Following elimination of T-wave oversensing, myopotential noise emerges as a major cause of inappropriate shock in S-ICD

Kenta Tsutsui
Yoshifumi Ikeda
Ritsushi Kato
Hitoshi Mori
Saki Hasegawa
Sou Asano
Mai Tahara
Sayaka Tanaka
Shiro Iwanaga
Toshihiro Muramatsu
Shintaro Nakano
Kazuo Matsumoto

**Introduction**: Inappropriate shock (IAS) is a major complication of subcutaneous implantable cardioverter-defibrillator (S-ICD) that dreadfully impacts an affected patient's quality and longevity of life, and reportedly occurs at an egregious rate of 5-15% every year. T-wave oversensing (TWO), a common cause of IAS, is expected to decrease thanks to anti-TWO measures such as preoperative surface electrocardiogram screening and the 9 Hz in-device electrogram filter (SmartPass®).

**Methods**: To determine if an incidence of TWO-induced IAS is suppressed, and if it is indeed the case, to determine remaining causes of IAS, we conducted a single-center registry study that tracks the postoperative course of 54 consecutive patients who received S-ICD from 2016 to 2019.

**Result**: During the follow-up period of 638±355 days, IAS occurred in 11% of the study population (6/54) which appears comparable to previously reported incidence. Remarkably, the TWO-induced shocks were eliminated (0/6). Instead, myopotential oversensing emerged as the most common cause of IAS events (4/6) while atrial fibrillation ranked the second (2/6). The in-device electrogram of the four myopotential-induced IAS patients retrieved during the post-shock interrogation revealed that (1) provocation maneuver mimicking a triggering activity (e.g. abdominal clench, push-ups, raising the left upper extremities, lifting a heavy item) reproduced myopotential noise disguised as R-waves, which should trigger an IAS if uninterrupted, in multiple vectors; (2) in-device R-wave amplitude of the myopotential-induced IAS group did not differ from those of shock-free patients (Alternative, 1.1±0.4 mV vs 1.8±0.9 mV, Secondary, 2.3±1.4 mV vs 2.5±1.2 mV, Primary, 2.1±0.8 mV vs 3.0±1.5 mV); and (3) there was no temporal changes in R-wave amplitude from the implantation (Alternative, 1.2±0.5 mV vs 1.1±0.6 mV, Secondary, 1.7±0.6 mV vs 1.8±0.7 mV, Primary, 1.7±1.1 mV vs 1.9±1.2 mV), indicating that the R-wave amplitude trend consistently over time. These findings suggest that it is neither constantly low nor acutely dropped R-wave amplitude but a relatively high noise level that drives IAS.

All the patients who suffered from a myopotential-induced IAS were male. Right-sided S-ICD lead implantation (which was chosen providing the preoperative screening on the left sternal border failed but that on the right sternal border was satisfactory) was associated with a markedly higher risk of the myopotential-induced inappropriate shock when compared with the left-sided implantation (50% vs 2%,
Conclusion: The present study highlights the fact that IAS continues to occur due to myopotential noise oversensing despite TWO elimination. Further study should address the underlying mechanism of a myopotential-induced inappropriate shock and generalizability of this observation.