Case Report

Inappropriate Shocks from Implanted Cardioverter Defibrillators Caused by Sensing of Diaphragmatic Myopotentials

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Abstract. Inappropriate shocks remain one of the major problems associated with the use of implantable cardioverter defibrillators (ICD). We describe 3 patients who had inappropriate shocks due to oversensing of diaphragmatic myopotentials. In all 3, oversensing could be demonstrated during deep inspiration or Valsalva maneuver. The problem was remedied in one by insertion of a separate rate sensing lead in the right ventricular outflow tract, in the second by decreasing the rate of antibradycardia pacing of the ICD, and in the third by decreasing the sensitivity of the ICD. We conclude that the possibility of sensed diaphragmatic myopotentials should be considered at the time of ICD implant so that appropriate preventive measures can be taken.

Key Words. implantable cardioverter defibrillator, oversensing, diaphragmatic potentials

Introduction

Inappropriate shocks continue to be one of the major problems associated with the use of implanted cardioverter defibrillators (ICD) [1,2]. Although spurious discharges are most commonly caused by supraventricular arrhythmias, especially atrial fibrillation, inappropriate shocks may also be triggered by lead problems such as wire fractures or insulation defects, by oversensing of cardiac signals (e.g., T waves, P waves) and by extraneous noise [3,4]. In some cases, the etiology of shocks may be difficult to determine. We describe herein 3 patients with repeated inappropriate discharges of their ICD’s that were eventually traced to oversensing of diaphragmatic myopotentials.

Case Report

Case 1 was a 64-year-old man with a history of a severe dilated cardiomyopathy who underwent ICD implantation (Mini II model 1762 pulse generator and an Endotak DSP model 0125 lead, Guidant Corp., St. Paul, MN) following aborted sudden cardiac death arrest in August of 1997. Several months later, he experienced several asymptomatic shocks and interrogation of his device revealed multiple activations, none of them triggered by ventricular tachyarrhythmias (Figure 1). Noise and oversensing during sinus rhythm with deep inspiration and valsala maneuver were documented on his rate sensing electrogram (Figure 2), but ICD function was otherwise normal. During surgical exploration, no loose set screws or oversensing with device manipulation was noted. Accordingly, a separate rate sensing lead (Model 4269, Guidant Corp) was placed in the right ventricular outflow tract. The patient has had no further shocks and no further device activations have been recorded in the ensuing 6 months.

Case 2 was a 70-year-old man with nonobstructive coronary artery disease, normal left ventricular function and aborted sudden cardiac death who underwent ICD implantation (Mini II Model 1762 pulse generator, Endotak DSP Model 0125 lead, Guidant Corp.) in September of 1996 following the induction of poorly tolerated sustained monomorphic ventricular tachycardia during baseline electrophysiologic study. Subsequently, he received several shocks during atrial fibrillation and interrogation of his ICD also revealed multiple arrhythmia detection’s during normal sinus rhythm which occurred during the mid morning, appearing to correspond to times when he was attempting to defecate (during one of these episodes, he experienced a shock). His rate sensing electrogram revealed evidence of oversensing from extraneous noise only during ventricular pacing at a rate of 75 beats/min (from his ICD) with deep inspiration (Figure 3A and B). The patient was programmed to a 5 second delay before therapy

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Fig. 1. The rhythm strip from the shocking lead of the ICD that immediately preceded a shock in case #1.

Fig. 2. A recording from a standard surface ECG lead (above), the rate sensing lead (middle) and the marker channels (below) during a Valsalva maneuver. The noise on the rate sensing channel is sensed as ventricular fibrillation (see arrows). VS = ventricular sensing, VF = ventricular fibrillation.

Fig. 3. (A) A rhythm strip from a surface ECG lead (above), the rate sensing lead (middle), and marker channels (below) during deep inspiration while the patient #2 is in normal sinus rhythm. VS = ventricular sensing, VP = ventricular pacing, VF = ventricular fibrillation. (B) The same lead configuration during deep inspiration while the patient is ventricularly paced. Note the presence of noise (see arrows) that is sensed as ventricular fibrillation.