Cardiac computed tomography versus cardiac magnetic resonance for characterization of left atrium anatomy before radiofrequency catheter ablation of atrial fibrillation: impact on radiation exposure and outcome

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DISCLOSURE

- SPEAKER BUREAU FOR GENERAL ELECTRIC
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- CONSULTANT FOR HEARTFLOW
- SPEAKER BUREAU FOR MEDTRONIC
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BACKGROUND

Atrial fibrillation (AF) is the most common arrhythmia with an overall prevalence of 0.5-2% and 5-6% in the general population and among the elderly, respectively. It accounts for more than 400000 hospitalizations each year and it is the attributed cause for 15% of all strokes, totalling more than 100000 per year.

The use of radiofrequency catheter ablation (RFCA) in order to perform complete circumferential linear lesions of pulmonary veins in a point-by-point fashion is the most established strategy for pulmonary veins (PVs) isolation and it has proved effective in drug-refractory AF disease

BACKGROUND

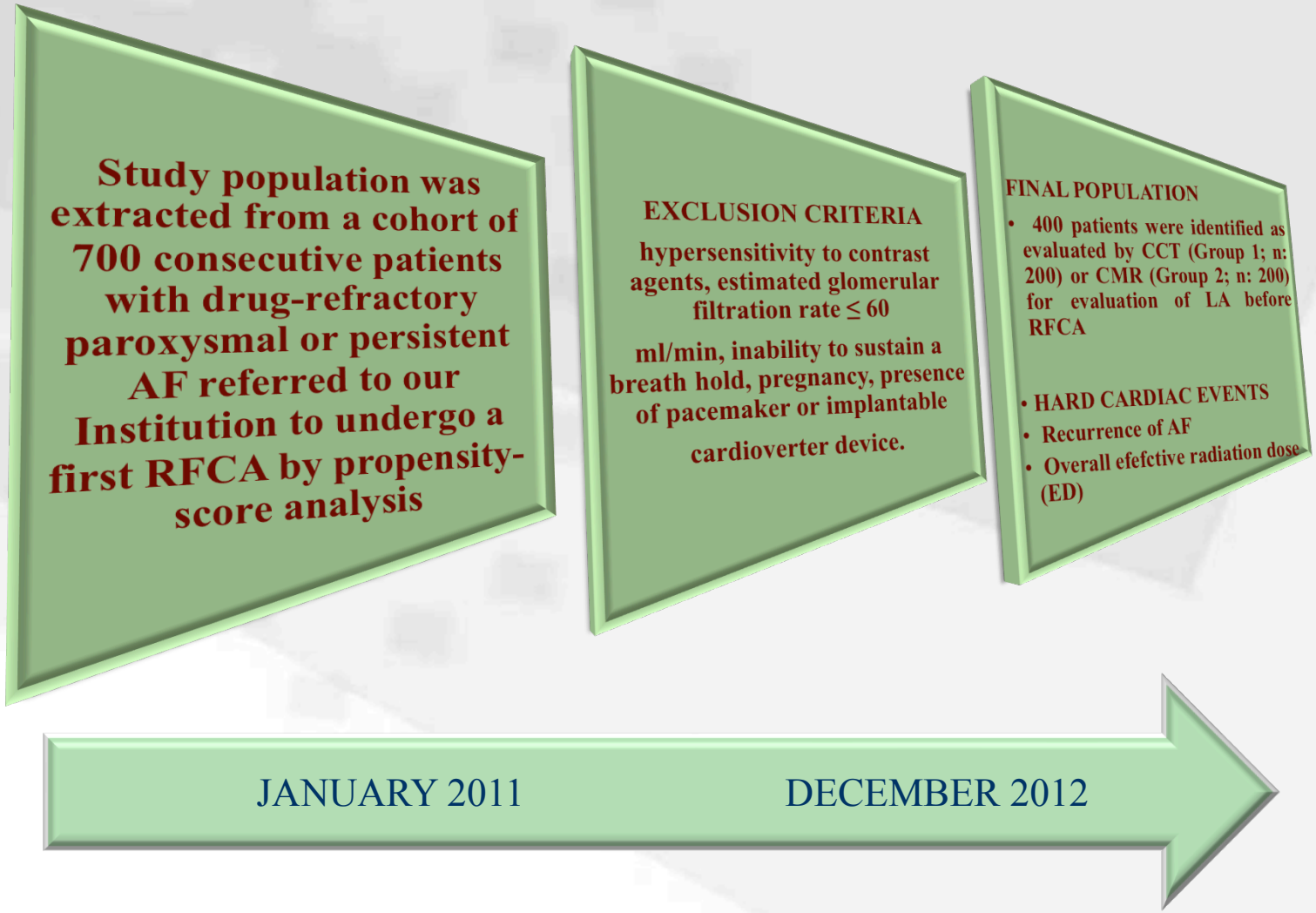
The outcome of RFCA has been improved by the pivotal role of multimodality cardiovascular imaging such as cardiac computed tomography (CCT) or cardiac magnetic resonance (CMR) for the characterization LA anatomy before RFCA

