

## Case Report

## Pacing-Facilitated Proarrhythmia

SPYROS TSIKRIKAS, DIMITRIOS BRAMOS, GEORGE KOLLIAS, KONSTANTINOS P. LETSAS,  
MICHALIS EFREMIDIS, ANTONIOS SIDERIS

*Second Department of Cardiology, Division of Cardiac Electrophysiology, Evangelismos General Hospital of Athens, Athens, Greece*

Key words:  
**Implantable  
cardioverter-  
defibrillator,  
ventricular  
tachycardia,  
short-long-short  
sequences.**

The implantable cardioverter-defibrillator (ICD) has been proven to reduce the mortality of patients with life-threatening ventricular arrhythmias, and has become the therapy of choice for patients with aborted sudden cardiac death or poorly tolerated ventricular tachycardias. Abrupt changes in ventricular cycle lengths or short-long-short (S-L-S) sequences might precede the initiation of ventricular tachycardia and ventricular fibrillation. The S-L-S sequences might be passively permitted or actively facilitated by pacing. We present a case of ICD-facilitated ventricular tachycardia.

*Manuscript received:*  
July 27, 2010;  
*Accepted:*  
December 2, 2010.

*Address:*  
Spyros Tsikrikas

*Second Department of  
Cardiology  
Division of Cardiac  
Electrophysiology  
Evangelismos General  
Hospital of Athens  
106 76 Athens, Greece  
e-mail:  
[spyrostsik@yahoo.gr](mailto:spyrostsik@yahoo.gr)*

**T**he implantable cardioverter-defibrillator (ICD) has been proven to reduce the mortality of patients with life-threatening ventricular arrhythmias. However, such devices can occasionally have a proarrhythmic effect. Here we describe a case of ICD-facilitated ventricular tachycardia.

### Case presentation

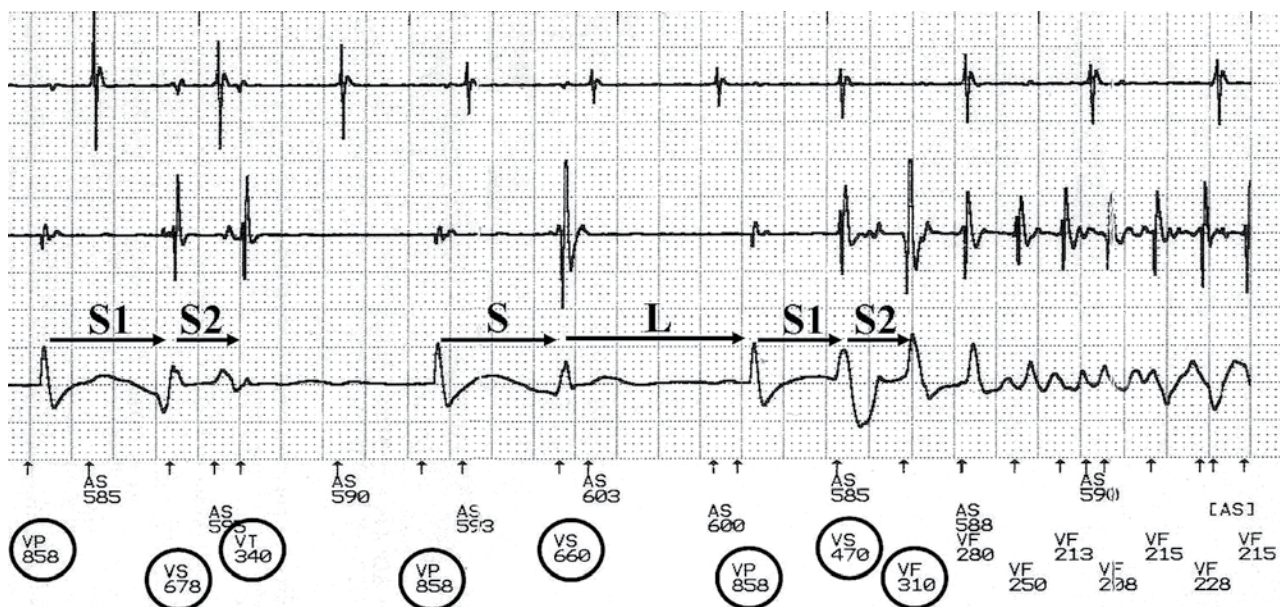
A 64-year-old man with a dual-chamber ICD, which had been implanted after aborted sudden cardiac death, was admitted to our hospital complaining of three episodes of dizziness associated with palpitations and concomitant ICD discharges. His medical history also included atrial fibrillation and atrioventricular conduction disturbances. The ECG on admission showed pacing rhythm along with premature ventricular contractions, while blood examinations including serum electrolytes were within normal values. The initial ICD settings included: i) DDD mode, ii) lower rate limit of 70 beats/min, iii) maximum tracking rate of 130 beats/min, iv) one ventricular tachycardia (VT) zone of

