Implantable cardioverter defibrillator (ICD) therapy is effective in reducing mortality in patients with left ventricular dysfunction and symptoms of heart failure. Nonessential ICD therapies include those unrelated to a sustained ventricular tachyarrhythmia. They include inappropriate therapies (eg, therapies for atrial fibrillation, supraventricular arrhythmias, or noise) and ICD therapies for nonsustained ventricular arrhythmias.

Recent data from a large prospective observational study found a 23% incidence of appropriate ICD shocks and a 17% incidence of inappropriate ICD shocks during 5 years. Receipt of painful ICD shocks, whether essential or not, is linked to significant morbidity and mortality. It is not known whether the receipt of ICD shocks is responsible for the higher risk of death or if the clinical deterioration that leads to the development of ventricular arrhythmias or atrial fibrillation is related to a higher risk of death. At the same time, extending the time to delivery of ICD therapies may increase the risk of adverse events, most notably syncope.

A prior systematic review by Ha et al found no compelling evidence that interventions aimed at reducing ICD shocks (antiarrhythmic drugs, ablation therapy, or ICD programming) significantly altered the risk of death. Since that
publication, several large studies have been reported, including the Multicenter Automatic Defibrillator Implantation Trial—Reduce Inappropriate Therapy (MADIT-RIT), the Avoid Delivering Therapies for Non-sustained Arrhythmias in ICD Patients III (ADVANCE III), and the Programming Implantable Cardioverter-Defibrillators in Patients with Primary Prevention Indication to Prolong Time to First Shock (PROVIDE) randomized trials. Further, prior individual trials that assessed the effect of therapy reduction programming were not powered to detect a difference in mortality. This systematic review and meta-analysis sought to quantify the effect of therapy reduction programming on the risks of all-cause mortality, ICD shocks, inappropriate shocks, and syncope.

Methods

This analysis was performed in adherence to the Preferred Reporting Items for Systemic reviews and Meta-Analyses (PRISMA) statement on the quality of reporting of meta-analyses. Therapy reduction programming included any ICD programming that was designed to prolong the time required to detect a sustained ventricular arrhythmia.

Search Strategy

Two independent reviewers sought relevant articles on therapy reduction programming via searches of the MEDLINE and EMBASE databases, as well as clinicaltrials.gov. In addition, the reference lists of all published studies and the biographies of review articles were searched for additional articles. The search was not limited by language and is considered up to date as of October 1, 2013. Only studies that followed patients for ≥6 months and in which mortality data were reported or available from the authors were included. The primary authors of studies that appeared to be eligible, apart from mortality data, were contacted for these data.

Study Selection and Eligibility Criteria

The primary outcome was all-cause mortality. Secondary outcomes included rates of syncope, appropriate shocks, and inappropriate shocks as defined by the individual studies included. Both randomized and nonrandomized studies were included. A separate analysis was performed among the randomized trials before pooling.

Bias Assessment

The internal validity of included studies was assessed using Cochrane Collaboration’s tool for assessing risk of bias in randomized trials (Table 1).23

Statistical Analysis

Data were pooled and analyzed using Stata version 11 statistical software. A random effects model was used. The effect size is presented as the relative risk reduction. Statistical heterogeneity was evaluated using the $I^2$ statistic and its 95% confidence interval (CI). Meta-regression was used to assess the potential influence of baseline characteristics.

Results

Study Selection

A total of 307 records were identified. Twenty-one full text articles were assessed for eligibility (Figure 1). Six trials met the inclusion criteria. They included 4 randomized trials (Comparison of Empiric to Physician-Tailored Programming of ICDs [EMPIRIC], MADIT-RIT, ADVANCE III, and PROVIDE) and 2 prospective studies (the Primary Prevention Parameters Evaluation [PREPARE] and the Role of Long Detection Window Programming in Patients With Left Ventricular Dysfunction, Non-ischemic Etiology in Primary Prevention Treated with a Biventricular ICD [RELEVANT]). These 6 studies included 7687 (3598 conventional and 4089 therapy reduction programming) patients.

