Chapter 5

Prognostic Importance of Atrial Fibrillation in Implantable Cardioverter Defibrillator Patients.

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Abstract

Objective: To assess the prevalence of different types of atrial fibrillation (AF) and their prognostic importance in implantable cardioverter defibrillator (ICD) patients.

Background: The prevalence of AF has taken epidemic proportions in the population with cardiovascular disease. The prognostic importance of different types of AF in ICD patients remains unclear.

Methods: Data on 913 (79% men, mean age 62±13 years) consecutive patients receiving an ICD at the Leiden University Medical Center were prospectively collected. Among other characteristics, the existence and type of AF (paroxysmal, persistent or permanent) was assessed at implantation. During follow-up, the occurrence of appropriate or inappropriate device therapy, as well as mortality was noted.

Results: At implantation, 73% of patients had no history of AF, 9% had a history of paroxysmal AF, 7% had a history of persistent AF and 11% had permanent AF. During 833±394 days follow-up, 117 patients (13%) died, 228 patients (25%) experienced appropriate device discharge and 139 patients (15%) received inappropriate shocks. Patients with permanent AF exhibited more than double the risk for mortality, ventricular arrhythmias triggering device discharge, and inappropriate device therapy. Patients with paroxysmal or persistent AF did not show a significant increased risk for mortality or appropriate device therapy but demonstrated almost three times risk for inappropriate device therapy.

Conclusions: In the population currently receiving ICD treatment outside the setting of clinical trials a large portion has either a history of AF or permanent AF. Both types of AF have prognostic implications for mortality and appropriate, as well as inappropriate device discharge.
Introduction

Large randomized trials have shown a beneficial effect of implantable cardioverter defibrillator (ICD) therapy, initially in survivors of life-threatening arrhythmias,(1-3) but more recently also in the primary prevention of sudden arrhythmic death in selected ischemic and non ischemic patients at high risk, based solely on a poor left ventricular ejection fraction (LVEF).(4-7) The implementations of these results in the international guidelines have, besides a considerable increase in the number of implants, caused a significant change in the population considered for ICD therapy as the majority of implantations now occurs in patients with a low LVEF and symptoms of heart failure (primary prevention patients) (8)

Atrial fibrillation (AF) is common in patients with low LVEF and symptoms of heart failure with a reported prevalence of AF in congestive heart failure patients of up to 50% in patients with New York Heart Failure (NYHA) functional class IV.(9-12). Furthermore, AF is associated with significant morbidity and mortality both in the general population and more specific in patients with heart failure.(13, 14)

As the number of ICD implants in patients with low LVEF and heart failure is increasing, it can be expected that more patients with paroxysmal, persistent or permanent AF will receive an ICD. So far, most studies focused on a single type of AF (e.g. paroxysmal/persistent or permanent AF) and were often conducted in the setting of a clinical trial.(15-19) The prevalence and prognostic implications of a history of AF at ICD implant remain unclear. The present study aims at providing insight in the effects of AF on mortality, occurrence of ventricular arrhythmias and inappropriate device therapy during long-term follow-up in a large cohort of ICD patients.
Methods

Patients and study protocol

Since 1996, all patients receiving an ICD at the Leiden University Medical Center were prospectively collected in the departmental Cardiology Information System (EPD-Vision®, Leiden University Medical Center). Characteristics at baseline, data of the implant procedure, and data of all follow-up visits were recorded.

Eligibility for ICD implantation in this population was based on international guidelines which, due to evolving guidelines, might have changed over time. Patients were implanted after surviving life-threatening ventricular arrhythmias or in the presence of a depressed LVEF with or without non sustained ventricular tachycardia.(8, 20)

Atrial fibrillation

At baseline, patients were grouped according to the type of AF. This resulted in the following four groups: (1) patients without a history of (documented) AF, the “no AF” group; (2) patients with a history of paroxysmal AF as documented on ECG; (3) patients with a history of persistent AF as documented on ECG; and (4) patients with permanent, accepted AF. If the arrhythmia terminates spontaneously and within 7 days, AF is designated paroxysmal; when sustained beyond 7 days or being terminated by pharmacological or electrical cardioversion, AF is termed persistent. The category of persistent AF also includes cases of long-standing AF, usually leading to permanent AF, in which cardioversion has failed or has been foregone.(10, 21)

Device implantation

All defibrillator systems used were implanted transvenously and without thoracotomy. During the implant procedure testing of sensing and pacing thresholds and defibrillation threshold testing
was performed. Used systems were manufactured by Biotronik (Berlin, Germany), Medtronic (Minneapolis, MN, United States), Boston Scientific (Natick, MA, United States, formerly CPI, Guidant [St. Paul, MN, United States]) and St. Jude Medical/Ventritex (St. Paul, MN, United States).

