PAF episodes were divided into group A ("sudden onset") and group B ("PAC activity before onset"). The mean PAC episode durations of both groups were then compared. Sudden PAC onset was defined as missing PAC activity in the last 10 beats before PAC initiation.

Results: Group A comprised 145 (54.9 %) PAC episodes. A significantly longer mean PAC episode duration was found in group A as compared to group B (6.06 ± 42.36 vs. 1.85 ± 6.72 seconds, p < 0.01).

Conclusion: In our study group more than half of the PAC episodes were initiated without any PAC activity in the last 10 beats before onset. 2. Arrhythmia episodes with sudden PAC onset were associated with a prolonged PAC episode duration as compared to PAC episodes with prevalent pre-onset PAC activity. 3. The combination of missing PAC activity and long PAC episode duration may reflect a higher atrial "substrate factor" facilitating PAC induction and maintenance. The efficacy of preventive pacing algorithms might therefore be limited in patients with predominantly sudden onset of PAC.

Poster Session

1052
Pulmonary Vein Isolation to Treat Atrial Fibrillation I

Sunday, March 07, 2004, 3:00 p.m.-5:00 p.m.
Morial Convention Center, Hall G
Presentation Hour: 4:00 p.m.-5:00 p.m.

1052-207
Left Atrial Flutter Post Pulmonary Vein Isolation: Draw a Line or Resealisation of the Recovered Pulmonary Vein Ostium?

Jennifer E. Cummings, Mandeep Bhargava, J. David Burkhart, Yaariv Khaykin, George John, Ronald Abraham, Karin Schmitt, Robert Schweikert, David O. Martin, Nassir Marrouche, Andrea Natale, The Cleveland Clinic Foundation, Cleveland, OH

Background: The incidence of left atrial flutter (LAFL) post pulmonary vein isolation (PVI) for treatment of atrial fibrillation (AF) has been reported to vary between 2 and 8%. We report our experience with this arrhythmia.

Methods: 613 patients presented for PVI for treatment of symptomatic AF. All PVI's and when possible, the superior vena cava (SCV), were ablated in all patients. Patients were followed post-ablation for incidence of recurrent arrhythmias and brought back to the electrophysiologist for evaluation.

Results: After a mean follow-up of 492±30 days, 15 patients developed recurrence of LAFL. Out of 24 flutter circuits identified in these patients, 5 could not be mapped. The remaining 19 circuits were defined using the CARTO 3D mapping system. Of these 19 circuits, 10 circuits were defined to be between the mitral annulus and a posterior wall scar, 5 were between two posterior wall scars, 3 were around the left PV, and 1 rotated around the septum primum. In all 15 patients, recovery of 2-3 PV ostial conduction was detected. Re-isolation of the recovered sites was subsequently performed. Additionally, a flutter line was needed to terminate a mitral annulus circuit and a circuit between 2 posterior wall scars. After a mean follow-up of 340±90 days, only one patient experienced recurrence of LAFL.

Conclusion: In patients with recurrent LAFL post PVI, re-isolation of recovered PV ostia appears to be sufficient in curing the majority of patients presenting with LAFL following PVI treatment of AF.

1052-208
Left Atrial Flutter Following Circumferential Pulmonary Vein Ablation for the Treatment of Atrial Fibrillation

Jim Dong, Bernhard Zrenner, Jürgen Schiecek, Isabel Deisenhofer, Michael Schneider, Ildiko Dobran, Martin Karch, Andreas Pfeilman, Christian von Bary, Claus Schmitt, German Heart Center Munich, Munich, Germany

Background: Circumferential pulmonary vein ablation (CPVA) has emerged as a curative treatment for atrial fibrillation. The cryoablation catheter was placed at the ostium of each pulmonary vein. The PVs were then ablated by delivering cooled radiofrequency (RF) energy to the PV ostium. The cryoablation catheter was placed at the ostium of each pulmonary vein for 120 seconds. The resulting lesions were demarcated by a "cryolesion pool", which was clearly visible by electroanatomic mapping.

