Device Management of heart failure patients with atrial fibrillation

Professor Dr. Andreas Schuchert
University Heart Center, University-Hospital Hamburg-Eppendorf, Martinistr. 52, 20246 Hamburg, Germany

Keystones for the management of atrial fibrillation in heart failure patients are the optimal medical treatment of heart failure, the prevention of deterioration and progression, the wide-spread use of oral anticoagulation, and the case-adjusted decision of rhythm or rate control (1). The specific aspects of device management in AF + HF patients can be grouped in the use of cardiac pacemakers, of implantable defibrillators (ICD), and of devices for cardiac resynchronisation therapy (CRT).

I. Pacemaker therapy

There are three applications for a pacemaker in patients with atrial fibrillation. The most often discussed approach is the prevention of paroxysmal atrial fibrillation so-called preventive pacing.

The underlying concept is to maintain the sinus rhythm (=rhythm control). The conventional approach is the prescription of anti-arrhythmic drugs. One main limitation of anti-arrhythmic drugs is their pro-arrhythmic effects. Therefore, anti-arrhythmic drugs should be cautiously prescribed in selected cases. The use of non-pharmacological alternatives could be an alternative. One of the non-pharmacological alternatives is the implantation of a cardiac pacemaker. Most of the present studies published in for this issue included patients with accepted pacemaker indications mainly sick sinus syndrome and a history of atrial fibrillation independently of their left ventricular function. Until studies with heart failure patients are present, the results of these studies must be extrapolated to the heart failure patients.

First of all, heart failure patients with an accepted pacing indication should receive a DDD or AAI and not a VVI pacemaker. One proven benefit of AAI/DDD pacing is the less frequent incidence of atrial fibrillation after pacemaker implantation (2,3). Secondly, the lower pacing rate should be adjusted to at least 70 ppm which seems to have a preventive effect in patients with sinus bradycardia (4, 5, 6, 7). The authors of these trials also used faster lower pacing rates which were necessary due to faster sinus rates, but are hardly tolerated during long-term follow-up. The solution for these patients is the activation of specific pacing algorithms developed to prevent the onset of atrial fibrillation.

The first controlled studies conducted for this purpose tested “the more pacing the better outcome” hypothesis. This approach had a neutral effect in two randomised studies (8,9). Some newer studies assessed other continuous or triggered preventive pacing functions which induce more constant atrial pacing rates. This approach effectively prevented recurrent episodes of atrial fibrillation (10, 11, 12, 13). Two of the more recent studies demonstrated that the use of triggered pacing functions significantly reduced the AF burden compared to the control group (12, 13). Therefore, there seems to be significant differences between the different preventive pacing functions provided by the different manufacturers. More studies are needed to definitely verify their clinical value.

Another issue is the potential harm coming from conventional right ventricular pacing. As some studies demonstrated in pacemaker and ICD patients an association between more frequent ventricular pacing and the incidence of heart failure, the percentage of pacing should be reduced in all patients to the absolute necessary amount (14, 15).

The second indication for pacing could be the immediate termination of a new-onset episode of atrial fibrillation. The present available solution for the immediate termination is the delivery of antitachycardia pacing by the pacemaker. This, however, was yet not effective in randomised studies and is at present not pacing indication any longer (16).

The third indication refers to patients in whom the aim is rate control. This includes the prevention of rapid atrial fibrillation in otherwise asymptomatic heart failure patients. Slowing of the ventricular rate often leads to a moderate improvement in left ventricular function in many patients. When rate control remains refractory to medical therapy, rate control can be achieved with radiofrequency ablation of the AV node and the subsequent implantation of a permanent pacemaker. Nowadays this option should be restricted to the few patients with definitely drug-refractory atrial fibrillation in whom an adequate rate control is not achieved. The “ablate and pace” strategy has been established for over 15 years and its benefits are well documented. After AV-nodal ablation and pacemaker implantation 89 to 90% patients reported about overall improvement. The additional medical treatment with anti-arrhythmic drugs to maintain sinus rhythm can not be recommended, but such an approach was associated with more frequent hospitalisations. In older patients in whom rate-controlling drugs are not feasible, ablate and pace should be performed early especially in case of additional heart failure symptoms and depressed LV function. In most of these patients the implantation of a VVIR pacemaker is sufficient and a DDDR pacemaker can be implanted in patients with paroxysmal atrial fibrillation. The pacemaker should be implanted before or immediately after AV node ablation. Another group for a VVI pacemaker are patients with symptomatic slow ventricular rates during persistent or permanent atrial fibrillation and will benefit from the restoration of the norm frequent heart rates.

