S-ICD IS NOW GUIDELINE recommended by ACC/HRS/AHA for patients at high risk for infection, inadequate venous access and any patient without a pacing indication\(^1\)

<table>
<thead>
<tr>
<th>High Risk for Infection</th>
<th>Any Patient Without a Pacing Indication</th>
<th>Inadequate Venous Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>~75% OF ICD Indicated Patients have ≥1 comorbidity associated with device infection.(^2,^3,^4)</td>
<td>70% OF DR &amp; VR ICD Patients under 75 have no pacing indication at implant.(^5,^6)</td>
<td>AS MANY AS 61% OF PATIENTS may have venous stenosis following initial device implantation.(^7)</td>
</tr>
</tbody>
</table>

Class I\(^1\)  
Class IIa\(^1\)  
Class I\(^1\)

**EMBLEM™ S-ICD SYSTEM**

**THOSE WHO KNOW CHOOSE S-ICD.**

[Read more >](#)

**Emblem™ MRI S-ICD System Indications, Safety, and Warnings >>**

Sources:
Six-year follow-up of the initial Dutch subcutaneous implantable cardioverter-defibrillator cohort: Long-term complications, replacements, and battery longevity

Anne-Floor B. E. Quast MD1 | Vincent F. van Dijk MD2 | Sing-Chien Yap MD, PhD3
Alexander H. Maass MD, PhD4 | Lucas V. A. Boersma MD, PhD2
Dominic A. Theuns PhD3 | Reinoud E. Knops MD, PhD1

1Heart Center, Department of Clinical and Experimental Cardiology, Academic Medical Center, University of Amsterdam, Amsterdam, the Netherlands
2Department of Cardiology, St Antonius Hospital, Nieuwegein, the Netherlands
3Department of Cardiology, Erasmus Medical Center, Rotterdam, the Netherlands
4Department of Cardiology, University Medical Center Groningen, University of Groningen, Groningen, the Netherlands

Correspondence
Anne-Floor B.E. Quast, Academic Medical Center, Department of Cardiology, Room F3-241, PO Box 22700, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands.
Email: a.f.quast@amc.uva.nl
Anne-Floor B.E. Quast and Vincent F. van Dijk contributed equally to this study.

The following authors made disclosures regarding Boston Scientific:
SC Yap: honoraria relevant to this topic; LVA Boersma: consultant; D. Theuns: research grant support and consultant; RE Knops: research grant support and consultant.

Other authors: No disclosures.

Abstract
Introduction: Experience with the subcutaneous implantable cardioverter-defibrillator (S-ICD) is expanding rapidly. However, data on long-term performance or complications related to elective generator replacement are lacking.

Methods: Follow-up (FU) data of all patients implanted between December 2008 and April 2011 were collected. Complications were defined as those requiring surgical intervention. Kaplan-Meier estimates for complication and shock rates, with corresponding 95% confidence intervals (CI), were calculated.

Results: One hundred and eighteen patients were included. Median FU was 6.1 years (IQR 5.6–6.5 years). Short-term complication rate (0–30 days) was 3% (CI 0–6%). Long-term complication rate at 6 years was 19% (CI 12–26%), corresponding with an annual complication rate of 3%. One patient in this cohort developed a need for a transvenous ICD (TV-ICD) in order to provide pacing for bradycardia (1%). Six patients were implanted with a TV-ICD after experiencing an S-ICD complication for which extraction was necessary. In total, 10 S-ICDs were extracted; none resulted in a complication. Eight patients had a nonsystemic ICD-related infection and no lead failures were observed. The majority, 68 (58%) patients, received an elective generator replacement. Two patients had a complication related to generator replacement (3%). Battery longevity was 5.6 years (IQR 5.2–6.1). Appropriate and inappropriate shock rates of 6-year estimates were 17% (CI 9–25%) and 21% (CI 15–27%), respectively.

Conclusions: This cohort represents the longest follow-up to date and shows a low annual complication rate without lead failures or systemic infections. Battery longevity of the first S-ICD generation results in relative early generator replacement procedures.

