Paroxysmal and chronic atrial fibrillation ablation using multi-array catheters and low radiofrequency energy

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Background: Delivery of high-power standard radiofrequency (RF) energy in the left atrium (LA) has been associated with several complications. We evaluate the safety and efficiency of multi-array electrodes using low energy (3–10 W) and unipolar/bipolar RF delivery for routine ablation in patient with paroxysmal (PAF) and persistent/chronic (CAF) atrial fibrillation.

Methods and results: A total of 127 patients (PAF = 92 and CAF = 35) underwent RF ablation using multi-array ablation and mapping electrodes. Pulmonary vein isolation (PVI) was performed using a circular pulmonary vein ablation catheter for both mapping and ablation. In CAF patients, ablation of fractionated electrograms at the septum and in the LA was performed with additional multi-array electrode catheters (MASC and MACC). Follow-up including 7-day continuous ECG monitoring was currently available in 72 patients after 3.9 ± 1.7 months. Success was defined as freedom of AF without anti-arrhythmic drug (AAD) treatment. Improvement was defined as sinus rhythm on AAD or reduction of symptoms in presence of residual PAF. Low-energy-phased RF ablation led to complete PVI in 122 patients, in 5 patients during the learning curve PVI had to be completed by standard radiofrequency ablation. No complications occurred during mean procedure times from 2 to 2.6 h. Follow-up after 4 months is currently available for the first 72 patients and showed an overall success rate of 62.5% with additional 26% improving.

Conclusion: Multi-array mapping and ablation electrodes using phased unipolar/bipolar RF with lower energies are safe in clinical use. Procedure times are acceptable and short-term efficacy promising.

Late thromboembolic events after circumferential pulmonary vein ablation of atrial fibrillation

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Background: Thromboembolic events (TEs) are the major potential risk for atrial fibrillation (AF). Catheter ablation can restore sinus rhythm in selected patients with AF, but its preventive function for TEs is still underdetermined.

Objectives: To investigate the predictors of late TEs and to guide the antiarrhythmic and anticoagulation treatment strategies.

Methods and results: We retrospectively studied 393 consecutive patients with AF who were referred for circumferential pulmonary vein isolation (PVI). The periprocedure TE was only documented in one patient without early recurrence of AF. Our study demonstrates a strong relationship between the recurrence of AF after ablation and TE postoperation and supports the proposal that free of recurrence is an indication for discontinuation of anticoagulation after ablation.

Predictors of early recurrence of atrial tachycardias after catheter ablation for patients with atrial fibrillation

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Objective: The aim of the study was to investigate the predictors of early recurrence of atrial tachyarrhythmias (ATas) after catheter ablation (CA) for patients with atrial fibrillation (AF).

Methods and results: One hundred and fourteen patients with AF who received CA were enrolled in this study. All patients underwent circumferential pulmonary vein isolation (PVI) guided by CARTO system. Linear ablations (LAs) in the roof and mitral isthmus, and ablation of complex fractionated atrial electrograms (CFAEs) were performed after PVI in patients with chronic AF. External cardioversion was needed if AF was still sustained. Univariate analysis and multivariate analysis were carried out to assess the predictive value of 17 clinical and procedural variables on early (within 3 months) recurrence of ATa after the initial CA. Pulmonary vein isolation was achieved in all patients. Atrial fibrillation was converted to sinus rhythm in 6, to atrial flutter after left atrial LA in 4, and converted to atrial flutter after ablation of CFAE in 6 patients in 34 chronic AF patients. All the external cardioversion was successful. Early recurrence of AF occurred in 37 patients. Only AF duration, left atrial enlargement, and AFCL could predict the early recurrence of AF after multivariate analyses. During a follow-up of 10 ± 7 months, late recurrence of AF happened in 22 (59.5%) of the 37 patients with early recurrence of AF, and in 5 (7.5%) of the 67 patients without early recurrence of AF.

Conclusion: Atrial fibrillation duration, left atrial enlargement, and AFCL are independent predictors for the early recurrence. Early AF recurrence could predict late AF recurrence.

Continuous surveillance of atrial fibrillation recurrence after pulmonary vein isolation: a novel approach using implantable loop recorder

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Background and objective: Recurrence of atrial fibrillation (AF) after pulmonary vein isolation (PVI) is common. Better detection of AF is important to assess the efficacy of ablation procedure and to guide the antiarrhythmic and anticoagulation treatment strategies.

Methods and results: We studied the feasibility of a novel method to continuously monitor the atrial rhythm post-AF ablation. Extraocular atrial electrogram (A-EGM) mapping was performed using implantable loop recorder (ILR) following limited thoracotomy approach for epicardial PVI. We tested different orientations of ILR in frontal plane to obtain the best vector and optimum magnitude of A-EGM during sinus rhythm (SR) and AF. Atrial electrogram could be optimally deciphered both in SR and AF when ILR was positioned in the right inframammary region. Extracardiac A-EGM could discern AF episode satisfactorily. Diminutive ventricular electrogram did not interfere with the diagnosis of SR or AF.

