Advancements in Cardiology Research & Reports

Research Article

Supplementary Appendix

Text 1 Procedure and variable of interest concerning CCT scan

Cardiac computed tomography (CCT) was performed using 256-slice (Somatom Definition Flash, Siemens Medical Solutions, Erlangen, Germany) scanner technologies with similar protocols in patients in a supine position during suspended end-expiration, 24h to 72h prior of the AF ablation procedure. Retrospective electrocardiographic gating was employed, with tube current applied to 70% of the R-R interval, for patients in normal sinus rhythm. For patients in AF, a non-gated protocol was employed. The scan limits were as follows: collimation 0.75mm, 1mm section width, tube voltage 120 kV, and tube current 550-600 mA. Nonionic iodinated contrast agent (90 ml, Iomeron 400, Bracco Imaging, France) was injected through an ante cubital right vein at a rate of 5 ml/s with a power injector followed by normal saline 50 ml at a rate of 5 ml/s to allow washout of highly concentrated contrast from the right heart. After detection of the contrast bolus, threshold value of 100 Hounsfield Units of the ascending aorta, image acquisition was started with a time delay of 5 seconds. For CCT, images were acquired from the level of the aortic arch to the dome of the diaphragm. If the heart rate was >65 bpm, beta-blocker agent was administered before the scan procedure (Atenolol 5 mg IV). Trinitrine was systematically used before the CCT (two breaths). Post-processing of cardiac computed tomographic images was performed on a dedicated advanced image processing workstation (Aquarius iNtuition, Terarecon, Foster City, USA).

Reconstructed cardiac computed tomographic images were reviewed and interpreted by one experienced independent investigator blinded to clinical and TEE data (one cardiologist or one radiologist). In the database, the following information were collected from transoesophageal echocardiography:

- Anatomy of the pulmonary veins: long axis, short axis and area. Each assessment was averaged between ostium and 3 mm upstream. Ostium eccentricity is estimated thanks to formula: (long axis – short axis) / long axis.

a. LA area and LA volume

b. LA/LAA thrombus. It was defined as an intracavitary contrast filling defect with attenuation values similar to non-enhanced tissue. Intracavitary thrombi were differentiated from normal pectinate muscles and from filling, motion, and acquisition artifacts

a. Coronary artery calcium score

b. LAA length and morphology: chicken wing, windsock, cauliflower and cactus

c. LA ridge type. A, the ridge extending from the LSPV to the LIPV; B, the ridge extending from the superior portion of the LSVP to the inter-venous saddle.

a. LA width

Text 2 Detailed RMNS Ablation Procedure

Surface ECG and bipolar endocardial electrogram (filtered from 30 to 500Hz) parameters were continuously monitored and stored in a computer-based digital amplifier/recorder system. A deflectable quadripolar catheter (5mm interelectrode spacing, Xtrem, ELA medical, Mont rouge, France) was positioned into the coronary sinus for pacing and recording purposes.The LA was accessed via a patent foramen ovale, if present, or viatransseptal puncture, and aguidewire was inserted into the LA using an 8F-long sheath. During the procedure,the sheath was perfused with a heparinized solution (3000U of heparin in 500mL of sodium chloride 0.9% at a rate of 150mL/h). A multipolar deflectable catheter (Lasso, Biosense Webster, Diamond Bar, CA, USA) was inserted via the long sheath so as to map the PV ostia for all ablation procedures. RF ablation was carried out using a 3.5mm open irrigated-tip magnetic ablation catheter (NaviStar® RMT ThermoCool®, Biosense Webster, Diamond Bar, CA, USA). The catheter was pushed forward into the LA by means of a second transseptal puncture. The venous sheath was subsequently retracted in the right atrium and continuously perfused. Following transseptal puncture, intravenous unfractionated heparin was administered as a bolus (7500U), in addition to further boluses provided throughout the procedure in order to maintain an activated clotting time (ACT) of at least 300 seconds. ACT was determined 30 min after transseptal puncture and every 30 min thereafter. In the event of ACT <300, an additional bolus of 2500U was administered. Ablation procedure can be practiced under local anesthesia with a deep sedation using intravenous nalbuphine and midazolam, or general anesthesia.