Long-term follow-up

Patient check-up was scheduled every three to six months. Device interrogation printouts were checked for appropriate and inappropriate ICD therapy (anti tachycardia pacing [ATP] or shocks). Therapies were classified as appropriate when they occurred in response to ventricular tachycardia or ventricular fibrillation and as inappropriate when triggered by sinus or supraventricular tachycardia, T-wave oversensing, or electrode dysfunction. Furthermore, follow-up included all-cause mortality.

In the Dutch health care system, all patients are followed by the implanting center. Since periodical follow-up was performed every three to six months, patients without data on the past six months were considered as lost to follow-up.

Statistical analysis

Continuous data are expressed as mean ± standard deviation; dichotomous data are presented as numbers and percentages. Comparison of continuous or dichotomous data was performed with the Student’s t test for paired and unpaired data and Chi-square tests with Yates correction when appropriate. Non-parametric data (NYHA functional class) was compared using the Mann-Whitney U-test. Cumulative event rates (all-cause mortality, appropriate device therapy, appropriate device shocks and inappropriate device shocks) were analyzed by the method of Kaplan-Meier. The relation between different types of AF at baseline and the occurrence of endpoints was assessed using a Cox proportional hazard model, calculating a hazard ratio with a
95%-confidence interval (95% CI) and adjusting for age, sex, renal clearance, LVEF, QRS-duration, NYHA functional class, and usage of beta-blockers. For all tests, a p-value <0.05 was considered significant.

Results

Baseline characteristics

Data of 955 consecutive patients receiving an ICD in the Leiden University Medical Center were prospectively collected. Forty-two patients (4.4%) were lost to follow-up. The remaining 913 ICD recipients were included in the analysis. Mean follow-up time was 833±394 days. The majority of patients (79% men, mean age 62±13 years) had a depressed LVEF (32±14%), wide QRS complex (127±35 ms) and poor renal function (renal clearance 83±38 ml/min). Medication included beta blockers in 76%, ACE inhibitors or AT antagonists in 82% and diuretics for heart failure in 70%. Baseline characteristics are summarized in Table 1.

Six-hundred-and-sixty-three (73%) out of all 913 patients had no history of AF (no AF), 84 (9%) patients had a history of paroxysmal AF, 64 (7%) patients had a history of persistent AF, and the remaining 102 (11%) patients had permanent AF. All patients with a history of paroxysmal or persistent AF were in sinus rhythm at discharge after device implantation. As is shown in Table 1, when compared to patients without a history of AF, patients with AF were older, had higher NYHA functional class and were more often treated with diuretics, amiodarone and oral anticoagulants.
Table 1. Baseline characteristics.

