

## Single Lead Dual-Chamber Pacing: A Report on 29 Cases

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### Summary

*Dual-chamber pacing is a major improvement in pacemaker technology, but the need for two leads increases the operating time and the risk of complications. Single-lead dual-chamber pacing, with rings in the atrial portion of the lead for sensing and pacing, can achieve AV-synchrony without requiring an additional atrial lead. A study of 29 patients with overlapping biphasic (OLBI) pacing was conducted. The results were promising despite a slight risk of dislodgement of the ventricular tip.*

### Key Words

Single-lead, dual-chamber pacing, OLBI pacing

### Introduction

Dual-chamber pacing, first implemented in the 1970s, was a major improvement in pacemaker technology. By maintaining atrioventricular (AV) synchrony, it retains the atrial component of the ventricular filling and therefore improves cardiac output. In addition, it lowers the LV/AO gradient in certain forms of hypertrophic cardiomyopathy by varying the AV interval, and is thus being considered as a treatment for this disease. However, with two leads, more time is needed for the implantation procedure and the risk of complications is increased. The single-lead VDD system, with its sensors in the atrial portion of the lead, achieves AV synchrony without requiring an extra lead. However, this system requires an essential characteristic in the patient: normal sinus function with a good response to exercise.

The next natural step would be the development of a single-lead system that can sense and pace both chambers [1]. The EIKOS SLD System developed by BIOTRONIK, using the overlapping biphasic (OLBI) principle, meets this goal [2].

The OLBI stimulation method consists of the simultaneous emission of two pulses with the same amplitude and width but opposite polarity; one from each atrial ring (Figure 1). However, according to the published studies, there are still a percentage of patients that can-

not be effectively paced with the OLBI technique [3]. In some cases, the side effects, such as diaphragmatic stimulation, are so annoying as to force the change to another mode of pacing. In order to assess the feasibility and reliability of the OLBI technique of atrial pacing, we began implanting EIKOS SLD pacemaker systems. The present study reports the difficulties we found and the conclusions reached.

### Materials and Methods

From May 97 to February 99, 29 EIKOS SLD pacemaker systems (BIOTRONIK, Germany) were implanted in our department. Seventeen patients were male and 12 were female. The mean age was  $71.4 \pm 9.7$  years. The indications were symptomatic second-degree (10) and complete (19) AV block and the sinus rhythm was over 60 bpm. Two SL-60/11-UP, 15 SL-60/13-UP and 12 SL-60/15-UP leads were implanted; the distance from the distal tip to the atrial dipole was 11, 13 and 15 cm, respectively. The length of the lead was chosen according to the patients' chest X-rays and height.

The implantation technique was the one used routinely in our department. In 17 patients, the right cephalic vein approach was used, and in 12 patients we used the right subclavian vein approach.

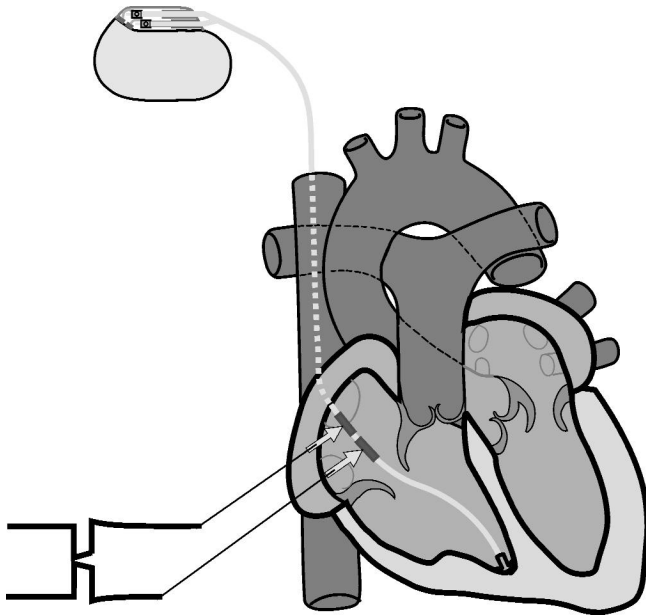


Figure 1. The OLBI principle.

After the lead tip had been positioned in the right ventricular apex and a good pacing threshold had been obtained, the atrial rings were moved up and down the right atrium until a good sensing threshold was reached. In only one instance the atrial rings were too low and we had to move the distal tip closer to the interventricular septum in order to obtain atrial sensing. Then, moving the atrial rings as little as possible, we determined the best site for atrial pacing. The

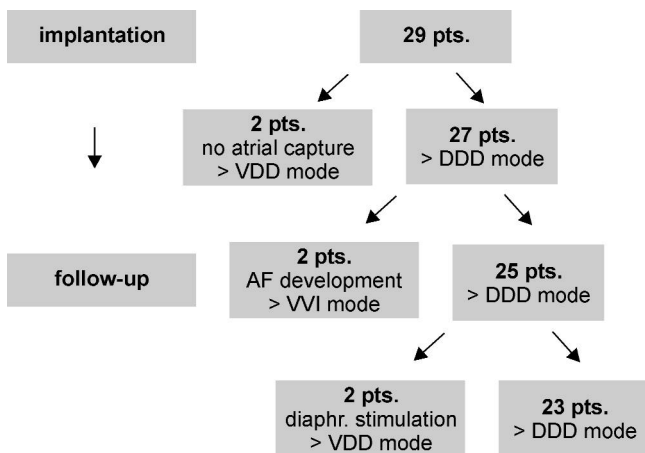


Figure 2. In 85% of 27 patients effective and safe atrial capture was obtained using the OLBI principle.

P-wave amplitude and the atrial pacing threshold were recorded during implantation and during follow-up examinations ranging from 1 to 21 months post-implantation.

**Results**

During implantation, all patients achieved good atrial sensing, with P waves ranging from 0.5 mV to 5 mV. In two patients, the atrium could not be paced with a pulse amplitude of 4.6 V and their pacemakers were set to VDD mode. In the majority, atrial pacing was achieved with pulse amplitudes of 2.4 V and their pacemakers were set to DDD mode.

In one patient, the electrode tip was damaged in the attempt to pass it from the cephalic vein to the subclavian vein, and the lead had to be replaced.

During follow-up, 2 patients were found in atrial fibrillation and their pacemakers were changed to VVI mode. In two patients, although the atrial pacing threshold was under 2.4 V, there was intermittent diaphragmatic stimulation and their pacemakers were set to VDD mode. The remaining patients had no changes made to their pacemakers (Figure 2).

In three patients, there was loss of ventricular pacing on the second day after implantation due to lead dislodgement, and surgical correction was needed.

In one patient, there was thrombosis of the right subclavian vein and hypo-coagulation therapy was required for six months.

**Discussion**

The high incidence of early lead dislodgement (10.3%) was due to two different causes: first, the distal part of the lead was too thin and we had some difficulties trying to anchor it to the right ventricle. And second: in order to find the place with the best sensing and pacing atrial threshold, the lead sometimes had to be stretched too taut and was thus prone to dislodgement. In any case, this lead has been improved and has a better distal tip and is available in five different lengths (11 to 17 cm from the distal tip to the atrial rings) and we believe that this problem has been resolved.

Subclavian vein thrombosis is not a common complication, and in our case we do not think it is significant. Excluding the two patients who developed atrial fibrillation:

1. 85% of all patients achieved good atrial pacing without significant complications, and
2. all patients had good atrial tracking.

### **Conclusion**

Single-lead, dual-chamber pacing with the OLBI technique:

1. has a low complication rate,
2. offers excellent VDD characteristics, and
3. is a safe and reliable procedure.

### **References**

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