Voltage map. The absolute differences in voltage and surface area were presented using box plots, with five values for each plot: minimum, first quartile, median, third quartile, and maximum. A median voltage difference below 0.05 mV and a median surface area difference below 2 cm² (equals to 0.8% of mean LA surface area) were used to define clinical equivalence to 8-second map.

Results: A total of 14 high-density AF maps were successfully collected in 9 patients. Each map included 1304 ± 218 points. Fig A shows the absolute difference in voltage of 1-7 second maps from 8-second map for a total of 18,262 map points collected in 14 AF maps. Figs B-D show the absolute difference in surface area of 1-7 second maps from 8-second map for voltage ranges of <0.1 mV, 0.1-2.5 mV, and >2.5 mV. There was no significant difference in median peak-peak voltage or surface area among voltage maps with 1-8 second EGM lengths (p > 0.99, Kruskal-Wallis test). Fig E illustrates the similarity of voltage maps using EGM lengths of 1, 3, 5, and 8 seconds from a representative patient.

Conclusions: The differences in voltage and surface area between 1-7 second maps and 8-second maps became smaller as longer EGM lengths were used. Voltage maps computed using EGM lengths of 2-7 seconds showed clinical equivalence to that using 8 seconds in characterizing AF substrate.

ATRIAL FIBRILLATION - CATHETER ABLATION

P1710
Effectiveness of additional substrate modification for recurrent paroxysmal atrial fibrillation patients
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Backgrounds: We already know less effectiveness of additional substrate modification for persistent atrial fibrillation (AF) patients from some study. But it is unclear about effectiveness of additional substrate modification for recurrent paroxysmal AF (P AF) patients. The purpose of this study was to evaluate effectiveness of additional substrate modification for recurrent PAF patients with chronic pulmonary vein (PV) reconnection.

Methods: We enrolled 261 consecutive recurrent PAF patients who underwent second procedure from July 2009 to December 2015. We retrospectively extracted patients with chronic PV reconnection from the database. These patients were divided into two groups; pulmonary vein isolation (PVI) alone group and PVI plus additional substrate modification group at second procedure. Outcome was freedom from AF recurrence rate at 1, 2, 3 years after second procedure. We also evaluated patient characteristics.

Results: The number of PVI alone group was 87 (mean age 60.2 ± 10.2 years, Male 80 (97.9%) and PVI plus substrate modification group was 174 (60.2 ± 10.2 years, Male 117 (67.2%). Mean follow up period was 768.2 ± 572.4 days. At 1, 2, 3 years after second procedure, there was no significant difference in freedom from recurrence rate (89.8% vs 88.5%, 82.1% vs 78.1%, 76.6% vs 69.7%, respectively; P = 0.5006).

Conclusion: Same as for persistent AF patients, additional substrate modification is not probably effective for recurrent PAF patients.

P1711
Significant reduction in procedure duration in remote magnetic-guided catheter ablation of atrial fibrillation using the third-generation magnetic navigation system
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Background: The magnetic navigation system (MNS) has shown to be safe and effective for catheter ablation of atrial fibrillation (AF). Yet, longer procedure duration as compared to manual catheter ablation may limit its widespread use.

Objective: This study aimed to assess the impact of the newest generation MNS using an optimized mapping and ablation protocol on the efficacy and safety of remote magnetic catheter (RMC) guided pulmonary vein isolation (PVI).

Methods: The study population comprised 52 patients with symptomatic AF who underwent RMC-guided PVI using either the second-generation MNS Niobe II (initial 28 patients, group I) or the recently introduced third-generation MNS Niobe ES in combination with an optimized intraprocedural mapping and ablation protocol patients, group II).
Results: Acute PVI was achieved in 26/28 (93%) patients in group I and 24/24 patients (100%) in group II. Mean procedure time was 263.9±81.9min in group I and significantly lower in group II (139.7±22.6min, p<0.01). Mean fluoroscopy time of 18.8±8.7min in group I decreased to 7.9±2.6 in group II (p<0.01). After a median follow-up of 640.5 days (Q1: 460.75, Q3: 766.6), 16/24 (67%) patients undergoing RMC-guided PVI in group II remained in stable SR. No periprocedural complications were noted for either group.