180-220 beats/min, and v) a ventricular fibrillation (VF) zone >220 beats/min. ICD interrogation revealed three episodes of polymorphic VT degenerated to VF that were successfully terminated by the device. A short-long-short (S-L-S) sequence preceded all episodes and was considered to be the underlying mechanism for these potentially fatal arrhythmic events. Figure 1 shows the characteristic S-L-S sequence before a VT/VF episode.

### Discussion

ICD therapies can occasionally prove proarrhythmic due to induction of VT/VF.<sup>1</sup> Sweeney et al have analysed the onset of VT events in patients from two ICD trials in an attempt to categorise the various relationships between the pacing stimuli and subsequent tachycardias.<sup>2</sup> The underlying mechanisms were:

- i. Non-pacing associated: no pacing within 5 cycles of the onset of VT/VF. This was the most common mode of VT/VF onset and was relatively evenly distributed among the various pacing modes;



**Figure 1.** ECG strip showing an episode of ventricular fibrillation (VF) induced by the characteristic short-long-short (S-L-S) sequence.

- ii. Pacing associated: pacing was present within 5 cycles before VT/VF initiation, without an S-L-S sequence. This accounted for the next largest number of VT/VF episodes;
- iii. Pacing permitted: VT/VF is initiated by an S-L-S sequence not caused by pacing stimuli but passively allowed by the device mode and lower rate. This mode of onset was fairly equally distributed but least common with DDD pacing;
- iv. Pacing facilitated: single ventricular pacing stimuli initiate or terminate pauses prematurely, producing an S-L-S sequence followed by VT/VF. This sequence was most common with DDD pacing.

Our case belongs to the last category; when the pacing lower rate was increased from 70 to 80 beats per min, all episodes of VT/VF were eliminated. The role of the S-L-S sequence in the appearance of VF/VT in patients with pacemakers or ICDs has also

been described by others who recognised the importance of this mechanism in approximately 20% of cases.<sup>3</sup> Careful reprogramming of the pacemaker parameters is needed in order to avoid pacing-facilitated proarrhythmia.

## References

1. Tzeis S, Andrikopoulos G, Rassias I, Theodorakis G. Tachycardia induction due to inappropriate implantable cardioverter defibrillator therapy: what is the mechanism? *Hellenic J Cardiol.* 2010; 51: 558-562.
2. Sweeney MO, Ruetz LL, Belk P, Mullen TJ, Johnson JW, Sheldon T. Bradycardia pacing-induced short-long-short sequences at the onset of ventricular tachyarrhythmias: a possible mechanism of proarrhythmia? *J Am Coll Cardiol.* 2007; 50: 614-622.
3. Anthony R, Daubert JP, Zareba W, et al. Mechanisms of ventricular fibrillation initiation in MADIT II patients with implantable cardioverter defibrillators. *Pacing Clin Electrophysiol.* 2008; 31: 144-150.