KEYWORDS
battery longevity, complications, long-term performance, replacement, subcutaneous ICD, ventricular tachycardia

INTRODUCTION

The subcutaneous implantable cardioverter-defibrillator (S-ICD) was approved in Europe in 2009 and in the United States in 2012 as an alternative to the conventional ICD with intracardiac transvenous leads.1 The S-ICD was designed to reduce lead-related complications and treat ventricular arrhythmias with the same efficacy as a transvenous ICD (TV-ICD). Short- and mid-term performances of the S-ICD have been described in several registries, cohorts and post-market approval studies.2–6 Propensity-matched cohorts showed similar rates of device-related complications, inappropriate therapy, and appropriate therapy efficacy as landmark ICD trials describing TV-ICD performance with a follow-up of up to 4 years.7,8
The incidence of transvenous lead failures, in many cases due to fracture or insulation defects, increases as leads are situated over a long period of time. Device-related infections requiring extraction of the entire system occur throughout follow-up, with an incidence peak after implant and generator replacement. The risk of complications associated with these lead-extractions is increased by a longer lead-dwelling time. Long-term follow-up data on S-ICD performance are needed to evaluate whether the expected long-term advantages of the extracardiac design of the S-ICD in reducing these complications are indeed present.

The entire S-ICD system, including the parasternal lead, is placed subcutaneously and therefore requires a higher energy current in order to convert ventricular arrhythmic episodes compared with a TV-ICD. As a consequence, this results in a larger battery and, therefore, generator compared with a TV-ICD pulse generator to provide adequate energy output and battery longevity. Battery longevity of the first generation 1010 S-ICD was expected to be 5.1 years. The European Regulatory Trial was the first cohort to publish data on S-ICD battery longevity and showed a slightly longer battery longevity than predicted by the manufacturer. Current generations of the S-ICD are expected to last approximately 7 years.

This study aims to describe a sizeable cohort with the longest published follow-up data on S-ICD performance, focusing on long-term device-related complications, generator replacement, and battery and lead longevity.

2 METHODS

2.1 Study design and patient population

In this study, the long-term clinical outcomes of the previously described Dutch cohort are presented. Event data were collected retrospectively through patient files. Arrhythmic events were adjudicated by participating centers according to protocol. Approval by the Medical Ethics Committee was waived as stored data were used for this retrospective analysis.

This cohort consists of all consecutive S-ICD patients implanted between December 2008 and April 2011 in four high-volume participating centers in the Netherlands, who were previously described in a publication by Olde Nordkamp et al. All patients had a Class I or IIa indication for ICD therapy according to the most recent guidelines at the time of implant. Patients were implanted with an S-ICD because of an inability to be implanted with a TV-ICD, existing patient preference for an S-ICD or an existing physician preference (e.g., due to previous complications of TV-ICD therapy).

2.2 Follow-up and events

All patients were seen in the outpatient clinic for regular follow-up visits according to the local hospital schedules. Device-related complications were defined as those requiring surgical intervention and were classified as short-term device-related complication when they occurred in the first 30 days postimplant, or long-term device-related complications when they occurred more than 30 days postimplant. Appropriate S-ICD therapy was defined as a shock given for ventricular tachycardia (VT) or ventricular fibrillation (VF). S-ICD shocks given for non-VT/VF were considered inappropriate therapy. Patients with S-ICD extraction or replacement for other reasons than elective replacement indication (ERI), for example, infection, malfunction, or the need for pacing, were not included in the battery longevity analysis. Patients who died before ERI were treated as censored observations. Premature ERI was defined as ERI within 36 months of implantation, which is based on the value given in the warranty.

2.3 Statistical analysis

Continuous data are presented as median with quartiles or mean ± standard deviation depending on the distribution of the data. Battery longevity was calculated as time from implant until generator replacement procedure as a result of reaching ERI. Device-related complication, appropriate, and inappropriate shock rate were calculated as Kaplan-Meier estimates with 95% confidence intervals (95% CI). Appropriate and inappropriate shock rates per 100 patients-years were calculated by dividing the total number of shocks given by the total follow-up duration.

