

# Unusually high His-bundle signal amplitude – ICD sensing considerations

Niezwykłe wysoka amplituda sygnału pęczka Hisa w kanale przedsionkowym ICD

Agnieszka Sławuta<sup>1</sup>, Jakub Adamowicz<sup>1</sup>, Magdalena Sokołowska<sup>2</sup>,  
Aleksandra Gajek<sup>2</sup>, Martek Frączkowski<sup>1</sup>, Jacek Gajek<sup>3</sup>

<sup>1</sup>Department of Cardiology, Klodzko County Hospital, Klodzko, Poland

<sup>2</sup>Students Scientific Association, Department of Clinical Nursing, Wrocław Medical University, Wrocław, Poland

<sup>3</sup>Department of Clinical Nursing, Wrocław Medical University, Wrocław, Poland

## Abstract

In patients with chronic atrial fibrillation and congestive heart failure presenting with narrow QRS complex the direct His-bundle pacing the use of dual chamber implantable cardioverter-defibrillator can be a definite treatment option meeting all therapeutic goals. This approach enables heart rate regularization, appropriate increase of beta-blocker dose with additional benefit in terms of arrhythmic death prophylaxis. The proper functioning of implantable cardioverter-defibrillator demands appropriate atrial channel/His-bundle signal sensing. The low His-bundle electrogram amplitude usually does not interfere with the device function and the DDI or DVI programming modes are reasonable.

The authors present a case of unusually high His-bundle signal amplitude sensed by atrial channel of implantable cardioverter-defibrillator, which could potentially contribute to some particular programming considerations. The attending physician should be aware of some arrhythmia discriminators which may delay or even withhold the appropriate shock.

Key words: atrial fibrillation, congestive heart failure, direct His-bundle pacing, implantable cardioverter-defibrillator

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## Introduction

In patients with chronic atrial fibrillation and congestive heart failure presenting with narrow QRS complex the most appropriate option of electrotherapy is the direct His-bundle pacing using dual chamber implantable cardioverter-defibrillator (ICD) [1]. Atrial fibrillation population is a complex and demanding group when it comes to treatment. This arrhythmia causes two main hemodynamically important disturbances: lack of atrial contraction as well as irregularity of cardiac cycles. The latter has unfavorable consequences especially with coexisting diastolic dysfunction, even though the main problem in heart failure patients is systolic dysfunction of left ventricle. If a patient requires ICD implantation, this approach can provide two crucial ad-

vantages: heart rate regularization as a primary treatment goal and a preservation of narrow QRS complex [2]. It can result in reverse remodeling in a substantial percentage of patients [3].

In this implanted device setting the sensing in atrial channel connected to the His-bundle electrode is important. We present a case of unusually high His-bundle signal amplitude, which could potentially contribute to some particular programming considerations.

## EGM description

The EGM was derived from Boston Scientific Inogen dual-chamber ICD (Fig. 1). Programmer screen presents 3 simultaneous tracings from: 1) atrial channel, 2) ventricular

Address for correspondence: dr n. med. Agnieszka Sławuta, Oddział Kardiologii, ZOZ Klodzko, ul. Szpitalna 1a, 57–300, Klodzko, Poland,  
e-mail: aslawuta@tlen.pl



**Figure 1.** Simultaneously recorded tracings of atrial, ventricular and coil to can (shock) electrograms. In the atrial channel, clearly visible His-bundle potentials preceding ventricular potentials. In all but one complexes, His-bundle potential is detected by the device as atrial one (AS). The selective His-bundle pacing is properly assessed as AP and VS. The ventricular sensing is appropriate. No ventricular pacing present

channel and 3) coil to can (shock) electrograms. In the atrial tracing, clearly visible His-bundle potentials precede ventricular potentials. In most complexes, His-bundle potential is detected by the device and qualified as atrial one (AS) with one exception. The selective His-bundle pacing is properly assessed as AP and VS. The ventricular sensing is appropriate.

## Discussion

Setting adequate sensing parameters in ICD programming can be challenging when atrial channel is connected to His-bundle electrode. The amplitude of His-bundle signal is usually relatively small, hence it is rarely sensed. The best solution for almost all device configuration would be a DVI mode with no atrial sensing, which is not possible permanently in all ICD devices. Another solution is to set the atrial sensing to such low values that virtually blind the channel for all atrial and His-bundle signals. In some patients with large amplitude differences between the atrial/His-bundle and the ventricular signal, the atrial sensing can be possible for ventricular signal only (cross talk), which usually does not negatively influence the proper function of the device. Considering ICDs lacking in possibility of unipolar sensing, the amplitude of ventricular signal at His-bundle position (atrial channel) can

be individual for every patient. Of course in dual chamber device the DDI, or even more specific DVI mode, would secure the desired direct His-bundle pacing and a proper pharmacological treatment would slow down the intrinsic atrioventricular conduction, resulting in almost 100% of regular His-based pacing. Furthermore, the rate response mode (DDIR or DVIR) adjusts the pacing rate to metabolic demands.

In our patient the unusually high His-bundle signal amplitude enabled a variety of ICD modes and sensing programming options as well. Periodically occurring lack of His-bundle signal sensing did not influence a proper ICD function with regard to pacing. A possibility of such high His-bundle signal amplitude sensed by the ICD as atrial signal was already demonstrated in some patients at our facility [4]. This can lead to a tempting option to leave the standard DDD programming, where atrial and ventricular channels sense electrograms similar to the sinus rhythm. Approaching this situation, the programming physician should be aware of some arrhythmia discriminators, such as SVT 1:1 ratio conduction, which may delay or even withhold the appropriate shock.

From clinical point of view, the presented tracing was taken shortly after implantation, when beta-blocker dose was not yet adequately titrated, resulting in lower than expected percentage of pacing.

## Streszczenie

Dla pacjentów z utrwalonym migotaniem przedsionków i zastoinową niewydolnością serca z wąskimi zespołami QRS w zapisie elektrokardiograficznym optymalną opcją terapeutyczną może być stała stymulacja pęczka Hisa z wykorzystaniem dwujamowego kardiowertera-defibrylatora. To podejście zapewnia regularność rytmu komór oraz umożliwia zwiększanie dawki beta-adrenolityku z następczym obniżeniem ryzyka nagłego zgonu sercowego. Odpowiednie funkcjonowanie układu wymaga właściwego wyczuwania sygnału w kanale przedsionkowym/pęczka Hisa. Niska amplituda sygnału pęczka Hisa zazwyczaj nie wpływa na funkcjonowanie urządzenia w przypadku wykorzystania trybów stymulacji DDI lub DVI.

Autorzy prezentują przypadek bardzo wysokiej amplitudy sygnału pęczka Hisa wyczuwanej w kanale przedsionkowym wszczepialnego kardiowertera-defibrylatora, która wymaga pogłębionej analizy skutków określonego trybu funkcjonowania urządzenia. U takich pacjentów programowanie urządzenia wymaga, by uwzględnić działania pewnych dyskryminatorów arytmii, które mogą opóźnić lub nawet wstrzymać wyzolenie adekwatnej terapii wysokoenergetycznej.

Słowa kluczowe: migotanie przedsionków, zastoinowa niewydolność serca, stała stymulacja pęczka Hisa, wszczepialny kardiowerter-defibrylator

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