Methods: Twenty-five (78%) PVs were successfully isolated, 16 using the circular cryoablation catheter alone, and 9 after additional ablation with a 6mm-tipped catheter. Of 371 (12x84 per PV) applications delivered using the circular cryoablation catheter, 107 (29%) were terminated within 60s due to suboptimal catheter positioning. The remaining 264 (71%) were continued for >60s (mean 200±64s), of which 92 (35%) were effective. To detect a possible cumulative effect, applications for each PV were divided into tertiles. Effective applications were evenly distributed across these tertiles, but overall there was a progressive increase in the effective cycle length over time.

Results: At 10.5±7.5 months of follow-up following a single (n=75) or redo ablation procedure (n=11), 30 of the 75 patients were free of AF (52%), 10 were improved (13%), and 26 had experienced no benefit from the ablation procedure (36%). The most significant complications were two episodes of pericardial tamponade, mitral valve injury in one patient, two strokes, and complete but asymptomatic PV stenosis in one patient. A Cox proportional hazards multivariate regression analysis identified the presence of persistent AF, permanent AF, and age more than 50 years as independent predictors of AF recurrence after the first PV isolation procedure. 15 out of 18 patients with AF recurrence after initial PV isolation were free of AF recurrence after redo PV isolation.

Conclusion: Cryoablation catheter ablation of AF appears to be a safe and effective procedure for the treatment of AF.

1052-209
Safety and Efficacy of Catheter Ablation of Atrial Fibrillation Using an Irrigated-Tip Ablation Catheter

Chandrasekhar R. Vasamreddy, Vinod Jayam, Lars Lidfjeld, David Bradley, Khurram Nasir, Zayd Eladadah, Timm Dickfeld, Kevin Donahue, Ronald Berger, Hugh Calkins, Johns Hopkins School of Medicine, Baltimore, MD

Introduction: The purpose of the study is to report the safety and efficacy of catheter ablation of atrial fibrillation (AF) using an irrigated-tip ablation catheter.

Methods: Seventy-five consecutive patients (51 men; age 54 ± 13 years) with symptomatic drug refractory paroxysmal (42 patients), persistent (21 patients) or permanent (12 patients) AF underwent catheter ablation of AF using an irrigated-tip ablation catheter and a standard ablation strategy, which involved electrical isolation of all pulmonary veins and creation of a cavotricuspid linear lesion.

Results: At 10.5±7.5 months of follow-up following a single (n=75) or redo ablation procedure (n=11), 30 of the 75 patients were free of AF (52%), 10 were improved (13%), and 26 had experienced no benefit from the ablation procedure (36%). The most significant complications were two episodes of pericardial tamponade, mitral valve injury in one patient, two strokes, and complete but asymptomatic PV stenosis in one patient. A Cox proportional hazards multivariate regression analysis identified the presence of persistent AF, permanent AF, and age more than 50 years as independent predictors of AF recurrence after the first PV isolation procedure. 15 out of 18 patients with AF recurrence after initial PV isolation were free of AF recurrence after redo PV isolation.

Conclusions: Catheter ablation of AF using a strategy involving isolation of all PVs, the creation of a linear lesion in the cavotricuspid isthmus, using cooled RF energy is associated with moderate efficacy and an important risk of complications. The best results of this procedure are achieved in the subset of patients who are less than 50 years of age and have only paroxysmal AF. It is likely that more aggressive ablation strategy that involve more extensive and circumferential ablation lesions will be needed in patients over 50 years with persistent or permanent AF to achieve higher success rate.

1052-210
Accurate Identification of Pulmonary Vein Ostial With Real-Time Impedance Measurements

Peter Cheung, Burr W. Hall, Aman Chugh, Kamala Tamirisa, Jinh Hn, Kristina Lemola, Frank Pelosi, Jr., Fred Morady, Hakim Oral, University of Michigan, Ann Arbor, MI

Background: During radiofrequency ablation to encircle or isolate the pulmonary veins (PVs), accurate identification of the ostia is critical to prevent PV stenosis. Impedance may be higher within a PV than at its ostium. The purpose of this study was to determine whether monitoring of real-time impedance facilitates identification of the PV ostia.