Conclusion: Robust leadless atrial electrogram recording is feasible during SR and AF. Incorporating atria-based algorithms and extended storage capacity into contemporary rate-based limited-memory functional design of ILR can accurately and continuously reveal the AF burden for a prolonged period after AF ablation.
The role of isoprenaline-induced calcium-activated transient outward chloride current in atrial electrical remodelling of rabbit

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Objective: To investigate the relationship between the changes of I_{Ca,L} and I_{Cl,L} and the repolarization characteristic of action potential in phase 1 under isoprenaline (ISO) administration in atrium myocytes of rabbit.

Methods and results: The membrane currents and action potential (AP) were recorded by the whole-cell patch-clamp technique in atrium myocytes of rabbit. (i) After recording I_{Ca,L}, atrium myocytes were perfused with ISO (1 μmol/L) at once. I_{Ca,L} was significantly increased in 5 min later, and the peak of I_{Na} was gradually increased while I_{Ca,L} gradually decreased with increased clamp voltage. The I_{Na} was resistant to 4-AP (3 mmol/L) but sensitive to DIDS (150 μmol/L). This current was blocked by CsCl (200 μmol/L). The elicited rate of I_{Na} was 91.67% (<P < 0.05) (ii) The shape of AP is like an inverse triangle with no plateau in phase 2 after ISO (1 μmol/L) perfusion. Moreover, compared with the parameters of control group, APD50 and APD90 were significantly shortened from (65.4 ± 4.2) ms and (95.8 ± 3.8) ms to (12.8 ± 3.8) ms and (72.0 ± 4.7) ms, and reduced to 80.45 and 71.81%, respectively (<P < 0.01, n = 12). 4-AP (3 mmol/L) has on obvious effect on the shape of AP; however, the plateau of AP in phase 2 was recovered by DIDS (150 μmol/L) perfusion; APD90 and APD10 were (41.1 ± 4.5) ms and (79.6 ± 3.4) ms, respectively. This results showed that ion transport were changed by ISO perfusion in atrium myocytes, and I_{Na} plays an important role in the phase 1 repolarization of AP.

Conclusion: Before ISO administration, we can only observe I_{Ca,L} in atrium myocytes of rabbit. After isoproterenol intervention, some intracellular ionic consistence, and membrane ionic channel were changed. I_{Ca,L} and I_{Cl,L} reveal obvious predomiance which shorten APD significantly. Atrium myocytes electrical remodelling has occurred. Remodelling of ionic channel maybe have a relationship with the opening of I_{Ca,L}. This ionic remodelling maybe the electrophysiological base of re-entrant atrial tachycardia.

Keywords: Isoprenaline, Atrial myocytes; Whole-cell patch-clamp technique; Calcium-activated transient outward chloride current; Action potential; Electrical remodelling of ionic channel

Electrophysiological characteristics of Marshall potential in dogs-based on anatomic properties

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Background: The electrophysiological characteristics of the Marshall potential is important in ligament of Marshall (LDM) ablation.

Methods and results: Marshall potential was recorded under sinus rhythm, left atrial appendage (LAA) pacing first random five dogs (Group 1), and LDM ablation was performed. Histological examination was performed in 10 rest dogs, which were divided into two groups based on histological results (Groups 2 and 3). Group 2 activation of Marshall (AM) intervals prolonged or shortened by LAA pacing. Group 3 AM intervals were prolonged during LAA pacing (125 ± 9 vs. 80 ± 6 ms, P = 0.043, when pacing rate = 350) (126 ± 9 vs. 80 ± 6 ms, P = 0.0442, when pacing rate = 450). Marshall potential was separated from atrial electrogram by LAA pacing in Groups 2 and 3. There was no significant difference in AM intervals during sinus rhythm and right atrial appendage pacing. Conclusion: Marshall potential has different forms of electrograms including the prolonged AM interval, which is presented by LAA pacing. This might be useful in LDM ablation.

Keywords: Ligament of Marshall; Histological connections; Atrial fibrillation; Left appendage pacing

Epichardial application of focused ultrasound ablation for atrial fibrillation in dogs

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Objectives: To study the feasibility of focused ultrasound (FU) ablation in atrial fibrillation (AF) and compare the effect of ablation on the two lines that around the pulmonary veins (PVs) (group CPVA) or the posterior LA including all PVs (group BOXA).

Methods and results: Twenty mongrel dogs were studied. Model of paroxysmal AF was induced by burst stimulation after the injection of acetylcholine (ACh) into the fat pad containing autonomic ganglia at the base of the PV. Epicardial beating-heart FU ablation was induced by burst stimulation after the injection of acetylcholine (ACh) into the fat pad containing autonomic ganglia at the base of the PV. Epicardial beating-heart FU ablation was performed around the PVs (group CPVA) or the posterior LA including all PVs (group BOXA) by scanning with a 4 mm diameter catheter at the speed of 2 mm/s, and the epicardial electrograms were recorded by the four poles catheter electrode which sutured to the ligament of Marshall (LOM) ablation. Marshall potential was recorded under sinus rhythm, left atrial appendage pacing (LAA) during sinus rhythm and right atrial appendage pacing. ATR effects of continuous AF during electrical cardioversion was higher in patients with OSA. However, the association between OSA and the development of AF in patients without prior history of AF is unknown. The objective of this study is to investigate the incidence of developing atrial tachyarrhythmia (ATR) in patient with high risk for OSA and no prior history of AF.

