

0909 '00 APR -7 A9:38

# Clinical Assessment of Rate Adaptive Pacemakers

Megan Moynahan and Mitchell Shein  
Pacing and Electrophysiology Devices Branch  
Division of Cardiovascular and Respiratory Devices

---

---

---

---

---

---

---

---

## Purpose

- Discuss advantages and disadvantages of various study designs
- Understand the ramifications of certain study design choices

---

---

---

---

---

---

---

---

## Outline

- Means to increase ventricular rate
- Evaluating the performance of rate adaption
  - > effectiveness
  - > clinical benefit
- Questions for the Panel

---

---

---

---

---

---

---

---

### Means to Increase Ventricular Rate

- Atrial Tracked Dual-Chamber Pacing (DDD)
- Sensor Mediated Rate Adaptation

---

---

---

---

---

---

---

---

### What is a "sensor"?

sensor = transducer + algorithm

---

---

---

---

---

---

---

---

### Transducer Types

- |                              |                               |
|------------------------------|-------------------------------|
| ● Activity                   | ● Pre-ejection interval       |
| ● Acceleration               | ● dP/dt                       |
| ● Central Venous Temperature | ● Right Atrial Pressure       |
| ● Minute Ventilation         | ● Ventricular Evoked Response |
| ● QT interval                |                               |

---

---

---

---

---

---

---

---

**Evaluating the  
Performance of Rate  
Adaption**

---

- Effectiveness
- Clinical Utility

---

---

---

---

---

---

---

---

**Evaluating the Effectiveness of  
Rate Adaption**

---

Demonstration that the sensor provides rate changes that are appropriate and proportionate to changes in patient activity.

---

---

---

---

---

---

---

---

**Evaluating the Effectiveness of  
Rate Adaption**

---

- Historical control
- Wilkoff - normative values for patients undergoing the Chronotropic Assessment Exercise Protocol (CAEP)
- Kay - normalized the curve for heart rate versus workload

---

---

---

---

---

---

---

---

## **Evaluating Clinical Benefit of Rate Adaption**

Demonstration that the sensor provides a measurable change in a clinically relevant parameter, e.g., exercise capacity, QoL, etc.

20

---

---

---

---

---

---

---

---

## **Parameters for Measuring Clinical Benefit**

- Time to Peak Heart Rate
- Cardiac Output
- Oxygen Dynamics
- Exercise Duration
- Anaerobic threshold
- Symptomology
- Quality of Life

21

---

---

---

---

---

---

---

---

## **Types of Study Designs**

- Single-arm crossover studies
- Randomized controlled studies
- Comparison to historical control (CAEP)

22

---

---

---

---

---

---

---

---

## Questions for the Panel

1. Considering cardiac output, exercise tolerance, Q of L, and other surrogate endpoints, please discuss the advantages and disadvantages of these as primary study endpoints.

- A. What would be a clinically meaningful response for each of these endpoints?
- B. For each endpoint, please discuss the follow-up duration necessary to capture a clinically meaningful change.
- C. What secondary endpoints would be important to collect to fully characterize the effect of rate adaptive pacing?

2. Discuss the advantages and disadvantages of the following study designs in terms of their ability to evaluate the rate adaptive feature of pacemakers:

- A. Randomized controlled study
- B. Crossover study
- C. Single-arm historical control study
- D. Other (please discuss)

3. Considering the numerous types of indications for cardiac pacing and customization of the device for each patient, the potential for confounding variables in pacing trials exists.

A. Please discuss which confounding clinical variables, such as the impact of physician programming, could significantly impact the design and/or outcome of these trials.

B. Please provide any suggestions regarding clinical study design and data analysis for these trials.

---

---

---

---

---

---

---

---