<table>
<thead>
<tr>
<th>Clinical parameters</th>
<th>All</th>
<th>No AF</th>
<th>Paroxysmal AF</th>
<th>Persistent AF</th>
<th>Permanent AF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=913)</td>
<td>(n=663)</td>
<td>(n=84)</td>
<td>(n=64)</td>
<td>(n=102)</td>
</tr>
<tr>
<td>Male gender</td>
<td>722 (79%)</td>
<td>515 (78%)</td>
<td>64 (76%)</td>
<td>53 (83%)</td>
<td>90 (88%)†</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>62±13</td>
<td>61±13</td>
<td>64±11*</td>
<td>66±10†</td>
<td>67±10‡</td>
</tr>
<tr>
<td>Secondary prevention</td>
<td>140 (15%)</td>
<td>94 (14%)</td>
<td>22 (26%)†</td>
<td>9 (14%)</td>
<td>15 (15%)</td>
</tr>
<tr>
<td>History of VT</td>
<td>93 (66%)</td>
<td>62 (66%)</td>
<td>15 (68%)</td>
<td>7 (78%)</td>
<td>9 (60%)</td>
</tr>
<tr>
<td>History of VF</td>
<td>47 (34%)</td>
<td>32 (34%)</td>
<td>7 (32%)</td>
<td>2 (22%)§</td>
<td>6 (40%)</td>
</tr>
<tr>
<td>Primary prevention</td>
<td>773 (85%)</td>
<td>569 (86%)</td>
<td>62 (74%)†</td>
<td>9 (14%)</td>
<td>15 (15%)</td>
</tr>
<tr>
<td>History of nsVT</td>
<td>201 (26%)</td>
<td>150 (26%)</td>
<td>17 (27%)</td>
<td>15 (27%)</td>
<td>19 (22%)</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>561 (61%)</td>
<td>423 (64%)</td>
<td>49 (58%)</td>
<td>39 (61%)</td>
<td>50 (49%)†</td>
</tr>
<tr>
<td>NYHA functional class</td>
<td>I</td>
<td>228 (25%)</td>
<td>188 (28%)</td>
<td>17 (20%)</td>
<td>10 (16%)*</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>346 (38%)</td>
<td>253 (38%)</td>
<td>37 (44%)</td>
<td>24 (38%)</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>320 (35%)</td>
<td>208 (31%)</td>
<td>28 (33%)</td>
<td>30 (47%)*</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>19 (2%)</td>
<td>14 (2%)</td>
<td>2 (2%)§</td>
<td>0 (0%)§</td>
</tr>
<tr>
<td>Renal clearance (ml/min)</td>
<td>83±38</td>
<td>86±38</td>
<td>75±39†</td>
<td>77±43</td>
<td>72±29‡</td>
</tr>
<tr>
<td>QRS-duration (ms)</td>
<td>127±35</td>
<td>125±34</td>
<td>123±33</td>
<td>129±35</td>
<td>140±34‡</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>32±14</td>
<td>33±14</td>
<td>32±15</td>
<td>32±14</td>
<td>30±12</td>
</tr>
<tr>
<td>Diabetes</td>
<td>177 (19%)</td>
<td>127 (19%)</td>
<td>16 (19%)</td>
<td>14 (22%)</td>
<td>20 (20%)</td>
</tr>
<tr>
<td>History of smoking</td>
<td>380 (42%)</td>
<td>287 (43%)</td>
<td>36 (43%)</td>
<td>24 (38%)</td>
<td>33 (32%)*</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>26±4</td>
<td>26±4</td>
<td>26±4</td>
<td>6±4</td>
<td>26±4</td>
</tr>
<tr>
<td>Device type</td>
<td>Single chamber</td>
<td>43 (5%)</td>
<td>20 (3%)</td>
<td>4 (5%)§</td>
<td>2 (3%)§</td>
</tr>
<tr>
<td></td>
<td>Dual chamber</td>
<td>409 (45%)</td>
<td>234 (49%)</td>
<td>39 (46%)</td>
<td>26 (41%)</td>
</tr>
<tr>
<td></td>
<td>CRT-D</td>
<td>461 (51%)</td>
<td>319 (48%)</td>
<td>41 (49%)</td>
<td>36 (56%)</td>
</tr>
<tr>
<td>Medication</td>
<td>Beta-blockers</td>
<td>691 (76%)</td>
<td>510 (77%)</td>
<td>63 (75%)</td>
<td>46 (72%)</td>
</tr>
<tr>
<td></td>
<td>ACE inhibitors / AT antagonist</td>
<td>750 (82%)</td>
<td>548 (83%)</td>
<td>66 (79%)</td>
<td>49 (77%)</td>
</tr>
<tr>
<td></td>
<td>Ca-antagonists</td>
<td>64 (7%)</td>
<td>52 (8%)</td>
<td>3 (4%)</td>
<td>3 (5%)§</td>
</tr>
<tr>
<td></td>
<td>Diuretics</td>
<td>641 (70%)</td>
<td>440 (66%)</td>
<td>65 (77%)*</td>
<td>47 (73%)</td>
</tr>
<tr>
<td></td>
<td>Statins</td>
<td>594 (65%)</td>
<td>445 (67%)</td>
<td>53 (63%)</td>
<td>44 (69%)</td>
</tr>
<tr>
<td></td>
<td>Amiodarone</td>
<td>125 (14%)</td>
<td>68 (10%)</td>
<td>19 (23%)‡</td>
<td>15 (23%)†</td>
</tr>
<tr>
<td></td>
<td>Aspirin</td>
<td>364 (40%)</td>
<td>300 (45%)</td>
<td>32 (38%)</td>
<td>22 (34%)</td>
</tr>
<tr>
<td></td>
<td>Oral anticoagulants</td>
<td>504 (55%)</td>
<td>316 (48%)</td>
<td>51 (61%)*</td>
<td>42 (66%)†</td>
</tr>
</tbody>
</table>