3 RESULTS

3.1 Patient population

All 118 patients of the initially described Dutch S-ICD experience cohort were included in this study reaching a median follow-up of 6.1 years (IQR 5.6–6.5 years). All patients were implanted between December 2008 and April 2011 with the first generation S-ICD model SQ1010. Patients who were implanted before CE approval in 2009 all signed informed consents approved by the local Medical Ethics Committee and were aware of the innovative nature of the S-ICD at the time. This cohort is mainly male, relatively young, and has a relative preserved left ventricular ejection fraction (LVEF). Details are provided in Table 1 and were described previously. Fourteen patients died during follow-up (FU) (12%). No mortality was associated with S-ICD implant, replacement, or a complication of S-ICD therapy. One patient received a heart transplant during FU after which the S-ICD was explanted.

3.2 Battery longevity

The majority of the cohort, 68 (58%) patients, received an elective generator replacement. With the exception of premature S-ICD extractions due to device-related complications, 23 patients (19%) did not yet reach ERI and still have the first generation 1010 S-ICD in situ. Patients in whom the S-ICD was extracted or replaced due to complications (n = 13), or patients who died before ERI was reached (n = 13) or received a heart transplant (n = 1) were not taken into account in this battery longevity analysis. Median battery longevity in this cohort was 5.6 years (IQR 5.2–6.1). The battery longevity of all individual
TABLE 1 Baseline characteristics

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>N = 118</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male, n (%)</td>
<td>89 (75%)</td>
</tr>
<tr>
<td>Age at implant, years ± SD</td>
<td>50 ± 14</td>
</tr>
<tr>
<td>Clinical disease, n (%)</td>
<td></td>
</tr>
<tr>
<td>Ischemic CMP</td>
<td>45 (38%)</td>
</tr>
<tr>
<td>Dilated CMP</td>
<td>22 (19%)</td>
</tr>
<tr>
<td>Non-ischemic CMP</td>
<td>8 (6.8%)</td>
</tr>
<tr>
<td>Inherited cardiac disease</td>
<td>27 (23%)</td>
</tr>
<tr>
<td>Congenital heart disease</td>
<td>1 (0.8%)</td>
</tr>
<tr>
<td>Idiopathic VF</td>
<td>15 (13%)</td>
</tr>
<tr>
<td>LVEF, % ± SD</td>
<td>41 ± 15</td>
</tr>
<tr>
<td>NYHA functional class, n (%)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>86 (75%)</td>
</tr>
<tr>
<td>II</td>
<td>23 (20%)</td>
</tr>
<tr>
<td>III</td>
<td>5 (4.4%)</td>
</tr>
<tr>
<td>IV</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>ICD indication, n (%)</td>
<td></td>
</tr>
<tr>
<td>Primary indication</td>
<td>71 (60%)</td>
</tr>
<tr>
<td>Secondary indication</td>
<td>47 (40%)</td>
</tr>
<tr>
<td>Atrial fibrillation, n (%)</td>
<td>13 (11%)</td>
</tr>
</tbody>
</table>

CMP = cardiomyopathy; ICD = implantable cardioverter-defibrillator; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association; SD = standard deviation; VF = ventricular fibrillation.

*Data were available for 114 patients.

patients is graphically represented in Figure 1, showing 3 patients with premature battery depletion. These patients were implanted with a subset of S-ICD devices on which a battery advisory was issued by Boston Scientific. Two patients were given several shocks by the S-ICD, three appropriate shocks in the first patient and 13 inappropriate shocks in the second patient.

3.3 Device-related complications

The short-term device-related complication rate was 3% (95% CI 0–6%) at 30 days postimplant. One-year complication rate was 8% (95% CI 3–12%). Long-term complication rate at 6-year follow-up was 19% (95% CI 12–26%), corresponding with an annual complication rate of 3% (Figure 2). No lead failures were observed during 6 years of follow-up. Overall, 23 complications occurred in 22 patients (Table 2) for which surgical intervention was needed; specification of the device-related complications and time of occurrence are described in Table 3.

In 7 patients, lead or generator dislocation was diagnosed more than 1 year post-implant. In 3 patients, lead dislocation was diagnosed after an inappropriate shock occurred on oversensing of myopotentials due to the migration of the lead. In 2 patients, lead dislocations were diagnosed as a cause of oversensing of myopotentials in nontreated, stored, episodes by the S-ICD. No inappropriate shocks occurred in these patients. These patients were implanted before the introduction of the additional suture sleeve at xiphoid level; repositioning of the lead was done including an additional suture sleeve in all these patients.