Characteristics

The characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs. Baseline characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs. Baseline characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs. Baseline characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs. Baseline characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs. Baseline characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs. Baseline characteristics of the patients in these 6 trials are shown in Table 2. Most (77%) participants were men and had history of coronary heart disease (58%). A minority of patients (19%) had history of atrial arrhythmias (atrial fibrillation, atrial flutter, or atrial tachycardia). Few (12%) patients received an ICD for secondary prevention. Most patients received β-blockers (84%) and few (14%) received antiarrhythmic drugs.

Table 1. Risk of Bias in the Included Studies (Cochrane Collaboration’s Tool)

<table>
<thead>
<tr>
<th>Study</th>
<th>Adequate Sequence Generation</th>
<th>Concealment of Allocation</th>
<th>Single or Double Blinding</th>
<th>Blinding to Outcome</th>
<th>Incomplete Outcome Data Addressed</th>
<th>Free of Selective Reporting</th>
<th>Free of Other Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPIRIC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Unclear</td>
<td>Yes</td>
</tr>
<tr>
<td>PREPARE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Unclear</td>
<td>No</td>
</tr>
<tr>
<td>RELEVANT</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MADIT-RIT</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Unclear</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PROVIDE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

ADVANCE III indicates Avoid Delivering Therapies for Non-sustained Arrhythmias in ICD Patients III; EMPIRIC, Comparison of Empiric to Physician-Tailored Programming of ICDs; MADIT-RIT, Multicenter Automatic Defibrillator Implantation Trial—Reduce Inappropriate Therapy; PROVIDE, Primary Prevention Parameters Evaluation; PROVIDE, Programming Implantable Cardioverter-Defibrillators in Patients with Primary Prevention Indication to Prolong Time to First Shock; and RELEVANT, Role of Long Detection Window Programming in Patients With Left Ventricular Dysfunction, Non-ischemic Etiology in Primary Prevention Treated with a Biventricular ICD.
characteristics were similar in the therapy reduction and conventional programming arms (not shown), apart from a lower mean left ventricular ejection fraction in the conventional (25%) versus therapy reduction group (28%) in PREPARE.

Therapy Reduction Programming
ICD programming for the comparator groups in each of the 6 studies is summarized in Table 3. Therapy reduction programmed included combinations of longer detection intervals and higher detection rates. All but one of the programming strategies included algorithms designed to discriminate between supraventricular tachycardia and noise from ventricular arrhythmias. Algorithms to discriminate supraventricular tachycardia from ventricular arrhythmias were not used in the MADIT-RIT high rate programming strategy.

Primary Outcome (Mortality)
All-Cause Mortality
A total of 469 deaths (6%) were observed; 207 (5.0%) in the therapy reduction and 262 (7.3%) in the conventional programming group. Therapy reduction programming was associated with a significant and consistent 30% (95% CI, 27%–33%) risk reduction in all-cause mortality.

Table 3. Summary of Therapy Reduction Programming Strategies and Comparator Groups

