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S-ICD: EXPANDING THE INDICATION

This clinical update reviews preliminary data supporting the use of S-ICD in patients with a typical indication for ICD therapy who are older and more unwell than previously studied. Also discussed are two abstracts from the Heart Rhythm Scientific Sessions 2019: one presenting data showing that antitachycardia pacing (ATP) does not reduce the need for shock and the other discussing the real-world performance of the atrial fibrillation (AF) monitor. Finally, concerns over the time to therapy with the S-ICD are addressed.

1. Low complication rates in high-risk patients

ICD implantation is most commonly indicated for primary prevention of sudden cardiac death in patients with a left ventricular ejection fraction (LVEF) of 35% or less.[1] Historically, however, and as demonstrated by the patient profile in the EFFORTLESS and IDE registries, few S-ICD patients had this indication.[2] The UNTOUCHED global, multicentre, non-randomised prospective study aims to assess outcomes in this group of patients following S-ICD implantation, and preliminary safety and efficacy data have recently been reported by Boersma *et al*.[1]

Patient population closer to MADIT-RIT

With an average age of 56 ± 12 years, the 1,116 patients enrolled in UNTOUCHED were older than those in the IDE,[3] EFFORTLESS[4] and post-approval studies,[5] had a lower LVEF and more than half (54%) had ischaemic cardiomyopathy (Table 1). Heart failure and comorbidity rates were higher than in these previous studies and were similar to those seen in patients receiving TV-ICD in the MADIT-RIT trial.[1]

Table 1: Baseline characteristics of patients in UNTOUCHED, IDE, EFFORTLESS, PAS and MADIT-RIT trials.[1]

	UNTOUCHED[1]	IDE*	EFFORTLESS*	PAS*	MADIT-RIT (TV-ICD ONLY)*
Device Type	S-ICD	S-ICD	S-ICD	S-ICD	TV-ICD
Age, Years	56 ± 12	52 ± 16	48 ± 17	53 ± 15	61 ± 12
LVEF, %	26 ± 6	36 ± 16	43 ± 18	32 ± 15	27 ± 7
NYHA II / III / IV	888 / 1,013 **(88)**	202 / 270 **(75)**	206 / 985 **(21)**	1,358 / 1,637 **(73)**	702 / 729 **(96)**
Primary Prevention	1,116 / 1,116 **(100)**	255 / 321 **(79)**	638 / 985 **(65)**	1,254 / 1,637 **(77)**	742 / 742 **(100)**
Ischaemic	570 / 1,065 **(54)**	73 / 321 **(23)**	311 / 983 **(32)**	672 / 1,637 **(41)**	457 / 741 **(62)**
Hypertension	787 / 1,116 **(71)**	187 / 321 **(58)**	279 / 985 **(28)**	1,009 / 1,637 **(62)**	500 / 739 **(68)**
Diabetes	364 / 1,116 **(33)**	90 / 321 **(28)**	110 / 985 **(11)**	550 / 1,637 **(34)**	239 / 733 **(33)**

Values are ratio of patients: n/N (%) or mean ± standard deviation unless otherwise stated. * Source: Boston Scientific Corporation, data on file.

100% of patients in the UNTOUCHED study were **Primary prevention** with **LVEF <35%** and **more than half (54%)** had **ischaemic cardiomyopathy**

- 64.9% EFFORTLESS[4]
- 76.7% PAS[5]
- 79.4% IDE[3]
- 100% UNTOUCHED[1]

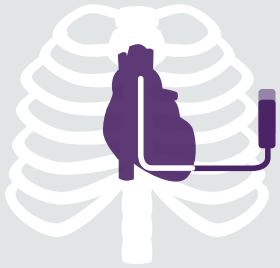
High implantation success

An S-ICD was successfully implanted in 1,112 patients (99.6%).[6] Defibrillation testing (DFT) was performed in 82.1% of patients; the conversion rate was 99.2%, with 93.5% successfully converting at 65 J or lower.[1] Amin *et al.* have previously identified low body mass index (BMI) as a predictor of DFT success.[7] This was confirmed in the UNTOUCHED cohort[1], highlighting the importance of correct device positioning in patients with a high BMI.

Low complication rate, even in high-risk patients

Thirty-day freedom from complications was 95.8%,[1] comparable to the rates seen in IDE (95.6%),[3] EFFORTLESS (95.9%)[4] and PAS (96.2%).[5] Complications were mostly related to postoperative healing and pain management.[1]

S-ICD IMPLANTATION WAS SUCCESSFUL IN 99.6% OF PATIENTS WITH A 30-DAY FREEDOM FROM COMPLICATION RATE OF 95.8%



99.6%
implant
success rate

In conclusion, these preliminary data show that the S-ICD has low perioperative complication rates and a high conversion rate, even in a high-risk cohort of older patients with low LVEF and high comorbidity rates. This supports the use of S-ICD in this common ICD indication.

