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RHYTHM DISORDERS AND ELECTROPHYSIOLOGY

CASE REPORT: CLINICAL CASE

Rapid Return to Play After Extravascular Implantable Cardioverter-Defibrillator Implantation in a Competitive Runner

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ABSTRACT

We present a case of long QT syndrome type 2 in a competitive runner who underwent implantation of a primary prevention extravascular implantable cardioverter defibrillator with a rapid return to partial activity within 2 weeks and a return to full activity within 4 weeks of implantation without affecting wound healing or device function. (JACC Case Rep. 2024;29:102490) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

An 18-year-old competitive runner with collegiate prospects presented to an outpatient cardiology clinic for evaluation after an episode of dizziness, altered consciousness, and intermittent palpitations in the absence of true syncope immediately following an 800-m race. An ECG demonstrated sinus bradycardia (heart rate 54 beats/min) a prolonged QT of 531 m and a QTcB of 502 ms, with notched T waves in 3 leads. An exercise test demonstrated paradoxical prolongation of QTc with exercise, with a QTc of 575 at 4 minutes of recovery (**Figure 1**). His calculated Schwartz score was 5, consistent with high probability of long QT syndrome (LQTS).[1]

TAKE-HOME MESSAGES

- Despite decades of use, there is a lack of consensus and evidence for exercise restriction following cardiac implantable electronic device implantation. Studies under way may provide additional clarity about the optimal length of exercise restriction.
- This case highlights 1 example of successful rapid return to activity after implantation of the new EV-ICD. The newly improved EV-ICD, implanted in the retrosternal position, provides distinct advantages and limitations and deserves continued study.

PAST MEDICAL HISTORY

The patient had no significant past medical history and no family history of cardiac disease or sudden cardiac death.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis for his episode of altered consciousness, palpitations, and near-syncope included a spontaneously terminating or nonsustained ventricular arrhythmia in the context of his evaluation suggestive of LQTS. Postexertional or vagally mediated presyncope was also considered.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

EV-ICD = extravascular-implantable cardioverter defibrillator

LQTS = long QT syndrome

INVESTIGATIONS

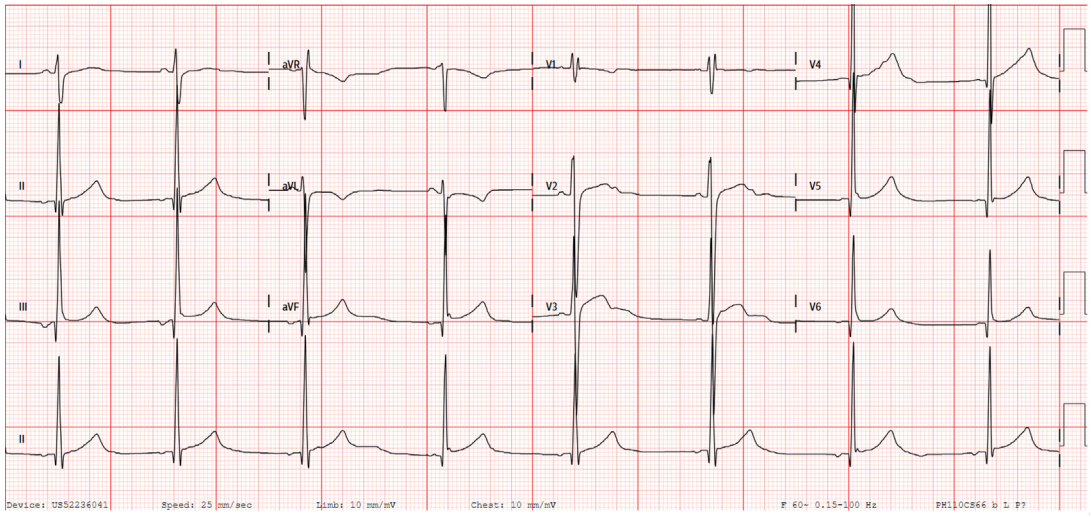
Genetic testing demonstrated definite LQTS type 2 with a pathogenic frameshift variant in KCNH2 c.3097_3098dup (p.Pro1034Glyfs*24). After continued episodic palpitations despite the initiation of nadolol, a patch monitor demonstrated a symptomatic episode of non-sustained ventricular tachycardia.