FIGURE 1 Battery longevity. All individual patients who reached elective replacement indication and underwent either a replacement or extraction procedure are represented in the figure with their respective battery longevity in years in order of decent. Three premature battery depletion can be appreciated in this figure (the 3 most far right patients in this figure) [Color figure can be viewed at wileyonlinelibrary.com]

FIGURE 2 Complication rate. Kaplan-Meier plot of the device-related complication rate through 6-year follow-up for the S-ICD that required surgical intervention [Color figure can be viewed at wileyonlinelibrary.com]

One patient experienced discomfort of the S-ICD and noticed the S-ICD generator migrated toward posterior; the generator was repositioned. The last lead dislocation occurred intraoperatively during an elective generator replacement and is described in more detail below.
TABLE 2  Clinical outcomes

<table>
<thead>
<tr>
<th>Clinical outcomes</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with a device-related complication</td>
<td>22 (19%)</td>
</tr>
<tr>
<td>Total number of complications</td>
<td>23 (19%)</td>
</tr>
<tr>
<td>Elective generator replacements</td>
<td>68 (58%)</td>
</tr>
<tr>
<td>Complications secondary to replacement</td>
<td>2 (3%)</td>
</tr>
<tr>
<td>Patients with appropriate shocks</td>
<td>21 (18%)</td>
</tr>
<tr>
<td>Median number of shocks per patient</td>
<td>2</td>
</tr>
<tr>
<td>Annual appropriate shock rate</td>
<td>3 %</td>
</tr>
<tr>
<td>Number of shocks/100 patient years</td>
<td>10</td>
</tr>
<tr>
<td>First shock efficacy</td>
<td>91%</td>
</tr>
<tr>
<td>Patients with inappropriate shocks (IAS)</td>
<td>25 (21%)</td>
</tr>
<tr>
<td>Median number of shocks per patient</td>
<td>1</td>
</tr>
<tr>
<td>Annual inappropriate shock rate</td>
<td>4 %</td>
</tr>
<tr>
<td>Number of shocks/100 patient years</td>
<td>8</td>
</tr>
<tr>
<td>Patients with TWOS</td>
<td>9 (8%)</td>
</tr>
</tbody>
</table>

ERI = elective replacement indication; IAS = inappropriate shocks; S-ICD = subcutaneous implantable cardioverter-defibrillator; TWOS = T-wave oversensing.

TABLE 3  Specification of device related complications and time of occurrence

<table>
<thead>
<tr>
<th>Complication</th>
<th>30-day</th>
<th>1-year</th>
<th>&gt;1–6 year</th>
<th>Total complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsystemic infection</td>
<td>3</td>
<td>3</td>
<td>2 *</td>
<td>8</td>
</tr>
<tr>
<td>Failed conversion testing</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Indication for pacing</td>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dislocation of lead or generator</td>
<td>2</td>
<td>5 **</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Pocket erosion</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Premature battery depletion</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction due to discomfort</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
<td><strong>23</strong></td>
<td><strong>23</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

FU = Follow-up.
*One of these infections was within 1 month of elective generator replacement.
**One of the lead repositionings was during elective generator replacement.

TABLE 4  Distribution of S-ICD programming postimplant

<table>
<thead>
<tr>
<th>Programmed therapy zones at implant</th>
<th>N = 112</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT zone, n (%)</td>
<td>7 (6%)</td>
</tr>
<tr>
<td>VF zone, n (%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Single zone</td>
<td>1 (1%)</td>
</tr>
</tbody>
</table>

VF = ventricular fibrillation; VT = ventricular tachycardia.
*In 6 patients, programmed settings directly postimplant were not available.

3.5  S-ICD extractions

The entire S-ICD system was extracted in 10 patients (8%), 8 of which were extracted due to a nonsystemic pocket infection. The extraction procedures of the S-ICD did not result in any complication. Over the 6-year time course, only 1 patient developed a need for bradycardia pacing, for which a TV-ICD was implanted (Table 3). After successful extraction, 7 patients received a TV-ICD, 2 a new SICD, and 1 refused to continue ICD therapy despite a guideline indication. The 2 patients who were reimplanted with an S-ICD had no further complications, showing that there is not a definite need to convert to TV-ICD therapy in these cases.