Methods and results: We prospectively studied 85 patients (mean age 68.5 ± 10.8, 85 male) with no prior history of AF who underwent implantation of devices with electrograms storing capability for high atrial rate detection [35 pacemakers, 42 implantable cardioverter defibrillators (ICDs), and 8 biventricular ICDs]. Patients at high risk for OSA were identified by the Berlin Questionnaire, which has been validated to identify patients with OSA. Patients were routinely followed in the device clinic and via transtelephonic monitoring. Intracardiac electrograms were reviewed if atrial high-rate episodes were detected. Forty-two (49%) patients were identified to be at high risk for OSA (HR group) vs. 43 (51%) patients at low risk (LR group). During follow-up period of 9 months, 14 of 42 patients (33.3%) in HR group and 5 of 43 patients (11.6%) in LR group developed ATR (P = 0.035).

Conclusion: Patients with high risk of OSA and without prior history of AF are at higher risk of developing ATRs than patients with low risk of OSA.

Obstructive sleep apnoea and the risk of developing atrial tachyarrhythmia

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Background and objectives: Obstructive sleep apnoea (OSA) is strongly associated with atrial fibrillation (AF). The incidence of recurrent AF after electrical cardioversion was higher in patients with OSA. The objective of this study is to investigate the incidence of developing atrial tachyarrhythmia (ATR) in patient with high risk for OSA and no prior history of AF.

Methods and results: We prospectively studied 85 patients (mean age 68.5 ± 10.8, 85 male) with no prior history of AF who underwent implantation of devices with electrograms storing capability for high atrial rate detection [35 pacemakers, 42 implantable cardioverter defibrillators (ICDs), and 8 biventricular ICDs]. Patients at high risk for OSA were identified by the Berlin Questionnaire, which has been validated to identify patients with OSA. Patients were routinely followed in the device clinic and via transtelephonic monitoring. Intracardiac electrograms were reviewed if atrial high-rate episodes were detected. Forty-two (49%) patients were identified to be at high risk for OSA (HR group) vs. 43 (51%) patients at low risk (LR group). During follow-up period of 9 months, 14 of 42 patients (33.3%) in HR group and 5 of 43 patients (11.6%) in LR group developed ATR (P = 0.035).

Conclusion: Patients with high risk of OSA and without prior history of AF are at higher risk of developing ATRs than patients with low risk of OSA.
Conclusion: Pulmonary vein isolation is an effective treatment for long-pause resulting from paroxysmal AF. Significant difference of SNRT before and after PVI (SNRT was observed (correlation efficiency was from 0.24 to 0.53, respectively. No significant relationship between long-pause and 1200 to 2500 ms (mean 1682 ± 284 ms) before and after ablation, respectively. Sinus nodal recovery measured by atrial stimulation at S1S1 1600 and 600 bpm were from 2100 to 5100 ms (mean 3464 ± 118 ms) before and at 1, 2, 3, and 4 h of RAP. (i) In control group, RAP could shorten atrial ERP and augment atrial VW more (P < 0.05) compared with that without SS. During RAP, atrial ERP shortened atrial ERP furthermore (P < 0.05) whether SS or not. (ii) Before RAP, 13 open-chest dogs (ablation group) underwent EFPA, another 12 dogs (control group) underwent sham procedure. Atrial effective refractory period (ERP), vulnerability window (VW) of atrofibrillation were measured at high right atrium, ostial and mid-diastolic coronary sinus (CSO and CSD) with and without sympathetic stimulation (SS) before and at 1, 2, 3, and 4 h of RAP. (i) In control group, RAP could shorten atrial ERP and increase VW significantly (P < 0.05). Given SS, atrial ERP shortened atrial ERP furthermore (P < 0.05) compared with that before RAP. Under SS, there is an increasing trend of VW during RAP compared with that before RAP. Sympathovagal stimulation could shorten atrial ERP and augment atrial VW more (P < 0.05) which was not observed in control group. (ii) Before RAP, ERP and VW in the ablation group were similar to that of the control group whether SS or not (P > 0.05). After EFPA, ERP increased significantly (P < 0.05) and VW decreased nearly to zero (P < 0.05) whether SS or not. During RAP, atrial ERP and VW in the ablation group remained unchanged (P > 0.05) whether SS or not. Conclusion: The changes in myocardial sleeves of PV observed in our research can cause AF by means of trigger activity and/or re-entrant mechanism. On the assumption of our ultrastructural study, we cannot strengthen the theory of nodal cells in PV; however, node-like cells are proved to exist.

The relationship of long-pause after atrial fibrillation termination and sinus nodal recovery time and impact of pulmonary vein isolation on it

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Objective: To analyse the relationship of long-pause after atrial fibrillation (AF) termination and sinus nodal recovery time (SNRT), and the impact of pulmonary vein isolation (PVI) on it in order to disclose the potential mechanism of long-pause after AF and to discuss the optional therapy for this kind of long-pause.