<table>
<thead>
<tr>
<th>Study, y</th>
<th>Therapy Reduction Programming</th>
<th>Conventional Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPRIC (2006)</td>
<td>VF–250 bpm; NID 18 of 24</td>
<td>VF–rate not specified; NID 12 of 16 (50%) or 18 of 24 (49%)</td>
</tr>
<tr>
<td></td>
<td>FVT–200 bpm; NID 18 of 24; ATP×1</td>
<td>FVT–rate not specified (used in 70%)</td>
</tr>
<tr>
<td></td>
<td>VT–150 bpm; NID 16; ATP×2</td>
<td>VT–rate not specified; ≥1 ATP (95%)</td>
</tr>
<tr>
<td>PREPARE (2008)</td>
<td>VF–250 bpm; NID 30 of 40</td>
<td>VF–rate not specified; NID 12 of 16 (58%) or 18 of 24 (42%)</td>
</tr>
<tr>
<td></td>
<td>FVT–182 bpm; NID 30 of 40; ATP×1</td>
<td>FVT–rate not specified; ≥1 ATP (25%)</td>
</tr>
<tr>
<td></td>
<td>VT–167 bpm; NID 32; monitor only</td>
<td>VT–rate not specified; ≥1 ATP (95%)</td>
</tr>
<tr>
<td>RELEVANT (2009)</td>
<td>VF–250 bpm; NID 30 of 40</td>
<td>VF–250 bpm; NID 12 of 16</td>
</tr>
<tr>
<td></td>
<td>FVT–182 bpm; NID 30 of 40; ATP×1</td>
<td>FVT–182 bpm; NID 12 of 16; ATP×1</td>
</tr>
<tr>
<td></td>
<td>VT–167 bpm; NID 32; monitor only</td>
<td>VT–167 bpm; NID 32; monitor only</td>
</tr>
<tr>
<td>MADIT-RIT (2012)</td>
<td>High rate</td>
<td>Zone 1–200 bpm; 1 s delay (3–4 beats); ATP×1</td>
</tr>
<tr>
<td></td>
<td>Zone 1–200 bpm; 2.5 s delay (8–10 beats); ATP×1</td>
<td>Zone 2–170 bpm; 2.5 s delay (7–8 beats); ATP×1</td>
</tr>
<tr>
<td></td>
<td>Zone 2–170 bpm; monitor only</td>
<td>Zone 2–170 bpm; monitor only</td>
</tr>
<tr>
<td></td>
<td>Duration delay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zone 1–250 bpm; 2.5 s delay; ATP×1</td>
<td>Zone 1–200 bpm; 1 s delay (3–4 beats); ATP×1</td>
</tr>
<tr>
<td></td>
<td>Zone 2–200 bpm; 12 s delay (40–50 beats); ATP×1</td>
<td>Zone 2–170 bpm; 2.5 s delay (7–8 beats); ATP×1</td>
</tr>
<tr>
<td></td>
<td>Zone 3–170 bpm; 60 s delay (169–99 beats); ATP×1</td>
<td>Zone 3–170 bpm; 60 s delay (169–99 beats); ATP×1</td>
</tr>
<tr>
<td>ADVANCE III (2013)</td>
<td>VF–188 bpm; NID 30 of 40; ATP×1</td>
<td>VF–188 bpm; NID 18 of 24; ATP×1</td>
</tr>
<tr>
<td></td>
<td>VT–150 bpm; NID 32; monitor only</td>
<td>VT–150 bpm; NID 32; monitor only</td>
</tr>
<tr>
<td>PROVIDE (2013)</td>
<td>VF–250 bpm; NID 42</td>
<td>VF–214 bpm; NID 12</td>
</tr>
<tr>
<td></td>
<td>VT 2–214 bpm; NID 18; ATP×1</td>
<td>VT 2–181 bpm; NID 12; ATP×2</td>
</tr>
<tr>
<td></td>
<td>VT 1–181 bpm; NID 25; ATP×2</td>
<td>VT 1–150 bpm; NID 12; monitor only</td>
</tr>
</tbody>
</table>

2° indicates secondary prevention implantable cardioverter-defibrillator therapy; AAD, antiarrhythmic drug therapy; ADVANCE III, Avoid Delivering Therapies for Non-sustained Arrhythmias in ICD Patients III; BB, β-blocker therapy; CHD, history of coronary heart disease; EMPIRIC, Comparison of Empiric to Physician-Tailored Programming of ICDs; FU, follow-up; ICD, implantable cardioverter-defibrillator; LVEF, left ventricular ejection fraction; MADIT-RIT, Multicenter Automatic Defibrillator Implantation Trial—Reduce Inappropriate Therapy; n, number of patients in study; NA, not applicable; NYHA, New York Heart Association functional class; OBS, observational, nonrandomized study; PREPARE, Primary Prevention Parameters Evaluation; PROVIDE, Programming Implantable Cardioverter-Defibrillators in Patients With Left Ventricular Dysfunction, Non-ischemic Etiology in Primary Prevention Treated with a Biventricular ICD; and VT, ventricular tachycardia.
Sensitivity Analyses

Similar reductions in mortality were observed when only the 4 randomized trials were included (26% relative reduction, 95% CI, 11%–39%; P=0.002; Figure 2B). Furthermore, the effect size was somewhat larger when the 2 MADIT-RIT therapy reduction groups were combined (35% relative reduction, 95% CI, 9%–49%; P=0.004) versus when they were assessed separately (Figure 2A).

