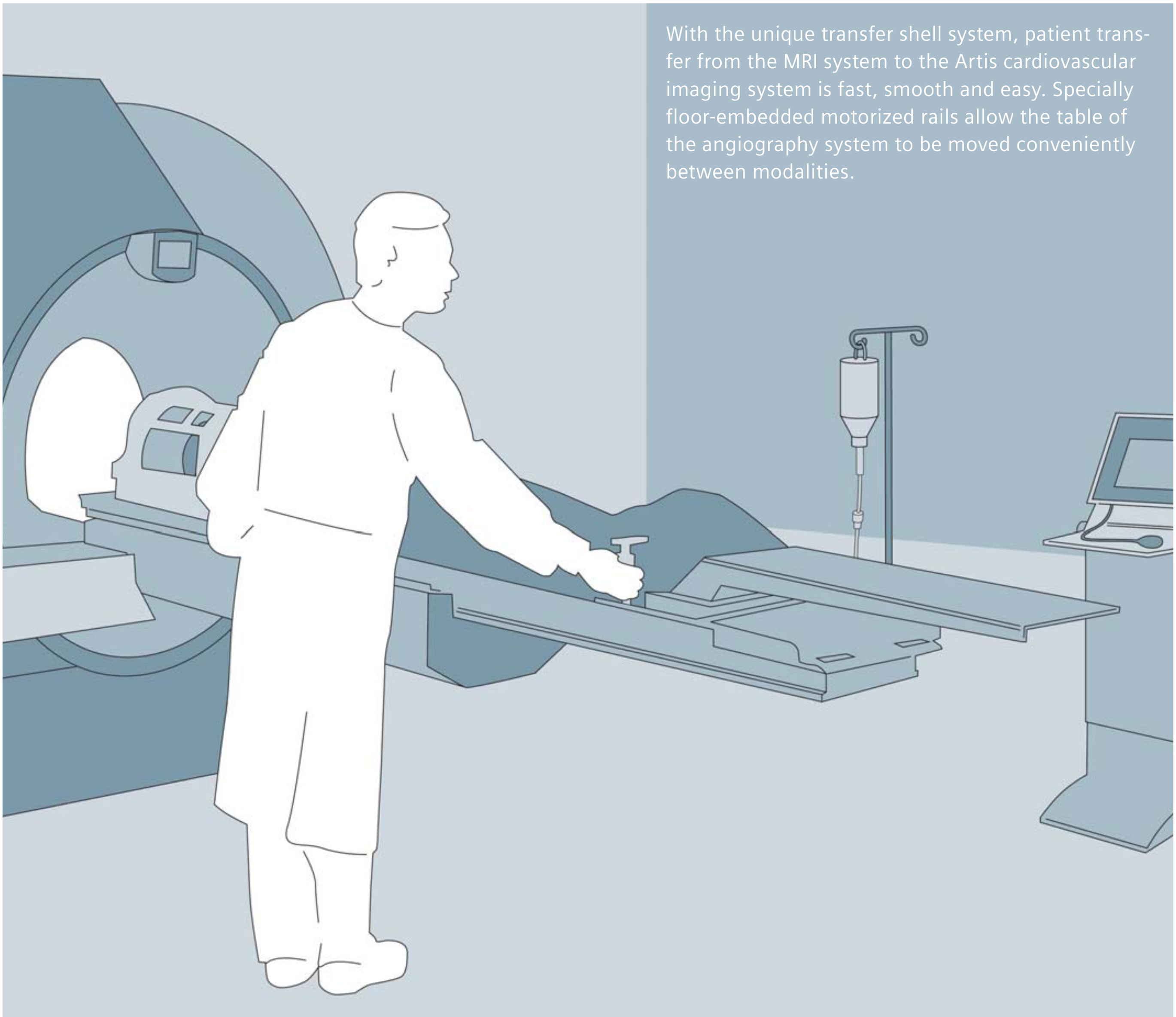
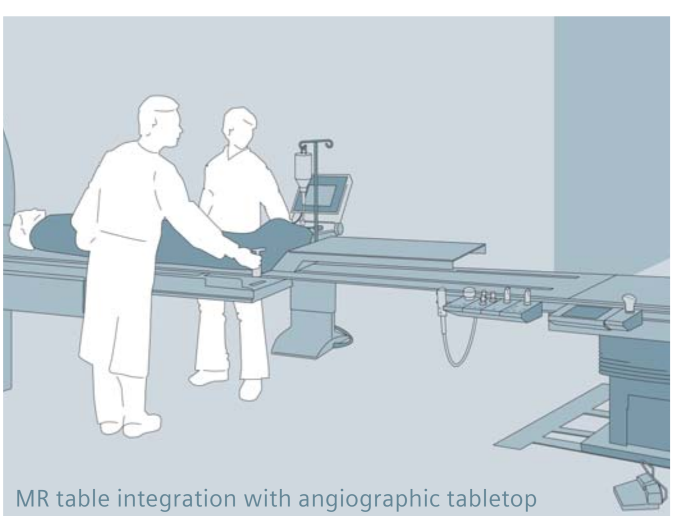
Left to right: Prof. H. Heidbüchel, MD, J. Ector, MD, PhD, S. de Buck, PhD



With the unique transfer shell system, patient transfer from the MRI system to the Artis cardiovascular imaging system is fast, smooth and easy. Specially floor-embedded motorized rails allow the table of the angiography system to be moved conveniently between modalities.



MR table integration with angiographic tabletop