Methods and results: Eleven patients with syncpe or pre-syncpe were involved because of long-pause after paroxysmal AF. Segmental PV was performed. Sinus nodal recovery time was measured by atrial stimulation at S1S1 1600 and 600 bpm for 1 min before and after PVI. Pulmonary vein isolation was achieved in 11 patients. Seven patients were free of AF and syncpe or pre-syncpe during the mean follow-up of 13 months. Permanent pacemaker was implanted in two patients because of syncpe or pre-syncpe resulting from long-pause demonstrated by electrogram. The other two patients with recurrence of AF are still in follow-up without any antiarrhythmic drugs because of long-pause. The long-pause was for 2100 to 5100 ms (mean 3464 ± 918 ms) before ablation. Sinus nodal recovery time measured by atrial stimulation at S1S1 1600 bpm were from 1200 to 2300 ms (mean 1655 ± 378 ms) and from 1000 to 1900 ms (mean 1491 ± 284 ms) before and after ablation, respectively. Sinus nodal recovery measured by atrial stimulation at S1S1 1600 bpm were from 1200 to 2500 ms (mean 1682 ± 419 ms) and from 1200 to 900 ms (mean 1518 ± 218 ms) before and after ablation, respectively. No significant relationship between long-pause and SNRT was observed (correlation efficiency was from 0.24 to 0.53, P > 0.05). There was no significant difference of SNRT before and after PVI (P > 0.05).

Conclusion: Pulmonary vein isolation is an effective treatment for long-pause resulting from AF termination. Sinus nodal malfunction may not contribute to the long-pause resulting from paroxysmal AF.

Early and mid-term results of combined radiofrequency ablation and mitral valve repair in patients with chronic continuous atrial fibrillation and severe mitral regurgitation

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Objective: To evaluate the early results of combined radiofrequency ablation (RFA) and mitral valve repair surgery with chronic continuous atrial fibrillation (CCAF) and severe mitral regurgitation (MR).

Methods and results: From March 2005 to June 2008, 32 consecutive patients (mean age 55.6 and male 56%) with mean duration of CCAF 33.3 months underwent modified Cox Maze III procedure using RFA together with concomitant mitral valve repairs. Post-operative complications, rate of conversion to sinus rhythm, re-operation rate, and in-hospital mortality were analysed. Nineteen patients had further concomitant cardiac operation (16 tricuspid annuloplasty, 2 coronary artery bypass graft, 2 atrial valve replacement, and 1 atrial septal defect). Twenty-two patients (69%) required complex mitral repair techniques. Mean ICU stay was 47.3 h. There were no in-hospital mortality and no late mortality. Post-operative complications included one aortic dissection, one heart block with pacemaker insertion, and one pre-operative ventricular tachycardia with automatic implanteable cardioverter-defibrillator insertion. Two patients had bleeding complications and one with drain wound infection required antibiotics therapy. There was no stroke or thromboembolic event. Seventeen patients (53%) discharged home in sinus rhythm. By September 2008, 24 patients (75%) required antibiotics therapy. There was no stroke or thromboembolic event. Seventeen patients (53%) discharged home in sinus rhythm and further 4 patients were pending for DC cardioversion. There were already in sinus rhythm and further 4 patients were pending for DC cardioversion. By September 2008, 24 patients (75%) were free of AF symptoms and very good short- to mid-term freedom from thromboembolic events.

Impact of epicardial fat pad ablation on acute atrial electrical remodelling

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Objective: To investigate the impact of epicardial fat pad ablation (EFPA) on acute atrial electrical remodelling (AAER).

Methods and results: A total of 25 adult mongrel dogs under general anesthesia were involved in this study. Bilateral cervical sympathovagal trunks were decentralized. Acute atrial electrical remodelling was performed through rapid atrial pacing (RAP) at 600 bpm for 4 h. Before RAP, 13 open-chest dogs (ablation group) underwent EFPA, another 12 dogs (control group) underwent a sham procedure. Atrial effective refractory period (ERP), vulnerability window (VW) of atrial fibrillation were measured at high right atrium, ostial and distal coronary sinus (CSO and CSD) with and without sympathetic stimulation (SS). Before and at 1, 2, 3, and 4 h of RAP, (i) In control group, RAP could shorten atrial ERP and increase VW significantly (P < 0.05). Given SS, atrial ERP shortened atrial ERP furthermore (P < 0.05) compared with that before RAP. Under SS, there is an increasing trend of VW during RAP compared with that before RAP. Sympathovagal stimulation could shorten atrial ERP and augment atrial VW more (P < 0.05) which was not observed in control group. (ii) Before RAP, ERP and VW in the ablation group were similar to that of the control group whether SS or not (P > 0.05). After EFPA, ERP increased significantly (P < 0.05) and VW decreased nearly to zero (P < 0.05) whether SS or not. During RAP, atrial ERP and VW in the ablation group remained unchanged (P > 0.05) whether SS or not.