However, no comparative data between CCT and CMR have been described regarding to the impact of different imaging modalities on procedural and clinical outcomes.

… the aim of the study was

to compare the procedural characteristics, overall radiation exposure and clinical outcomes between RFCA guided by image integration with CCT versus CMR.

MATERIALS AND METHODS



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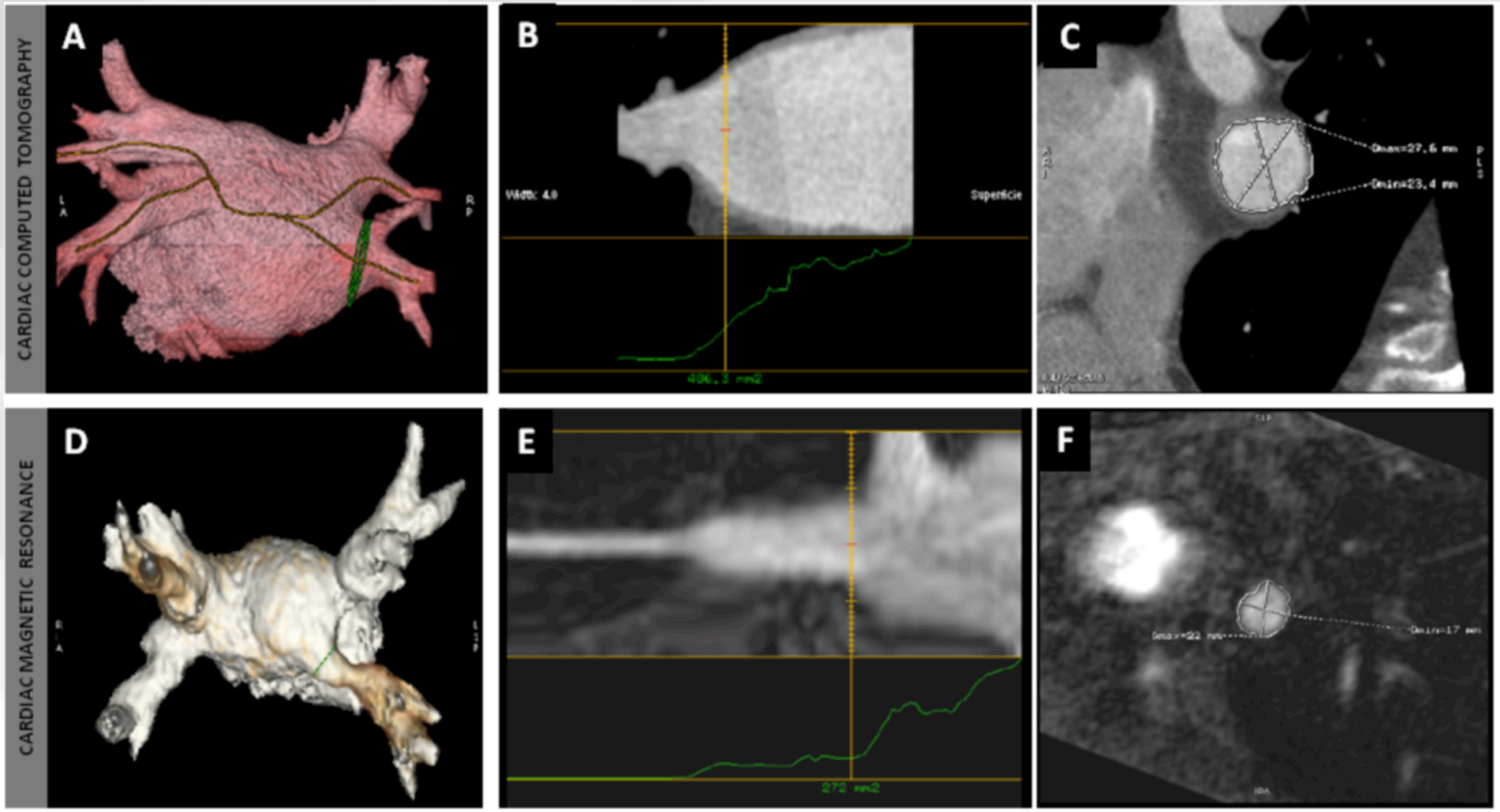

