Automatic left ventricular pacing management: not only a technical step up

Renato Pietro Ricci*

Department of Cardiovascular Diseases, San Filippo Neri Hospital, Via Martinotti, 20, 00135 Rome, Italy

Received 11 May 2009; accepted after revision 17 May 2009

This editorial refers to ‘Fluctuation of left ventricular thresholds and required safety margin for left ventricular pacing with cardiac resynchronization therapy’ by H. Burri et al., on page 931

A technical tool to improve patient management

Actual delivery of cardiac resynchronization therapy (CRT) and consistent left ventricular capture are critical factors to have a good clinical response in patients with heart failure and cardiac disynchrony receiving biventricular devices.

Left ventricular pacing threshold stability and evolution over time may theoretically differ from right ventricular pacing threshold behaviour because of its epicardial nature. In their interesting study, Burri et al.1 by using an automatic left ventricular capture management algorithm demonstrated that left ventricular pacing threshold remained stable during 1 year follow-up with more than 90% of patients having a maximum increase in threshold of <1.0 V. Only in patients with left ventricular threshold higher than 2.0 V a greater threshold variability was observed in 21% of cases. Reliability of the algorithm had been demonstrated by Crossley et al.2 who reported a 99.7% performance of the algorithm. As a matter of fact, Biffi et al.3 reported a 85% performance. That is probably due to the different time frames of the automatic threshold measurement: shortly after manual testing in the Crossley2 study and in the night before manual testing in the Biffi3 study. This difference introduces the issue of the circadian variation of left ventricular pacing threshold which has not yet addressed and for which clinical studies should be encouraged.

The finding of the high stability of left ventricular pacing threshold may have a great clinical impact. The authors concluded that a safety margin of 1.0 V is sufficient to ensure left ventricular capture and may be even lower (0.5 V) in devices with autoadaptive capture management algorithms. A similar approach has been suggested by Biffi.3 The possibility of combining consistent left ventricular capture with a low safety margin may allow us to prevent phrenic nerve stimulation, when this represents an issue, and to assure a long duration of the battery without energy wasting in all patients.

In patients with high left ventricular threshold or with threshold instability, autoadaptive capture management may be critical in keeping consistent left ventricular capture even though autoadjustment of pacing output may critically decrease battery life. It is not known if intermittent loss of left ventricular capture may be responsible for some not responders to cardiac resynchronization therapy.

Remote monitoring of heart failure patients with cardiac resynchronization therapy devices

Remote monitoring of implanted devices is increasingly used in clinical practice. Patients with heart failure receiving biventricular pacemakers may benefit more than other patients from this technology, since new device may monitor, on a daily basis, several parameters related to disease progression such as rest heart rate, heart rate variability, patient activity, and intrathoracic fluid accumulation.4 Furthermore, evaluation of appropriateness and efficacy of high-voltage therapies, as well as to timely recognition of arrhythmic asymptomatic events, in particular atrial fibrillation and frequent ventricular arrhythmias treated by antitachycardia pacing therapies, which have higher incidence and worse clinical consequences in heart failure patients, may allow prompt clinical reaction to deterioration of heart failure and may impact on patient clinical outcome. Clinical studies have demonstrated that remote monitoring allows remote management of ventricular arrhythmias and impending heart failure episodes without in-person visits in more than 70% of cases.5

Automatic detection of left ventricular threshold may enhance the benefits of remote control. First, it allows complete remote follow-up at scheduled intervals without the need of in-hospital tests. Secondly, the hospital centre may be timely alerted about the loss of left ventricular capture or left ventricular threshold.
instability, which may prevent actual CRT delivery. Prompt clinical intervention may be set before clinical impairment.

**Technical consideration**

Currently available algorithms to measure left ventricular pacing threshold detect left ventricular capture by pacing by the left ventricular lead and by assessing the timing of the ventricular sense on the right ventricular lead. Since the interventricular interval tends to be shorter than the atrioventricular interval, a captured test pace will be sensed in the opposite chamber earlier than the atrioventricular-conducted ventricular sense on a non-captured test pace. This approach may be associated with a high prevalence of missed measurements due to several factors that may be more frequent in patients with heart failure, such as high heart rate, premature atrial and ventricular beats, atrial fibrillation, and recurrent unsustained ventricular arrhythmias. Detection of the evoked response such as in right ventricular pacing showed better performance. Possibility of applying evoked response in left ventricular pacing threshold analysis should be investigated. Furthermore, possibility of repetitive measurement of threshold during the day should be implemented.

**Health technology cost effectiveness**

The last point to be considered is represented by the actual cost-effectiveness of continuous technological improvement. During the last decade, technology showed a tremendous progress with plenty of potential clinical applications. If in the past clinical needs and physician new ideas drove industry to develop new tools to improve patient management, nowadays technological progress anticipates potential clinical usefulness and clinical trials are often organized to verify potential benefits of new technology. That could be better than before, since several new strategies may be fast evaluated among which to identify the best for our patients. The risk is to have devices more and more sophisticated with progressively increasing costs, increased complexity and greater time consumption in routine clinical practice, and greater possibility of misprogramming. The clinical benefits of CRT technological progress in improving implant success and patient monitoring during the follow-up can be actually verified by everybody in daily practice. Nevertheless, for every new tool, careful evaluation of its cost-effectiveness should not be forgotten.

**Conflict of interest:** the author received a minor consultancy fees from St Jude and Medtronic.

**References**