MANAGEMENT

The patient was initially administered on low-dose β-blocker therapy with nadolol 20 mg daily; however, this was poorly tolerated given his pre-existing sinus bradycardia and with symptoms of significant fatigue following medication initiation, making compliance difficult. After the episode of non-sustained ventricular tachycardia was noted, extensive discussion of his qualification for a Class I indication for an implantable cardioverter defibrillator, including risks and benefits, were undertaken.[2] Given the patient's young age with a prolonged anticipated dwell time of transvenous leads and risks associated with future transvenous lead management, an extravascular device was considered. Furthermore, he had a significant concern about the effect of a prolonged recovery with arm restrictions on his athletic performance, and given his slim profile, a subcutaneous implantable cardioverter defibrillator (Boston Scientific) would have been bulky. On the basis of these factors, the decision was made to proceed with implantation of an extravascular implantable cardioverter defibrillator (EV-ICD) (Medtronic).[3] Given his slender build with an acute xiphocostal angle, measurements of the EV-ICD lead compared with a preprocedural computed tomographic scan were obtained to ensure not only adequate length in the retrosternal space but also the potential for a favorable implant location leftward of the right atrial appendage to minimize the risk of P-wave oversensing (**Figure 2**).

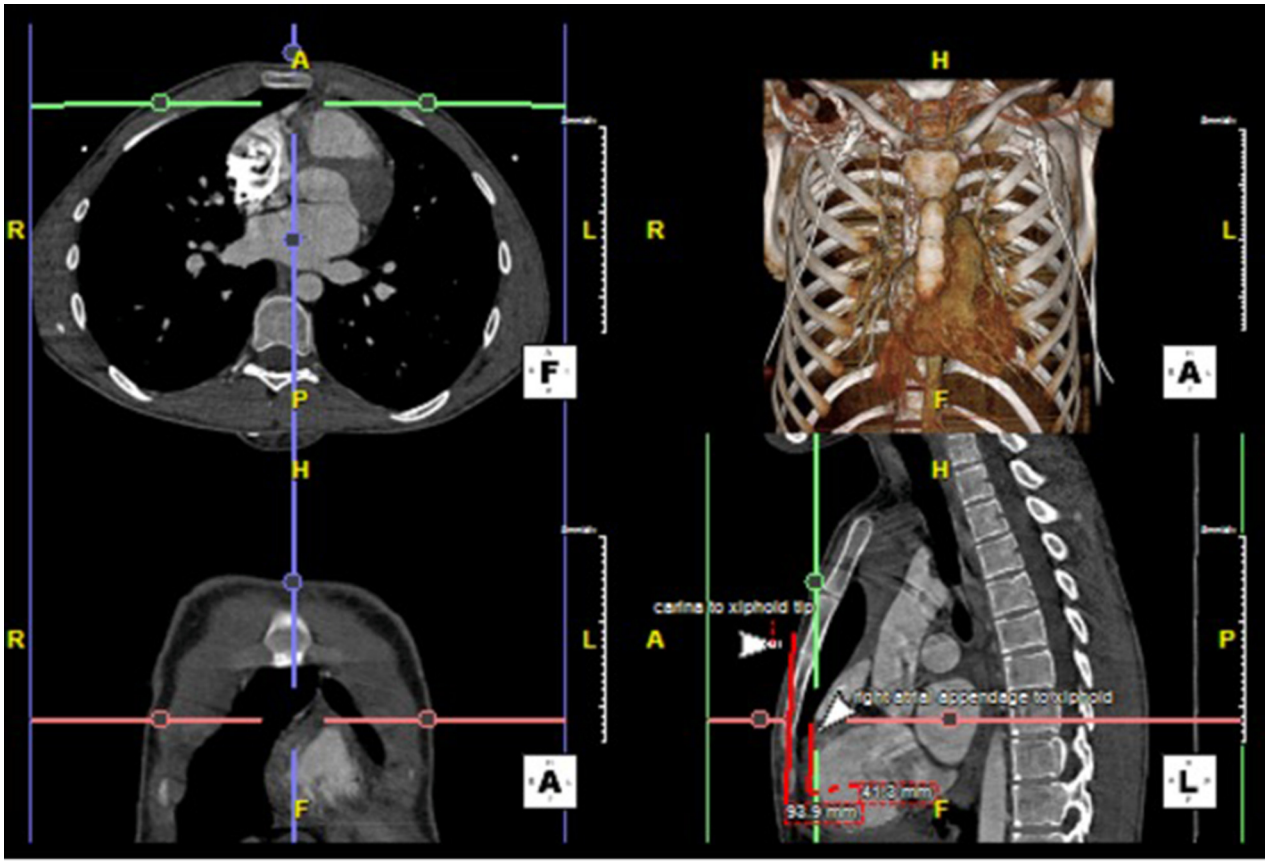
The implantation of the EV-ICD was successful without complication. An oblique incision parallel to the costal margin in the xiphocostal space was made, followed by dissection to the rectus fascia, which was divided. Blunt dissection was used to split the fascia and then obtain access to the retrosternal space.