Example for measurements of left atrium volume and pulmonary vein ostial area and diameters by cardiac computed tomography (upper panels) and cardiac magnetic resonance (lower panels). Volume rendering reconstruction (panels A and D) are displayed and the cutting planes at the junction of the pulmonary vein (green line) were oriented perpendicularly to the long axis of the pulmonary vein (panels B and E) . The resulting reconstruction plane is used for the measurement of pulmonary vein ostial cross-sectional area and maximal and minimal diameters (panels C and F).

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RESULTS

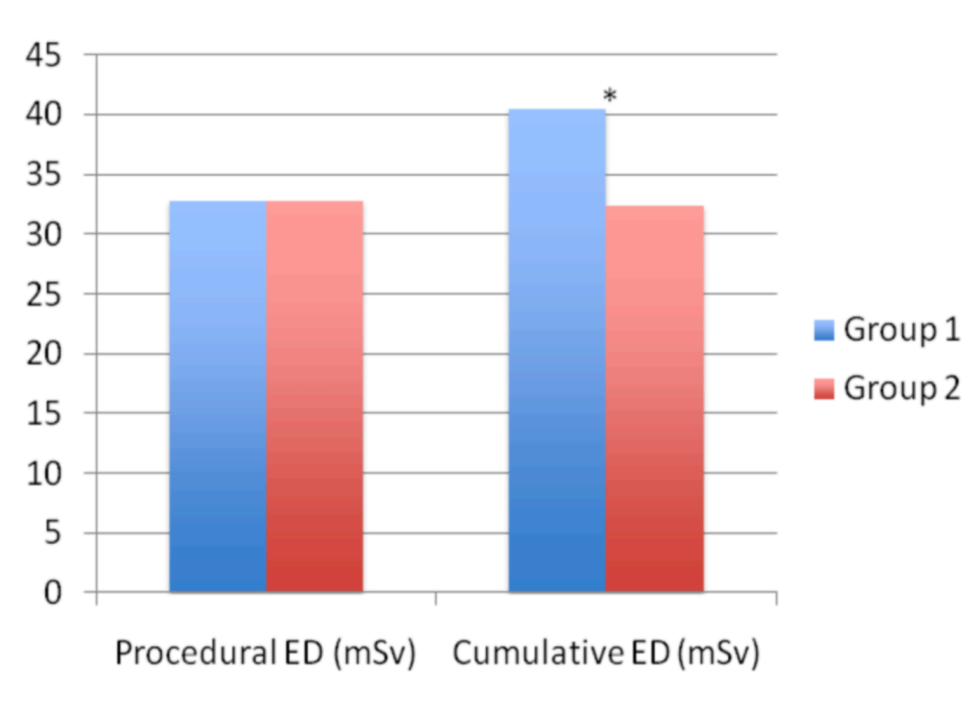
	GROUP 1 (CCT)	GROUP 2 (CMR)	p
Baseline Carachteristics			
Number, n (%)	200	200	-
Age, years (mean±SD)	61.6±10.9	59.7±10.4	0.07
Male, n (%)	155 (77)	160 (80)	0.54
Body mass index, (mean±SD)	25.9±4.2	26.1±3.7	0.64
Risk Factors			
Hypertension, n (%)	98 (49)	87 (44)	0.26
Smoker, n (%)	19 (10)	17 (9)	0.72
Hyperlipidaemia, n (%)	57 (29)	54 (27)	0.73
Diabetes, n (%)	10 (5)	4 (2)	0.10
Family History, n (%)	26 (13)	15 (8)	0.07
Medical Therapy			
Beta-blockers, n (%)	78 (39)	67 (33)	0.25
Calcium channels-blockers, n (%)	25 (13)	24 (12)	0.87
ACE-inhibitors, n (%)	70 (35)	69 (35)	0.91
Aspirin, n (%)	42 (21)	49 (25)	0.40
Nitrates, n (%)	1 (0.5)	1 (1)	1
Statins, n (%)	35 (18)	34 (17)	0.89
Amiodaron, n (%)	59 (30)	45 (23)	0.11
Flecainide, n (%)	59 (30)	73 (37)	0.13
Propafenon, n (%)	27 (14)	22 (11)	0.44
Sotalol, n (%)	11 (6)	11 (6)	1
Type of atrial fibrillation			
Paroxysmal, n (%)	142 (71)	141 (71)	0.91
Persistent, n (%)	58 (29)	59 (30)	0.91
Echocardiographic characteristics			
Left ventricle end-diastolic volume/Body surface area, ml/m^2) (mean±SD)	47.3±12.4	49.4±13.8	0.11
Left ventricle end-systolic volume/Body surface area, ml/m^2 (mean±SD)	18.9±7.0	20.0±8.8	0.17
Left ventricle ejection fraction, % (mean±SD)	60.9±9.2	59.2±9.1	0.36
Left atrium diameter, mm (mean±SD)	42.5±6.5	42.8±7.0	0.68
Left atrium area, mm^2 (mean±SD)	23.9±5.2	24.1±6.0	0.74
Follow-up			
Duration, days (mean±SD)	557.3±302.4	523.7±265.0	0.24
Recurrency of atrial fibrillation, n (%)	58 (29)	52 (26)	0.5