2. Low need for ATP in primary prevention ICD patients

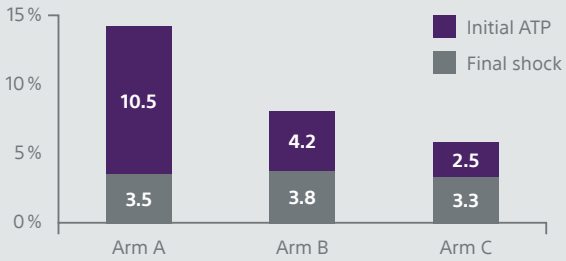
The European Heart Rhythm Association and 'S-ICD Why Not?' surveys report that in nearly half of all cases, the most common reason for choosing a TV-ICD over an S-ICD is the perceived need for ATP.[8,9] However, data from the MADIT-RIT trial have shown that a high cut-off rate and delayed therapy reduces the risk of inappropriate interventions.[10]

To further investigate, Schuger *et al.* compared ATP only, ATP plus shock, and shock-only event rates in MADIT-RIT, in 1,500 primary prevention patients, for ventricular arrhythmias of 200 bpm or faster. Patients were randomised to standard, historical ICD programming ≥170 bpm (arm A), a high-rate therapy cut-off ≥200 bpm programming strategy (arm B), or a prolonged detection duration (60 seconds ≥170 bpm and 12 sec ≥200 bpm) strategy (arm C).[10]

ATP does not affect the final shock rate

The rate of initial ATP treatment varied between the arms: 10.5% in Arm A, 4.2% in Arm B and 2.5% in Arm C. However, final shock rates were similar (3.5% in Arm A, 3.8% in Arm B and 3.3% in Arm C), showing that ATP does not reduce the need for shock.[10]

THE MADIT-RIT TRIAL SHOWED THAT EARLY ATP MAY BE UNNECESSARY AND DOES NOT REDUCE THE DELIVERY OF APPROPRIATE SHOCKS



Delayed therapy significantly reduced the number of ATP interventions, suggesting that many episodes of VT are self-terminating. Early intervention with ATP is unlikely to be necessary and may overestimate the value of ATP.[10]

3. Real-world performance of the atrial fibrillation monitor

The AF monitor diagnostic in the S-ICD allows detection of atrial arrhythmias without an atrial lead, by combining measures of RR variability over windows of 192 beats. It has been evaluated in simulations, but real-world data are needed. At the Heart Rhythm Scientific Sessions 2019, Baalman *et al.* presented positive predictive value (PPV) data for the AF monitor, enabling assessment of its real-world performance.[11]

Details of 7,744 devices followed for up to 30 months were obtained from the S-ICD remote monitor database. Most of the devices (99.5 %) had the AF monitor switched on and, of these, 26 % of devices detected AF episodes. The PPV was 67.7 %, which is comparable to real-world performance of AF algorithms in insertable cardiac monitors.[11]

THE PERFORMANCE OF S-ICD AF MONITOR DIAGNOSTIC IS COMPARABLE TO AF ALGORITHMS IN INSERTABLE CARDIAC MONITORS

4. Time to therapy does not affect S-ICD effectiveness

A 2018 observational study by le Polain de Waroux *et al.* raised concerns over the time to first therapy with the S-ICD, reporting an average time of 16.2 ± 3.1 seconds and prolonged time to therapy (>18 seconds) in 14 % of patients. In some cases (6 %), noise oversensing inhibited ventricular fibrillation (VF) induction. The authors therefore argued that intraoperative DFT should be mandatory to assess the quality of arrythmia detection.[12]

Since then, Diemberger *et al.* have evaluated time to therapy, and the predictors and impact of delayed therapy, in a multicentre study of 570 consecutive patients, who underwent DFT at 65 J during S-ICD implantation.[13]

High rate of cardioversion success

Cardioversion was successful at 65 J in 97.7 % of patients, with 12 (2.1 %) patients requiring a second successful shock at 80 J. The shock was not delivered in one (0.2 %) patient because of noise caused by trapped air around the electrode. In contrast to the 2018 study, Diemberger *et al.* identified no cases of sustained noise. All cases of delayed therapy were associated with some undersensing and were successfully managed by reprogramming the device or repositioning the system.[13]

Time to therapy

The mean time to therapy was 15 ± 3 seconds and exceeded 18 seconds in 9 % of patients. Independent predictors of delayed therapy were LVEF (odds ratio [OR] 0.98; 95 % confidence interval [CI] 0.96–0.99; p=0.016) and a 2x gain programmed (OR 3.66; 95 % CI 1.44–9.30; p=0.006).[13]

The effectiveness at 65 J was not affected by time to therapy (OR 1.13; 95 % CI 0.97–1.32; p=0.122). Rates of both appropriate and inappropriate shock were similar in both patient groups.[13]

In conclusion, delayed time to therapy occurred rarely and was not associated with lower conversion success or effectiveness at follow-up. During a median follow-up of 15 months, the authors reported only a few cases of arrythmias necessitating more than a single shock to be terminated, or delayed therapies.[13]

DELAYED TIME TO THERAPY IS RARE AND IS NOT ASSOCIATED WITH LOWER CONVERSION SUCCESS OR DEVICE EFFECTIVENESS

Summary

S-ICD has a high implantation success rate and low complication rates in typical ICD patients: those with low EF, multiple co-morbidities, and more than half with an ischaemic indication.

Early intervention with ATP may be unnecessary and does not reduce the need for shock.

S-ICD AF monitor is comparable to real-world performance of AF algorithms in insertable cardiac monitors.

Longer time to therapy at conversion is not associated with lower conversion success, or lower effectiveness during follow-up.

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