CARTO 3

Advanced Catheter LocationTM is an impedance-based catheter-tracking system that enables precise cardiac mapping and navigation by means of multiple electrodes. Six electrode patches are attached to the body surface and constantly monitor the current emitted at a different frequency from each individual catheter electrode. Each electrode patch is also equipped with a magnetic sensor, enabling three-dimensional (3D) location. Currents detected at the patches transmit the electrodes' positions in 3D within the human body. The CARTO® 3 system's ability to visualize the handling and placement of circular mapping catheters in each vein may further reduce fluoroscopy time. Moreover, this new system improves catheter stability during ablation and facilitates the pinpointing of each catheter-electrode pair position. Visualization of catheter-electrode pairs is provided via real-time on-screen display of a geometrically reliable icon representing the distal portion of the LASSO® catheter in conjunction with the electrodes' positions. LA reconstruction was achieved using a fast anatomical map (FAM) algorithm. This method continuously records (in a non-gated manner) the Navistar catheter's movements. Based on this volume sampling, a surface reconstruction was assembled in accordance with the set resolution level.

Radiofrequency Catheter Ablation Procedures

Ablation endpoints consisted of the isolation of PVs defined by complete elimination or dissociation of pulmonary potentials and validated by means of a circumferential mapping catheter in paroxysmal and persistent AF, thereby including additional lesion lines for persistent AF: LA roof, mitral isthmus, fragmented potentials and coronary sinus defragmentation. RF was applied using an open irrigated-tip catheter whose power output did not exceed 30W near the PV ostia and 25W near the posterior ostia wall or whilst performing coronary sinus defragmentation. Irrigation with sodium chloride 0.9% at a rate of 20-35mL/min was used in order to maintain a tip temperature of <43°C.

Table 1: Impact of left atrium sizes during AF ablation.

	Whole Procedure Duration			Fluoroscopy Setting up Duration			Fluoroscopy Mapping Duration			Fluoroscopy Ablation Duration		
	β	95% CI	p	β	95% CI	p	β	95% CI	p	β	95% CI	p
Atrial volume	0.2	[0.1; 0.5]	<0.05	-1.2	[-4.0; 2.0]	0.5	1.3	[0.6; 2.0]	<0.01	-0,6	[-1.7 -0.51]	0.3
Atrial area	1.4	[0.3; 2.5]	<0.05	-3	[-17; -12]	0.7	5.7	[2.7; 8.8]	<0.01	-0,8	[-5.6; 4.0]	0.7

Univariate analysis.

Table 2: Impact of CT scan characteristics on fluoroscopy duration concerning left part of LA ablation.

	Total (n=102)			Paroxysmal AF (n=63)			Persistent AF (n=39)		
	β	95% CI	p	β	95% CI	p	β	95% CI	p
Left atrial appendage									
LAA ostium area	0.1	[-0.1 ; 0.2]	0.4	-0.1	[-0.2 ; 0.1]	0.5	0.2	[-0.2 ; 0.5]	0.4
LAA ostium eccentricity	79	[-180; 339]	0.5	114	[-100; 327]	0.3	157	[-451 ; 765]	0.6
LAA length	1.4	[-1.6; 4.4]	0.4	-1.1	[-0.10 ; 4.0]	0.4	3.5	[-2.9; 9.3]	0.2
Left atrial ridge									
Ridge type	36	[-31; 102]	0.3	17.1	[-38.3; 72.5]	0.5	73	[-73; 220]	0.3
Ridge width	-10.7	[-19,0; -2,4]	0.01	-8.7	[-15.6; -1.8]	0.01	-2.1	[-3.6; -0.6]	0.007
Left pulmonary veins									
LSPV area	-0.13	[-0.4; -0,17]	0.4	-0.21	[-0.43; 0.01]	0.06	-0.11	[-0.87; 0,65]	0.8
LSPV eccentricity	-87	[-323; -198]	0.5	-52.5	[-230; -125]	0.6	-142	[-728; 444]	0.6
LIPV area	-0.25	[-0.66; -0.16]	0.2	-0.53	[-0.87; -0.17]	<0.01	-0.13	[-0.92; 0,66]	0.7
LIPV eccentricity	300	[86.2; 513.0]	<0.01	281	[128; 434]	<0.01	434	[-97; 965]	0.1