After device implantation the lower pacing should be adjusted to 70 ppm. There are some observations that higher pacing rates reduce the beat-to-beat variability typically seen in atrial fibrillation and lead to a more stable ventricular heart rate (17). The latter can be achieved either with the fixed programming to higher pacing rate which many patients do not accepted during longer follow-up or by the activation of specific pacing functions.

The other approach for optimised ventricular pacing in these patients is to reduce or avoid the conventional right ventricular pacing. After AV node ablation and pacemaker implantation some patients do not improve and even deteriorate. One explanation comes from the placement of the ventricular lead in the right ventricular apex. The disadvantages of pacemaker-induced left branch bundle block with its subsequent ventricular mechanical asynchrony had been worked out during the last years. The presently studies solutions are the implantation of the ventricular lead in alternative pacing sites mainly in the right ventricular outflow tract or in a side branch of the coronary sinus. After the upgrading to a biventricular pacing system most patients improved in respect to their NYHA-class and had a decrease in their hospitalisations (18). Some more recent published studies could not verify these findings (19).

II. Implantable defibrillators

The main reasons for death in heart failure patients are sudden cardiac death caused by the onset of ventricular tachycardia or fibrillation or hemodynamic deterioration. The presently most accepted therapy for the prevention of the first cause is the implantation of a cardioverter / defibrillator (ICD). The implantation for secondary prevention that are patients with survived sudden cardiac death or with sustained ventricular tachycardia is well established. The present issue is the extension of the indication to primary prevention which are patients with a high risk for such an event, but yet with no arrhythmic event. The efficacy of ICD therapy for primary prevention has been definitely shown for patients with ischemic cardiomyopathy and a left ventricular ejection fraction < 35% (20, 21). In a subsequent analysis patients with atrial fibrillation seemed to have a greater benefit than those in sinus rhythm. In respect to patients with non-ischemic cardiomyopathy the data from several studies are divergent (21, 22).

A single-chamber device is often sufficient in patients with an indication for primary prevention. A potential interaction have atrial fibrillation if the ventricular rates are not properly rate controlled e.g. during exercise. During these conditions the ventricular rate exceeds the lower detection rate and the ICD classifies the high rates as an episode of ventricular tachyarrhythmia and triggers the delivery either of ventricular ATP or a shock. As a consequence, the patients receive one or recurrent inappropriate shocks which are very painful as the patient is in complete consciousness. The solution is an optimised ICD programming D with a high detection rate of the so-called VF

zone, the activation of additional detection criteria such as rate stability or sudden onset or if indicated the implantation of a dual-chamber ICD with a second atrial lead for an extended discrimination between atrial and ventricular tachyarrhythmias.

Another issue of paroxysmal atrial fibrillation is the observation that these patients may have more frequent episodes of ventricular tachyarrhythmias (23).

III. Cardiac resynchronisation therapy

Patients with advanced heart failure frequently have a left bundle branch block (LBBB). Echocardiographic and hemodynamic measurements revealed that the presence of LBBB induces mechanical resynchronisation of the left ventricle. The aim is a cardiac resynchronisation. The present non-pharmacological solution is the implantation of a biventricular pacemaker or ICD system. For this approach a special pacing lead is implanted in a lateral side branch of the coronary sinus and a conventional pacing lead in the apex of the right ventricle. Biventricular pacemakers restore the mechanical ventricular synchrony and improve morbidity as well as mortality (24, 25).

Most yet published randomised studies with a favourable outcome included patients in permanent sinus rhythm and the present recommendations include the presence of sinus rhythm (26). The outcome was less effective in patients with permanent atrial fibrillation and LBBB (27). Moreover, most patients in this study underwent AV node ablation to initiate permanent ventricular pacing. Despite this report and based on the observation of Leon there is an increasing number of reports with effective CRT in patients with permanent AF. In some case reports, the AF spontaneously terminated.

On the other hand, the new onset of atrial tachyarrhythmias is a frequent adverse effect in many patients who had received a CRT device (28). The MASCOT trial assesses the efficacy of a specific overdrive pacing function for the prevention of new-onset AF in these patients (29).