A significant reduction in mortality was also observed with therapy reduction versus conventional programming when only the 2 nonrandomized were separately assessed (42% relative reduction, 95% CI, 14%–61%; P=0.007).

When assessed using meta-regression, none of the baseline characteristics presented in Table 2, alone or in combination, significantly altered the relationship between reduced mortality with therapy reduction versus conventional programming.

Secondary Outcomes

Syncope

PREPARE did not report the number of patients with syncope in the conventional arm and that study was removed from the subanalysis of syncope. Nonetheless, PREPARE does provide insight into the frequency of syncope attributable to therapy reduction programming. A total of 40 syncopal events were reported in therapy reduction programming group in PREPARE. Of these, 12 (30%) were considered arrhythmic and 28 (70%) nonarrhythmic. Ten of the 12 arrhythmic events or 25% of all syncope were judged as related to therapy reduction programming.

A total of 179 syncope events (2.8%) were reported in the 5 remaining studies. This included 105 (3.1%) events among patients in the therapy reduction group and 74 (2.5%) events in the conventional programming group. No significant difference in the rate of syncope (9% increase; 95% CI, 17% reduction to 44% increase; P=0.5) was observed with therapy reduction versus conventional programming (Figure 3).

Figure 2. A, Therapy reduction vs conventional programming and risk of death, randomized and nonrandomized studies. Random effects meta-analysis of therapy reduction vs conventional programming on the outcome of all-cause mortality. All 6 studies are shown. The Multicenter Automatic Defibrillator Implantation Trial—Reduce Inappropriate Therapy (MADIT-RIT) groups are separately compared with the same control group. B, Therapy reduction vs conventional programming and risk of death, randomized trials only. Random effects meta-analysis of therapy reduction vs conventional programming on the outcome of all-cause mortality. The 4 randomized trials are shown. The MADIT-RIT groups are combined. ADVANCE III indicates Avoid Delivering Therapies for Non-sustained Arrhythmias in ICD Patients III; CI, confidence interval; EMPIRIC, Comparison of Empiric to Physician-Tailored Programming of ICDs; PROVIDE, Primary Prevention Parameters Evaluation; PROVIDE, Programming Implantable Cardioverter-Defibrillators in Patients with Primary Prevention Indication to Prolong Time to First Shock; and REV- EVANT, Role of Long Detection Window Programming in Patients With Left Ventricular Dysfunction, Non-ischemic Etiology in Primary Prevention Treated with a Biventricular ICD.

Figure 3. Risk of syncope with therapy reduction vs conventional programming. Random effects meta-analysis of therapy reduction vs conventional programming on the outcome of syncope. The 5 studies that reported syncope in both treatment arms are included. The 2 Multicenter Automatic Defibrillator Implantation Trial—Reduce Inappropriate Therapy (MADIT-RIT) groups are separately compared with the same control group. ADVANCE III indicates Avoid Delivering Therapies for Non-sustained Arrhythmias in ICD Patients III; CI, confidence interval; EMPIRIC, Comparison of Empiric to Physician-Tailored Programming of ICDs; PROVIDE, Programming Implantable Cardioverter-Defibrillators in Patients with Primary Prevention Indication to Prolong Time to First Shock; and REV- EVANT, Role of Long Detection Window Programming in Patients With Left Ventricular Dysfunction, Non-ischemic Etiology in Primary Prevention Treated with a Biventricular ICD.
ICD Shocks
Shock density (number of shocks per 100 patient-year of follow-up) was reduced for both appropriate and inappropriate (except EMPIRIC) shocks in therapy reduction programming arm compared with conventional arm. Neither EMPIRIC nor PREPARE separated out the numbers of patients receiving appropriate and inappropriate ICD therapies. Hence, these analyses were limited to the remaining 4 studies (Table 4).

Appropriate Shocks
A minority of patients received appropriate ICD shocks in the 4 studies included. A total of 290 patients received appropriate ICD shocks (5.4%); 153 (5.2%) in the therapy reduction and 137 (5.6%) in the conventional group. No significant difference in the risk of appropriate ICD shocks (relative reduction 6%; 95% CI, 25% reduction to 16% increase; P=0.5) was observed with therapy reduction versus conventional programming.