Conclusion: The changes in myocardial sleeves of PV observed in our research can cause AF by means of trigger activity and/or re-entrant mechanism. On the assumption of our ultrastructural study, we cannot strengthen the theory of nodal cells in PV; however, node-like cells are proved to exist.

Nodal cell theory in the pulmonary veins, thru or Miff? Study on morphology and ultrastructure

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Background: Slight number of studies has been conducted in the field of ultrastructure of pulmonary veins (PVs). There are different data about nodal cells’ existence in PV muscle sleeves of patients with atrial fibrillation (AF).

Methods and results: Twenty human autopsy hearts were studied (10 with cardiovascular disease AF in 4 patients). Moreover, in five patients with degenerative mitral valve disease and AF and in five patients with atrial septal defect without arrhythmia, biopsies have been taken from the right superior PV and left atrium. In PV muscle sleeves of patients with AF were found the local changes such as lymphocyte infiltration and fibrosis. Moreover, in two patients, we have also found fibro-lymphomatosis reminiscent picture of arrhythmogenic dysplasia in right ventricle. The results of electron microscopy investigation indicated that the cells of PV muscle sleeves conditionally can be divided into two groups: in the first group of patients, cells were similar to cardiomycocytes of left atrium, and in the second group of patients, we have found the cells with several ultrastructural characteristics similar to the nodal cells (loysis of myofibrils, lack of nexuses in the insertion disc) but we did not find the P cells, T cells, and Purkinje fibres.

Conclusion: The changes in myocardial sleeves of PV observed in our research can cause AF by means of trigger activity and/or re-entrant mechanism. On the assumption of our ultrastructural study, we cannot strengthen the theory of nodal cells in PV; however, node-like cells are proved to exist.
Ganglionated plexi ablation for paroxysmal atrial fibrillation

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Background: Ablation of left atrial ganglionated plexi (GP) is a promising method for the treatment of atrial fibrillation (AF). However, data regarding the clinical effectiveness of this approach are few and contradictory.

Objectives: To assess autonomic denervation offered by an anatomic approach for GP ablation and evaluate its clinical effectiveness by means of an implantable arrhythmia-monitoring system.

Methods and results: In 15 patients with symptomatic, drug-refractory, paroxysmal (n = 56) and persistent (n = 19) AF, radiofrequency ablation of the main clusters of GPs in the left atrium was performed. In all patients, an ECG monitor (Reveal XT, Medtronic USA) was implanted before or immediately after AF ablation and data were analysed monthly over a 6-month follow-up period. Immediately post-ablation, SDNN, rMSSD, and HF decreased, while HRmean, HRvar, and LF/HF increased. Freedom from AF increased progressively in patients with paroxysmal and persistent AF; after 6 months it was 85.7 and 69.2%, respectively.

Duration and number of episodes of AF after ablation gradually decreased over the follow-up period. Parasympathetic denervation was more prominent in patients free of AF compared with those with AF recurrence.

Conclusion: Anatomic ablation of the left atrial GP can be safely performed and enables maintenance of sinus rhythm in the majority of patients with paroxysmal and persistent AF.

Changes of swelling-activated chloride channel in atrial myocardium of rabbits with heart failure

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Background and objectives: Heart failure is associated with an increased incidence of atrial fibrillation in patients with chronic heart failure. The potential mechanism has not been well explored. Recent study has demonstrated that swelling-activated chloride channel (I_{cl,swell}) may promote atrial fibrillation in dilated atria. The purpose of the present study is to observe the changes of I_{cl,swell} in isolated atrial myocardium after heart failure in rabbits.

Methods and results: Twenty rabbits were randomly divided into two groups: control group (n = 10, sham-operation rabbits) and heart failure group (n = 10 group). Chronic heart failure model was produced by combined aortic regurgitation and coarctation of the abdominal aorta, which was practiced 2 weeks later. Ten weeks after operation, changes of heart structure and function were inspected by cardiac color Doppler ultrasound. The pathological change was analysed by histological haematoxylin–eosin staining. The expression of I_{cl,swell} mRNA and proteins was detected by RT–PCR and western blotting, respectively. The left atria inner diameter of heart failure group was significantly enlarged (P < 0.05) compared with the control group. The pathological examination of heart failure group was consistent with the histological changes of heart failure. The expression of I_{cl,swell} protein and mRNA in heart failure group was markedly increased (P < 0.01).

Conclusion: The expression of I_{cl,swell} in atrial myocardium of rabbits with heart failure was significantly increased. I_{cl,swell} may play a role in the vulnerability to atrial fibrillation in dilated atria with heart failure.

Keywords: Heart failure; Atrial fibrillation; Atrial myocardium; Swelling-activated chloride channel

The characterization of the left atrial substrate and efficiency of the three-dimensional bipolar voltage map-guided pulmonary vein isolation for non-paroxysmal atrial fibrillation

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Purpose: We evaluated the efficacy of three-dimensional bipolar voltage map-guided pulmonary vein isolation (PVI) for non-paroxysmal atrial fibrillation (AF lasting over 3 months) with a left atrial substrate.