3.6  S-ICD therapy

Therapy zones were programmed at the physician’s discretion (Table 4). One patient was initially programmed with a single treatment zone that was later adjusted to dual-zone with progressive insights in S-ICD programming. Twenty-one patients (18%) received a total of 70 appropriate shocks corresponding with a 1-year KM estimate of 4% (CI 0–8%) and 6-year KM estimate of 17% (CI 9–25%) (Figure 3). First shock efficacy was 91% (Table 2). All patients with a failed first shock during an arrhythmic episode converted with consecutive shocks. One patient converted spontaneously before the second shock was given. There were no patients who failed all 5 shocks given within one episode by the S-ICD, neither were there any adverse events related to delayed defibrillation. The appropriate shock burden in this cohort was 10 per 100 patient-years. Fifty-three shocks were delivered for VT, 17 for VF (Figure 4).

The inappropriate shock rate (IAS) was determined with KM analysis at 1 year at 8% (CI 4–12%) and at 6 years at 21% (CI 15–27%) with

3.4  Complications due to generator replacement

Two of the 68 patients (3%) with elective generator replacement procedures experienced a complication (Table 2). One of these was a pocket-infection that occurred in the first 30 days after the replacement procedure. The other complication occurred intraoperatively, as the S-ICD lead was stuck in the header and could not be removed. The lead was extracted under conscious sedation and a new S-ICD lead was implanted simultaneously with a new generator within the same procedure.
an average annual rate of 3.5% (Figure 3). Twenty-five patients (21%) in this cohort experienced a total of 58 inappropriate shocks, resulting in an inappropriate shock burden of 8 per 100 patient years. The most common underlying mechanism of inappropriate therapy was T-wave oversensing, which was the cause of inappropriate shocks (IAS) in 9 patients (Table 2). In 6 patients, supraventricular tachyarrhythmia was the cause of IAS. The distribution of inappropriate therapy and their causes are graphically shown in Figure 4. After corrective action, such as vector change, exercise template storage, or a change in medication, the IAS rate was 5% (CI 1–9%) at 6-year FU, indicating a learning curve related to device programming.

4 | DISCUSSION

4.1 | Major findings

This study reports several important findings. Battery longevity was slightly above manufacturer’s prediction of the 1010 S-ICD model. The first generation S-ICD patients show a low long-term complication rate as compared to trials with transvenous ICD systems. No lead failures or systemic infections occurred in this cohort and no S-ICD-related complication led to patient mortality. The complication rate related to the device replacement procedures was low. These findings are important as these are the first results showing the advantages of the extravascular design on long-term clinical outcomes compared with previously published long-term results of TV-ICD patients. A previously published propensity matched cohort of S-ICD and TV-ICD patients did not show a difference in overall occurrence of device-related complications with a median follow-up duration of 2.5 years.

4.2 | Battery longevity

The results on battery longevity provided in this study are similar compared to the only previous published data on 55 S-ICD patients and slightly longer than the predicted 5 years by the manufacturer. Not all patients of this cohort reached ERI, yet therefore actual battery longevity of the entire cohort may even increase slightly. Currently available S-ICD models and future generations are expected to have an increased longevity due to battery improvements.

4.3 | Device-related complications

We describe device-related complications in one of the first large cohorts implanted shortly after the introduction of the S-ICD. Therefore, the well-known learning curve associated with a higher device-related complication rate is represented by these patients. The short-term device-related complication rate in current practice might be lower, although the recently published EFFORTLESS trial reported a 30 days complication rate of 4.1%, which is comparable with our data. Most complications, as can be appreciated in Figure 2, occur in the early postimplant period. More important, the mid- to long-term complication is very low, without a single lead failure and only 1 patient who needed bradycardia pacing. Furthermore, no systemic infections were reported. These complications are some of the most common in TV-ICD. As a consequence, the annual device related complication rate in this cohort is lower than reported in publications on TV-ICD patients, with annual rates of up to 12%.

