of subcutaneous implantable cardioverter-defibrillator (S-ICD) replacements. In this single-centre study, they have performed 72 device replacements, a remarkably large population with this relatively new technique. Dutch centres have been instrumental in the development of S-ICD therapy[2] and 'early adopters' with a large population with relatively long follow-up.[3] The current study shows low complication rates of S-ICD device replacement but the actual strength of the manuscript is the systematic analysis of defibrillation testing. This was performed in 63 patients and the first shock efficiency was coined high with 91.4%. Shock impedance at first implant and during device replacement was available in 48 patients. It was higher during replacement (86 ± 26Ω vs. 77 ± 28Ω) with a very large variability. In some patients, shock impedance was almost doubled between the two tests. We wonder if impedance changes occurred in the five patients where the device pocket was modified due to high PRAETORIAN scores. Most likely, high impedance is due to excess fibrous tissue occurring around the parasternal shock coil.

The results from van der Stuijt *et al.* are somewhat better than in the smaller study from Rudic *et al.*[4] that reported 20% shock failure in 25 S-ICD replacement procedures. Both reports are leading to doubts about the long-term performance of S-ICDs. High shock impedance and failed first shock during induced ventricular fibrillation might be an indication of higher risk for shock failure during real-life ventricular arrhythmias. Ventricular fibrillation induced during defibrillation testing in a patient under general anaesthesia might be easier to terminate than more stable rhythms such as fast monomorphic ventricular tachycardia in awake haemodynamically compromised patients . High shock impedance patients might thus be at risk of inefficient shock therapy with a false sense of security of a second successful shock during defibrillation testing. What we need is a systematic registry of shock efficacy during long-term follow-up of patients with S-ICDs. To prevent underreporting of failed ICD shocks, we should take any effort to receive device read-outs of all ICD patients that died with an active device. A previous study by Tseng *et al.*[5] that prospectively collected data from autopsies in San Francisco county demonstrated unexpected failure of pacemaker or ICD devices in a large proportion of sudden cardiac death. They calculated that 6.4% of ICD deaths were related to device malfunction. With S-ICD being a relatively new technology, efforts should be undertaken to prevent ineffective shock therapy at long-term follow-up.

Conflict of interest: none declared.

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High shock impedance during subcutaneous implantable defibrillator generator replacements: Authors' reply

We thank Dr Maass *et al.*[1] for their interest in our study[2] and are pleased to provide a reply to their questions.

The authors express their concern about the long-term performance of the subcutaneous implantable cardioverter-defibrillator (S-ICD), considering the increase in shock impedance in the years after implantation. According to Ohm's law, a higher shock impedance results in a lower shock success rate. However, despite the significant increase in shock impedance in our analysis, we showed a first shock success during defibrillation testing (DFT) of 91.4% during the replacement procedure. This is similar to the DFT success rate in *de novo* S-ICD implants and in transvenous devices.[3,4] Four of the patients with a high PRAETORIAN score underwent a DFT after pocket revision during the replacement procedure. These patients were among those with the largest increase in shock impedance (103Ω ± 37Ω during implant vs. 145Ω ± 47Ω during replacement). DFT was successful after one 65 J shock in three of these patients (75%), whereas the fourth patient had a successful DFT at 80 J, similar to his implant procedure. These results suggest that impedance is not as predictive of defibrillation success as anticipated.

Shock impedance represents the resistance between the coil and the generator of the S-ICD and depends mostly on generator-lead distance and the body tissues between these electrodes. As Dr Maass *et al.* described, excess formation of fibrotic tissue around the lead or generator or weight gain can result in an increase in shock impedance. Shock impedances >100Ω are associated with a higher chance of DFT failure, but a positive predictive value of 23% indicates this variable is unsuited as a predictor for shock success.[5] Moreover, a low shock impedance does not necessarily correspond with a successful DFT. When the generator is too anteriorly positioned, the electrical current may shunt over the thoracic wall, resulting in a conversion failure with a low shock impedance. Alternatively, the non-invasive PRAETORIAN score evaluates the implant position of the S-ICD and takes generator-lead distance and adipose tissue into account. A retrospective validation of the PRAETORIAN score demonstrated that half of all patients with a high PRAETORIAN score failed their DFT.[5] In our study, we showed a high defibrillation success and a low overall PRAETORIAN score, despite increases in impedance. Moreover, a recent analysis of 566 patients showed that patients with a high PRAETORIAN score have a 19-fold higher risk on ineffective shocks during follow-up (hazard ratio = 19.03; confidence interval 4.75–76.20; $P = 0.003$).[6] This seems to confirm our suggestion that the PRAETORIAN score is a better predictor for shock success than impedance.

As mentioned by Dr Maass *et al.*, a successful shock on an induced arrhythmia during the implant or replacement procedure does not guarantee shock success during a spontaneous ventricular arrhythmia. The ongoing PRAETORIAN DFT trial, of which the results are expected in 2024, will prospectively validate the PRAETORIAN score and compare the predictive values of the PRAETORIAN Score and DFT for shock success in spontaneous arrhythmias.[7]

Conflict of interest: none declared.

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