References

1. The Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) Investigators. A Comparison of Rate Control and Rhythm Control in Patients with Atrial Fibrillation. N Engl J Med 2002 347:1825-1833.
2. Kerr CR, Connolly SJ, Abdollah H, et al. Canadian Trial of Physiological Pacing: Effects of physiological pacing during long-term follow-up. Circulation 2004; 109: 357-362.
3. Lamas GA, Lee KL, Sweeney MO et al.; Mode Selection Trial in Sinus-Node Dysfunction. Ventricular pacing or dual-chamber pacing for sinus-node dysfunction. N Engl J Med 2002; 346: 1854-62.
4. Attuel P, Pellerin D, Mugica J, Coumel P. DDD pacing: an effective treatment modality for recurrent atrial arrhythmias. Pacing Clin Electrophysiol 1988; 11: 1647-54.
5. Garrigue S, Barold SS, Cazeau S, et al. Prevention of atrial arrhythmias during DDD pacing by atrial overdrive. Pacing Clin Electrophysiol 1998; 21: 1751-9.
6. Saksena S, Prakash A, Ziegler P, et al., for the DAPPAF Investigators. Improved suppression of recurrent atrial fibrillation with dual-site right atrial pacing and antiarrhythmic drug therapy. J Am Coll Cardiol 2002; 40: 1140 -50.
7. Wiberg S, Lönnerholm S, Jensen SM. Blomström P, Ringqvist I, Blomström-Lundqvist C. Effect of right atrial overdrive pacing in the prevention of symptomatic paroxysmal atrial fibrillation: a multicenter randomized study, the PAF-PACE study. Pacing Clin Electrophysiol 2003; 26: 1841-1848.
8. Padeletti L, Pürerfellner H, Adler SW, et al.; Worldwide ASPECT Investigators. Combined efficacy of atrial septal lead placement and atrial pacing algorithms for prevention of paroxysmal atrial tachyarrhythmia. J Cardiovasc Electrophysiol 2003; 14: 1189-1195.
9. Blanc JJ, De Roy L, Mansourati J, Poezevara Y, Marcon JL, Schoels W, Hidden-Lucet F, Barnay C; PIPAF Investigators. Atrial pacing for prevention of atrial fibrillation: assessment of simultaneously implemented algorithms. Europace. 2004; 6:371-9.
10. Carlson MD, Ip J, Messenger J, et al; Atrial Dynamic Overdrive Pacing Trial (ADOPT) Investigators. A new pacemaker algorithm for the treatment of atrial fibrillation: results of the Atrial Dynamic Overdrive Pacing Trial (ADOPT). J Am Coll Cardiol 2003; 42: 627-33.
11. Lozano IF, A. Vincent, J. Roda, M. Mendez, J. M. M. Ferrer, F. Andrade, J. J. Manzano, R. Ceres, J. Errejon and J. Toquero. Paroxysmal atrial fibrillation prevention by pacing in patients with pacemaker indication. Europace 2003; 5: 267–273
12. Lewalter T, A Yang,* D Pfeiffer, J Ruiter, G Schnitzler, T Markert, M Asklund, O Przibille, A Welz, B Esmailzadeh, M Linhart, B Luederitz. Individualized Selection of Pacing Algorithms for

the Prevention of Recurrent Atrial Fibrillation: Results from the VIP Registry. PACE 2006; 29: 1-11.