*p < 0.05; †p < 0.01; ‡p < 0.001. All compared with no AF group.
§Comparison was performed with Yates correction.
ACE = angiotensin-converting enzyme; AT = angiotensin; CRT-D = cardiac resynchronization therapy-defibrillator; LVEF = left ventricular ejection fraction; nsVT = non sustained ventricular tachycardia; NYHA = New York Heart Association
**Mortality**

During a mean follow-up of 833±394 days, 117 patients (13%) died. Study population mortality was 5% (95% CI 4-7%) at one year, 11% (95% CI 8-13) at two years and 15% (95% CI 12-17) at three years of follow-up. In the comparison of the four groups, survival analysis showed a three year cumulative event rate for mortality of 12% (95% CI 9-15%) for no AF, 15% (95% CI 8-24%) for paroxysmal AF, 17% (95% CI 7-27%) for persistent AF, and 32% (95% CI 20-43%) for permanent AF (Figure 1).

Of interest, patients with paroxysmal AF or persistent AF did not demonstrate a significant higher risk for mortality. However, patients with permanent AF exhibited a 70% increased risk for mortality (adjusted hazard ratio 1.7, 95% CI 1.0-2.7, p=0.033).

**Figure 1: All-cause mortality.** Kaplan-Meier curve for all-cause mortality in patients without a history of AF (no AF), paroxysmal AF, persistent AF, or permanent AF.
**Appropriate device therapy**

During follow-up, ventricular arrhythmias, causing appropriate device therapy (ATP or shocks), were observed in 228 (25%) patients. A total of 5116 episodes was noted, consisting of 4793 (range 1-2194) episodes terminated with ATP in 166 patients and 304 (range 1-33) episodes terminated by ICD shock in 112 patients.

Cumulative event rate for appropriate device therapy (ATP or shock) was 15% (95% CI 13-18%) at one year, 24% (95% CI 21-27) at two years and 30% (95% CI 24-34) at three years of follow-up. As is shown in Figure 2, three years cumulative event rate for appropriate device therapy was 29% (95% CI 24-33%) for no AF, 26% (95% CI 14-39%) for paroxysmal AF, 26% (95% CI 13-38%) for persistent AF, and 49% (95% CI 36-61%) for permanent AF. Patients with permanent AF exhibited twice the risk for appropriate therapy, when compared to patients without a history of AF (adjusted hazard ratio 2.2, 95% CI 1.6-3.2, \(p<0.001\)). The group with no history of AF demonstrated similar event rates as patients with a history of paroxysmal or persistent AF.

![Figure 2: Appropriate device therapy.](image)

Figure 2: Appropriate device therapy. Kaplan-Meier curve for the occurrence of first appropriate device therapy in patients without a history of AF (no AF), paroxysmal AF, persistent AF, or permanent AF.
As is shown in Figure 3 and Table 2, the occurrence of appropriate shocks alone showed a similar distribution as the occurrence of all appropriate therapy among the four groups. No differences were observed between patients without a history of AF and those with a history of paroxysmal or persistent AF. Moreover, a doubled risk of appropriate shocks was observed in the permanent AF group when compared to patients with no history of AF (adjusted hazard ratio 2.4, 95% CI 1.5-4.0, p<0.001).

Inappropriate device shocks

One-hundred-thirty-nine (15%) patients experienced at least one inappropriate device discharge. When comparing the four groups, major differences in event rates were observed. Three years event rate for inappropriate shocks was 13% (95% CI 10-17%) for no AF, 28% (95% CI 15-40%) for paroxysmal AF, 18% (95% CI 15-41%) for persistent AF, and 32% (95% CI 19-45%) for permanent AF.
### Table 2. Event rates, hazard ratios, and p-values for end-points