Conclusions: Use of the third-generation MNS for RMC-guided PVI is safe and effective and resulted in an almost 50% reduction in procedure duration, which is in par with manual PVI. Long-term success rates are comparable to manual ablation.

P1712
A novel design for the mitral isthmus line reducing the need for epicardial ablation
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Background: The mitral isthmus is a critical part for peri-mitral reentrant tachycardia as well as an important substrate of persistent atrial fibrillation (AF). Yet, bidirectional conduction block across the mitral isthmus line (MIL) may be challenging to achieve by endocardial ablation alone and regularly demanding additional epicardial ablation from within the coronary sinus (CS).

Aim: To evaluate an alternate supratracheal line design for the mitral isthmus, aiming to avoid epicardial ablation.

Methods: The study population comprised 114 patients with peri-mitral reentrant tachycardia in whom de novo ablation of a MIL was performed. The initial 57 patients (group A) received catheter ablation of a novel design for the MIL, connecting the left-sided PVs to the mitral annulus along the posterior base of the left atrial appendage (LAA) according to selective angiographic visualization of the LAA. The following 57 patients (group B) served as control group and underwent ablation of a standard MIL, connecting the left inferior pulmonary vein with the mitral annulus in a horizontal fashion.

Results: Bidirectional block was achieved in 56/57 patients of group A (98.2%) and 50/57 patients of group B (87.7%, p<0.006). Ablation of a superior MIL required significantly less ablation from within in the CS (7.0% vs. 71.9%, p<0.01). Predictors of successful block across the MIL were the requirement for ablation from within the CS (p<0.001) and overall length of the MIL (29.3±6.35 mm vs. 40.8±7.29 mm, p<0.005). A higher rate of periaticernal tamponade was observed in group A (5.2% vs. 0%), all of which were drained percutaneously without surgical requirement.

Conclusion: The superior MIL is associated with a high success rate of bidirectional block by endocardial ablation alone and bears minimal need for ablation from within the coronary sinus. However, this alternate supratracheal line can be associated with an increased rate of periaticernal tamponade.

P1713
A balancing act - contact force along the anterior aspect of the lateral pulmonary veins during catheter ablation of atrial fibrillation
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Background: Conduction gaps found in circumferential lesion sets along the lateral pulmonary veins (LPV) during catheter ablation for atrial fibrillation (AF) are most prevalent at the ridge between the LPV and the left atrial appendage (LA). A target catheter to tissue contact force (CF) of 10 to 30g has been suggested for durable lesion formation, but is difficult to achieve at this site.

Methods: A total of 20 patients with symptomatic AF underwent de novo pulmonary vein isolation (PVI) using a radiofrequency ablation catheter with integrated CF sensor (Thermocool Smarttouch SF 56, Biosense Webster). Selective PV angiography was performed to identify the individual PV ostium, followed by detailed electroanatomical point-by-point mapping of the left atrium, LAA and LPV. The ipsilateral PV ostia were tagged on the 3D LA map according to angiographic and electrophysiological criteria. Careful retraction of the mapping catheter from within the LPV during counterclockwise rotation identified the precise localization of the anterior LPV orifice by exhibiting a sudden jump when passing to the LA. Contact force was recorded approximately every 5 mm along the anterior aspect of the LPVs target CF suggesting for durable lesion formation. CF was recorded deep within the vein. However, deep ablation at this time may increase the risk for pulmonary vein stenosis. At the anterior LPV orifice CF is generally lower. Nonetheless, acute electrical isolation was successful in all cases.