FIGURE 1 Presenting Electrocardiogram



Sinus bradycardia with prolonged QTc.

FIGURE 2 **Computed Tomographic Angiography With 3D Remodeling Completed**



Notable findings, including minimal retrosternal space, considered favorable for implantation. At the level of the right ventricular free wall there is minimal lung tissue, whereas the right atrial appendage did extend slightly leftward.

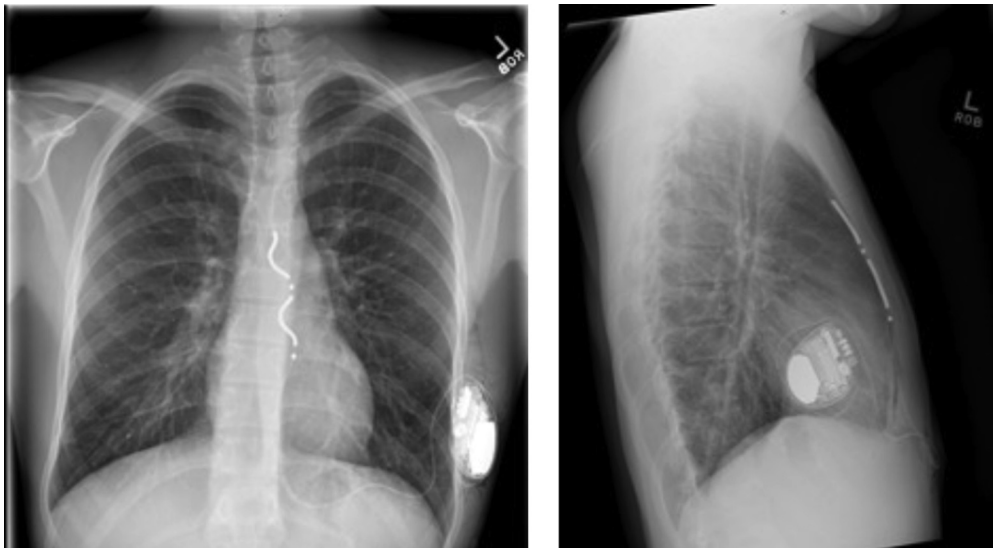
Under biplane fluoroscopic guidance, the tunneling tool was advanced to the level of the carina (Videos 1 and 2) and then withdrawn, leaving a peel-away sheath. A 63-cm Epsila (Medtronic) EV defibrillator lead was advanced into the space, and the sheath was withdrawn to expose the lead. R waves measured from 7 to 8 mV, and no P-wave oversensing was seen. The lead was secured and tunneled to a lateral pocket where the EV-ICD generator was placed. Defibrillation testing was completed, with no delay in detection resulting from undersensing, and a successful defibrillation at 30 J resulted in a clean termination of the tachycardia. His postoperative course was uncomplicated, and he was discharged the following day.

We recommended a modified restriction period with 2 weeks of light activity to allow for wound healing. He then resumed running without abdominal exercises for 2 weeks after a follow-up visit confirmed excellent incisional healing and absence of pocket-related complications. At 4 weeks, we performed an exercise stress test with a wireless connection to his EV-ICD to ensure appropriate sensing during intense cardiovascular exercise. He had appropriate sensing to his maximum heart rate throughout the test without lead noise noted. He subsequently was cleared for return to play and resumed full competitive activities without further restrictions.