<table>
<thead>
<tr>
<th></th>
<th>No AF</th>
<th>Paroxysmal AF</th>
<th>HR (95% CI)</th>
<th>Adjusted HR (95% CI)*</th>
<th>Persistent AF</th>
<th>HR (95% CI)</th>
<th>Adjusted HR (95% CI)*</th>
<th>Permanent AF</th>
<th>HR (95% CI)</th>
<th>Adjusted HR (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All-cause mortality</strong></td>
<td>663</td>
<td>84</td>
<td>1.3 (0.7-2.5)</td>
<td>1.2 (0.6-2.3)</td>
<td>12 (19%)</td>
<td>1.6 (0.9-4.1)</td>
<td>1.2 (0.6-2.2)</td>
<td>25 (25%)</td>
<td>2.6 (1.6-4.1)</td>
<td>1.7 (1.0-2.7)</td>
</tr>
<tr>
<td><strong>Appropriate therapy</strong></td>
<td>154</td>
<td>18</td>
<td>1.0 (0.6-1.6)</td>
<td>1.0 (0.6-1.6)</td>
<td>14 (22%)</td>
<td>0.9 (0.5-1.5)</td>
<td>0.9 (0.5-1.6)</td>
<td>42 (41%)</td>
<td>2.1 (1.5-2.9)</td>
<td>2.2 (1.6-3.2)</td>
</tr>
<tr>
<td><strong>Appropriate shock</strong></td>
<td>72</td>
<td>10</td>
<td>1.2 (0.6-2.2)</td>
<td>1.2 (0.6-2.4)</td>
<td>8 (13%)</td>
<td>1.0 (0.5-2.2)</td>
<td>1.1 (0.5-2.4)</td>
<td>22 (22%)</td>
<td>2.2 (1.4-3.6)</td>
<td>2.4 (1.5-4.0)</td>
</tr>
<tr>
<td><strong>Inappropriate shock</strong></td>
<td>78</td>
<td>21</td>
<td>2.5 (1.6-4.1)</td>
<td>2.9 (1.7-4.8)</td>
<td>15 (23%)</td>
<td>1.9 (1.1-3.4)</td>
<td>2.5 (1.4-4.4)</td>
<td>25 (25%)</td>
<td>2.2 (1.4-3.5)</td>
<td>2.7 (1.7-4.4)</td>
</tr>
</tbody>
</table>

*Hazard ratio adjusted for age, sex, renal clearance, left ventricular ejection fraction, QRS duration, New York Heart Association functional class, usage of beta-blocker; CI = confidence interval; HR = hazard ratio
permanent AF (Figure 4). When compared to the group without a history of AF, the permanent AF group showed a more than doubled risk for the inappropriate shocks (adjusted hazard ratio 2.7, 95% CI 1.7-4.4, p<0.001). Patients with a history of paroxysmal AF had the highest risk for inappropriate device shocks (adjusted hazard ratio 2.9, 95% CI 1.7-4.8, p<0.001) during follow-up. It is of note that in the group without a history of AF, (new-onset) AF during follow-up was the cause of inappropriate device shocks in 27 patients (4%)

![Kaplan-Meier curve for the occurrence of first inappropriate device shock in patients without a history of AF (no AF), paroxysmal AF, persistent AF, or permanent AF.](image)

**Figure 4: Inappropriate device shock.** Kaplan-Meier curve for the occurrence of first inappropriate device shock in patients without a history of AF (no AF), paroxysmal AF, persistent AF, or permanent AF.

**Discussion**

The main findings of the current study on the prognostic importance of AF in ICD patients can be summarized as follows: (1) in the population, currently receiving ICD treatment, 9% have a history of paroxysmal AF, 7% have a history of persistent AF and 11% have permanent AF; (2) patients with permanent AF exhibited a more than doubled risk for mortality, ventricular
arrhythmias triggering device discharge, and inappropriate device shocks than patients without AF; (3) patients with a history of paroxysmal or persistent AF did not show a significantly increased risk for mortality or appropriate device therapy but demonstrated a almost tripled risk for inappropriate device shocks.

The present analysis adds to prior literature in that it discriminates between different types of AF and that it assesses the population, presently considered for ICD treatment outside the setting of clinical trial.