P1714
Clinical implications for patients with persistent phrenic nerve palsy after cryoballoon ablation of pulmonary veins
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Aim of the study was to evaluate the clinical implications of persistent phrenic nerve palsy caused by cryoballoon ablation. Methods and results: 5 of 180 (3%) patients undergoing cryoballoon ablation of pulmonary veins due to paroxysmal or persistent atrial fibrillation had persistent phrenic nerve palsy without recovery until discharge. These patients were regularly followed up until the resolution of the phrenic nerve palsy. Phrenic nerve resolved in 3 patients during the first 4 months whereas in 2 patients phrenic nerve palsy lasted for 9 months respectively 2 years. In those patients a persistent diaphragmatic elevation was observed despite a recovery of the diaphragmatic motility. The major symptoms associated with persistent phrenic nerve palsy were exertional dyspnea in 3 patients and continuous coughing in 1 patient. All symptoms disappeared after recovery of the phrenic nerve.

Conclusions: Phrenic nerve palsy occurs in 3% of patients undergoing cryoballoon ablation. Exertional dyspnea and coughing are the main symptoms of patients with persistent phrenic nerve palsy after cryoballoon ablation. In all patients persistent phrenic nerve palsy recovered, the latest after 2 years. In patients with long persistent phrenic nerve palsy a persistent diaphragmatic elevation remains despite the recovery of the diaphragmatic motility.

Table 1

| Age (years) | 64 |
| Female | 20% |
| Paroxysmal AF | 20% |
| Second generation balloon | 80% |
| Phrenic nerve palsy during ablation of: | |
| - right superior vein | 80% |
| - right inferior vein | 20% |
| Diaphragmatic ECG monitoring | 20% |
| Successful ablation | 100% |

Baseline characteristics and procedure data

P1715
Clinical impact of non-fluoroscopic catheter tracking system on radiation exposure during pulmonary vein isolation
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Background: A novel non-fluoroscopic catheter tracking system can be used in addition to mapping systems in atrial fibrillation (AF) catheter ablation. However, the benefit on radiation exposure of the Mediguide™ system requires further investigation.

Purpose: The aim of this study was to clarify the clinical benefit of Mediguide system on radiation exposure compared to other ablation systems.

Methods: Among 524 patients undergoing AF ablation in our hospital from 2014 to 2016, we excluded those with a prior AF ablation (n=189), who underwent additional ablation besides pulmonary vein isolation (n=99), or were treated by an electrophysiologic fellow (n=163). Procedure time, radiation time, radiation effective dose, procedural complications, and incidence of AF recurrence on follow-up were compared between different ablation systems including Mediguide™, CARTO™, Cryoballoon, and Multi-electrode Pulmonary Vein Ablation Catheter (PVAC®).

Results: Seventy-three patients were included (51 men; 59±11 years; 60 paroxysmal AF). Mediguide™ was used in 17 patients (group A), CARTO™ in 22 (group B), Cryoballoon in 48 (group C), and PVAC® in 10 (group D). Although procedure time was shorter in patients with Cryoballoon and PVAC (median 110 [interquartile range 99–120] min in group C and 123 [112–146] min in group D compared to 181 [168–214] min in group A and 179 [160–195] min in group B, P=0.001 by Kruskal-Wallis test), radiation effective dose and exposure time were shorter in the patients with Mediguide™ (A: 1.1 [0.8–2.0] mSv; B: 2.5 [1.3–3.8] mSv; C: 2.0 [1.4–2.5] mSv; D: 1.7 [1–3.6] mSv, P=0.030 and A: [3–6] mSv; B: 14 [11–16] mSv; C: 14 [11–18] mSv; D: 20 [16–24] mSv, P=0.001). Multiple linear regression analysis identified small body mass index (P<0.001), short left atrial diameter (P=0.004), and the usage of Mediguide system (P=0.001) as independent determinants associated with a decreased radiation effective dose (Table 3). Cardiac tamponade occurred in 2 patients (one in group A and one in group B) and phrenic nerve injury in 1 patient in group C. During a mean follow-up of 11±4 months, 28 (38%) patients had AF recurrence. Kaplan-Meier curves demonstrated that the incidence of AF recurrence did not differ among the four groups (P=0.753 by log-rank test).

Conclusion: Mediguide™ in addition to mapping systems (Ensite™) reduces radiation exposure during pulmonary vein isolation.

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