Three-dimensional Imaging to Support the Cryoballoon Ablation of Atrial Fibrillation

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Background
The ablation of paroxysmal atrial fibrillation (AF) using a Cryoballoon (CB) is an alternative in isolating the pulmonary veins (PV) with RF energy. Before probing with the CB, the PV are imaged using a contrast agent (CA). Finding atypical or additional veins is difficult and time-consuming. Therefore, 3D imaging of the left atrium (LA) and adjacent structures could be helpful.

Methods
Patients with symptomatic, therapy-resistant AF were included. On the day before the ablation, a CT examination of the heart was performed (Siemens Dual Source, layer thickness 0.75 mm, 50-85 ml CA). The data was processed using the Carto Merge software (Biosense). The window structure was customized for an optimal segmentation of the LA, the aorta and the spinal column. Oval PV ostia were measured with the largest diameter. During the ablation, the anatomical structures were imaged in the simulation mode of the Carto software on the planes RAO 45°, AP and LAO 45°. The PV was probed without a prior CA injection. After CB inflation (Cryocath), CA was injected to determine the degree of occlusion (1-4) and at least 2 cryotherapies of 300 seconds per PV were performed. The PV isolation was documented using a Lasso catheter. In the follow-up processing, the PV ostia were measured using fluoroscopic angiography (Quantcor, Siemens), with the diameter of the CB being used for calibration. For a localization comparison between CT and fluoroscopy, the PV ostium was placed in relation to the two vertebrae located behind the LA (1 =upper edge of the upper vertebra to 4=lower edge of the lower vertebra). In the process, the left PV were assessed in LAO and the right in RAO.

Results
10 consecutive patients were examined (50% women, 90% paroxysmal AF, EF 56±7%, LA 43±3 mm). The CT segmentation took 12±3 min. In nine patients the 28-mm CB was used and in one patient the 23-mm CB. The average examination period, fluoroscopy period and radiation dose were 202±10 min, 48±4 min and 4659±2672 cGycm^2 respectively. 39 PV (1 common ostium of the left PV) were treated using 2.3±0.6 applications each, degree of occlusion 3.5±0.6, in 87% complete isolations. A significant correlation between the PV diameters measured in CT and fluoroscopy emerged (R=0.94; p<0.001, Tab. 1). The relative localization of the PV ostia showed a significant correlation between CT and fluoroscopy (Spearman Rank, p<0.001), Tab. 2.

	Diameter CT (mm)	Diameter Fluoro (mm)	p-value
Left superior PV	17.7±4.0	17.2±4.4	0.07
Left inferior PV	16.7±1.4	16.3±1.6	0.05
Right superior PV	18.1±3.0	17.8±2.6	0.08
Right inferior PV	15.3±2.4	14.7±2.1	0.02

Table 1: Comparison of PV diameters in CT and fluoroscopic angiography

	Fluoroscopy				
CT		**1**	**2**	**3**	**4**
	1	6	4	0	0
	2	1	10	5	0
	3	0	0	6	2
	4	0	0	1	4

Table 2: Comparison of the relative localization of PV ostia in relation to the spinal column

Conclusion
The 3D imaging of the left atrium provides meaningful additional information on fluoroscopy. The relationship of the PV ostia to the adjoining vertebrae facilitates the localization and attribution of the PV.

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