**Mortality**

Previous trials have demonstrated the importance of AF in the general population, as well as in a population with symptomatic or asymptomatic heart failure. (13, 14) Benjamin and co-workers showed that the occurrence of AF was associated with a 1.5- to 1.9-fold risk for all-cause mortality, even after adjustment for further cardiovascular conditions related to AF. (13) These findings seem comparable to the 1.7 times increased risk for mortality in patients with permanent AF, as observed in the current analysis. However, when specifically assessing a population with symptoms of heart failure, findings in current literature are inconsistent in the potential relation between AF and the risk for mortality. (14, 22-25) In a post-hoc analyses of the second Multicenter Automatic Defibrillator Implantation Trial, Zareba and co-workers made a comparison between patients with sinus rhythm and AF. Since AF was defined by its presence on the ECG at enrollment, one might assume that all the patients identified with AF have permanent AF and those with paroxysmal or persistent AF, if not coincidentally present at enrollment, will have been classified as having sinus rhythm. (7, 19) Furthermore, the trial only included primary prevention ICD recipients with a prior myocardial infarction. In contrast to the current study, Zareba at al. did not find a relationship between AF and mortality after adjustment for other variables. (19)
**Appropriate ICD therapy**

One might hypothesize that the occurrence of any type of AF is a marker of worse general cardiac status and therefore that AF will be positively correlated with the occurrence of ventricular arrhythmias. On the other hand, AF could initiate episodes of ventricular arrhythmias and might therefore directly influence the occurrence of ventricular arrhythmias and consequent appropriate device therapy. The facilitation of AF in the initiation of ventricular tachyarrhythmias has been observed by Roy and co-workers during an electrophysiological study. (26) Afterwards, Stein et al. observed 8.9% of the episodes of ventricular arrhythmia to be accompanied by AF. (27) Earlier studies suggested that ventricular arrhythmias are evoked by rapid and uncontrolled AV conduction. (28-30) More recently, Grönefeld et al. suggested that the AV nodal conduction pattern preceding ventricular tachyarrhythmia were short-long-short sequences, rather than solely a rapid conduction. (16) The irregular ventricular excitation leads to heterogeneous depolarization, which subsequently renders the myocardium more susceptible to ventricular arrhythmias. (31, 32)

In line with the current findings, prior studies confirm AF to have a positive correlation with the occurrence of ventricular arrhythmias. (16-18) Interestingly, a post-hoc analysis of the Multicenter Automatic Defibrillator Implantation Trial II did not demonstrate a difference in the occurrence of appropriate therapy when comparing (mostly permanent) AF with patients in sinus rhythm. (19) A possible explanation for this difference could be that the permanent AF group in the current study is sicker in a manner not completely accounted for by post hoc statistical adjustment. The present study did not show an increase in appropriate device therapy in the groups with a history of paroxysmal or persistent AF, which could imply that these patients do not have a deterioration of general cardiac status of such magnitude to consequently cause higher occurrence of ventricular arrhythmia. Thus far, no analysis had been reported on the prognostic implications of different types of AF.
Inappropriate ICD shocks

Previous studies have demonstrated the relationship between the existence of AF and inappropriate device discharge and the consequent negative effect of inappropriate device discharge on patient quality of life.(33-35) Furthermore, recent research has demonstrated the impact of inappropriate shock delivery on mortality.(33, 36) These findings stress the importance of clear identification of patients at high risk for inappropriate shocks in order to better inform patients and to optimize individual patient treatment. The current study maps the importance of different types of AF on the occurrence of inappropriate shocks and highlights the high event rate in patients with persistent, permanent and, most outspoken, paroxysmal AF. A potential explanation of the higher event rate in the paroxysmal AF group, even when compared to the group with permanent AF, can be explained by the fact that clinicians will more often adjust their treatment (such as AV-node ablation) if AF is ongoing. Additionally, the higher occurrence of ventricular arrhythmias in the group with permanent AF might cause a more aggressive pharmacological antiarrhythmic treatment.

Limitations

This was a non-randomized prospective observational cohort study, performed to assess the long-term follow-up in ICD patients outside the setting of a clinical trial. Since patients were collected over a period of four years, expanding guidelines for the implantation of defibrillators, treatment of acute myocardial infarction, and pharmacological antiarrhythmic therapy could have created an heterogeneous population. Furthermore, standard ICD settings at discharge could have been altered during follow-up. Finally, applying a different classification of AF might have altered the results.
Conclusion

In the population, currently receiving ICD treatment outside the setting of a clinical trial, 11% has permanent AF and 16% has a history of paroxysmal or persistent AF. The existence of permanent AF doubles the risk for mortality and appropriate, as well as inappropriate device therapy. Paroxysmal and persistent AF did not prove to have an effect on mortality or the occurrence of appropriate device discharge. However, the rate of inappropriate shocks is importantly increased in this group.
Reference List


