Results: All 8 patients converted to SR during follow-up. Atrial tissue shows a wide variation of reactive fibrosis, endocardial thickening and myocardial hypertrophy (mean wall thickness 5.4mm left, 3.8mm right atrium). SICTRA produces clearly delineated coagulation necrosis bordered by an irregular zone of fresh bleeding and incomplete necrosis without superficial charring or perforation. The necrotic core consists of homogenized, swollen anuclear myocardial cells up to a depth of 5.5mm. Endocardium and subendocardium display edematic loosening, swelling and microfragmentation of connective tissue fibers. In the early phase (2 to 6 days; n=5) interfibrillar disseminated bleeding and areactive necrosis is found. In the mid-term phase (> 20 days, n=3) mild inflammatory removal reaction and granulation tissue is found on the borders of the necrotic core. 24% of all studied lesions in patients with documented postoperative sinusrhythm were non-transmural and 100% of left atrial isthmus lines demonstrated non-transmurality. Multiple nervous fibers are detected in the pulmonary ostial region displaying different degrees of thermal damage.
Conclusions: Radiofrequency ablation in AF leads to coagulation necrosis of endocardium, subendocardium and the atrial myocardial layer to a depth of about 5.5mm bordered by an irregular zone of incomplete thermal damage. N superficial damage or charring is produced. complete transmurality can only be documented in 76% of intraoperatively applied lesion in patients converted to SR. If these lesions produce long-term electric conduction block has to be further analyzed.

4:30 p.m.

860-3 **Electroanatomical Mapping to Assess Phrenic Nerve Proximity to Superior Vena Cava and Pulmonary Vein Ostia**

Martin D. Lowe, Laurie A. Peterson, Kristi H. Monahan, Samuel J. Asirvatham, Douglas L. Packer, Mayo Clinic, Rochester, MN

Background: The phrenic nerve courses between the superior vena cava (SVC) and right superior pulmonary vein (RSPV) and as such is liable to injury during AF ablative procedures. This study was designed to assess the anatomical relationship between phrenic nerve and venous ostia of SVC and right sided PVs.
Methods: Thirty-one patients (26 males, mean age 53 ± 8 years) with a mean duration of AF of 4.3 ± 2.8 years who were undergoing pulmonary vein (PV) isolation alone, or in combination with LA linear ablation and SVC isolation, were studied. Electroanatomical mapping and geometric rendering (CARTO, Biosense Webster) of SVC, RA, LA and PVs was performed initially. Following 3D acquisition of cardiac and venous structures, phrenic nerve capture was mapped during high output pacing (10–20 mA, 2 ms pulse width) within SVC, RA and right sided PVs. Following stimulation within each PV the catheter was withdrawn to an ostial location and pacing performed at superior, inferior and anterior borders of the PV / LA junction, as verified by fluoroscopy and intra-cardiac echo.
Results: Phrenic nerve capture was seen in all patients from the SVC / RA, with multiple capture sites demonstrated in individual patients. During RSPV pacing the phrenic nerve was captured in 20 patients (65%), with the superior branch being the most common site for phrenic stimulation. In 5 patients (16%) the phrenic nerve could be captured at the ostium of the RSPV (3 at anterior border with LA, 1 superior and 1 inferior). Pacing within the RIPV captured the phrenic nerve in 4 patients (13%), but phrenic nerve capture was not obtained at the ostium in any patient. Delivery of RF energy following phrenic nerve mapping was directed away from capture sites, with power limit set to 30W at the SVC / RA junction and RSPV ostium. In 3 patients complete electrical isolation of SVC or PVs was not possible because of the risk of phrenic injury with higher energy deliveries.
Conclusion: The phrenic nerve is closely related to the SVC / RA junction and in nearly one fifth of patients runs adjacent to the RSPV ostium. Careful titration of energy delivery when performing SVC and RSPV isolation should be undertaken to avoid phrenic nerve damage.

4:45 p.m.

860-4 **Remote Catheter Ablation Using the New Magnetic Navigation System Niobe**

Sabine Ernst, Feifan Ouyang, Christian Linder, Matthais Antz, Karl-Heinz Kuck, St. Georg General Hospital, Hamburg, Germany

Introduction:
Accessibility of target sites during conventional electrophysiologic (EP) procedures can be hampered by catheter design limitations (steerability, torque,etc). The new Niobe magnetic navigation system consists of two computer-controlled permanent magnets located on opposite sides of the patient table, and a small magnet embedded in the tip of the ablation catheter which aligns with the user-defined magnetic field direction (0.08 Tesla). A motor drive, controlled via joystick, advances or retracts the catheter, thus enabling complete remote navigation.
Methods
A total of 54 pts (24 m) were enrolled in a safety and feasibility study. By protocol limitation, during the initial 20 procedures radiofrequency current (RFC) delivery was limited to the right atrium only. RFC was applied using a remote-controlled solid tip magnetic navigation-enabled catheter (55-60°C, 40 W, max.180 sec).
Results
In all pts, remote-controlled mapping of the target sites was successfully and safely performed. In 30 pts atrioventricular nodal re-entrant tachycardia was treated, in 14 pts an inferior isthmus blockade for atrial flutter was attempted, 6 pts had an inducible atrioventricular re-entrant tachycardia and two pts suffered from an ectopic atrial tachycardia. Remote RF catheter ablation was performed using a median of 7 RFC applications (median fluoroscopy time 12.3 min, median procedure duration 188 min). In 6 pts, the tachycardia substrate was located on the arterial side of the heart. A retrograde approach crossing the aortic valve by remote control was used in 3 pts, whereas in the remaining a transseptal approach was used. There were no acute complications.
Conclusions
The Niobe system is a new platform allowing the remote-controlled navigation of a 4 mm tip ablation catheter guided by intermittent fluoroscopy. In conjunction with a motor drive unit, this system was used for the first time in pts with simple EP substrates to perform completely remote-controlled ante- and retrograde EP mapping and RF ablation.