Inappropriate Shocks
A somewhat lower proportion of patients in the 4 included studies received inappropriate ICD shocks. A total of 267 patients received inappropriate ICD shocks (4.9%); 99 (3.4%) in the therapy reduction and 168 (6.9%) in the conventional programming group. A 50% relative reduction (95% CI, 37%–61%; P<0.001) in the risk of inappropriate ICD shocks with therapy reduction versus conventional programming was observed (Figure 4).

Discussion
This analysis demonstrates therapy reduction programming results in a 30% lower risk of death versus conventional programming. This was consistent among the 6 studies. The reduction in mortality with therapy reduction programming was similar in the 4 randomized trials and the 2 prospective studies. No significant difference in the risk of syncope or in the risk of appropriate shocks was observed with therapy reduction versus conventional programming. However, a 50% reduction in inappropriate shocks was found with therapy reduction versus conventional programming.

ICD shocks have been shown to cause myocardial injury and are potentially proarrhythmic. Furthermore, the receipt of ICD therapies, shocks and antiarrhythmic pacing therapies, has been linked to an increased risk of death from progressive heart failure. In both secondary prevention (Antiarrhythmic Versus Implantable Defibrillators [AVID]) and primary prevention studies (Sudden Cardiac Death Heart Failure Trial [SCD-HeFT] and Multicenter Automatic Defibrillator Implantation Trial II [MADIT II]), the receipt of ICD therapies is associated with a 3- to 5-fold higher risk of death that is temporally related to the receipt of these ICD therapies.

Limiting ICD therapies to only sustained and potentially life-threatening arrhythmias (essential therapies) may improve patient outcomes by reducing proarrhythmia requiring ICD shocks or other adverse sequelae. Furthermore, the specific method by which a reduction in nonessential therapies is achieved does not seem critical because reductions in mortality were consistent among the 6 studies, despite variations in therapy reduction programming strategies (Table 3). Initial concerns on a potential increase in rates of death or syncope with therapy reduction programming (prolonged Figure 4. Risk of inappropriate implantable cardioverter defibrillator shocks with therapy reduction vs conventional programming. Random effects meta-analysis of therapy reduction vs conventional programming on the outcome of inappropriate implantable cardioverter defibrillator shocks. The 4 studies that separately reported inappropriate shocks in both treatment arms are included. The 2 Multicenter Automatic Defibrillator Implantation Trial—Reduce Inappropriate Therapy (MADIT–RIT) groups are separately compared with the same control group. ADVANCE III indicates Avoid Delivering Therapies for Non-sustained Arrhythmias in ICD Patients III; CI, confidence interval; PROVIDE, Programming Implantable Cardioverter-Defibrillators in Patients with Primary Prevention Indication to Prolong Time to First Shock; and RELEVANT, Role of Long Detection Window Programming in Patients With Left Ventricular Dysfunction, Non-ischemic Etiology in Primary Prevention Treated With a Biventricular ICD.

Table 4. Rates of Appropriate and Inappropriate Shocks (Expressed per 100 Patient-Years of Follow-Up) in the 4 Studies That Separately Reported the Numbers of Patients Receiving Appropriate and Inappropriate Defibrillator Therapies

<table>
<thead>
<tr>
<th>Study</th>
<th>Appropriate Shocks (95% confidence interval)</th>
<th>Weight % (random effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELEVANT</td>
<td>0.37 (0.10, 1.35)</td>
<td>3.22</td>
</tr>
<tr>
<td>MADIT–RIT delay</td>
<td>0.51 (0.26, 0.94)</td>
<td>15.13</td>
</tr>
<tr>
<td>MADIT–RIT high rate</td>
<td>0.46 (0.25, 0.86)</td>
<td>14.40</td>
</tr>
<tr>
<td>ADVANCE III</td>
<td>0.57 (0.34, 0.95)</td>
<td>20.82</td>
</tr>
<tr>
<td>PROVIDE</td>
<td>0.49 (0.34, 0.69)</td>
<td>46.43</td>
</tr>
<tr>
<td>Overall (I2=0%, 95% CI 0% to 79%)</td>
<td>0.50 (0.36, 0.63)</td>
<td>100.00</td>
</tr>
</tbody>
</table>
detected) seem to be unfounded. As noted, only 1 death in the 6 studies included was possibly related to therapy reduction programming. Furthermore, syncope was uncommon in both the therapy reduction and conventional programming groups, and rates of syncope were similar in the 2 groups. However, only the PROVIDE trial further divided syncope into arrhythmic and nonarrhythmic and provided data in both treatment arms. In PROVIDE, there was no significant difference (P = 0.49) in arrhythmic syncope between therapy reduction (1%) and conventional programming groups (2%).