Methods and Results: In 26 consecutive patients (mean age ± 54 ± 11 years) who underwent a left atrial ablation procedure, the 3-D geometry of the left atrium, the PVs, and their ostia were reconstructed using an electroanatomical mapping system. The PV ostia were identified based on venography, changes in electrogram morphology, and sinus rhythm, 2/11 (18%) in persistent LAFL.

Conclusions: LAFL occurs in 22% of pts after CPVA. Discrete functional or fixed lines of block with single or multiple gaps, created by prior linear ablation lesions, serve as the most common substrates supporting LAFLs. LAFL may contribute to the recurrence of AF after CPVA.

1052-211
Early Changes in Pulmonary Vein Activation Predict Effectiveness During Pulmonary Vein Isolation Using a Novel Curvilinear Cryoablation Catheter

Tom Wong, Vias Markides, Nicholas S. Peters, D. Wyn Davies, St. Mary’s Hospital, Imperial College, London, United Kingdom

Background: Pulmonary vein (PV) isolation by cryoablation can be time-consuming, predominantly due to the long duration of each cryo-application but has safety advantages in avoiding PV stenosis and local thrombus formation. We have hypothesized that the likelihood of success of each cryo-application can be predicted by early changes in PV activation during cryo-delivery. This may consequently shorten the procedural cryo-application time that was needed for isolation.

Methods: Using a novel 7F steerable linear tipped cryoablation catheter (Artic Circle™), we targeted 32 PVs (diameter 19±5mm) in 17pts (12M, age 52±14yrs) with drug refractory paroxysmal atrial fibrillation. The cryoablation catheter was placed at the ostium of each targeted vein, proximal to a circumferential mapping catheter (Lasso™). Cryoablation lesions were created at −80ºC for 4min. PV isolation was defined as either the elimination of PV electrograms or their dissociation from left atrial (LA) electrograms. An effective application was defined as one causing a significant change in PV activation.

Results: Twenty-five (78%) PVs were successfully isolated, 16 using the circular cryoablation catheter alone, and 9 after additional ablation with a 6mm-tipped catheter. Of 371 (12x84 per PV) applications delivered using the circular cryoablation catheter, 107 (29%) were terminated within 60s due to suboptimal catheter positioning. The remaining 264 (71%) were continued for >60s (mean 200±64s), of which 92 (35%) were effective. To detect a possible cumulative effect, applications for each PV were divided into tertiles. Effective applications were evenly distributed across these tertiles, but overall there was a progressive increase in the effective cycle length over time. Effective applications were evenly distributed across these tertiles, but overall there was a progressive increase in the effective cycle length over time. Effective applications were evenly distributed across these tertiles, but overall there was a progressive increase in the effective cycle length over time.
Thromboembolic Events in Patients Undergoing Atrial Fibrillation Ablation-Incidence, Timing, and Predictors

Mark E. Vangelhoff, Erica S. Zado, Edward P. Gerstenfeld, Sanjay Dixit, Hemal Nayak, Andrea M. Russo, David J. Callans, Francis E. Marchlinski, University of Pennsylvania Health System, Philadelphia, PA

BACKGROUND: Thromboembolic stroke (TES) remains a serious complication of pulmonary vein (PV) isolation for atrial fibrillation (AF). We sought to determine the incidence and risk factors associated with TES in a consecutive series of pts undergoing AF ablation. METHODS: Between December 1999 and August 2003, 400 pts underwent PV isolation. Lasso mapping catheter (LMC) was used to define PV ostium (os) and PVa lesion using a 4 mm Navistar catheter (40 W, 52°C, 90 sec) were created proximal to LMC poles showing earliest PV potentials (entry). Heparin was infused to maintain activated clotting time (ACT) at >300 seconds and intracardiac echocardiographic monitoring (ACUNAV™) was performed.

RESULTS: Four patients (1.0%; 3 males; age: 53±2 years) developed TES (sudden onset new neurologic deficit). All TES events occurred in initial 6 hours after completion of procedure following reversal of ACT with protamine bolus (mean dose 15±5 mg). Three patients had complete neurologic recovery (two patients required tPA). Comparision between pts manifesting clotting time (ACT) at >300 seconds and intracardiac echocardiographic monitoring (ACUNAV™) was performed.

