SUDDEN CARDIAC ARREST

COMPLEX CASE STUDY

A Tale of Two Athletes: The Value of Implantable Loop Recorders in Elite Athletes

ANDREW HULL, BS, FRANK CANADY, BA, PRASHANT BHAVE, MD and IAN LAW, MD

The University of Iowa Children's Hospital, Division of Pediatric Cardiology, Iowa City, IA

ABSTRACT. Sudden cardiac arrests in athletes due to arrhythmias have become much more high profile, and the relative risk of sudden cardiac death has been shown to be greater in athletes when compared to non-athletes. In order to reduce mortality without unnecessarily taking healthy athletes away from competition, a useful diagnostic test is needed. Here we highlight the value of the implantable loop recorder (ILR) using two cases involving collegiate athletes. In both instances, the ILR facilitated a diagnosis, which ultimately lead to appropriate and timely management.

KEYWORDS. loop recorders, supraventricular tachycardia, ventricular tachycardia.

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Introduction

Sudden cardiac arrests in athletes are high-profile events and the risk of sudden cardiac arrest has been shown to be greater in athletes versus the general population.¹ Thus, prompt evaluation of an athlete with a possible arrhythmia as the cause is warranted. This case report highlights the diagnostic value of an implantable loop recorder (ILR) in two elite athletes, one with recurrent palpitations, the other with a history of bradycardia and syncope. The ILR proved useful in the accurate diagnosis and appropriate management of both athletes, underscoring the value of these devices in this special population.

Case report

Athlete 1

The first patient is a 21-year-old collegiate diver who presented with recurrent infrequent palpitations that occurred while performing training exercises. Due to the difficulty in obtaining event recordings during practice,

an ILR (Medtronic Linq, Minneapolis, MN) was placed. Within 1 month of implantation he manually triggered the device during his practice and two episodes of tachycardia were detected during the 8-minute transmission. Both events were wide variable complex tachycardia that was preceded by bradycardia. The second event was 44 beats in duration, ranging between 220 and 240 bpm. An electrophysiology (EP) study was performed to determine the possible etiology. The differential diagnosis was supraventricular tachycardia (SVT) with aberrancy versus ventricular tachycardia (VT).^{2,3} The loop recorder data and EP study data are shown in **Figure 1**.

During the EP study (performed under conscious sedation), catheter manipulation induced SVT; the patient confirmed that the symptoms during SVT at EP study matched the symptoms of his clinical episodes found on the ILR. Ventricular pacing revealed the presence of a left posterior accessory pathway. An isoproterenol infusion was started and SVT was induced using atrial burst pacing. This pacing produced atrioventricular re-entrant tachycardia (AVRT) with aberrancy. The loop recorder was then interrogated, which confirmed a wide variable complex arrhythmia nearly identical in appearance to what had been recorded during the previous symptomatic event (**Figure 1**). The patient subsequently underwent a successful radiofrequency ablation procedure. He returned to athletic participation and continued monitoring with the ILR. The ILR was explanted in September of 2015 and the

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Address correspondence to: Ian Law, MD: Stead Family University of Iowa Children's Hospital, 200 Hawkins Drive, Iowa City, IA 52242-1083. E-mail: ian-law@uiowa.edu

Figure 1: (A) The 44-beat run of wide complex tachycardia and the mechanically induced noise that preceded it. This was found on the original loop recorder tracings (standing). The trigger for the event was “back flips,” correlating with the brief bradycardia (squatting down prior to jumping) and artifact (due to the impact of landing after the jump). (B) The aberrant arrhythmia that was induced in the EP laboratory while the patient was supine was simultaneously recorded by the ILR and showed a wide complex QRS configuration.

Figure 2: Baseline electrocardiogram strip of lead V1 on athlete #2 at the time of initial evaluation showing second-degree heart block.

patient has remained asymptomatic for 9 months since the procedure.

Athlete 2

The second patient is a male 23-year-old former collegiate cross-country runner who presented with a syncopal episode and concern about seizure-like activity in the form of myoclonic spasms (witnessed by a by-stander). He had a previous similar episode at 17 years of age, which led to ambulatory monitoring that produced a diagnosis of second-degree heart block (Mobitz type I; **Figure 2**). During his initial presentation, he underwent hospital observation and was noted to have a resting heart rate in the mid- to high 30s with frequent Wenckebach AV block at rest. No intervention was indicated, as the second-degree heart block was felt to be secondary to high vagal tone and his syncopal event was isolated. Six years later, the patient remained very active in running and returned with a more significant episode of loss of consciousness

that occurred while at a library studying for a test. The event was unwitnessed and the patient was found on the floor. An electrocardiogram (ECG) showed sinus bradycardia with no evidence of AV block. The health-care team recommended that the patient receive an ILR.

Approximately 3 months later, the patient had recurrent loss of consciousness with convulsions; his father (a physician) witnessed this episode and manually activated the device. The remote transmission showed no significant brady- or tachyarrhythmia during the episode. As a result, the patient was referred to a neurologist, who obtained a brain magnetic resonance imaging (MRI) scan and an electroencephalogram. The MRI revealed a tumor in the left frontal lobe. The tumor was resected and subsequently treated with radiation and chemotherapy.