13. Schuchert A, E Bub, M Braun, H-P Rebeski, W Kroll, K Mortensen, T Meinertz, for the 3: 4 Study Group. Comparison of Triggered Versus Triggered and Continuous Atrial Pacing on AF Burden in Pacemaker Patients With Paroyxsmal Atrial Fibrillation. Heart Rhythm 1; 2004 Supplement p S 271
14. Sweeney MO, Hellkamp AS, Ellenbogen KA, Greenspon AJ, Freedman RA, Lee KL, Lamas GA; MOde Selection Trial Investigators. Adverse effect of ventricular pacing on heart failure and atrial fibrillation among patients with normal baseline QRS duration in a clinical trial of pacemaker therapy for sinus node dysfunction. Circulation. 2003;107:2932-7.
15. Wilkoff BL, Cook JR, Epstein AE, Greene HL, Hallstrom AP, Hsia H, Kutalek SP, Sharma A; Dual Chamber and VVI Implantable Defibrillator Trial Investigators. Dual-chamber pacing or ventricular backup pacing in patients with an implantable defibrillator: the Dual Chamber and VVI Implantable Defibrillator (DAVID) Trial. JAMA 2002; 288:3115-23.
16. Lee MA, Weachter R, Pollak S; ATTEST Investigators. The effect of atrial pacing therapies on atrial tachyarrhythmia burden and frequency: results of a randomized trial in patients with bradycardia and atrial tachyarrhythmias. J Am Coll Cardiol 2003; 41: 1926-32.
17. Wittkampf FH, de Jongste MJ, Lie HI, Meijler FL. Effect of right ventricular pacing on ventricular rhythm during atrial fibrillation. J Am Coll Cardiol. 1988;11:539-45
18. Leon A, Greenberg J, Kanaru N et al. Cardiac resynchronization in patients with congestive heart failure and chronic atrial fibrillation. J Am Coll Cardiol 2002;39:1258–1263.
19. Brignole M, M. Gammage, E. Puggioni, P. Alboni, A. Raviele, R. Sutton, P. Vardas, M.G. Bongiorni, L. Bergfeldt, C. Menozzi, G. Musso on behalf of the Optimal Pacing SITE (OPSITE) Study Investigators. Comparative assessment of right, left, and biventricular pacing in patients with permanent atrial fibrillation
20. Moss AJ, Zareba W, Hall WJ, Klein H, Wilber DJ, Cannom DS, Daubert JP, Higgins SL, Brown MW, Andrews ML; Multicenter Automatic Defibrillator Implantation Trial II Investigators. Prophylactic implantation of a defibrillator in patients with myocardial infarction and reduced ejection fraction. N Engl J Med. 2002;346:877-83
21. Kadish A, Dyer A, Daubert JP, Quigg R, Estes NA, Anderson KP, Calkins H, Hoch D, Goldberger J, Shalaby A, Sanders WE, Schaechter A, Levine JH; Defibrillators in Non-Ischemic Cardiomyopathy Treatment Evaluation (DEFINITE) Investigators. Prophylactic defibrillator implantation in patients with nonischemic dilated cardiomyopathy. N Engl J Med. 2004;350:2151-8

22. Bardy GH, Lee KL, Mark DB, Poole JE, Packer DL, Boineau R, Domanski M, Troutman C, Anderson J, Johnson G, McNulty SE, Clapp-Channing N, Davidson-Ray LD, Fraulo ES, Fishbein DP, Luceri RM, Ip JH; Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT) Investigators. Amiodarone or an implantable cardioverter-defibrillator for congestive heart failure. N Engl J Med. 2005;352:225-37.
23. Stein KM, DE. Euler, R Mehra, KH Seidl, DJ. Slotwiner, S Mittal, SM. Markowitz, BB. Lerman for the Jewel AF Worldwide Investigators. Do Atrial Tachyarrhythmias Beget Ventricular Tachyarrhythmias in Defibrillator Recipients? J Am Coll Cardiol 2002;40:335– 40
24. Cazeau, S, Leclercq C, Lavergne T, Walker S, Varma C, Linde C, Garrigue S, Kappenberger L, Haywood GA, Santini M, Bailleul C, Daubert JC; Multisite Stimulation in Cardiomyopathies (MUSTIC) Study Investigators. Effects of multisite biventricular pacing in patients with heart failure and intraventricular conduction delay. N Engl J Med 2001; 344:873-880.
25. Abraham WT, Fischer WG, Smith AL, Delurgio DB, Leon AR, Loh E, Kocovic DZ, Packer M, Clavell AL, Hayes DL, Ellestad M, Trupp RL, Underwood J, Pickering F, Truex C, McAtee P, Messenger J; MIRACLE Study Group. Multicenter InSync Randomized Clinical Evaluation: Cardiac resynchronization in chronic heart failure. N Engl J Med 2002; 346:1845-1853.
26. Swedberg K, Cleland J, Dargie H, Drexler H, Follath F, Komajda M, Tavazzi L, Smiseth OA, Gavazzi A, Haverich A, Hoes A, Jaarsma T, Korewicki J, Levy S, Linde C, Lopez-Sendon JL, Nieminen MS, Pierard L, Remme WJ. Guidelines for the diagnosis and treatment of chronic heart failure: executive summary (update 2005): The Task Force for the Diagnosis and Treatment of Chronic Heart Failure of the European Society of Cardiology. Eur Heart J. 2005:1115-40.
27. Leclercq C, Walker S, Linde C et al. Comparative effects of permanent biventricular and right-univentricular pacing in heart failure patients with chronic atrial fibrillation. Eur Heart J 2002; 23:1780–1787.
28. Knight BP, Desai A, Coman J, Faddis M, Yong P. Long-term retention of cardiac resynchronization therapy. J Am Coll Cardiol 2004; 44:72-77.
29. Padeletti L, Musilli N, Porciani MC, Colella A, Di Biase L, Ricciardi G, Pieragnoli P, Michelucci A, Gensini G. Atrial fibrillation and cardiac resynchronization therapy: the MASCOT study. Europace 2004; 5 Suppl 1:S49-54.