CONCLUSIONS: TES is infrequently observed in pts undergoing AF ablation and appears most common in the early post ablation period. Pts with prior history of TES events are at highest risk, 3 of 15 (20%). These data have important implications regarding patient selection, counseling, and management prior to and following AF ablation procedure.

<table>
<thead>
<tr>
<th>Lesions (Total #)</th>
<th>Ablation Time (hours)</th>
<th>History of prior embolic event</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVA (n=4)</td>
<td>46</td>
<td>3.83 (± 1.77)</td>
</tr>
<tr>
<td>No CVA (n=396)</td>
<td>43</td>
<td>2.78 (± 1.37)</td>
</tr>
</tbody>
</table>

*p < 0.001

Does Catheter Ablation of Atrial Fibrillation Alter Intrinsic Left Atrial Mechanical Function?

David Schwartman, Ravene Bazarr, Doug Hettrick, University of Pittsburgh, Pittsburgh, PA, Medtronic, Inc., Minneapolis, MN

Background: The impact of left atrial (LA) catheter ablation on intrinsic global mechanical function of the chamber is unclear. METHODS: Seven patients (median data: age 56 yrs; LA 42 mm; EF 54%) underwent LA ablation in an effort to suppress atrial fibrillation. Radiofrequency energy, applied in the LA body, was targeted so as to ‘encircle’ both left and right pulmonary venous vestibules. In each patient this yielded ablation or electrical isolation of the subtended myocardium. In each patient, instantaneous LA pressure and volume (conductance) were measured simultaneously. Measurements were made using a catheter placed into the LA body. Data was acquired immediately prior to and after ablation. Analysis utilized multiple indices of LA pump and reservoir functions. Results (table shows mean ± standard deviation):

<table>
<thead>
<tr>
<th>PUMP</th>
<th>Pre-Ablation</th>
<th>Post-Ablation</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Emptying Volume (cc)</td>
<td>11 ± 18</td>
<td>8 ± 7</td>
<td>0.3</td>
</tr>
<tr>
<td>A Loop Area (mmHg·cc)</td>
<td>43 ± 98</td>
<td>40 ± 105</td>
<td>0.9</td>
</tr>
<tr>
<td>End-Systolic Elastance Slope (mmHg·cc)</td>
<td>0.5 ± 0.3</td>
<td>0.5 ± 0.3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVOIR</th>
<th>Pre-Ablation</th>
<th>Post-Ablation</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Emptying Volume (cc)</td>
<td>17 ± 16</td>
<td>16 ± 5</td>
<td>0.6</td>
</tr>
<tr>
<td>V Loop Area (mmHg·cc)</td>
<td>23 ± 17</td>
<td>30 ± 29</td>
<td>0.2</td>
</tr>
<tr>
<td>End-Reservoir Elastance Slope (mmHg·cc)</td>
<td>1.3 ± 1.1</td>
<td>1.1 ± 0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Conclusions: Despite a large volume of ablated/isolated myocardium, ablation did not significantly alter intrinsic global LA mechanical function. A significant impact on regional function cannot be excluded.

1052-223

Pre-Existing Left Atrial Scarring in Patients Undergoing Pulmonary Vein Isolation: An Independent Predictor of Procedural Failure


Background: The goal of this study was to assess the impact of pre-existing left atrial scarring on long-term procedural outcomes in patients undergoing pulmonary vein isolation (PVI) for atrial fibrillation.

Methods: 613 patients presented for PVI for treatment of atrial fibrillation (AF). Prior to each PVI procedure the left atrium (LA) was mapped using a multipolar Lasso catheter. LA scar was defined as a voltage ≤0.5 mV. Out of 613 patients scar of the LA wall was present in 31 patients. All PVI and the SVC were ablated in all study patients.

Results: The table below describes the outcomes in the 2 study groups.

