

# Unexpected Inhibition of Pacing in a Patient with Complete AV Block after Upgrade of a Pacemaker to a Defibrillator: What is the Mechanism?

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Short Titel: Unexpected inhibition of pacing

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## Case Presentation

A 55-year-old male patient with a DDD-pacemaker for complete AV-block after septal ablation for hypertrophic obstructive cardiomyopathy presented with symptomatic non-sustained ventricular tachycardia (VT) at a rate of 166 bpm. The patient carried a right-sided transvenous DDD-pacemaker (right atrial lead: Intermedics 432-04; right ventricular lead: Intermedics 430-10). He was completely pacemaker dependent without ventricular escape rhythms. Due to multiple non-sustained VT an upgrade to a dual-chamber ICD was indicated. We decided to perform a left-sided de-novo DDD-ICD implantation and to deactivate the right-sided atrial and ventricular lead which were 21 years old.

An integrated bipolar ICD lead (Boston Scientific 0181) was placed in the right ventricular apex via the left axillary vein paying attention to maintain an adequate distance to the old ventricular lead. A new atrial lead (Boston Scientific 7741) was inserted into the right atrial appendage. The atrial and the ventricular defibrillator lead were connected to the new DF1-generator (Boston Scientific D143 Inogen).

Shortly after explantation of the old pacemaker generator, complete heart block occurred. The old pacemaker battery was quickly reconnected to reestablish pacing and to assess the situation. What is the mechanism of ventricular pacing inhibition, and what is the best solution? [Fig. 1, Fig. 2]

## Commentary

We observed that mechanical contact between the old pacemaker and the new integrated bipolar defibrillator lead caused oversensing (“lead chattering”) resulting in inhibition of ventricular stimulation.

At this point, three possible solutions were at hand:

1. Implantation of an additional septal pace/sense lead in appropriate distance to the integrated bipolar lead.
2. Explantation of the new integrated bipolar defibrillator lead and exchange against a true bipolar ICD lead.
3. Extraction of the 21 year old ventricular pacemaker lead.

Since we had utilized a DF-1 system, we decided to add a pace/sense lead and use the single-coil DF-1 part of the defibrillator lead which was placed in a good right ventricular apical position. [Fig 3.]

With the latest DF-4 standard, this would not have been possible. A new true bipolar defibrillator lead would have had to be positioned in the right ventricular outflow tract.

### *Oversensing in integrated bipolar leads*

In integrated bipolar leads the distal shock coil serves as the sensing anode. Their architecture is less complex than those of dedicated bipolar leads and they are less prone to T-wave oversensing and anodal stimulation [1, 2]. On the other hand, the large surface area of the sensing anode (which consists of the entire distal shock coil) renders these leads more prone to sensing of short VV intervals [3], P-wave oversensing, P-wave double-counting [2,4], diaphragmatic oversensing [5], or oversensing due to non-physiological electrical signals that are generated during interactions with other intracardiac leads. The large surface area of the high-voltage coil is more likely to touch an abandoned lead than the ring electrode of a true bipolar ICD lead. This mechanical interaction, or lead-chatter, can cause oversensing and inappropriate shocks [6] or, as in this case, inhibition of pacing due to oversensing. A true bipolar ICD lead should therefore be preferred in patients with abandoned ventricular leads.

### *DF-1 and DF-4 defibrillator leads*

The industry standards IS-1 and DF-1 enable interchangeability of generators and leads from different manufacturers since the late 1980s. Corresponding defibrillator leads feature two (single-coil lead; one IS-1, one DF-1) or three (dual coil lead; one IS-1 and two DF-1) connectors. The DF-4 standard was introduced in 2010 as a simpler solution with only one connection between lead and device, aiming to reduce material in the pocket, facilitate the implantation procedure, and lowering the risk of lead-to-port mismatch.

Our case demonstrates an important clinical advantage of the older DF1/IS1 standard [7], namely the possibility to simply add a pace/sense lead to overcome the problem of chattering.

[1] Moisés Rodríguez-Mañero, MD\*; Carlo de Asmundis, MD, PhD\*; T-Wave Oversensing in Patients With Brugada Syndrome: True Bipolar Versus Integrated Bipolar Implantable Cardioverter Defibrillator Leads; Circulation: Arrhythmia and Electrophysiology. 2015;8:792–798

[2] Gunderson BD, Swerdlow CD, Wilcox JM, Hayman JE, Ousdigian KT, Ellenbogen KA. Causes of ventricular oversensing in implantable cardioverter-defibrillators: implications for diagnosis of lead fracture. Heart Rhythm. 2010;7(5):626–633.2

[3] Ng J, Chopra N, Barbhuiya C, Reichlin T, Nof E, Nagashima K, Tadros T, Koplan B. Incidence of nonphysiologic short VV intervals detected by the sensing integrity counter with integrated bipolar compared with true bipolar leads: clinically inconsequential or cause for concern? J Interv Card Electrophysiol. 2014;39(3):281–285.