Methods and results: Thirty-two consecutive AF patients (60 ± 9 years old, 24 males) underwent electroanatomical mapping (CARTO) during AF prior to PVI, and the CARTO system displayed the mean peak-to-peak amplitude of the bipolar electrogams as a voltage map. We evaluated the surface area and distribution of the low voltage zones (LVZs) <0.4 mV. If LVZs existed in the posterior wall of the left atrium (LA), PVI was performed and included the LVZs. The LA volume was 116 ± 35 mL and percentage of the surface area of the LVZs was 32 ± 22% at baseline. During the follow-up (mean 12.1 months), 19 patients (59.4%) had no recurrence of AF without any anti-arrhythmic agents (AAAs) and 28 (87.5%) with and without AAAs. The LA volume in the recurrence group was significantly larger (100.5 vs. 126.9 mL, P = 0.03) than that in the non-recurrence group. The LVZ areas of the inferior and septal wall in the recurrence group were significantly larger (P = 0.035 and P = 0.003, respectively) than those in the non-recurrence group. However, there were no differences in the LVZ areas of the posterior wall between the two groups (P = 0.88).

Conclusion: The distribution of the LVZs had a great meaning for the outcome of the PVI for the patients with non-paroxysmal AF. Further, this three-dimensional bipolar voltage map-guided PVI might be reasonable as a tailored procedure.

A novel linear ablation system for left and right atrial compartmentalization in paroxysmal and persistent atrial fibrillation

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Objectives: To examine the efficacy and safety of a linear ablation system to perform left and right atrial compartmentalization in paroxysmal (PAF) and persistent (PER) atrial fibrillation.

Methods and results: A total of 39 patients, 27 males (mean age 60.8 years SD ± 8.6), 25 PAF and 14 PER, underwent ablation using the Cardima REVELATION T-Flex ablation system. Wide area circumferential ablation was performed to block conduction into all four pulmonary veins with the addition of roof and mitral isthmus lines. Patients with PER and redo procedures also underwent right atrial compartmentalization with anterior and septal superior vena cava to inferior vena cava lines. Patients were assessed pre-op, at 3 and 6 months, for symptoms and AF burden (using 72 h Holter monitoring). All 39 patients have been assessed at 3 months and 35 patients at 6 months. The AF burden and numbers of symptomatic, reduced symptoms, and asymptomatic patients at baseline, 3 months, and 6 months in the PAF and PER groups are shown in the Table. Two patients in the PAF group had flutter episodes on the 6-month Holter. Atrial fibrillation burden for the total group was 37.8 h (SEM ± 5.4) pre-procedure, 21.9 h (SEM ± 4.8) at 3 months, and 21.7 h (SEM ± 5.2) at 6 months. Paired t-test analysis (P = 0.01).

Conclusion: This is the first description of the use of this novel linear ablation system in the left atrium. Linear ablation of the left and right atria improves symptoms and AF burden in paroxysmal and persistent AF. The use of this ablation system to mimic Cox’s MAZE procedure is feasible and safe.
Effect of coenzyme Q10 administration on the incidence of atrial fibrillation in patients with heart failure

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Background: There is mounting evidence to support the influence of inflammation in the pathogenesis of atrial fibrillation (AF) and chronic heart failure (CHF). The use of coenzyme Q10 (CoQ10), an anti-oxidant, an adjunct treatment in AF patients with heart failure remains less well established.

Methods and results: Consecutive patients with CHF randomized in a double-blind fashion into two treatment arms: the CoQ10 group (combined administration of common drugs and CoQ10) and the control group (administration of common drugs). Ambulatory ECG Holter monitoring (24 h), Doppler echocardiography, and inflammatory cytokines were performed before treatment, 6 and 12 months after treatment. Fifty-one patients (36 M, 15 F; age range 45–82 years; mean age 62.3 years) completed the study. Two patients (8.3%) in the CoQ10 group and five patients (18.5%) in the control group had episodes of AF at 12 months after treatment (P > 0.05). Two patients went through the third Holter recording with AF in the control group. The duration of episodes of AF was 104 and 75 min in the two patients in CoQ10 group after 12 months. The mean ± SD duration of episodes was 628.5 ± 241 min in six patients in the control group. There were significant reductions in the level of TNF-α, hs-C-reactive protein, and malondialdehyde in the CoQ10 group after 6 and 12 month treatment.

Conclusions: CoQ10 as adjuvant treatment may have benefit in reducing the ratio of incidence of AF. The mechanisms of the effect may have relation with the reduced levels of inflammatory cytokines markers.

Keywords: Coenzyme Q10, Atrial fibrillation, Chronic heart failure; Inflammation

Effects of rapid atrial pacing on mRNA and protein expression of L-type calcium channel subunits and potassium channel Kv4.3 in rabbits

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Objective: To establish a rabbit model of rapid atrial pacing (RAP) and investigate atrial ultrastructural changes, mRNA and protein expression of L-type calcium channel subunits, and potassium channel Kv4.3.