<table>
<thead>
<tr>
<th></th>
<th>LA scar</th>
<th>No LA scar</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>31</td>
<td>582</td>
<td></td>
</tr>
<tr>
<td>Left atrial size</td>
<td>4.5±0.5</td>
<td>4.2±0.6</td>
<td>0.04</td>
</tr>
<tr>
<td>Structural heart disease</td>
<td>52% (16/31)</td>
<td>40% (232/528)</td>
<td>0.04</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>48±8%</td>
<td>54±6%</td>
<td>0.03</td>
</tr>
<tr>
<td>Recurrence of AF</td>
<td>46% (14/31)</td>
<td>14% (83/582)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

1052-224

Morphological Features of Marshall Ligament Tissue and Interalatrial Septum in Patients With Repeated Pulmonary Vein Isolation: An Intracardiac Echocardiographic Imaging Study

Jian-Fang Ren, Francis E. Marchlinski, David J. Callans, University of Pennsylvania, Philadelphia, PA

Background: Morphology of the ligament of Marshall (LOM) and interatrial septum (IAS) may be important features related to a successful isolation of left and right pulmonary vein (PV) respectively. The aim of this study was to provide AcuNav ultrasound catheter imaging measurements of LOM and IAS in pts with repeat radiofrequency (RF) ablation for AF. Methods and Results: In 517 pts undergoing PV ostial isolation using 4 mm electrode and RF (up to 40W, 52°C, 90sec), 76 (14.7%) (age 57±9 yrs) were required to repeat (twice, n=8; triple and 4 times, one each) PV ablation for AF. The thickness of LOM was measured at its cross-sectional view between left upper PV and LA appendage and the length at an off-axis view between distal coronary sinus and left upper PV ostium. The IAS thickness was measured at the area 5 mm adjacent to the fossa ovalis. These measurements were compared to another age-matched 40 pts without repeat RF for successful PV isolation with 6-month followup. (Table) The thickness of LOM and IAS was greater in repeat RF pts than those without repeat RF (p<0.05). Higher echogenicity of thickened LOM and lipomatous hypertyrophy of IAS were more frequently observed in repeat RF pts. Conclusion: Pts with repeat RF PV isolation had more thickening and echogenicity of LOM and IAS at time of morphologic imaging. This is consistent with more significant hypertrophy, fibrosis or degeneration. Alternative or more effective RF energy delivery tools may be required in pts with such findings to reduce need for repeat procedures.

Repeat RF

<table>
<thead>
<tr>
<th>LOM(mm)</th>
<th>Width</th>
<th>Length</th>
<th>IAS(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>5.9±1.7</td>
<td>17.4±2.4</td>
<td>10.4±0.4</td>
</tr>
<tr>
<td>Post</td>
<td>9.4±2.0</td>
<td>22.9±3.9</td>
<td></td>
</tr>
</tbody>
</table>

1052-225

Registration of Cardiac Computed Tomography Images With Three-Dimensional Electroanatomical Mapping to Guide Catheter Manipulation in the Left Atrium: Implications for Pulmonary Venous Isolation

Vivek Y. Reddy, Zachary Malchano, Petr Neuzil, Jin Weichert, Jeremy N. Ruskin, Massachusetts General Hospital, Boston, MA, Na Homolcne Hospital, Prague, Czech Republic

Background: 3D electroanatomical mapping (EAM) systems are frequently employed to facilitate catheter ablation of atrial fibrillation (AF). Because of the complexity of the chamber geometry, it is common to obtain preoperative CT/MRI to provide an anatomical “roadmap” of the left atrium (LA) & pulmonary veins (PVs). In the optimal scenario, the EAM dataset would be directly integrated and registered (i.e., properly aligned) with the EAM system so as to guide real-time catheter movement within the LA and to the PV ostia based on the actual chamber anatomy.

Methods: To determine the feasibility of this image integration paradigm to guide AF catheter ablation, simulations were performed using a life-size model of the LA, PVs, and aorta (Ao); the optimal means of achieving accurate registration between EAM data and imaging data was determined. Based on these simulation results, the image integration strategy was employed in a series of patients with AF (n=13) undergoing catheter ablation to electrically isolate the PVs. For these patients, CT images of the LA-PVs were pre-