Discussion

The evaluation of a potential arrhythmia comprises several options. The first step when there is a suspicion

of syncope or palpitations is usually short-term 24- or 48-hour Holter ambulatory rhythm monitoring.⁴ However, Holter monitoring yields a clear diagnosis in only about 10% of patients.⁵ Furthermore this approach would not have been an appropriate choice in these two athletes because the diver could not wear a device in the water (when his events occurred) and the runner's events were infrequent.

The second option is the application of an external cardiac monitor – usually a post-event recorder or a loop recorder. The post-event recorder must be available at all times; during a symptom episode, the patient applies the device to his chest, activates the device to record the echocardiographic tracing, then transmits the signal to an appropriate facility over the telephone line for interpretation. The loop recorder is worn continuously and updates the electrocardiographic tracing at a set interval; during a symptom episode, the patient logs the event and then the signal is transmitted to the facility for interpretation. These techniques have the same limitations for these athletes as the 24-hour Holter. Finally, both Holter monitors and external loop recorders require adhesive electrodes that stick to the chest and these may not hold well if there is excessive sweating. For athletes that compete in water sports, external monitors are not suitable.

ILRs supply a single-lead ECG and can provide constant long-term monitoring of the patient with undiagnosed syncope or palpitations.⁵ The ILR is usually placed in the subcutaneous tissue above the left pectoralis major and can be implanted with local anesthetic or conscious sedation. The patient, by using a special remote activator, can manually trigger rhythm recording and storage. The device can be programmed to record and store readings automatically if a pre-established heart rate (abnormally slow or abnormally fast) is detected by the device. The device can store 42 minutes of heart rhythm tracings and can be interrogated remotely, allowing for timely diagnosis and intervention.³ ILRs have a battery life of up to 36 months.⁴

In the first case, the ILR tracings suggested VT due to the appearance of the wide complex tachycardia. During the EP study, AVRT was the only induced arrhythmia. Intermittent aberrant conduction was seen during AVRT. Thus the EP study demonstrated that the wide QRS tachycardia captured during a symptomatic event by the loop recorder was not VT but AVRT with aberrant conduction. In retrospect, breath-holding or vagotonia during “back flips” likely set up conditions conducive to the initiation of orthodromic reciprocating tachycardia. In the second case, implantation of the loop recorder showed that this device can facilitate a correct non-cardiac diagnosis. Sinus bradycardia and/or Mobitz type I second-degree heart block is a more common finding in elite athletes. While long systolic pauses can lead to both syncope and a seizure, in this particular case the lack of any severe bradycardia during the last episode prompted a referral to a neurologist, leading to the correct diagnosis of a brain tumor. The ILR proved useful in this patient's case because syncope and seizure events

can present in similar ways and can potentially be misdiagnosed.^{6,7} Misdiagnosis of a true syncopal event as an epileptic episode is more common, but there are instances of misdiagnosing a seizure as a syncopal event, primarily if the patient is noted to have myoclonic spasms, which were reported in athlete 2. Being able to differentiate a seizure from a syncopal event in a patient is critical because many antiepileptic drugs exert their effects on ion channels, and this can be problematic for patients with existing known heart problems.⁶ Thus, while the loop recorder did not show a cardiac arrhythmia, the absence of an arrhythmia precipitated a more comprehensive non-cardiac work-up, leading to the correct diagnosis.

In cases such as these, where symptoms are infrequent, ILRs have a much higher rate of identification of symptoms than standard evaluations such as Holter monitors and external loop recorders. ILRs yield a 43% diagnosis for infrequent syncopal episodes while conventional tests such as ECGs and Holter monitors yield a 20% definitive diagnosis.⁸ In cases of infrequent palpitations, 73% of patients with presyncope or palpitations were diagnosed with ILRs, while conventional strategies yielded 21%.⁹

Athletes have been shown to have a 2.8 greater relative risk of sudden cardiac death in comparison to age-matched controls,¹ obligating a prompt diagnosis following worrisome events such as palpitations and syncope. An ILR is an ideal device when symptoms occur infrequently or in an inhospitable environment. Given the athletic activities of these two individuals, the device most likely to provide informative findings was clearly the ILR. Bypassing the non-invasive techniques for this minimally invasive technique mitigates any delay in obtaining a diagnosis and eliminates other intermediate steps that may increase the cost and anxiety. Implantation of an ILR is a relatively safe procedure, with the main complications being infection or allergic reaction to the material. However, the incidence of complications is very low and in one study involving 27 patients no infection was observed at the site of implantation.¹⁰

Conclusion

These two cases highlight the advantage of early incorporation of ILRs in the diagnostic work-up of young athletic persons with infrequent symptoms that are potentially related to cardiac arrhythmia. In the case of suspected arrhythmia and unexplained syncope, the differential diagnosis is very broad and accurate diagnosis is essential.¹ In these athletes, ILR implantation early in the diagnostic process was especially useful in expediting diagnosis and guiding appropriate therapy.

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