[4] Weretka S, Michaelsen J, Becker R, Karle CA, Voss F, Hilbel T, Osswald BR, Bahner ML, Senges JC, Kuebler W, Schoels W. Ventricular oversensing: a study of 101 patients implanted with dual chamber

defibrillators and two different lead systems. *Pacing Clin Electrophysiol.* 2003;26(1 Pt 1):65–70.

[5] Sticherling C, Klingenheben T, Hohnloser SH. An Unusual Cause of ICD Shock. *PACE* 20:2265-2267, 1997

[6] Pfitzner P, Trappe HJ. Oversensing in a cardioverter defibrillator system caused by interaction between two endocardial defibrillation leads in the right ventricle. *Pacing Clin Electrophysiol.* 1998;21(4 Pt 1):764–768.

[7] Sticherling C, Burri H. Introduction of new industry standards for cardiac implantable electronic devices: balancing benefits and unexpected risks; *Europace* (2012) 14, 1081–1086

## Figures

Figure 1: Electrocardiogram during intermittent AV-Block (paper speed 25 mm/sec)

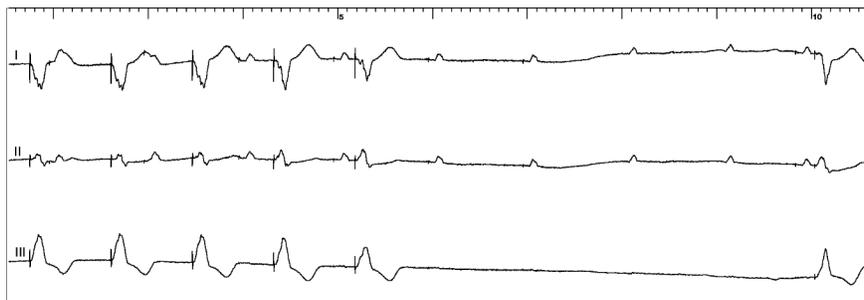


Figure 2: Fluoroscopy (45°left anterior oblique view) of the lead configuration during AV-Block. Note the proximity of the old ventricular pacing lead to the distal shock coil, which serves as the anode of the integrated bipolar defibrillator lead.

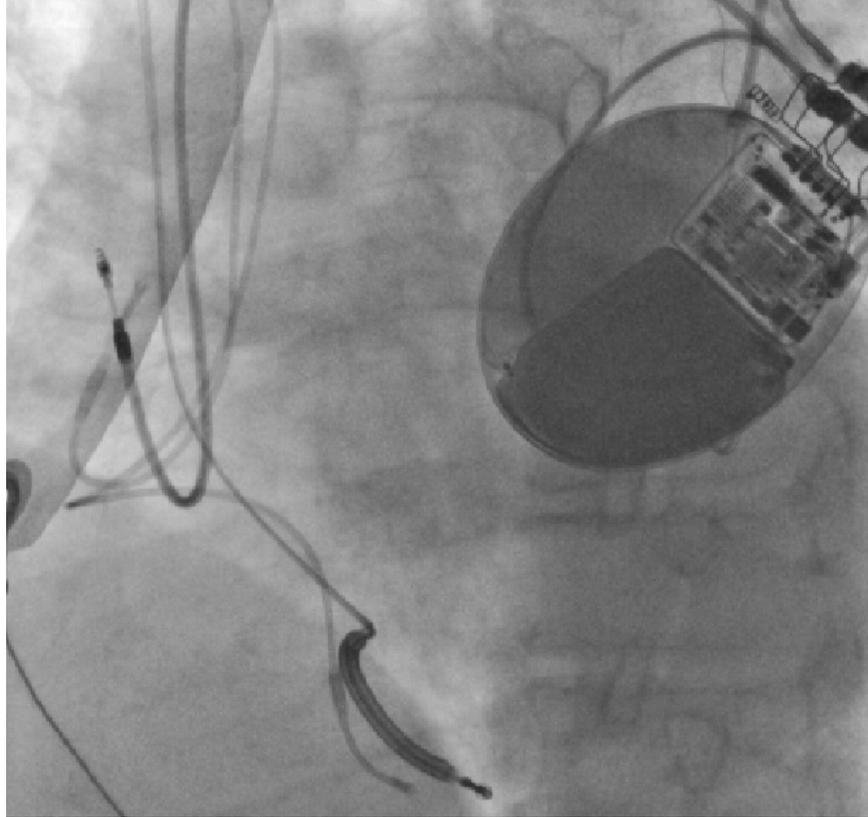


Figure 3: Fluoroscopy (PA view) of the lead configuration after addition of a pace/sense lead in the inter-ventricular septum.