ORAL CONTRIBUTIONS

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Advanced Electrocardiographic Techniques

Wednesday, March 10, 2004, 8:30 a.m.-10:00 a.m.
Morial Convention Center, Room 217

8:30 a.m.

874-1 **Right Ventricular but Not Biventricular Pacing Increases Markers of Ventricular Electrical Vulnerability**

Gioia Turitto, Seing Houy, Ravi Gupta, Ronald Pedalino, Nabil El-Sherif, SUNY - Downstate Medical Center, Brooklyn, NY

Background: Compared to right ventricular (RV) pacing, biventricular (BiV) pacing is believed to result in improved mechanical and electrophysiologic parameters. Tachycardia-dependent T-wave alternans (TWA) is associated with increased dispersion of ventricular repolarization and is considered a strong predictor of malignant ventricular tachyarrhythmias.
Methods: We compared the prevalence of TWA in a group of patients (26 males, 6 females, age: 59±15 years, left ventricular ejection fraction: 34±14%, with values <35% in 25 patients) during atrial pacing, atrio-ventricular (AV) pacing from the RV (AV-RV), and AV pacing from both RV and LV (AV-BiV). The study was conducted during electrophysiology evaluation and/or following device implantation. Pacing rate was 110/min and pacing modes were performed in random order for 10 min each. Criteria for positive TWA were voltage >1.9 μV with ratio (k) >3 for >1 min in ≥1 orthogonal lead and/or ≥2 precordial leads.
Results: TWA was induced by atrial pacing in 31% of patients, by AV-RV pacing in 81% of patients, and by AV-BiV pacing in 40% of patients. There was a statistically significant increase of all TWA parameters between atrial pacing and AV-RV pacing ($p<0.001$) and between AV-BiV and AV-RV pacing ($p<0.01$). However, there was no statistically significant difference between AP and AV-BiV pacing modes.
Conclusions: RV pacing, even for a short duration, is associated with markers of increased ventricular electrical vulnerability, which are significantly ameliorated by BiV pacing.

8:45 a.m.

874-2 **Reproducibility and Interpretation of Magneto-Cardio-Gram Maps in Detecting Ischemia**

Benjamin A. Steinberg, Ariel Roguin, Elaine Allen, Daniel R. Wahl, Craig S. Smith, Marcus St. John, Stanley Watkins, Richard Sohn, Henry R. Halperin, Peter Hill, Jon R. Resar, Johns Hopkins Hospital, Baltimore, MD

Magneto-Cardio-Gram (MCG) is a non-invasive technology which measures the magnetic field of the heart by superconducting quantum interference devices (SQUIDs) sensors. The novelty of the present system is that the sensors can be operated without electromagnetic shielding of the examination room thus allowing the system to be easily installed in the emergency department or chest pain unit. Preliminary studies in Europe found that this imaging modality may have better sensitivity as compared to ECG in detecting ischemia. We aimed (1) to assess the reproducibility, intraobserver and interobserver interpretation variability and (2) to assess the MCG maps with presence of coronary narrowings.
Methods and results: All measurements were performed in a non shielded room. (1) Two MCG maps were recorded in 22 otherwise healthy volunteers (age 22-53, median 31, 15 male) in an interval ranging from 2-48 hours. The maps were interpreted using the Cardimag software for contour maps, average MCG time traces and waveform morphology of repolarization by two observers blinded to each other. An ischemia algorithm, developed by CardioMag Imaging, was used, and the same conclusion (19-normal, 3 pathological) was achieved in all volunteers. The reproducibility was in the 4% angle range in all but one volunteer ($r=0.94$, $p<0.001$). The correlations of the intraobserver and interobserver interpretation were significant ($r=0.95$, $p<0.001$).
(2) MCG maps were obtained in 36 patients referred for angiography due to suspected coronary artery disease. Twenty-four of them had coronary narrowings defined as more than 50%. In this group, 16 (66%) had abnormal MCG maps as compared to only 5 (21%) who had abnormal ECGs ($p<0.01$).
Conclusions: MCG maps can be successfully obtained in a non-shielding room and allows feasible, accurate and reproducible measurements with little intraobserver and interobserver variability. Ischemic changes in the heart's magnetic field may occur before electrical changes. Our pilot data suggests that this imaging modality may offer better sensitivity as compared to ECG in detecting ischemia in a cohort of patients who had coronary narrowings in angiography.