Methods and results: Thirty-six rabbits underwent electrical stimulation at a frequency of 600 bpm for durations ranging from 0 to 48 h via bipolar endocardial leads through surgical techniques. Ultrastructural changes of the atrium were observed through a transmission electron microscope (TEM) after different pacing times. Messenger RNA (mRNA) and protein expressions of L-type calcium channel subunits and potassium channel Kv4.3 were analysed by reverse transcription-polymerase chain reaction (RT-PCR) and western blot. Atrial ultrastructures changed 3h of pacing later on; mitochondrial vacuolization, myofilament lysis, and glucogen accumulation were detected. mRNA expression of Ca2+ channel E1 and F1 subunits began to decrease after 6 h of pacing, while that of Kv4.3 mRNA expression reduced after 24 h of pacing, but that of the auxiliary subunit E.2 was not affected. Protein expression of E.1C subunit and potassium channel Kv4.3 paralleled their mRNA expression.

Conclusions: mRNA and protein expression levels of L-type calcium channel subunits and potassium channel Kv4.3 decreased after RAP, which followed ultrastructural changes of the atrium, the major mechanism might be transcriptional downregulation of these ion channels in response to intracellular calcium overload induced by RAP.
The different mechanisms of recurrence of atrial fibrillation after radiofrequency catheter ablation

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Objectives: To investigate the different mechanisms of late (>1 year after ablation), very late recurrence (>1 year after ablation), and recurrence of atrial fibrillation (AF) after repeat ablation.

Methods and results: From 1 January 2001 to 30 December 2005, 234 patients with AF accepted radiofrequency catheter ablation (RFCA) in which 156 patients accepted segmental pulmonary vein isolation and 78 patients accepted circumferential ablation of pulmonary veins. The follow-up time was 18–90 (54 ± 24) months. All patients with recurrence accepted repeat ablation and intra-cardiac electrophysiologic examine to determine the mechanisms of recurrence. Late recurrence occurred in 75 patients. Among them, recovery of PV–LA conduction was found in 58 (77.3%) patients and 28 non-PV ectopic foci were found in 17 (22.7%) patients. Very late recurrence occurred in 17 patients. Among them, recovery of PV–LA conduction was found in 4 (23.5%) patients and 21 non-PV ectopic foci was found in 13 (76.5%) patients. Forty-three patients who accepted repeat ablation suffered from recurrence again and accepted third ablation procedure. During the third ablation, recovery of PV–LA conduction was found in 8 (18.6%) patients and 47 non-PV ectopic foci was found in 35 (74.4%) patients. Non-PV ectopic foci were commonly seen in posterior wall of left atrial wall, coronary sinus ostium, crista terminalis, superior vena cava, inferior vena cava, and free wall of right atrium.

Conclusion: After RFCA of AF, the main reason of late recurrence was recovery of PV–LA conduction and the main mechanism of very late recurrence and recurrence after repeat ablation procedure was non-PV ectopic foci.

Keywords: Radiofrequency catheter ablation, Atrial fibrillation; Recurrence; Mechanism; Non-PV ectopic foci

Stratified clinical study of antithrombotic therapy in patients with atrial fibrillation

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Objective: To explore the clinical effects between oral aspirin anticoagulation therapy with oral warfarin antithrombotic treatment to prevent ischaemic stroke based on CHADS2 score of risk stratification in patients with atrial fibrillation (AF).

Methods and results: Eighty-two cases of non-valvular disease in patients with AF layered by CHADS2 score points that anticoagulated for more than 6 months; among them 40 cases of patients with CHADS2 ≥ 2 points taken aspirin, including 25 patients with ≥2 points taken oral aspirin treatment, and 13 patients with warfarin therapy, respectively, follow-up whether or not there is ischaemic stroke, death, and major bleeding events. Ischaemic stroke occurred in one patient of aspirin taking group with CHADS2 score ≥ 2 points, ischaemic stroke occurred in five cases of oral aspirin group with CHADS2 score ≥ 2 points and oral warfarin antithrombotic group did not have case of ischaemic stroke, but once case of stomach bleeding.

Conclusion: After risk stratification based on CHADS2 score, CHADS2 score of ≥2 points by taking aspirin anticoagulation therapy is safe and effective, and CHADS2 score of ≥2 points of which oral aspirin therapy than oral warfarin treatment are invalid to prevent ischaemic stroke.

Keywords: Atrial fibrillation; Antithrombotic therapy; Anticoagulation therapy; Aspirin; Warfarin

Management of pericardial effusion in patients with atrial fibrillation who underwent radiofrequency catheter ablation

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Background and objectives: Percardial effusion (PE) is a major complication of atrial fibrillation (AF) ablation, and it may lead to cardiac tamponade (CT) but can also occur merely without tamponade [pure PE (PPE)]. In this study, management of PE in patients with AF who underwent radiofrequency catheter ablation (RFCA) was investigated.