We observed a low

FIGURE 3  S-ICD therapy. Kaplan-Meier plot of the inappropriate shock rate (red) and appropriate shock rate (blue) during 6-year follow-up [Color figure can be viewed at wileyonlinelibrary.com]
device-related complication rate with the first experience of elective generator replacements of 3%. A large meta-analysis by Lewis et al. showed a median complication rate of 4.3% (0.55–7.37%). More data are needed to emphasize the true risk associated to SICD generator replacement. When necessary, the S-ICD extraction procedures did not result in any complications, which is important in case patients require future cardiac surgery or venous access. Moreover, reimplantation of an S-ICD after experiencing an infection was possible without any complications, indicating that it is not imperative to convert to TV-ICD therapy. The S-ICD therefore seems to provide benefit for these patients without jeopardizing the possibility for other device therapy options in the future. These data suggest that the performance of the S-ICD system on the long term is very promising.

4.4 | S-ICD therapy

Appropriate therapy is similar to large S-ICD registries that have been published previously. This could be explained by the patient characteristics of this cohort that show a young average age and low percentage of ischemic cardiomyopathies; these patients are therefore not comparable with landmark TV-ICD trials. The inappropriate shock rate, however, is higher than described in recent S-ICD registries. Most inappropriate defibrillations were due to T-wave oversensing; and considering the recent introduction of Smart Pass , these results could present an overestimation of the IAS rate in these patients. In one study, Smart Pass reduced TWOS by 82% compared with the first generation S-ICD studied in this analysis. Also, as previously mentioned, the learning curve of the implant technique is also applicable to other factors influencing the inappropriate therapy rate such as the knowledge of programming, screening, and exercise testing. This is also demonstrated by the low IAS rate of 5% after corrective action in this cohort. Progressive knowledge on these factors that has been acquired over the years and now results in lower rates of inappropriate therapy in S-ICD patients whom are currently implanted.

4.5 | Clinical implications

These results provide valuable insight in the long-term performance of S-ICD therapy. The shorter battery longevity, in comparison with TV-ICDs, in this cohort does not affect the long-term clinical outcome of device-related complications. Even with the learning curve of implanters and institutions present in this analysis, the complication curve of this cohort shows most complication early postimplant, confirming the long-term benefit of the S-ICD by omitting lead-related complications. Six-year follow-up of these 118 patients did not show any lead failures. Neither did the 10 S-ICD extractions that were indicated result in any complications. This demonstrates the long-term safety and efficacy of the S-ICD and confirms the value for young and active patients who are currently considered to have the most benefit of this therapy. As there is limited data on which patients develop a need for bradycardia pacing, antitachycardia pacing, or resynchronization therapy in the future, device selection can be a challenge. Considering the low risk of complications associated with S-ICD extraction and the low number of patients who develop an indication for TV-ICD therapy, the majority of patients could benefit from several years of extravascular ICD therapy with a S-ICD implantation even if a need for TV-ICD therapy occurs in the future. The developments in cardiac rhythm management could expand the S-ICD patient population in the future by providing the ability for combined therapy of a leadless pacemaker and S-ICD.

4.6 | Limitations

This analysis has been performed retrospectively. As these are the first long-term performance results of the S-ICD, naturally the initial learning curve of both implanters and institutions is included. Current S-ICD models have a longer projected battery longevity. Contempor ary insights in dual zone programming, combined with the recently introduced Smart Pass filter, have proven to significantly reduce the inappropriate shock rate but are not represented in this cohort. These programmable options were not available during most of the follow-up of these first generation S-ICD patients. The selection of these first S-ICD patients in the participating centers may have led to a selection bias by selecting young patients with relative little comorbidity for this cohort.

5 | CONCLUSION

The present study of the initial Dutch S-ICD cohort confirms the intended long-term benefits of an S-ICD, as demonstrated by an absence of lead failures and systemic device-related infections. Although there was a low risk of device-related infections in the first few months postimplantation, the risks associated with full S-ICD system extraction were negligible, which is in contrast with TV-ICD extractions. The median battery longevity was slightly longer than the predicted battery longevity. Finally, the S-ICD was effective in the treatment of ventricular tachyarrhythmias without any death due to device malfunction.

ORCID

Anne-Floor B. E. Quast MD http://orcid.org/0000-0003-2360-984X
Vincent F. van Dijk MD http://orcid.org/0000-0002-3832-1518
Dominic A. Theuns PhD http://orcid.org/0000-0002-5160-9700

REFERENCES