RESULTS

	GROUP 1 (CCT)	GROUP 2 (CMR)	p
Left atrium diameter, mm (mean±SD)	37.2±7.9	37.8±8.6	0.70
Left atrium volume, mm^3 (mean±SD)	116.9±46.5	101.0±40.2	<0.001
Lef atrium anatomic pattern			
Four pulmonary veins, n (%)	131 (66)	136 (69)	0.59
Left common ostium pulmonary vein, n (%)	43 (21)	42 (21)	0.9
Right intermediate pulmonary vein, n (%)	19 (10)	11 (6)	0.13
Left common ostium plus right intermediate pulmonary veiin, n (%)	2 (1)	6 (3)	0.15
Right common ostium pulmonary vein, n (%)	5 (2)	3 (1)	0.47
Right superior pulmonary vein			
Maximum diameter, mm (mean±SD)	22.3±4.4	20.6±4.9	<0.001
Minimum diameter, mm (mean±SD)	16.6±3.9	15±3.9	<0.001
Area, mm^2 (mean±SD)	316.1±127.9	264.5±133.7	<0.001
Right intermediate pulmonary vein			
Maximum diameter, mm (mean±SD)	10.6±2.7	10.1±3.1	0.62
Minimum diameter, mm (mean±SD)	7.5±1.9	7.6±2.0	0.76
Area, mm^2 (mean±SD)	123.6±150.3	70.2±29.6	0.16
Right inferior pulmonary vein			
Maximum diameter, mm (mean±SD)	20.9±4.7	18.3±4.7	<0.001
Minimum diameter, mm (mean±SD)	16.3±3.7	14.0±3.6	<0.001
Area, mm^2 (mean±SD)	295.3±122.2	220±115.4	<0.001
Right common ostium pulmonary vein			
Maximum diameter, mm (mean±SD)	32.9±5.7	35.3±4.0	0.51
Minimum diameter, mm (mean±SD)	22.9±8.2	20.7±2.9	0.67
Area, mm^2 (mean±SD)	566.9±348.0	609.5±87.0	0.87
Left superior pulmonary vein			
Maximum diameter, mm (mean±SD)	20.6±3.4	18.1±3.5	<0.001
Minimum diameter, mm (mean±SD)	13.3±3.0	13.0±2.5	0.33
Area, mm^2 (mean±SD)	235.3±78.6	195.0±62.9	<0.001
Left inferior pulmonary vein			
Maximum diameter, mm (mean±SD)	18.3±3.0	17.2±2.7	0.001
Minimum diameter, mm (mean±SD)	12.1±2.8	11.2±2.9	0.01
Area, mm^2 (mean±SD)	190.4±65.0	159.6±52	<0.001
Left common ostium pulmonary vein			
Maximum diameter, mm (mean±SD)	37.0±27.0	27.2±6.6	0.02
Minimum diameter, mm (mean±SD)	17.1±5.3	15.6±4.6	0.21
Area, mm^2 (mean±SD)	477.3±181.2	380.2±216.1	0.02