Methods and results: A total of 156 consecutive patients with AF (108 males, 57.6 ± 11.3 years), underwent RFCA guided by a three-dimensional mapping system (CARTO or CARTO-merge, Biosense-Webster Inc., Diamond Bar, CA, USA), were included in this study. The ablation strategy included circumferential pulmonary vein ablation, linear ablation, and/or complex fractionated atrial electrogams ablation. Echocardiography and other exams were performed to differentiated CT and PPE. After that, different managements were taken due to the states of patients. Those patients with PE were followed up in out-patient, and echocardiography was taken to evaluate the consequence. Percardial effusion was untreated in 16 patients (10.3%), whereas circumferential pulmonary vein isolation was achieved in all 156 patients. One patient had acute CT just after ablation, whose symptoms released after pericardiotenese and exploratory thoracotomy, without any sequel after 18 months of follow-up. Pure pericardial effusion was confirmed in another 15 patients (9.62%) and 93.75% of PE), the symptoms were released after expectant treatment but not any invasive treatment. Percardial effusion disappeared in six patients after 3 months and in the other nine patients after 6 months without any sequel.

Conclusion: Percardial effusion could be encountered frequently after extensive ablation in patients with AF, but most of them appeared as PPE that could be managed with expectant treatment and without any sequel.
Risk factors associated with pericardial effusion in radiofrequency catheter ablation of atrial fibrillation

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Background and objectives: Pericardial effusion (PE) is a major complication of atrial fibrillation (AF) ablation, and it may lead to cardiac tamponade but can also occur merely without tamponade [pure PE (PPE)]. However, risk factors associated with PPE in this population remain unknown. In this study, risk factors associated with PPE in patients with AF who underwent radiofrequency catheter ablation (RFCA) were evaluated.

Methods and results: A total of 156 consecutive patients with AF (108 males, 57.6 ± 11.3 years), underwent RFCA guided by a three-dimensional mapping system (CARTO or CARTO-Merge, Biosense-Webster Inc., Diamond Bar, CA, USA) and circular mapping catheter (Lasso, Biosense-Webster Inc.), were included in this study. The ablation strategy included circumferential pulmonary vein ablation, linear ablation, and/or complex fractionated atrial electrograms (CFAEs) ablation. Ablation process, ablation sites, ablation duration, and other factors were recorded. Echocardiography and other exams were performed to discriminate PPE. Risk factors which may associate with PPE were analysed by Logistic regression analysis. Pure pericardial effusion was identified in 15 patients (9.62%), whereas circumferential pulmonary vein isolation was achieved in all 156 patients. The composition of gender (P = 0.0001), ablation in coronary sinus (CS; P = 0.026), ablation of CFAE (P = 0.037), and superior vena cava (SVC; P = 0.041) had significant difference between patients with PPE and without PE by a univariate analysis. Female [β = 3.594, exp(β) = 36.4, 95% confidence interval (CI): 4.24–312.1, P = 0.001] and ablation in CS [β = 2.419, exp(β) = 11.2, 95% CI: 1.01–124.6, P = 0.049], revealed by Logistic regression analysis, were the two independent indicators associated with PPE after AF ablation.

Conclusion: Pure pericardial effusion could be encountered frequently after extensive ablation in patients with AF. Female and ablation in CS were the two independent risk factors associated with PPE, ablation of CFAE and SVC could also increase the incidence of PPE, so it must take precautions against the ablation of those sites (CS, CFAE, and SVC) to reduce the incidence of PPE as much as possible.

Prospective comparison of CartoMerge and CartoXP to guide circumferential pulmonary vein isolation for the treatment of paroxysmal atrial fibrillation

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Background: This prospective study was to compare clinical outcomes of CartoXP and CartoMerge in guiding catheter ablation for paroxysmal atrial fibrillation (PAF).

Methods and results: Eighty-one patients with symptomatic, drug refractory PAF were assigned to CartoMerge group [n = 42, mean age (54.5 ± 13.1) years, history of AF = 3.2 years] or CartoXP group [n = 39, mean age (59.8 ± 15.6) years, history of AF = 2.9 years]. The integrated images were used to guide the procedure of circumferential pulmonary vein isolation (CPVI) in CartoMerge group. In the other group, CPVI was guided just by CartoXP. The endpoint of CPVI in both groups was abolition or dissociation of pulmonary vein potentials (PVPs). Mean distance between mapping points and the MSCT surfaces in CartoMerge group was (1.59 ± 0.33) mm. Accomplishment of abolition or dissociation of PVPs was achieved 95.2% in CartoMerge group and 92.3% in CartoXP group. Durations of procedure and exposure to X-ray were 156 ± 25 and 179 ± 21 min (P, 0.001), and 19.6 ± 7.5 and 28.5 ± 12.8 min (P < 0.001), respectively. After a follow-up with duration of (11.9 ± 3.1) vs. (12.4 ± 3.6) months post the first ablation procedure, patients free of AF were 33 (78.6%) in CartoMerge group and 29 (74.4%) in CartoXP group (P = 0.50). No patient suffered pulmonary vein stenosis, atrio-oesophageal fistula, stroke, or death.

Conclusion: Compared with CartoXP, CartoMerge shortened the catheter ablation procedure and exposure to X-ray, without affecting the clinical outcomes of CPVI in experienced centres.