Limitations

Individual patient data were not available, and only pooled study data were used. Hence, our ability to look at specific patient characteristics (eg, secondary versus primary prevention or history versus no history if atrial arrhythmias) was limited, and our analysis was not adequately powered to detect smaller but clinically important differences for the characteristics assessed in the meta-regression models. As noted, the 95% CI surrounding the heterogeneity estimates was wide because of the small number of studies included. Cardiovascular deaths were not separately reported, preventing a separate analysis of cardiovascular versus noncardiovascular death. We also relied on the definitions of syncope, inappropriate and appropriate therapies from each of the included studies and were not able to apply standard definitions because of a lack of such data. Moreover, only PROVIDE and PREPARE differentiated arrhythmic from nonarrhythmic syncope. As noted, no difference in the rate of arrhythmic syncope among the comparator groups was identified in that trial. The trials included were not designed to assess risk of syncope events as a result of therapy reduction programming strategy and a trade-off between avoidance of ICD therapies versus a risk of arrhythmic syncope likely exists and merits further study. Finally, caution should be exercised in extrapolating the results of this analysis to all ICD recipients. Most of the patients included had a low ejection fraction and received an ICD for a primary prevention indication. Additional data are required to understand the use of therapy reduction programming in other groups of ICD recipients.

Conclusions

Therapy reduction programming is associated with a large, significant, and consistent reduction in mortality without an apparent increase in the risk of syncope. Although a trade-off between avoidance of ICD therapies versus a risk of arrhythmic syncope likely exists, the reduction in ICD therapies was related largely to the reduction in inappropriate therapies.

Acknowledgments

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Disclosures

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References


Controversy exists on optimal ICD programming. Conventional programming is designed to rapidly detect and treat tachyarhythmias (primary prevention). Yet, ICD shocks are painful, reduce quality of life, and are linked to adverse outcomes (secondary prevention) and those at high risk of sudden cardiac arrest because of the presence of left ventricular systolic dysfunction.

Implantable cardioverter-defibrillator (ICD) therapy improves survival in patients with sustained ventricular arrhythmias and is based on the desire to reduce the risk of syncope via aggressive treatment of all potentially life-threatening arrhythmias. However, the rate of ICD shocks for potentially life-threatening arrhythmias is many times larger than the mortality benefit from an ICD. Further, many arrhythmias may self-terminate, and early, aggressive ICD treatment results in the delivery of shocks for nonlife-threatening rhythms such as atrial fibrillation. Programmed settings to limit the delivery of ICD therapies only to arrhythmias that are both sustained and rapid (therapy reduction programming) aims to reduce the number of shocks but may undertreat arrhythmias and increase the risk of syncope. This systematic review and meta-analysis evaluated the effect of therapy reduction versus conventional programming on the risks of death and syncope in mostly primary prevention ICD recipients. A large and consistent reduction in mortality was observed with therapy reduction versus conventional programming, mostly because of a reduction in inappropriate ICD therapies. No apparent increase in the risk of syncope was observed. These data support the standard adoption of therapy reduction programming in primary prevention ICD recipients to improve clinical outcomes.
Impact of Programming Strategies Aimed at Reducing Nonessential Implantable Cardioverter Defibrillator Therapies on Mortality: A Systematic Review and Meta-Analysis
Vern Hsen Tan, Stephen B. Wilton, Vikas Kuriachan, Glen L. Sumner and Derek V. Exner

Circ Arrhythm Electrophysiol. 2014;7:164-170; originally published online January 20, 2014; doi: 10.1161/CIRCEP.113.001217

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