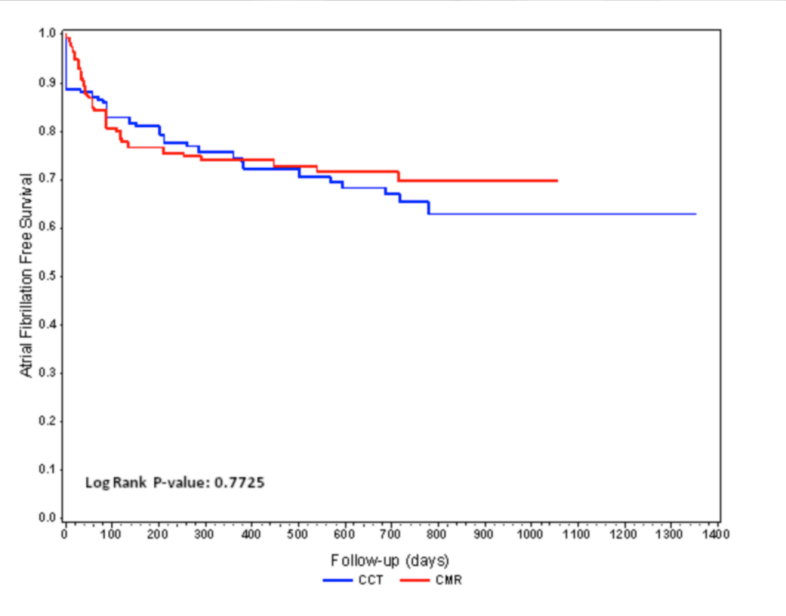
RESULTS

	GROUP 1 (CCT)	GROUP 2 (CMR)	p
Fluoroscopy time, minutes (mean±SD)	32.6±16.0	35.0±16.6	0.15
Procedural duration, minutes (mean±SD)	180.2±59.0	182.8±53.5	0.65
Pulmonary veins identified, n (mean±SD)	4.0±0.1	3.97±0.2	0.08
Pulmonary veins targeted, n (mean±SD)	3.9±0.4	3.9±0.4	0.53
Pulmonary veins isolated, n (mean±SD)	3.9±0.4	3.9±0.4	0.9



Comparison of effective radiation dose (ED) of pulmonary veins ablation and overall cumulative ED (pulmonary veins ablation plus cardiac computed tomography) between Group 1 and Group 2. *: p< 0.005 Group 1 vs. Group 2.

RESULTS



Kaplan–Meier estimation of the time to atrial fibrillation recurrence after pulmonary veins ablation in Group 1 (Blue line - CCT) and Group 2 (Red line - CMR).

	MULTIVARIATE ANALYSIS			
	Group 1 (CCT)		Group 2 (CMR)	
	HR (95% CI)	p value	HR (95% CI)	p value
Baseline				
Age	0.996 (0.972 – 1.021)	0.7455	0.982 (0.955 – 1.009)	0.1819
Male	1.645 (0.926 – 2.925)	0.0898	2.881 (1.587 – 5.229)	0.0005
Family History	0.375 (0.117 – 1.202)	0.0989	-	-
Echocardiographic characteristics				
Left atrium area, mm^2 (mean±SD)	1.05 (1.000 – 1.09)	0.0413	-	-
Computed tomography or Magnetic resonance characteristics				
Left atrium volume	-	-	1.08 (1.010 – 1.150)	0.0241

LIMITATIONS OF THE STUDY

SELECTION BIAS: We cannot, therefore, exclude an enrolment bias because the choice of imaging modality may have been influenced by the patients' clinical characteristics at baseline. However, the propensity score methodology has been validated as alternative to randomized design of study and, moreover, observational studies are more fully representative of every day clinical practice

FOLLOW-UP BIAS: AF recurrence was identified from fixed temporal clinical evaluation. This method may be unable to detect episodes of paroxysmal AF without need of hospital admission with consequent AF occurrence underestimation

LA LATE GADOLINIUM ENHANCEMENT: LA fibrosis detection by delayed enhancement sequences by CMR has not been systematically performed and therefore it has not been included in our study. So, no conclusions can be achieved on this topic from our study population

CONCLUSIONS

CCT and CMR seem to be comparable in terms of LA and PVs anatomy description. Both techniques provide a comprehensive assessment of LA and PVs size that translates into similar procedural RCFA characteristics and freedom from AF event after the procedure. However, due to the absence of X-ray and better temporal resolution, RFCA CMR-guided is associated with lower overall radiation exposure and better stratification of patients with AF recurrence suggesting a more robust role of CMR in this setting as compared to CCT. This needs to be taken in account especially considering the emerging role that the LA fibrosis detection by CMR may potentially play in the next future of management of AF patients.