DISCUSSION

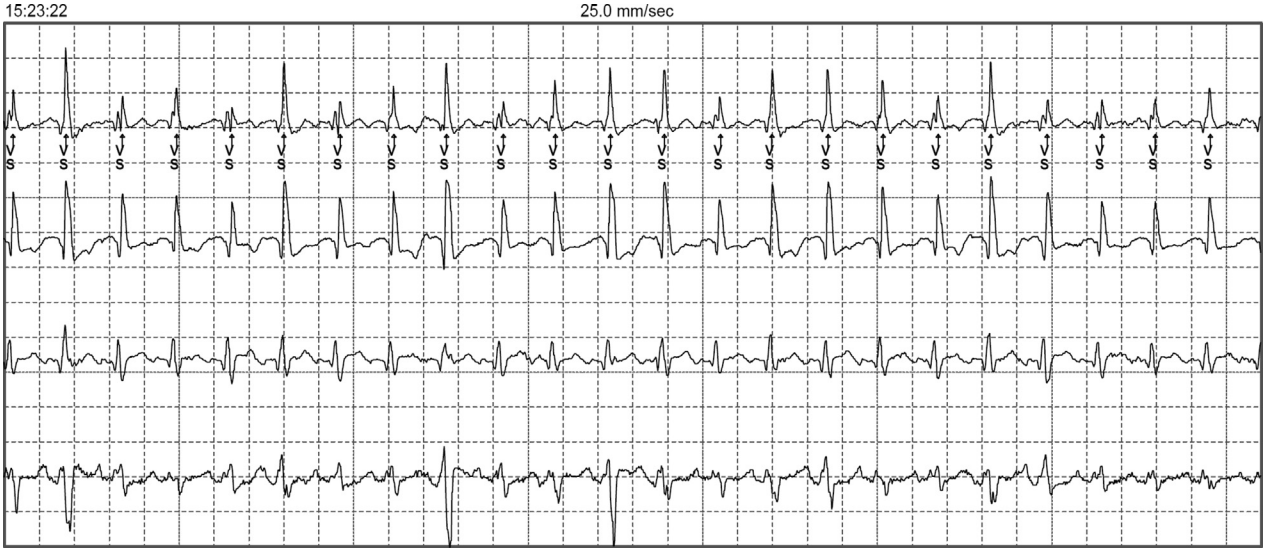
Activity restriction after placement of a cardiac implantable electronic device is a widespread practice with the goal of minimizing the risk of lead displacement and promoting wound healing. Despite

FIGURE 3 Posteroanterior and Lateral Chest X-Ray



Demonstrating final lead and device position.

FIGURE 4 Extravascular Implantable Cardioverter Defibrillator Electrogram



Recorded during exercise stress test.

decades of use, there are not universally accepted standards to restrict patient activity after transvenous cardiac implantable electronic device surgery, and significant variability is seen following transvenous devices.[4] Efforts are currently under way to investigate the need for conventional restrictive limitation after implantation,[5] especially considering the risk of shoulder disabilities.[6] Subcutaneous ICDs have general manufacturer recommendations, including activity restrictions as long as 6 weeks,[7] but the outcomes of this practice have not been studied.

We were mindful of the fact that lead dislodgement was the most common reason for EV-ICD system revision during the EV-ICD trial,[3] with a total of 9 events (1.5% of patients). Most of these events were associated with anchoring sleeve attachment malfunctions. Four dislodgements were identified within 3 days of implantation, whereas the remainder were noted at least 3 weeks and ≤120 days later. Given the confined nature of the retrosternal space paired with a mindful securing of the suture sleeve, we anticipated that after allowing for a period of wound healing, the lead would likely be stable within 2 weeks of the procedure and there was little additional clinical benefit to restriction of activities that did not involve significant stress on the site of sleeve attachment. The exercise test to screen for lead noise and lead instability during high-intensity exercise was an added source of reassurance. Our experience suggests that rapid return to play is feasible in selected patients with close postoperative follow-up and protocols to confirm sensing and lead stability.

FOLLOW-UP

The patient has returned to regular activities and competitive running without incident or event. His remote transmissions continue to demonstrate excellent sensing parameters without oversensing events.

CONCLUSIONS

Here we report a rapid return to activity by a young competitive athlete after EV-ICD implantation without evidence of lead dislodgement or effect on device function. Given that the device will likely be applied more and more in young and active patients, future studies and outcomes should continue to assess the optimal time for exercise restriction after EV-ICD implantation.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS extravascular implantable cardioverter defibrillator, long QT syndrome

APPENDIX For supplemental videos, please see the online version of this paper.