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RESEARCH LETTER

Physical Activity Reduction in Patients Following ICD Therapy

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Technological advances have furthered the ability of cardiovascular implantable electronic devices (CIEDs) to extend beyond their original design. Implantable cardioverter-defibrillators (ICDs), invented to detect and treat life-threatening ventricular arrhythmias via defibrillation, have evolved into complex health care delivery platforms. The modern CIED utilizes multimodal sensors to not only detect arrhythmias but also acquire physiological variables. CIED-derived sensor data provide a powerful platform to evaluate the potential impact of ICD therapies related to activity.

Activity, as measured by accelerometers, has been shown to predict mortality in cardiovascular patients and the general population.[1] We previously reported that low levels of CIED-derived 30-day median patient activity predicted both mortality and heart failure in patients implanted with an ICD or CRT (cardiac resynchronization therapy).[2] However, there is currently limited data on the temporal changes in device-derived activity in CIED populations, especially in relationship to ICD therapy events. Therefore, we aimed to assess the temporal changes in CIED-derived daily physical activity before and following inappropriate and appropriate ICD therapy events in a large cohort of patients with CIEDs, enrolled in the MADIT-RIT (Multicenter Automatic Defibrillator Trial Reducing Inappropriate Therapy).

The MADIT-RIT study assessed novel ICD programming strategies to reduce inappropriate ICD therapy events in primary prevention patients with ICDs, using 3 programming arms, (1) conventional programming, (2) high-rate cutoff, and (3) delayed therapy arm. The study showed a significant reduction in inappropriate ICD therapies and a reduction in all-cause mortality with high-rate cutoff or delayed therapy.[3] MADIT-RIT was approved by an institutional review committee, and that the subjects gave informed consent.

In MADIT-RIT, CIED-derived patient activity was obtained from ICD device interrogations. Patient activity data were measured via a 2D accelerometer integrated within the Boston Scientific ICD pulse generator. The accelerometer output is converted into minutes of activity each day using validated manufacturer-specific algorithms. For each day a participant is in the study, we calculated the number of days until or since their next or previous shock. The daily ICD activity measurements were then reframed in the context of days since shock, as opposed to days in study. Study data will not be made available to other researchers.

Of the 1483 subjects in the study, 295 received inappropriate or appropriate ICD therapy, 186 received appropriate therapy, and 152 received inappropriate therapy (some receiving both). The majority of the subjects received only 1 or 2 ICD therapy events over the median duration of 17 months of follow-up, 27 subjects received ≥10 shocks. Patients with appropriate therapy were older (62 versus 59 years), but there were no differences in sex, race, or NYHA (New York Heart Association) class between those with appropriate versus inappropriate shocks. Appropriate shocks were also much more likely in diabetes patients; no other clinical variables (eg, hypertension, smoking, body mass index) were different between the appropriate and inappropriate groups.

The Figure shows median daily activity in minutes in patients who received ICD therapy, for 3 weeks before and after a shock. We found a significant decline in

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Nonstandard Abbreviations and Acronyms

CIED	cardiovascular implantable electronic device
ICD	implantable cardioverter-defibrillator
MADIT-RIT	Multicenter Automatic Defibrillator Trial Reducing Inappropriate Therapy

CIED-derived activity following an appropriate therapy (58% of patients), with no clinical differences in patients with or without appropriate therapy. Total weekly activity was compared before and after shock by paired *t* test, using only the first event for each patient. We found an average of 4% (37 min/wk) reduction in physical activity in the week following appropriate therapy (P=0.02), when compared with the week before therapy. However, we did not see a statistically significant difference in activity following inappropriate ICD therapy. Interestingly, patients receiving inappropriate therapies had overall higher rates of activity, especially on the day of/after shock (145 minutes versus 121 minutes). The impact of appropriate shocks was similar in patients with ICD and CRT-D. Patients who received >1 appropriate shock were more affected (5% activity reduction) than those who received only a single appropriate shock (3% activity reduction).

These novel results are relevant for the management of patients with CIEDs presenting with appropriate ICD therapies, showing that a significant reduction in physical activity occurs following these events, which may warrant reassessment to determine clinical status and the need for intensified treatment. While the specific mechanism of this finding cannot be ascertained in a retrospective post hoc analysis, there could be several explanations, including patient discomfort, deteriorating heart failure, or health care utilization/hospitalization preventing the patients from being active.[4] The finding that activity only declined in those with appropriate ICD therapy and not in those with inappropriate therapy suggests that the underlying arrhythmia substrate might play a role. In conclusion, we found a decline in physical activity in patients with CIED following an appropriate ICD therapy, which could identify a high-risk cohort that might benefit from intensified medical treatment.

ARTICLE INFORMATION

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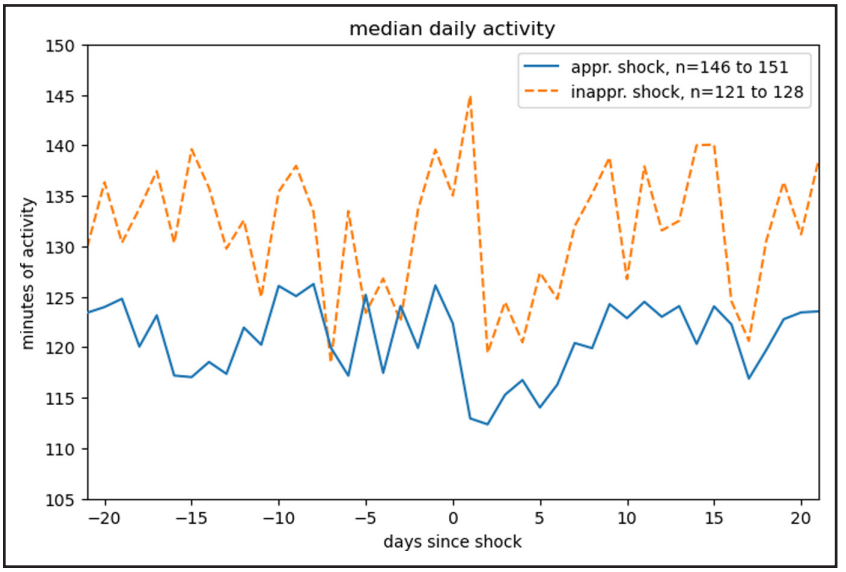

Figure. Median daily activity for 3 weeks before and after an implantable cardioverter-defibrillator (ICD) therapy.
n≥121 (inappropriate), n≥146 (appropriate). (Data availability varies by day.)